

REHABILITATION OF ST-16 AND OTHER ALLIED EQUIPMENT OF 747 MW COMBINED CYCLE POWER PLANT GUDDU

Central Power Generation Company Limited (Genco-II)

CONTRACT NO. (T-Rehab-02)
REHABILITATION OF ST-16 AND OTHER ALLIED EQUIPMENT OF 747 MW
COMBINED CYCLE POWER PLANT GUDDU

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INVITATION FOR BIDS

(IFB)

INVITATION FOR BIDS

FOR

CONTRACT NO. (T-Rehab-02)

REHABILITATION OF ST-16 AND OTHER ALLIED EQUIPMENT OF 747 MW COMBINED CYCLE POWER PLANT GUDDU

CORRIGENDUM # 1

1. Reference is made to the Invitation for Bids issued by Central Power Generation Company Limited (CPGCL) for Contract No. T-Rehab-02, previously published in newspapers and floated through EPADS 2.0.
2. It is hereby notified for information of all prospective bidders that, pursuant to the advice of the Public Procurement Regulatory Authority (PPRA) in view of the limitations of EPADS 2.0 as well as the matters discussed during the Pre-Bid Meeting held on September 14, 2026, the procurement procedure has been revised. The procurement shall now be conducted through the **Single Stage-Two Envelope (SSTE) procedure** in accordance with PPRA Rules 2004.
3. Accordingly, the electronic procurement process through EPADS 2.0 for the subject procurement shall stand discontinued. The Bidding Documents previously made available through EPADS 2.0 are hereby withdrawn and shall no longer be applicable for submission of Bids.
4. A fresh set of Bidding Documents incorporating the revised bidding procedure and related amendments has been issued. The revised Bidding Documents are available for download, free of cost, from the **CPGCL website** https://cpgcl.com/ and **PPRA website** https://ppra.gov.pk/.

   Bidders shall submit their Bids strictly in accordance with the fresh/revised Bidding Documents.
5. Each Technical Bid shall be accompanied by a Bid Security of an amount not less than **PKR 500,000,000/- (Pak Rupees Five Hundred Million only)** or an equivalent amount in a freely convertible currency. The Bid Security shall be provided in the form and manner specified in the Bidding Documents.
6. The Bids must be delivered on or before **15:00 hours on November 10, 2026** to the following address:

   Chief Executive Officer
   Central Power Generation Company Limited (CPGCL)
   Through Genco Holding Company Limited (GHCL)
   1st Floor, OFP Building, Sector G-5/2,
   Islamabad, Pakistan
7. Requests for clarification, if any, shall be submitted in accordance with the Instructions to Bidders at the address specified in the Bidding Documents.
8. The Technical Bids will be opened at **15:30 hours on November 10, 2026**, at the same address, in the presence of the Bidders' representatives who choose to attend. The Price Bids shall be kept in safe custody and shall be opened only for those Bidders whose Technical Bids are found responsive in accordance with the Bidding Documents.
9. The Employer reserves all its rights regarding rejection of bids as defined in Clause 33(1) of PPRA Rules 2004.

Chief Executive Officer CPGCL
Thermal Power Station, Guddu, Sindh, Pakistan.
Telephone: (0092)-722-691088
Email: ceo.cpgcl@gmail.com

SECTION 1

INSTRUCTIONS TO BIDDERS

(ITB)

SECTION-1

INSTRUCTIONS TO BIDDERS

A. GENERAL

IB.1 Scope of Bid and Source of Funds

1.1 **Scope of Bid**

Central Power Generation Company Limited (CPGCL), (hereinafter called "the Employer") wishes to receive Bids on EPC/Turnkey basis for the scope of work which includes, but shall not be limited to:

The design, manufacture, supply, installation, testing, and commissioning, including the design and construction of civil works, related to the rehabilitation of Steam Turbine-16 (ST-16) and its allied auxiliaries at the 747 MW Combined Cycle Power Plant (CCPP). This involves addressing fire damages by repairing or replacing ST-16 components, performing a major overhaul of ST-16, and replacing the irreparable Steam Turbine Generator (STG) with a new unit of identical specifications.

The scope also covers the structural assessment, modification, and rehabilitation of the ST-16 and STG foundations and allied civil structures. The Contractor will execute the safe removal of damaged equipment and installation of new systems, providing all necessary temporary structural supports. Additional tasks include the replacement of the generator circuit breaker, excitation system, and damaged isolated phase busbars. It also covers the testing and integration of peripheral equipment and the replacement of damaged power and control cables.

Furthermore, the project encompasses upgrading the ST control system and the plant Distributed Control System (DCS), installing hydrogen gas leakage detection systems, bearings fire protection system and rehabilitating the vibration monitoring system.

The Works to be executed under this Contract comprise design, construction, manufacturing, supply, and installation on an EPC/turnkey basis. A detailed scope of work is described in these Bidding Documents. The successful Bidder shall be required to complete the Works within the stipulated period specified in these Bidding Documents.

Bidders must quote prices for the complete scope of work. Any Bid covering a partial scope of work will be considered non-responsive, pursuant to Clause IB.24.

1.2 Source of Funds

The Employer through its own resources, will make payments under the Contract for which these Bidding Documents are issued.

IB.2 Eligible Bidders

2.1 Bidding is open to all firms and persons meeting the following requirements:

i) A Bidder may be a natural person, private entity, or government-owned enterprise or any combination of them with a formal intent to enter into an agreement or under an existing agreement in the form of a Joint Venture (in which case all partners shall be jointly and severally liable). Subject to sub clause IB 2.1 (iii), the Bidder shall be duly licensed by the Pakistan Engineering Council (PEC) minimum in the appropriate category relevant to the value of the Works or had applied for renewal of license before submission of its bid.

ii) A Bidder, and all partners constituting the Bidder, shall have the nationality of an eligible country, in accordance with Appendix A to Instruction to Bidders. A Bidder shall be deemed to have the nationality of a country if the Bidder is a citizen or is constituted, incorporated, or registered, and operates in conformity with the provisions of the laws of that country (for clarity see definition at PEC Bye-law No. 2)fa) and 2)ja of Construction and Operation of Engineering Works Bye-laws, 1987). This criterion shall also apply to the determination of the nationality of proposed subcontractors or suppliers for any part of the Contract including related services.

iii) Foreign firm shall not be eligible to participate in bidding individually. Foreign firm shall enter into joint venture with Pakistani firm registered with the PEC in equivalent/compatible category and submit the same to the Employer before participating in bidding. A foreign firm/partner to JV bidder, in case of award to JV Bidder, shall get registration from PEC in equivalent/compatible category and submit the same to the Employer prior to award of Contract.

iv) Pakistani firms shall be on Active Taxpayers List (both Income Tax and Sales Tax) of the Federal Board of Revenue and relevant Provincial Revenue Authority. Foreign firms will get themselves registered from relevant tax authorities after award of contract, as required under the laws of Pakistan.

v) A Bidder shall not have a conflict of interest. All Bidders found to have a conflict of interest shall be disqualified. A Bidder may be considered to be in a conflict of interest with one or more parties in this bidding process if any of, including but not limited to, the following apply:

(a) they have controlling shareholders in common; or

(b) they receive or have received any direct or indirect subsidy from any of them; or

(c) they have the same legal representative for purposes of this bid; or

(d) they have a relationship with each other, directly or through common third parties, that puts them in a position to have access to material information about or improperly influence the bid of another Bidder, or influence the decisions of the Employer regarding this bidding process; or

(e) a Bidder participates in more than one bid in this bidding process, either individually or as a partner in a Joint Venture, except for alternative offers if permitted under IB 41. This will result in the disqualification of all Bids in which it is involved. However, subject to any finding of a conflict of interest in terms of IB 2.1 (v) [(a) - (d)] above, this does not limit the participation of a Bidder as a subcontractor in another Bid or of a firm as a subcontractor in

more than one Bid; or

(f) a Bidder, Joint Venture partner, associates, parent company or any affiliated entity, participated as a consultant in the preparation of the design or technical specifications of the plant and services that are subject of the Bid; or

(g) a Bidder was affiliated with a firm or entity that has been hired (or is proposed to be hired) by the Employer as Project Manager for the Contract; or

(h) a Bidder would be providing goods, works, or non-consulting services resulting from or directly related to consulting services for the preparation or implementation of the project specified in the IB 1.1 that it provided or were provided by any affiliate that directly or indirectly controls, is controlled by, or is under common control with that firm.

vii) The Bidder shall not be blacklisted by any government, public department, national or international organization, institution, or donor agency at the time of bid submission. The Bidder shall provide details of any previous blacklisting, if applicable. An affidavit regarding this matter is to be provided by the Bidder at the time of bid submission which will subsequently become part of the Contract Agreement as well.

viii) Firms shall be excluded if by an act of compliance with a decision of the United Nations Security Council taken under Chapter VII of the Charter of the United Nations, Pakistan prohibits any import of goods or contracting of works or services from that country or any payments to persons or entities in that country.

IB.3 Eligible Goods and Services

3.1 All Goods and ancillary Services to be supplied under this Contract shall have their origin in eligible countries as per Appendix A to Instructions to Bidders and all expenditures made under the Contract will be limited to such Goods and Services.

3.2 For purpose of this Clause, "origin" means the place where the Goods are mined, grown or produced, and from where the ancillary services are supplied. Goods are produced when, through manufacturing, processing or substantial and major assembling of components, a commercially recognized product results that is substantially different in basic characteristics or in purpose or utility from its components.

IB.4 Cost of Bidding

4.1 The Bidder shall bear all costs associated with the preparation and submission of its Bid and the Employer will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the Bidding process.

B. BIDDING DOCUMENTS

IB.5 Contents of Bidding Documents

5.1 In addition to Invitation for Bids, the Bidding Documents are those stated below, and should be read in conjunction with any Addenda issued in accordance with Clause IB.7.

1. Instructions to Bidders (ITB) with Appendices to ITB as follows:
   - (i) Appendix A to ITB: Name of Eligible Countries
   - (ii) Appendix B to ITB: Evidence of Bidder's & Subcontractor's capability
     - (a) Form ELI-1: Bidder's Information Sheet
     - (b) Form ELI-2: Joint Venture Information Sheet
     - (c) Form FIN-1: Historical Financial Performance
     - (d) Form FIN-2: Average Annual Turnover
     - (e) Form EXP-1: Contracts of Similar Size and Nature
     - (f) Form EXP-2: Experience of Subcontractors/ Manufacturers
   - (iii) Appendix C to ITB: Form of Bid Security
   - (iv) Appendix D to ITB: Domestic Goods (Value added in Pakistan)

2. Letter of Technical Bid and Schedules to Bid as follows:
   - (i) Schedule A: Specific Works data (Schedule of Technical Data)
   - (ii) Schedule B: Proposed Organization for the Project & Work Methodology
     - (a) Form 1: Site Organization & Method Statement
     - (b) Form 2: Mobilization Schedule
   - (iii) Schedule C: Construction Schedule
   - (iv) Schedule D: Personnel
     - (a) Form PER-1: Proposed Personnel
     - (b) Form PER-2: Resume of proposed Personnel
   - (v) Schedule E: Subcontractors

     Form SUBCON: Proposed Subcontractors/ Manufacturers for Major Items of Plant and Services
   - (vi) Schedule F: Country of Origin Declaration Form
   - (vii) Schedule G-1: Deviations from Technical Provisions
   - (viii) Schedule G-2: Deviations from Contractual Provisions
   - (ix) Schedule H: Specimen JV Agreement (if applicable)
   - (x) Schedule I: Equipment
   - (xi) Schedule K: Manufacturer's Authorization

3. Letter of Price Bid & Schedules to Bid

   Schedules to Bid are the following:
   - (i) Schedule J: Integrity Pact

4. Schedule of Prices
5. Preamble to Conditions of Contract

6. General Conditions of Contract (GCC)
7. Particular Conditions of Contract (PCC)
8. Standard Forms
   Forms include the following:

   (i) Form of Contract Agreement
   (ii) Form of Performance Security
   (iii) Form of Bank Guarantee for Advance Payment

9. Specifications - Technical Provisions

5.2 The Bidders are expected to examine carefully the contents of all the above documents. Failure to comply with the requirements of Bid submission will be at the Bidders own risk. Pursuant to Clause IB.24, Bids which are not substantially responsive to the requirements of the Bidding Documents shall be rejected.

IB.6 Clarification of Bidding Documents

6.1 A prospective Bidder requiring any clarification(s) in respect of the Bidding Documents may notify the Employer in writing or by e-mail at the following address:

Chief Executive Officer CPGCL
Thermal Power Station, Guddu, Sindh, Pakistan.
Telephone: (0092)-722-691088
Email: ceo.cpgcl@gmail.com

The Employer will examine the request for clarification of the Bidding Documents which it receives not later than twenty (20) days prior to the deadline for the submission of bids and if needed will issue the clarification/amendment of the Bidding Documents at least ten (10) days before the date of submission of Bids (without identifying the source of enquiry) to all prospective Bidders.

IB.7 Amendment of Bidding Documents

7.1 At any time prior to the deadline for submission of bids, the Employer may, for any reason, whether at his own initiative or in response to a clarification requested by a prospective Bidder, modify the Bidding Documents by issuing an addendum.

7.2 Any addendum thus issued shall be part of the Bidding Documents pursuant to Sub-Clause 7.1 hereof and shall be communicated in writing to all prospective Bidders. Prospective Bidders shall acknowledge receipt of each addendum in writing to the Employer. The Bidder shall also confirm in the Form of Technical Bid and Form of Price Bid that the information contained in such addenda have been considered in preparing his bid..

7.3 To afford prospective Bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer may at its discretion extend the deadline for submission of bids in accordance with Clause IB.19.

C. PREPARATION OF BIDS

IB.8 Language of Bid

8.1 The Bid prepared by the Bidder and all correspondence and documents relating to the Bid, exchanged by the Bidder and the Employer shall be written in the English language, provided that any printed literature furnished by the Bidder may be written in another language so long as accompanied by duly notarized English translation of its pertinent passages in which case, for purposes of interpretation of the Bid, the English translation shall govern.

IB.9 Documents Comprising the Bid

9.1 The Bid submitted by the Bidder shall be prepared in two (02) separate envelopes, one containing the "Technical Bid" and the other containing "Price Bid", both envelopes enclosed together in an outer envelope. The Bid prepared by the Bidder shall comprise the following components.

The Bid shall comprise the following:

I. Technical Bid

(a) Cover letter for Technical Bid

(b) Letter of Technical Bid duly filled in, signed and stamped, in accordance with Clause IB.17.

(c) Schedules (A to K excluding J) to Bid duly filled in, signed and stamped, in accordance with the instructions contained therein.

(d) Bid Security furnished in accordance with clause IB 15.

(e) Power of Attorney, duly notarized, authorizing the signatory of the bid to act for and on behalf of the Bidder in accordance with Clause IB 17.5.

(f) in the case of a bid submitted by a Joint Venture, the Bid shall include a copy of the Joint Venture Agreement entered into by all partners. Alternatively, a Letter of Intent to execute a Joint Venture Agreement in the event of a successful bid shall be signed by all partners and submitted with the Bid, together with a copy of the proposed agreement

(g) Documentary evidence established in accordance with Clause IB.13 that the Bidder is eligible to Bid and is qualified to perform the Contract if its Bid is accepted

(h) Documentary evidence established in accordance with Clause IB.14 that the Plant and ancillary Services to be supplied by the Bidder are eligible Plant and Services and conform to the Bidding Documents.

(i) PEC license pursuant to Sub-Clause 2.1; and

(j) Any other documents prescribed in Particular Conditions of Contract or Technical Provisions to be submitted with the Bid.

II. Price Bid

(a) Cover letter for Price Bid

(b) Letter of Price Bid duly filled in, signed and stamped, in accordance with Clause IB.17.

(c) Schedule of Prices completed in accordance with Clauses IB10, IB.11 IB.12 and IB.17.

(d) Schedule J to Bid, duly filled in, signed and stamped, in accordance with the instructions contained therein.

(e) Bidders applying for eligibility for domestic preference in bid evaluation shall supply all information & evidence to establish the claim for domestic preference required to satisfy the criteria for eligibility as described in Clause IB.27.

(f) Any other documents prescribed in Particular Conditions of Contract or Technical Provisions to be submitted with the Bid.

IB.10 Letters of Bids and Schedules

10.1 The Bidder shall complete, sign and seal the Letters of Bids, Schedules (A to K, or as modified) to Bid, Appendices to ITB and Schedule of Prices furnished in the Bidding Documents and shall also enclose other information as detailed in Clause IB.9.

10.2 For the purpose of granting a margin of domestic preference pursuant to Clause IB.27, the Employer will classify the Bids, when submitted in one of three groups as follows subject to change, if any, as per policy of the Federal Government as applicable on the date of bid opening:

(a) **Group 'A' Bid.** (i) for Goods for which labour, raw materials and components from within Pakistan account for at least 20% of the ex-factory bid price of the products offered (ii) for Goods for which labour, raw materials and components from within Pakistan account for over 20% and up to 30% of the ex-factory bid price of the products offered (iii) for Goods for which labour, raw materials and components from within Pakistan account for over 30% of the ex-factory bid price of the products offered;

(b) **Group 'B' Bid.** For Goods manufactured in Pakistan for which the domestic value added in the manufacturing cost is less than 20% of the ex-factory bid price; and

(c) **Group 'C' Bid.** For Goods of foreign origin.
In preparing their bids, the Bidders, whether local or foreign, shall enter in the Schedule of Prices, ex-factory price for indigenously manufactured products and CIF price as well as customs duty and sales tax and other import charges for products to be imported from outside Pakistan.

IB.11 Bid Prices

11.1 The Bidder shall fill up the Schedule of Prices attached to these documents indicating the unit rates and prices of the Works to be performed under the Contract. Prices on the

Schedule of Prices shall be entered keeping in view the instructions contained in the Preamble to the Schedule of Prices.

11.2 The Bidder shall fill in rates and prices for all items of the Works described in the Schedule of Prices. Items against which no rate or price is entered by a Bidder will not be paid for by the Employer when executed and shall be deemed covered by rates and prices for other items in the Schedule of Prices.

11.3 The Bidder's breakup of price components in accordance with Sub-Clause 11.1 above will be solely for the purpose of facilitating the comparison of Bids by the Employer and will not in any way limit its right to contract on any of the terms offered.

11.4 Unless otherwise stipulated in the Conditions of Contract, prices quoted by the Bidder shall remain fixed during the Bidder's performance of the Contract and not subject to variation on any account. When the Bidders are required to quote only fixed price(s), a Bid submitted with an adjustable price quotation will be treated as non-responsive, pursuant to Clause IB.24.

11.5 Any discount offered shall be valid for at least the period of validity of the Bid. A discount valid for lesser period shall be considered null and void.

IB.12 Currencies of Bid

12.1 Prices shall be quoted in the following currencies:

(a) For Plant/Goods and Services which the Bidder will supply from within Pakistan, the prices shall be quoted in the Pak. Rupees (the "**Local Currency Component**").

(b) For Plant/Goods and Services which the Bidder will supply from outside Pakistan, the prices shall be quoted in U.S. Dollars or any freely convertible currency (the "**Foreign Currency Component**").

12.2 Further, a Bidder expecting to incur a portion of its expenditure in the performance of the Contract in more than one currency (but use no more than 3 foreign currencies), and wishing to be paid accordingly, shall so indicate in its bid.

12.3 The currencies of payment shall be as stated in Particular Conditions of Contract. However, provisions in Sub-Clauses 12.1 & 12.2 above, shall not in any way constitute a contractual or legal binding on the Employer for the payment in the currencies required by the Contractor.

IB.13 Documents Establishing Bidder's Eligibility and Qualifications

13.1 Pursuant to Clause IB.9, the Bidder shall furnish, as part of its bid, documents establishing the Bidder's eligibility to bid and its qualifications to perform the Contract if its Bid is accepted.

13.2 The documentary evidence of the Bidder's eligibility to bid shall establish to the Employer's satisfaction that the Bidder, at the time of submission of its bid is from an

eligible source country as defined under Clause IB.2. (Form-ELI-1 of Appendix B to ITB along with documents mentioned therein). In the case of a Joint Venture, each partner shall additionally submit Form ELI-2 of Appendix B to ITB, in accordance with Sub-Clause IB 13.5(a).

13.3 The documentary evidence of the Bidder's qualifications to perform the Contract if its Bid is accepted, shall establish the following to the Employer's satisfaction:

(a) documentary evidence that the Bidder has the experience required as per Sub-Clause IB 13.4 (a) necessary to perform the Contract i.e. Forms EXP-1 of Appendix B to ITB along with document required therein;

(b) documentary evidence that the Bidder (or, where applicable, the Bidder's proposed Sub-Contractor/Manufacturer together with the Bidder) has the steam turbine and generator manufacturing experience required as per Sub-Clause IB 13.4 (b) & (c) necessary to perform the Contract, i.e. Form EXP-2 of Appendix B to ITB along with the documents required therein, including, where reliance is placed on a proposed Sub-Contractor/Manufacturer, the commitment letter required under Sub-Clause IB 13.4(b) and/or (c); and

(c) documentary evidence that the Bidder has the financial capability required as per Sub-Clauses IB 13.4 (d) & (e) necessary to perform the Contract i.e. Forms FIN-1 & FIN-2 of Appendix B to ITB along with document required therein.

13.4 **Bidder's Qualification Criteria**

Qualification of a bidder shall be evaluated based on following criteria which the bidder must fulfill:

(a) Contracts of Similar Size and Nature:

The bidder, either as a single entity or as the lead partner in a joint venture, must have experience in installation and commissioning of the following:

(i) at least two (2) steam turbines, each with an output of **250 MW (gross)** or higher within the last fifteen (15) years.

All the mentioned plants shall have been operating satisfactorily for a minimum of one (1) year prior to the bid opening date.

(b) Steam Turbine Manufacturing Experience:

Either the Bidder, or any partner in case of Joint Venture, or the Bidder's proposed Sub-Contractor for steam turbine overhauling / rehabilitation, must have successful experience in the design and manufacturing of at least five (05) steam turbines rated **250 MW (gross)** or higher. The successful experience of steam turbines shall include a minimum of 24,000 hours commercial operation prior to the date of opening of Bids. If the Bidder claims to meet this mandatory requirement based on its proposed Sub-Contractor, a commitment letter from the proposed Sub-Contractor/ Manufacturer of steam turbine on their letterhead to execute the steam turbine overhauling / rehabilitation scope shall be provided by the Bidder along with the Technical Bid.

(c) Generator Manufacturing Experience:

Either the Bidder, or any partner in case of Joint Venture, or the Bidder's proposed Sub-Contractor for steam turbine generator, must have successful experience in the design and manufacturing of at least five (05) generators of **320 MVA** or higher rating. The successful experience of generator shall include a minimum of 24,000 hours commercial operation prior to the date of opening of Bids. If the Bidder claims to meet this mandatory requirement based on its proposed Sub-Contractor, a commitment letter from the proposed Sub-Contractor/Manufacturer of generator on their letterhead to supply steam turbine generator shall be provided by the Bidder along with the Technical Bid.

(d) Historical Financial Performance:

Submission of audited balance sheets or, if not required by the law of the Bidder's country, other financial statements acceptable to the Employer, for the last **five (05)** years to demonstrate the current soundness of the Bidder's financial position and its prospective long-term profitability. As a minimum, the Bidder's net worth, for the last year, calculated as the difference between total assets and total liabilities should be positive.

(e) Average Annual Turnover:

Minimum average annual turnover equal to or more than **US$ 75 Million** (or equivalent in PKR) calculated as total certified payments received for contracts in progress or completed, within the last five (05) years.

13.5 **Joint Venture**

In order for a Joint Venture to qualify:

(a) All firms comprising the joint venture shall be legally constituted and shall meet the eligibility requirement of Sub-Clause 2.1 hereof. Each partner of joint venture shall submit Form ELI-2 of Appendix B to ITB with the bid along with documents mentioned therein in addition Form ELI-1 for joint venture.

(b) The lead partner of the Joint Venture shall meet the requirement set in Sub-Clause IB 13.4(a).

The lead partner of the Joint Venture shall submit Form EXP-1 of Appendix B of ITB with the bid along with documents mentioned therein.

(c) The requirements of Sub-Clause IB 13.4(b) (Steam Turbine Manufacturing Experience) and Sub-Clause IB 13.4(c) (Generator Manufacturing Experience) may each be met by any one partner of the Joint Venture, or by the Bidder's proposed Sub-Contractor as provided under Sub-Clause IB 13.4(b) and (c) respectively. It shall not be necessary for more than one partner, or for every partner, to individually meet these requirements.

The partner (or, where applicable, the proposed Sub-Contractor together with the Bidder) meeting a requirement under this paragraph shall submit Form EXP-2 of Appendix B to ITB with the bid along with documents mentioned therein, including, where reliance is placed on a proposed Sub-Contractor, the commitment letter required under Sub-Clause IB 13.4(b) and/or (c).

(d) All partners of the Joint Venture shall jointly meet the financial requirements specified in Sub-Clause IB 13.4(d) (Historical Financial Performance) and Sub-Clause IB 13.4(e) (Average Annual Turnover), as per the following criteria:

i) All partners of the Joint Venture shall jointly meet the requirement of average annual turnover specified in Sub-Clause IB 13.4(e). Where one partner alone meets this requirement, each of the other partners shall nonetheless submit Form FIN-2 and the documents mentioned therein for average annual turnover.

ii) The Joint Venture's net worth for the last year, calculated as the aggregate of the total assets less the aggregate of the total liabilities of all partners, shall be positive, in satisfaction of Sub-Clause IB 13.4(d).

Each partner shall submit Form FIN-1 and Form FIN-2 of Appendix B to ITB with the bid along with documents mentioned therein.

(e) All partners of the Joint Venture shall at all times and under all circumstances be liable jointly and severally to Employer for the execution of the entire Contract in accordance with the Contract terms and conditions and a statement to this effect shall be included in the authorization as mentioned under para (h) below as well as in the Form of Bid and Form of Contract Agreement (in case of a successful bidder).

(f) The Form of Bid, and in the case of successful bidder, the Form of Contract Agreement, shall be signed so as to be legally binding on all partners.

(g) One of the Joint Venture partners shall be nominated as being in-charge and this authorization shall be evidenced by submitting a power of attorney signed by legally authorized signatories of all the joint venture partners.

(h) The partner-in-charge shall be authorized to incur liabilities, receive payments and receive instructions for and on behalf of any or all partners of the joint venture.

(i) A copy of the agreement entered into by the joint venture partners shall be submitted with the bid stating the conditions under which it will function, its period of duration, the persons authorized to represent and obligate it and which persons will be directly responsible for due performance of the Contract and can give valid receipts on behalf of the joint venture, the proportionate participation of the several firms forming the joint venture, and any other information necessary to permit a full appraisal of its functioning. No amendments / modifications whatsoever in the joint venture agreement shall be agreed to

between the joint venture partners without prior written consent of the Employer.

(j) The maximum J.V. partners shall not be more than three (03).

Notes for Sub-Clause IB 13.4 & IB 13.5

- Wherever a Form in this section requires a Bidder to state a monetary amount, the Bidder should indicate the US$ equivalent using the rate of exchange determined as follows:

  a) For turnover or financial resources data required for each year - Exchange rate (US$ equivalent) prevailing twenty-eight (28) days prior to the date of opening of Bids.

  b) For value of single Contract - Exchange rate prevailing on the date of the respective Contract.

- Exchange rates shall be taken from the publicly available source identified in Clause IB 26 or, in case such rates are not available in the source identified above, any other publicly available source acceptable to the Employer. Any error in determining the exchange rates may be corrected by the Employer.

- If the Bidder is part of a Group of Companies, a detailed group structure indicating shareholding percentages, legal status, names of all entities, and common directorship up to the ultimate parent shall be provided.

IB.14 Documents Establishing Plants' Eligibility and Conformity to Bidding Documents

14.1 Pursuant to Clause IB.9, the bidder shall furnish, as part of its bid, documents establishing the eligibility and conformity to the Bidding Documents of all Goods and Services which the bidder proposes to perform under the Contract.

14.2 To establish the eligibility of the plant and services in accordance with IB 3, Bidders shall submit following with the bid:

(i) The Country of Origin Declaration Form (Schedule F to Bid).

(ii) Manufacturer's Authorization (Schedule K to Bid), if applicable pursuant to IB 13.4 (b) and IB 13.4 (c).

(iii) For major items of the Plant and Services as listed by the Employer in the Technical Provisions, which the Bidder intends to purchase or subcontract, the Bidder shall give details of the name and nationality of the proposed Subcontractors, including manufacturers, for each of those items. In case the Employer requires Successful Bidder / Contractor to change the subcontractor prior or subsequent to signing of the Contract, for the purpose of compliance to the qualification criteria of the subcontractors / manufacturers for major equipment as listed in Technical Provisions, no adjustment of the rates and prices will be permitted.

(iv) The Bidder shall submit Form EXP-2 and Form for proposed subcontractors (Schedule E to Bid) and/or manufacturers for major items of Plant and Services along with manufacturer's authorization and copies of the relevant supply record, contract agreements etc. to prove experience and supply requirements.

14.3 The documentary evidence of the Goods and Services' conformity to the Bidding Documents may be in the form of literature, drawings and data and shall furnish:

(a) A detailed description of the Goods, essential technical and performance characteristics in response to the Section 9 (Specifications – Technical Provisions).

(b) Completely filled Schedule of Technical Data (Schedule-A to Bid) of each item.

(c) Complete set of technical information, description data, literature and drawings as required in accordance with Schedule A to Bid, Specific Works Data. This will include but not be limited to the following:

(i) General arrangement drawings.
(ii) P&IDs / flow diagrams
(iii) Performance data and correction curves.
(iv) Electrical single-line diagrams.
(v) Any other document / drawing which is required for evaluation purposes.

(d) A clause-by-clause commentary on Technical Provisions, provided with the Bidding Documents, demonstrating the Goods' and Services' substantial responsiveness to those Specifications or a statement of deviations and exceptions to the provisions of the Technical Provisions as required in Schedule G to Bid.

14.4 For purpose of the commentary to be furnished pursuant to Sub-Clause 14.3(d) above, the Bidder shall note that standards for workmanship, material and equipment, and references to brand names or catalogue numbers, designated by the Engineer in the Technical Provisions are intended to be descriptive only and not restrictive. The bidder may substitute alternative standards, brand names and/or catalogue numbers in its bid, provided that it demonstrates to the Engineer's satisfaction that the substitutions are substantially equivalent or superior to those designated in the Technical Provisions. Copies of the standards proposed by the bidder other than those specified in the Bidding Documents shall be furnished.

14.5 The Bidder shall propose, in order of his priority; plant, equipment or goods of not more than three manufacturers. The Employer at his own jurisdiction may evaluate the plant, equipment or goods of only one of such manufacturers.

IB.15 Bid Security

15.1 Each Bidder shall furnish, as part of his Technical Bid, a Bid Security of an amount not less than **PKR 500,000,000** (Pak Rupees Five Hundred Million only) or an equivalent

amount in any freely convertible currency.

15.2 The Bid Security shall be an unconditional bank guarantee from a reputable scheduled bank in Pakistan. In the case of Bank Guarantee, the Bid Security shall be submitted using the prescribed form attached as Appendix C hereof. The Bank guarantee shall be issued by a Scheduled Bank in Pakistan or from a foreign bank duly counter guaranteed by a Scheduled Bank in Pakistan in favor of the Employer valid for a period twenty-eight (28) days beyond the Bid Validity date. Bid Security in the form of Swift message shall not be acceptable.

For avoidance of doubt, a Bid Security issued by a foreign bank but not counter guaranteed by a Scheduled Bank in Pakistan shall not be acceptable, and the Bid shall be rejected being as non-responsive pursuant to IB 24.

15.3 The Bid Security is required to protect the Employer against the risk of Bidder's conduct which would warrant the security's forfeiture, pursuant to Sub-Clause 15.7 hereof.

15.4 Any Bid not accompanied by an acceptable Bid Security shall be considered by the Employer as non-responsive, pursuant to Clause IB.24.

If a Bidder submits a Bid Security that has following discrepancies (to the extent mentioned against each), the Employer shall request the Bidder to submit a compliant Bid Security within fourteen (14) calendar days of receiving such request. Failure to provide a compliant Bid Security within the prescribed period of receiving such a request shall cause the rejection of the Bid. Any Bid accompanied by bid security with deviation greater than the extent mentioned below shall be rejected pursuant to clause IB 24.

(i) Bid Security amount is short within 10% of Bid Security amount; and/or

(ii) Bid Security validity period is short by a maximum of two days.

(iii) Any changes with respect to format/text which does not hurt the right of Employer for encashment of the guarantee and does not limit the obligation of the Bidder as required in the Bidding Document/Bid Security format.

For avoidance of doubt, the above provision shall not permit the late submission of the original Bid Security after the deadline for submission of Bids.

15.5 The Bid Securities of unsuccessful Bidders will be returned upon furnishing by the successful Bidder of a Performance Security or on the expiry of validity of Bid Security whichever is earlier.

15.6 The Bid Security of the successful Bidder will be returned when the Bidder has furnished the required Performance Security, pursuant to Clause IB.34 and signed the Contract Agreement, pursuant to Clause IB.35.

15.7 The Bid Security may be forfeited:

(a) if a Bidder withdraws its bid during the period of Bid validity, except as provided in Sub-Clause IB 21.1; or

(b) if a Bidder does not accept the arithmetical corrections of his Bid Price, pursuant to Sub-Clause 26.2 hereof; or

(c) If a bidder is found involved in corrupt and fraudulent practices; or

(d) in the case of a successful Bidder, if he fails to:

(i) furnish the required Performance Security in accordance with Clause IB.34, or

(ii) sign the Contract Agreement, in accordance with Clause IB.35.

IB.16 Validity of Bids

16.1 Bids shall remain valid for 180 days after the date of Bid Opening as prescribed in Clause IB.22. A Bid valid for a shorter period shall be rejected by the Employer as non-responsive in accordance with Clause IB.24.

16.2 In exceptional circumstances prior to expiry of original Bid validity period, the Employer may request the Bidders to extend the period of validity for a specified additional period. The request and the responses thereto shall be made in writing. A Bidder may refuse the request without forfeiture of his Bid Security. A Bidder agreeing to the request will be required to extend the validity of his Bid Security for the period of the extension, and in compliance with Clause IB.15 in all respects.

IB.17 Format and Signing of Bid

17.1 Bidders are particularly directed that the amount entered on the Letter of Price Bid shall be for performing the Contract strictly in accordance with the Bidding Documents.

17.2 All Forms, Appendices to ITB, Schedules to Bid (A to K), Schedules of Prices are to be properly completed and signed.

17.3 No alteration is to be made in the Form of Bid nor in the Schedules thereto except in filling up the blanks as directed. If any alteration be made or if these instructions be not fully complied with, the Bid may be rejected.

17.4 The Bidder shall prepare one original set of the Technical Bid and one original set of the Price Bid of the documents comprising the Bid as described in clause IB 9 and clearly mark it “ORIGINAL - TECHNICAL BID” and “ORIGINAL - PRICE BID”. In addition, the Bidder shall prepare three (03) copies of the Bid, and clearly mark each of them “COPY – TECHNICAL BID” and “COPY – PRICE BID”. In the event of any discrepancy between the original and the copies, the original shall prevail.

17.5 The Bid shall be signed by a person or persons duly authorized to sign on behalf of the Bidder. The Bidder shall submit with its Technical Bid a written Power of Attorney (POA), duly notarized, authorizing the signatory of the Bid to act for and on behalf of the Bidder. The POA must contain the name, identity, designation, and signatures of the persons signing the POA, and to whom the Bidder has authorized to act for and on behalf of the Bidder.

i. For foreign firm/Bidder, board resolution and power of attorney (duly attested by Consulate General of Pakistan/Pakistan Embassy) are required.

ii. For local firm, board resolution and/or power of attorney provided on stamp paper worth Rs.1000 or as per governing law, whichever is higher, are required.

In case of non-submission or non-compliance of a valid power of attorney (POA), post bid clarification shall be sought to submit the same within five (5) calendar days of receiving such request, and its failure to submit the acceptable POA shall lead to rejection of the bid.

The Forms, Schedules and other documents comprising the Bid shall be duly signed and stamped by the person or persons authorized to sign the Bid, wherever required under the Bidding Documents.

17.6 The Bid shall contain no alterations, omissions or additions, except to comply with instructions issued by the Employer, or as are necessary to correct errors made by the Bidder, in which case such corrections shall be initialed by the person or persons signing the Bid.

17.7 Bidders shall indicate in the space provided in the Letter of Technical Bid and Letter of Price Bid, their full and proper addresses at which notices may be legally served on them and to which all correspondence in connection with their Bids and the Contract is to be sent.

17.8 Bidders should retain a copy of the Bidding Documents as their file copy.

D. SUBMISSION OF BIDS

IB.18 Sealing and Marking of Bids

18.1 The Bidder shall submit its Bid as under:

(a) ORIGINAL and Three (03) COPIES of the original Technical Bid and Price Bid shall be separately sealed and put in separate envelopes and marked as such.

(b) The envelopes containing the ORIGINAL and COPIES of both Technical Bids and Price Bids will be put in one sealed envelope and addressed/identified as given in Sub-Clause IB 18.2 hereof.

18.2 The inner and outer envelopes shall;

(a) be addressed to the Employer at the address given in the Invitation for Bids.

(b) bear the name and address of the Bidder, Project name, Contract No. and Date of opening of Bid.

(c) provide a warning not to open before the time and date for Bid opening

18.3 The Bid shall be delivered in person or sent by registered mail at the address as given

in the Invitation for Bids.

18.4 In addition to the identification required in Sub-Clause 18.2 hereof, the inner envelope shall indicate the name and address of the Bidder to enable the Bid to be returned unopened in case it is declared "late" pursuant to Clause IB.20.

18.5 If the outer envelope is not sealed and marked as above, the Employer will assume no responsibility for the misplacement or premature opening of the Bid.

18.6 Bidders are also required to submit soft copies [one USB in PDF format with its Technical Bid and Price Bid (Price Bid & SOPs to be provided in excel format also). The soft copy of the Technical Bid shall be enclosed in the envelope containing the hard copy of the Bidder's Original Technical Bid, and the soft copy of the Price Bid shall be enclosed in the envelope containing the hard copy of the Bidder's Original Price Bid. If there is any discrepancy between the data/information in the soft copy of the Bidder's Technical Bid and the hardcopy of the Bidder's Technical Bid and between the price indicated in the hard copy of the Bidder's Original Price Bid, and in the soft copy of the Bidder's Price Bid, the data and information indicated in the hard copy of the Original Technical Bid and the Original Price Bid shall prevail.

IB.19 Deadline for Submission of Bids

19.1 (a) Bids must be received by the Employer at the address specified in the Invitation for Bids, not later than the time and date stipulated in the Invitation for Bids.

(b) Bids with charges payable will not be accepted, nor will arrangements be undertaken to collect the Bids from any delivery point other than that specified above. Bidders shall bear all expenses incurred in the preparation and delivery of Bids.

(c) Where delivery of a Bid is by mail and the Bidder wishes to receive an acknowledgment of receipt of such Bid, he shall make a request for such acknowledgment in a separate letter attached to but not included in the sealed Bid package.

(d) Upon request, acknowledgment of receipt of Bids will be provided to those making delivery in person or by messenger.

19.2 Bids submitted through telegraph, telex, fax or e-mail shall not be considered.

19.3 The Employer may, at its discretion, extend the deadline for submission of Bids by issuing an addendum in accordance with Clause IB.7, in which case all rights and obligations of the Employer and the Bidders previously subject to the original deadline will thereafter be subject to the deadline as extended.

IB.20 Late Bids

20.1 (a) Any Bid received by the Employer after the deadline for submission of Bids prescribed in Clause IB.19 will be returned unopened to such Bidder.

(b) Delays in the mail, delays of person in transit, or delivery of a Bid to the wrong office shall not be accepted as an excuse for failure to deliver a Bid at the proper

place and time. It shall be the Bidder's responsibility to determine the manner in which timely delivery of his Bid will be accomplished either in person, by messenger or by mail.

IB.21 Modification, Substitution and Withdrawal of Bids

21.1 Any Bidder may modify, substitute or withdraw its Bid after Bid submission provided that modification, substitution or written notice of the withdrawal is received by the Employer prior to the deadline for submission of Bids.

21.2 The modification, substitution or withdrawal of any Bid shall be prepared, sealed, marked and delivered in accordance with the provisions of Clause IB.18 with the outer and inner envelopes additionally marked "MODIFICATION", "SUBSTITUTION" or "WITHDRAWAL", as appropriate.

21.3 Withdrawal of a Bid during the interval between the deadline for submission of Bids and the expiration of the period of Bid validity specified in the Letter of Technical Bid & Letter of Price Bid, may result in forfeiture of the Bid Security pursuant to Sub-Clause IB.15.7.

E. BID OPENING AND EVALUATION

IB.22 Bid Opening

22.1 The Employer shall open the Technical Bids in public at the address, on the date, and time specified in the Invitation for Bids in the presence of Bidder's designated representatives and anyone who chooses to attend. The Price Bids will remain unopened and will be held in custody of the Employer until the specified time of their opening. If the Technical Bid and the Price Bid are submitted together in one envelope, the Employer shall reject the entire bid and record it at the time of bid opening.

22.2 First, envelopes marked "WITHDRAWAL" shall be opened and read out and the envelope with the corresponding Bid shall not be opened, but returned to the Bidder. No bid withdrawal shall be permitted unless the corresponding withdrawal notice contains a valid authorization to request the withdrawal and is read out at bid opening.

22.3 Second, outer envelopes marked "SUBSTITUTION" shall be opened. The inner envelopes containing the Substitution Technical Bid and/or Substitution Price Bid shall be exchanged for the corresponding envelopes being substituted, which are to be returned to the Bidder unopened. Only the Substitution Technical Bid, if any, shall be opened, read out, and recorded. Substitution Price Bid will remain unopened in accordance with IB 22.1. No envelope shall be substituted unless the corresponding Substitution Notice contains a valid authorization to request the substitution and is read out and recorded at bid opening.

22.4 Next, outer envelopes marked "MODIFICATION" shall be opened. No Technical Bid and/or Price Bid shall be modified unless the corresponding Modification Notice contains a valid authorization to request the modification and is read out and recorded at the opening of Technical Bids. Only the Technical Bids, both Original as well as

Modification, are to be opened, read out, and recorded at the opening. Price Bids, both Original as well as Modification, will remain unopened in accordance with IB 22.1.

22.5 All other envelopes holding the Technical Bids shall be opened one at a time, and the following read out and recorded:

(a) the name of the Bidder;
(b) whether there is a modification or substitution;
(c) the presence of a bid security; and
(d) any other details as the Employer may consider appropriate.

Only Technical Bids and alternative Technical Bids (where permitted under IB 41) read out and recorded at bid opening shall be considered for evaluation. All pages of the Letter of Technical Bid are to be initialed by all representatives of the Employer attending the bid opening. No Bid shall be rejected at the opening of Technical Bids except for late Bids, in accordance with Sub-Clause IB 20.1, and as per IB 22.1.

22.6 The Employer shall prepare a record of the opening of Technical Bids that shall include, as a minimum: the name of the Bidder and whether there is a withdrawal, substitution, or modification; and alternative Bids (where permitted under IB 41); and the presence or absence of a bid security. The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record. A copy of the record shall be distributed to all Bidders who submitted Bids on time.

22.7 At the end of the evaluation of the Technical Bids, the Employer will invite Bidders who have submitted substantially responsive Technical Bids and who have been determined as being qualified for award to attend the opening of the Price Bids. The date, time, and location of the opening of Price Bids will be advised in writing by the Employer. Bidders shall be given reasonable notice of the opening of Price Bids.

22.8 The Employer will notify Bidders in writing who have been rejected on the grounds of their Technical Bids being substantially nonresponsive to the requirements of the Bidding Document and return their Price Bids unopened.

22.9 The Employer shall conduct the opening of Price Bids of all Bidders who submitted substantially responsive Technical Bids, in the presence of Bidders` representatives who choose to attend at the address, on the date, and time specified by the Employer. The Bidder's representatives who are present shall be requested to sign a register evidencing their attendance.

22.10 All envelopes containing Price Bids shall be opened one at a time and the following read out and recorded:

(a) the name of the Bidder;
(b) whether there is a modification or substitution;
(c) the presence and amount of bid security
(d) the Bid Prices, including any discounts and alternative offers (where permitted under IB 41); and
(e) any other details as the Employer may consider appropriate.

Only Price Bids, discounts, and alternative offers (where permitted under IB 41) read

out and recorded during the opening of Price Bids shall be considered for evaluation. All pages of the Letter of Price Bid and Price Schedules are to be initialed by all representatives of the Employer attending the bid opening. No Bid shall be rejected at the opening of Price Bids.

22.11 The Employer shall prepare a record of the opening of Price Bids that shall include, as a minimum: the name of the Bidder, the Bid Price, any discounts, and alternative offers (where permitted under IB 41). The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record. A copy of the record shall be distributed to all Bidders who submitted Bids on time.

IB.23 Clarification of Bids

23.1 To assist in the examination, evaluation and comparison of Bids, the Employer may, at its discretion, ask the Bidder for a clarification of its Bid. The request for clarification and the response shall be in writing and no change in the price or substance of the Bid shall be sought, offered or permitted, except to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the Bids, in accordance with IB 26.2. Any clarification submitted by a Bidder that is not in response to a request by the Employer shall not be considered.

23.2 If a Bidder does not provide clarifications of its Bid by the date and time set in the Employer's request for clarification, its Bid may be rejected.

23.3 The Employer will make the Bidder's Eligibility and Qualification determination based on the provided information with the Bid, and preferably, will not ask for any clarification regarding the discrepancies, missing documents/information, notarized English translation, required to establish the Bidder's Eligibility and Qualification as per Clause IB.13.

IB 23A Deviations, Reservation and Omissions

23A.1 During the evaluation of Bids, the following definitions apply:

(a) "Deviation" is a departure from the requirements specified in the Bidding Document;

(b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Bidding Document; and

(c) "Omission" is the failure to submit part or all of the information or documentation required in the Bidding Document.

IB.24 Preliminary Examination & Determination of Responsiveness of Bids

24.1 The Employer shall examine the Technical Bid to confirm that all documents and technical documentation requested in IB 9.1(I) have been provided, and to determine the completeness of each document submitted. If any of these documents or information is missing, the Bid may be rejected.

24.2 The Employer shall confirm that the following documents and information have been

provided in the Technical Bid. If any of these documents or information is missing, the offer shall be rejected.

(a) Letter of Technical Bid is unsigned pursuant to IB 17.5 or altered pursuant to IB 17.3;

(b) written confirmation of authorization to commit the Bidder;

(c) Bid is not accompanied by a substantially compliant bid security as per IB 15.4

(d) it covers scope of work given in Bidding Documents partially.

(e) Technical Proposal in accordance with IB. 14

24.3 Prior to the detailed evaluation, pursuant to Clause IB.25 the Employer will determine the substantial responsiveness of each Bid to the Bidding Documents. The Employer's determination of a bid's responsiveness is to be based on the contents of the Bid itself, as defined in IB. 9.

A substantially responsive Bid is one which conforms to all the terms and conditions of the Bidding Documents without material deviations, reservation or omission. A material deviation, reservation or omission is one:

(i) which affect in any substantial way the scope, quality or performance of the Works;

(ii) which limits in any substantial way, inconsistent with the Bidding Documents, the Employer's rights or the Bidder's obligations under the Contract; or

(iii) whose rectification/adoption would affect unfairly the competitive position of other Bidders presenting substantially responsive Bids.

24.4 The Employer shall examine the technical aspects of the Bid submitted in accordance with IB 14, Technical Proposal, in particular to confirm that all requirements of Section 9 (Specifications - Technical Provisions) have been met without any material deviation, reservation, or omission.

24.5 A Bid determined as substantially non-responsive will be rejected and will not subsequently be made responsive by the Bidder by correction of the material deviation, reservation or omission.

IB.24A Nonmaterial Nonconformities

24A.1 Provided that a Bid is substantially responsive, the Employer may waive any nonconformities in the Bid that do not constitute a material deviation, reservation, or omission.

24A.2 Provided that a Bid is substantially responsive, the Employer may request that the Bidder submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial nonconformities in the Bid related to documentation requirements. Requesting information or documentation on such nonconformities shall not be related to any aspect of the Price Bid. Failure of the Bidder to comply with the request may result in the rejection of its Bid.

24A.3 Provided that a Bid is substantially responsive, the Employer shall rectify quantifiable nonmaterial nonconformities related to the Bid Price. To this effect, the Bid Price shall be adjusted, for comparison purposes only, to reflect the price of a missing or non-conforming item or component. The adjustment shall be made using the method indicated in IB 27A.

IB.25 Detailed Evaluation of Technical Bids

25.1 The Employer will carry out a detailed technical evaluation of the Bids not previously rejected as being substantially nonresponsive, to determine whether the technical aspects are in compliance with the Bidding Document. The Bid that does not meet minimum acceptable standards of completeness, consistency, and detail, and the specified minimum and/or maximum requirements for specified functional guarantees, will be treated as nonresponsive and hence rejected. To reach such a determination, the Employer will examine and compare the technical aspects of the bids on the basis of the information supplied by the Bidders, taking into account the following:

(a) overall completeness and compliance with the Technical Provisions; deviations from the Technical Provisions; conformity of the plant and services offered with specified performance criteria; suitability of the plant and services offered in relation to the environmental and climatic conditions prevailing at the site; and quality, function and operation of any process control concept included in the Bid. The Bid that does not meet minimum and/or maximum acceptable standards of completeness, consistency, and detail will be rejected for non-responsiveness;

(b) Evaluation of Bidder's experience pursuant to IB 13.4 and IB 13.5 if applicable.

(c) Evaluation of Subcontractor's and/or manufacturer's experience pursuant to IB 14.2.

(d) Compliance of offered equipment, listed in Form of Proposed Subcontractors / Manufacturer for Major item of Plant and Services (Form SUBCON of Schedule E to Bid) to Technical Provisions and Specifications therein.

(e) An assessment of the Bidder’s technical capacity to mobilize key equipment and personnel for the contract consistent with its proposal regarding work methods, scheduling, and material sourcing in sufficient detail and fully in accordance with the requirements stipulated in Section 9.

Non-compliance with equipment and personnel requirements described in Section 9 shall not normally be a ground for bid rejection and such non-compliance will be subject to clarification during bid evaluation and rectification prior to contract award.

25.2 The Employer shall determine to its satisfaction during the evaluation of Technical Bids whether a Bidder meets the eligibility and qualifying criteria specified in IB. 13 & IB. 14.

The determination shall be based upon an examination of the documentary evidence of the Bidder's qualifications submitted pursuant to IB 13 & 14. Where expressly permitted under IB 13.4(b), IB 13.4(c) and IB 13.5(c), the qualifications and experience of the proposed Specialist Subcontractor/Manufacturer may be considered for the

specific requirement for which such reliance is permitted. The Employer will have the right to verify the particulars regarding the plant and other related information furnished with the bid, and the joint venture as well as the partners thereof shall be liable for disqualification in the event of any mis-statement/mis-representation on their part

25.3 An affirmative determination shall be a prerequisite for the opening and evaluation of a Bidder's Price Bid. The Employer reserves the right to reject the bid of any Bidder found to be in circumstances described in GCC 45.2 (c). A negative determination shall result in the disqualification of the Bid, in which event the Employer shall return the unopened Price Bid to the Bidder.

25.4 The capabilities of the manufacturers and subcontractors proposed in its Bid for the major items of plant and services to be used by a Bidder will also be evaluated for acceptability in accordance with IB 13 & 14. Their participation should be confirmed with a letter of intent between the parties, as needed. Should a manufacturer or subcontractor be determined to be unacceptable, the Bid will not be rejected, but the Bidder will be required to propose, without changing its bid price, an acceptable substitute manufacturer or subcontractor meeting the minimum technical specifications stated in Section 9 (Specifications – Technical Provisions). If a Bidder does not provide an acceptable substitute manufacturer or subcontractor by the date and time set in the Employer's request for substitution of manufacturer or subcontractor, its Bid may be rejected.

IB.26 Conversion to Single Currency, Correction of Arithmetic Errors

26.1 To facilitate evaluation and comparison, the Employer will convert, all Bid Prices expressed in the amount in various currencies in which Bid Price is quoted, to Pak. Rupees at the Telegraphic Transfer and On-Demand (TT&OD) composite (selling) exchange rates published by the National Bank of Pakistan and applicable to similar transactions, on the date of the opening of technical Bids.

26.2 During the evaluation of Price Bids, the Employer shall correct arithmetical errors on the following basis:

(a) where there are errors between the total of the amounts given under the column for the price breakdown and the amount given under the Total Price, the amounts given under the column for the price breakdown shall prevail and the Total Price will be corrected accordingly, unless in the opinion of the Employer there is an obvious misplacement of the decimal point in the price breakdown or the unit price when multiplied with the quantity results in an abnormally high or abnormally low Total Price, in which case the Total Price as quoted shall prevail and the unit price shall be corrected accordingly;

(b) where there are errors between the total of the amounts of Schedule Nos. 1 to 4 and the amount given in Schedule No. 5 (Grand Summary), the total of the amounts of Schedule Nos. 1 to 4 shall prevail and the Schedule No. 5 (Grand Summary) will be corrected accordingly;

(c) if there is a discrepancy between the grand total price given in Schedule No. 5 (Grand Summary) and the bid amount in point (1) of the Letter of Price Bid, the

grand total price given in Schedule No. 5 (Grand Summary) will prevail and the bid amount in point (1) of the Letter of Price Bid will be corrected; and

(d) if there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetical error, in which case the amount in figures shall prevail subject to (a), (b), and (c) above.

(e) If the Bidder does not accept the corrected amount of Bid, his Bid will be rejected and his Bid Security forfeited as per IB.15.7.

IB.27. Domestic Preference

27.1 In the comparison of evaluated Bids, the Goods manufactured in Pakistan, will be granted a margin of preference in accordance with the following procedures, provided the Bidder shall have established to the satisfaction of Employer that the manufacturing cost of such Goods includes a domestic value addition equal to at least 20% of the ex-factory Bid price of such Goods duly certified by the Engineering Development Board (EDB). The claim for domestic preference without a certificate from the EDB shall not be entertained. Bidders applying for domestic preference shall fill in Appendix D to these Instructions to substantiate their claim.

27.2 The Employer will first review the Bids to determine, the Bid group classification in accordance with Sub-Clause 10.2 hereof.

27.3 The comparison shall be Ex-factory price of the Goods to be offered from within Pakistan (such prices to include all costs as well as custom duties and taxes paid or payable on raw materials and components incorporated or to be incorporated in the Goods) and the DDP (CIF + Customs duty, sales tax and other import charges) Pakistan seaport price of the Goods to be offered from outside Pakistan.

27.4 The lowest evaluated bid of each Group shall first be determined by comparing all evaluated bids in each Group among themselves taking into account:

(a) In the case of Goods manufactured in Pakistan, sales tax, local body charges and other similar taxes which will be payable on the furnished Goods in Pakistan.

(b) In the case of Goods of foreign origin offered from abroad, customs duties, sales tax and other import charges which will be payable on furnished Goods in Pakistan.

(c) In the case of Goods of foreign origin already located in Pakistan, customs duty, sales tax and import charges on CIF price as applicable for Sub-Clause 27.4(b) here above.

27.5 The price preference to Group A bids will be:

(i) 15% of the ex-factory bid price, if the value addition through indigenous manufacturing is at least 20%;

(ii) 20% of the ex-factory bid price, if the value addition through indigenous manufacturing is over 20% and up to 30%; and

(iii) 25% of the ex-factory bid price, if the value addition through indigenous manufacturing is over 30%.

27.6 The applicable price preference i.e., as per Sub-Clause 27.5 here above will be applied to Group A Bid by reducing the ex-factory bid price.

27.7 The computation for the purpose of domestic preference under Sub-Clause IB 10.2 and Clause IB 27 and award of contract shall be subject to change, if any, as per policy of the Federal Government as applicable on the date of bid opening

IB 27A Evaluation and Comparison of Price Bids

27A.1 The Employer shall use the criteria and methodologies listed in this clause. No other evaluation criteria or methodologies shall be permitted.

27A.2 Price Bid shall be rejected if:

(a) Letter of Price Bid is unsigned pursuant to IB 17.5 or altered pursuant to IB 17.3, or

(b) the quoted price is adjustable during currency of the contract when Bidders are required to quote fixed price, and vice versa.

27A.3 To evaluate a Price Bid, the Employer shall consider the following:

(a) the bid price, excluding provisional sums and the provision, if any, for contingencies in the Price Schedules;

(b) price adjustment for correction of arithmetical errors in accordance with IB 26.2;

(c) price adjustment due to discounts offered in accordance with IB 11.5;

(d) price adjustment due to quantifiable nonmaterial nonconformities in accordance with IB 24A.3;

(e) converting the amount resulting from applying (a) to (c) above, if relevant, to a single currency in accordance with IB 26.1;

(f) application of domestic preference as per clause IB 27, if applicable;

(g) assessment whether the bid is abnormally low in accordance with IB 27B; and

(h) In addition to the criteria listed in IB 27A.3 (a)–(g), other relevant factors are as follows:

Adjustments in price that result from the procedures outlined below shall be added, for purposes of comparative evaluation only, to arrive at an "Evaluated Bid Price." Bid prices quoted by Bidders shall remain unaltered.

Pursuant to IB 24A.3, the cost of all quantifiable nonmaterial nonconformities or omissions from the contractual and commercial conditions shall be evaluated. The Employer will make its own assessment of the cost of any nonmaterial nonconformities and omissions for the purpose of ensuring fair comparison of Bids

A. Price Adjustment for Completeness in Scope of Work

(i) Scope of work of each bid will be examined for completeness and compliance with the contract requirements. Subject to IB 24A.3, if minor item(s) appear to be excluded, or if any Bidder has not quoted price against any particular item or kept blank in price column (the same is considered as missing item), then the cost of minor missing items in the scope shall be added to the bid price to allow for bid comparison on an equal basis. The price adjustment shall be based on the highest price offered for the same item among all responsive Bidders. In case of non-availability of price from other Bidders, the price will be estimated by the Employer.

(ii) In case there is a discrepancy between the quantity of an item quoted by the Bidder and the quantity specified in the bidding documents, the quantity specified in the bidding documents shall prevail, and the total cost will be corrected by multiplying the unit rate and quantity.

B. Price Adjustment for Commercial Compliance

The cost of making good any deficiency resulting from any quantifiable variations and deviations from the Bid Schedules and Conditions of Contract, as determined by the Employer will be added to the Corrected Total Bid Price for comparison purpose only.

C. Price Adjustment for Technical Compliance

The cost of making good any deficiency resulting from technical noncompliance will be added to the Corrected Total Bid Price for comparison purposes only. The adjustments will be applied taking the highest price quoted by other Bidders being evaluated in detail in their original Bids for corresponding item. In case of non-availability of price from other Bidders, the price will be estimated by the Employer.

D. Price Adjustment for Terms of Payment

The terms and conditions for the payments by the bidders shall also be taken into consideration for evaluation and comparison of bids.

Bids offering terms of payment that entail lower rate of advance payment and/or delayed/deferred payments than specified in the Conditions of Contract, provided however that such proposals are considered acceptable by the Employer, shall be given an advantage in the evaluation, calculated from the mark-up using the following rates:

- For foreign currency component: 8% per annum
- For local currency component: 15.5% per annum

The price thus worked out shall be subtracted from the Corrected Total Bid Price for comparison purpose only.

On the other hand, if a bid deviates from the terms of payment/payment conditions as specified in the Conditions of Contract by offering more stringent payment terms, including higher rates of advance payment and/or earlier payments than specified in the Conditions of the Contract, and if such deviation is considered acceptable to the Employer, mark-up earned for any earlier payments involved in the terms outlined in the bid, as compared to those stipulated in the Conditions of Contract, shall be calculated at the above-mentioned mark-up rates and added to the Corrected Total Bid Price for comparison purposes only.

E. Price Adjustment for Completion Schedule

No credit will be given in this evaluation to the Bids indicating completion prior to the dates stated in the Preamble to Conditions of Contract.

Bids indicating a completion period later than the period set out in the Preamble to the Conditions of Contract shall be adjusted in the evaluation by adding a factor of 0.1 percent of the bid price for each calendar day of completion later than the specified period of completion.

However, Bids indicating completion beyond 90 days later than the date set out in the Preamble to Conditions of Contract, shall not be considered and rejected as non-responsive.

F. Price Adjustment for Steam Turbine Performance

The evaluated Bid Price of each Bidder shall be adjusted for the purpose of bid comparison only (not for contract purposes) as follows:

$$Price\ adjustment\ for\ Steam\ Turbine\ Performance = (GGPO_{Max} - GGPO_{Bidder}) \times PKR\ 225{,}000$$

Where:

$GGPO_{Max}$ is the highest Guaranteed Gross Power Output (in kW) at Reference Conditions offered by any substantially responsible Bidder, and

$GGPO_{Bidder}$ is the Guaranteed Gross Power Output (in kW) at Reference Conditions offered in the Bid under evaluation.

'The maximum adjustment for performance shall be 5% of the evaluated bid price. The minimum GGPO acceptable shall be 255 MW and Bids below this threshold shall be rejected as non-responsive.

The evaluation adjustment shall be added to the Bidder's evaluated Bid Price solely for the purpose of ranking Bids. It shall confer no right on any Bidder to claim or receive payment in excess of the Contract Price agreed

at award.

27A.4 If the Bid, which results in lowest Evaluated Bid Price, is seriously unbalanced or front loaded in the opinion of the Employer, in relation to the Employer's estimate of the cost of work to be performed under the Contract, the Employer may require the Bidder to produce detailed price analysis for any or all items of the Schedule of Prices to demonstrate the internal consistency of those prices with the construction methods and time schedule proposed. After evaluation of the price analyses, taking into consideration the terms of payment, the Employer may require that the amount of the Performance Security set forth in Clause IB.34 be increased at the expense of the successful Bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract.

27A.5 The Employer shall compare all substantially responsive Bids to determine the lowest evaluated Bid, in accordance with IB 27A.3

IB.27B Abnormally Low Bids

27B.1 An abnormally low bid is one where the bid price, in combination with other elements of the bid, appears to be so low that it raises concerns as to the capability of the Bidder to perform the contract for the offered bid price.

27B.2 When the offered bid price appears to be abnormally low, the Employer shall undertake a three-step review process as follows:

(a) identify abnormally low costs and unit rates by comparing them with the engineer's estimates, other substantially responsive bids, or recently awarded similar contracts;

(b) clarify and analyze the bidder's resource inputs and pricing, including overheads, contingencies and profit margins; and

(c) decide whether to accept or reject the bid.

27B.3 With regard to IB 27B.2 (b) above, the Employer will seek a written explanation from the bidder of the reasons for the offered bid price, including a detailed analysis of costs and unit prices, by reference to the scope, proposed methodology, schedule, and allocation of risks and responsibilities. This may also include information regarding the economy of the manufacturing process; the services to be provided, or the construction method to be used; the technical solutions to be adopted; and any exceptionally favorable conditions available to the bidder for the works, equipment or services proposed.

27B.4 After examining the explanation given and the detailed price analyses presented by the bidder, the Employer may:

(a) accept the bid, if the evidence provided satisfactorily accounts for the low bid price and costs, in which case the bid is not considered abnormally low;

(b) accept the bid, but require that the amount of the performance security be increased at the expense of the bidder to a level sufficient to protect the Employer against financial loss. The amount of the performance security shall

generally be not more than 20% of the contract price; or

(c) reject the bid if the evidence provided does not satisfactorily account for the low bid price, and make a similar determination for the next ranked bid, if required.

IB.28 Process to be Confidential

28. 1 Subject to Clause 23 heretofore, no Bidder shall contact Employer on any matter relating to its Bid from the time of the Bid opening to the time the Bid evaluation result is announced by the Employer. The evaluation result shall be announced at least ten (10) days prior to award of Contract. The announcement to all Bidders will include table(s) comprising read out prices, discounted prices, price adjustments made, final evaluated prices and recommendations against all the bids evaluated.

28.2 Any effort by a Bidder to influence Employer in the Bid evaluation, bid comparison or Contract Award decisions may result in the rejection of his Bid.

28.3 Mechanism for redressal of grievances shall be in accordance with rule No. 48 of Public Procurement Rules 2004.

F. AWARD OF CONTRACT

IB.29. Post-Qualification

29.1 The Employer, at any stage of the bid evaluation, having credible reasons for or *prima facie* evidence of any defect in supplier's or contractor's capacities, may require the suppliers or contractors to provide information concerning their professional, technical, financial, legal or managerial competence whether already pre-qualified or not:

Provided that such qualification shall only be laid down after recording reasons therefore in writing. They shall form part of the records of that bid evaluation report.

29.2 The determination will take into account the Bidder's financial, technical and production capabilities. It will be based upon an examination of the documentary evidence of the Bidder's qualification submitted under Appendix B to Instructions to Bidders "Evidence of Bidder's & Subcontractor's Capability" by the Bidder pursuant to Clause IB.13, as well as such other information as required under the Bidding Documents.

29.3 An affirmative determination will be a pre-requisite for award of the Contract to the lowest evaluated Bidder. A negative determination will result in rejection of that Bidder's Bid in which event, Employer will proceed to undertake a similar determination of the next lowest evaluated Bidder's capabilities to perform the Contract satisfactorily.

IB.30 Award Criteria

30.1 Subject to Clause IB.32, the Employer will award the Contract to the Bidder whose Bid has been determined to be substantially responsive to the Bidding Documents and who has offered the lowest evaluated Bid Price, provided that such Bidder has been

determined to be qualified to satisfactorily perform the Contract in accordance with the provisions of Clauses IB.24 to 27A and IB 29.

IB.31 Employer's Right to Vary Quantities

31.1 Employer reserves the right at the time of award of Contract to increase or decrease by up to 15% the quantity of goods and services specified in the Schedule of Prices without any change in the unit price or other terms and conditions.

IB.32 Employer's Right to Accept any Bid and to Reject any or all Bids

32.1 Notwithstanding Clause IB.30, the Employer reserves the right to accept or reject any Bid, and to annul the bidding process and reject all Bids, at any time prior to award of Contract, without thereby incurring any liability to the affected Bidders or any obligation to inform the affected Bidders of the grounds for the Employer's action except that the grounds for its rejection shall upon request be communicated, to any Bidder who submitted a Bid, without justification of grounds. Rejection of all bids shall be notified to all Bidders promptly.

32.2 No negotiations with the Bidder having been evaluated as lowest responsive or any other Bidder shall be permitted. However, the Employer may have clarification meeting(s) to clarify any item(s) in the bid evaluation report.

IB.33 Notification of Award

33.1 Prior to expiration of the period of bid validity prescribed by the Employer, the Employer will notify the successful Bidder in writing ("Letter of Acceptance") that his bid has been accepted. This letter shall name the sum which the Employer will pay the Contractor in consideration of the design, execution and completion of the Works by the Contractor as prescribed by the Contract (hereinafter and in the Conditions of Contract called the "Contract Price").

33.2 The Letter of Acceptance and its acceptance by the Bidder will constitute the formation of the Contract, binding the Employer and the Bidder till signing of the formal Contract Agreement.

33.3 Upon furnishing by the successful Bidder of a Performance Security, the Employer will promptly notify the other Bidders that their bids have been unsuccessful and return their bid securities.

IB.34 Performance Security

34.1 The successful Bidder shall furnish to the Employer a Performance Security in the form and the amount stipulated in the Conditions of Contract within a period of twenty-eight (28) days after the receipt of Letter of Acceptance.

34.2 Failure of the successful Bidder to comply with the requirements of Sub-Clause IB.34.1 or Clause IB.35 or Clause IB.44 shall constitute sufficient grounds for the annulment of the award and forfeiture of the Bid Security.

IB.35 Signing of Contract Agreement

35.1 Within fourteen (14) days from the date of furnishing of acceptable Performance Security under the Conditions of Contract, the Employer will send to the successful Bidder the Form of Contract Agreement provided in the Bidding Documents, duly filled in and incorporating all agreements between the parties for signing and return it to the Employer.

35.2 The formal Agreement between the Employer and the successful Bidder shall be executed within fourteen (14) days of the receipt of such Form of Contract Agreement by the successful Bidder from the Employer.

G. ADDITIONAL INSTRUCTIONS

IB.36 Instructions not Part of Contract

36.1 Bids shall be prepared and submitted in accordance with the above Instructions to Bidders including Additional Instructions which are provided to assist Bidders in preparing their Bids, and do not constitute part of the Bid or the Contract Documents.

IB.37 Contract Documents

37.1 The Documents which will be included in the Contract are listed in the Form of Contract Agreement set out in these Bidding Documents.

IB.38 Sufficiency of Bid

38.1 Each Bidder shall satisfy himself before Bidding as to the correctness and sufficiency of his Bid and of the rates and prices entered in the Schedule of Prices. Except insofar as it is otherwise expressly provided in the Contract, the rates and prices entered in the Schedule of Prices shall cover all his obligations under the Contract and all matters and things necessary for the proper completion of the Works.

IB.39 One Bid per Bidder

39.1 Each Bidder shall submit only one bid either by himself, or as a partner in a joint venture. A Bidder who submits or participates in more than one bid (other than alternatives pursuant to Clause IB.41) will be disqualified and bids submitted by him shall not be considered for evaluation and award.

IB.40 Bidder to Inform Himself

40.1 The Bidder is advised to obtain for himself at his own cost and responsibility all information that may be necessary for preparing the Bid and entering into a Contract for execution of the Works. This shall include but not be limited to the following:

(a) inquiries on Pakistani Income Tax and Sales Tax to the Commissioner of the Income Tax and Sales Tax, in Pakistan.

(b) inquiries on customs duties and other import taxes, to the concerned authorities

of Customs and Excise Department.

(c) information regarding port clearance facilities, loading and unloading facilities, storage facilities, transportation facilities and congestion at Pakistan seaports.

(d) investigations regarding transport conditions and the probable conditions which will exist at the time the Goods will be actually transported.

IB.41 Alternate Proposals by Bidder

Not Applicable

IB.42 Site Visit and Local Conditions

42.1 Bidder must verify and supplement by his own investigations the information about site and local conditions. However, Employer will assist the Bidder wherever practicable and possible.

42.2 All Bidders are required to visit the site at their own expense to review the areas allocated for the Plant and the interfacing facilities, if any. Bidders may also wish to study local conditions, available facilities, communications, craft wages, roads and other transport facilities. Bidders shall also acquaint themselves with the relevant laws, rules, and regulations of Pakistan.

42.3 The Bidders and any of their personnel or agents will be granted permission by the Employer to enter upon his premises and lands for the purpose of such inspection, but only upon the express condition that the Bidders, their personnel and agents, will release and indemnify the Employer, his personnel and agents from and against all liability in respect thereof and will be responsible for death or personal injury, loss of or damage to property and any other loss, damage, costs and expenses incurred as a result of such inspection.

IB.43 Pre-Bid Meeting

43.1 The Employer may, at his own or at the request of any prospective Bidder(s), hold a Pre-Bid meeting to clarify issues and to answer any questions on matters related to the Bidding Documents. The date, time and venue of the pre-bid meeting will be communicated to all the prospective bidders. All prospective bidders or their authorized representatives may attend the pre-bid meeting.

43.2 The Bidders will be required to submit questions, if any, in writing so as to reach the Employer not later than three (3) days before the pre-bid meeting.

IB.44 Integrity Pact

The Bidder shall sign and stamp the Integrity Pact provided at Schedule J to Bid in the Bidding Document for all Federal Government procurement contracts exceeding Rupees ten million. Failure to provide such Integrity Pact shall make the Bid non-responsive.

IB.45 General Performance of the Bidders

45.1 The Employer reserves the right to obtain information regarding performance of the Bidders on their previously awarded contracts/works. The Employer may in case of consistent poor performance of any Bidder as reported by the employers of the previously awarded contracts, inter alia, reject his bid and/or refer the case to the Pakistan Engineering Council. Upon such reference, PEC in accordance with its rules, procedures and relevant laws of the land take such action as may be deemed appropriate under the circumstances of the case including black listing of such Bidder and debarring him from participation in future bidding for similar works.

APPENDICES TO INSTRUCTIONS TO BIDDERS

The Appendices to ITB are as given below:

- Appendix A: Name of Eligible Countries
- Appendix B: Evidence of Bidder's & Subcontractors Capabilities
- Appendix C: Form of Bid Security
- Appendix D: Domestic Goods (Value added in Pakistan)

Appendices are given here below:

Appendix A to
Instructions to Bidders

NAME OF ELIGIBLE COUNTRIES

Eligible countries to participate in this bidding process are those which have been notified by Ministry of Interior, Government of Pakistan as Business-Friendly Countries (BVL); information can be accessed through following link:

https://www.visa.nadra.gov.pk/business-visa-list-bvl.

Appendix B to
Instructions to Bidders

EVIDENCE OF BIDDER'S & SUBCONTRACTOR'S CAPABILITY

[Note: Bidders to fill following forms to provide information regarding its eligibility and capability]

Form ELI - 1: Bidder's Information Sheet

Bidder's Information	
Bidder's legal name	
In case of a Joint Venture, legal name of each partner	
Bidder's country of constitution	
Bidder's year of constitution	
Bidder's legal address in country of constitution	
Bidder's authorized representative (name, address, telephone number(s), fax number(s), e-mail address)	
Attached are copies of the following documents: ❑ 1. In case of a single entity, articles of incorporation or constitution of the legal entity named above ❑ 2. Authorization to represent the firm or Joint Venture named above, in accordance with IB 17.5 ❑ 3. In case of a Joint Venture, a letter of intent to form a Joint Venture or Joint Venture agreement, in accordance with IB 13.5.	

Form ELI - 2: Joint Venture Information Sheet

Each member of the Joint Venture must fill out this form separately. Subcontractor proposed must also fill out this form.

Joint Venture/Subcontractor Information	
Bidder's legal name	
Joint Venture Partner's or Subcontractor's legal name	
Joint Venture Partner's or Subcontractor's country of constitution	
Joint Venture Partner's or Subcontractor's year of constitution	
Joint Venture Partner's or Subcontractor's legal address in country of constitution	
Joint Venture Partner's or Subcontractor's authorized representative information (name, address, telephone number(s), fax number(s), e-mail address)	
Attached are copies of the following documents: ❑ 1. Articles of incorporation or constitution of the legal entity named above, in accordance with IB 2.1 ❑ 2. Authorization to represent the firm named above, in accordance with IB 17.5	

Form FIN - 1: Historical Financial Performance

Each Bidder must fill out this form.

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name below:

Joint Venture Partner: _____

Financial Data for Previous 5 Years [$ Equivalent]				
Year 1:	**Year 2:**	**Year 3:**	**Year 4:**	**Year 5:**

Information from Balance Sheet

Total Assets (TA)					
Total Liabilities (TL)					
Net Worth = TA-TL					
Current Assets (CA)					
Current Liabilities (CL)					
Working Capital = CA-CL					

Information from Income Statement

Total Revenues					
Profits Before Taxes					
Profits After Taxes					

❑ Attached are copies of financial statements (balance sheets including all related notes, and income statements) for the last 5 years, as indicated above, complying with the following conditions.

- All such documents reflect the financial situation of the legal entity or entities comprising the Bidder and not the Bidder's parent companies, subsidiaries or affiliates.
- Historical financial statements must be audited by a certified accountant.
- Historical financial statements must be complete, including all notes to the financial statements.

Historical financial statements must correspond to accounting periods already completed and audited (no statements for partial periods shall be requested or accepted).

Form FIN - 2: Average Annual Turnover

Each Bidder must fill out this form.

The information supplied should be the Annual Turnover of the Bidder or each member of a Joint Venture calculated as total certified payments received for contracts in progress or completed during the last five years, converted to equivalent US dollars at the rate of exchange (selling) prevailing twenty-eight (28) days prior to Bid Opening Date.

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name below:

Joint Venture Partner: _____

Annual Turnover Data for the Last 5 Years			
Year	**Amount Currency**	**Exchange Rate**	**$ Equivalent**
		Average Annual Turnover	

Form EXP – 1: Contracts of Similar Size and Nature

Fill out one (1) form per contract.

Contract of Similar Size and Nature		
Contract No. . . . . of	**Contract Identification**	
Award Date :		**Completion Date :**
Role in Contract	❑ **Contractor** ❑ **Management Contractor** ❑ **Subcontractor**	
Total Contract Amount	**US$**	
If partner in a Joint Venture or subcontractor, specify participation of total contract amount	**Percent of Total**	**Amount**
Employer's name **Address** **Telephone number** **Fax number** **E-mail**		
Description of the Similarity in Accordance with IB 13.4 (a)		
Steam turbine make / model **Gross Output** **Installation/commissioning date** **Commercial operation date** **Operating period before bid opening** **Bidder's role** **Employer/client** **Country/location** **Contract value**		

❑ Attached are copies of:

- Contract agreements with sufficient details to establish Bidder's experience in accordance with IB 13.4,
- Joint Venture Agreements (applicable if contract performed in joint venture) with sufficient detail of Bidder's participation.
- Verifiable End User Certificates establishing successful operation of contracts for the period mentioned in IB 13.4 on end user's proper letter head showing email address, telephone no., fax no., postal address, etc.

➢ Notarized English translation shall also be attached if any document is not in English language.

➢ All documents shall reflect experience of the legal entity or entities comprising the Bidder and not the Bidder's parent companies, subsidiaries or affiliates.

Form EXP - 2: Experience of Subcontractors/ Manufacturers

Fill out one (1) form per contract.

Contract for the Major Items		
Contract No . . . . . .of.	**Contract Identification**	
Award Date		**Completion Date**
Role in Contract	❑ **Contractor** ❑ **Management Contractor** ❑ **Subcontractor**	
Total Contract Amount	**$**	
If partner in a Joint Venture or subcontractor, specify participation of total contract amount	**Percent of Total**	**Amount**
Employer's name **Address** **Telephone number** **Fax number** **E-mail**		
Description of the Major Items in Accordance with sub-clause IB 13.4(b) & (c) and IB 14.2		
Number of units, **Unit rating,** **Turbine/generator type,** **Design responsibility,** **Manufacturing responsibility,** **Commercial operation hours,** **Commissioning date,** **Operating history.**		

In case of manufacturers, please attach:

- Copies of relevant supply record, contract agreements etc. to prove experience and supply.
- Manufacturer's Authorization
- One satisfactory Operational Certificate from end user from Pakistan or outside the country of origin of offered equipment/goods. The submitted certificate must indicate the name of the end user/client along with its contact address, phone numbers, fax numbers, web-site and e-mail addresses.

In case of Subcontractors of Key activities, please attach:

- Contract agreements with sufficient details to establish Bidder's experience in accordance with IB 13.4,
- Joint Venture Agreements (applicable if contract performed in joint venture) with sufficient detail of Bidder's participation.
- End User Certificates establishing successful operation of contracts for the period mentioned in IB 13.4.

➢ Notarized English translation shall also be attached if any document is not in English language.

➢ All documents shall reflect experience of the legal entity or entities comprising the Bidder and not the Bidder's parent companies, subsidiaries or affiliates.

Note:

1. No change of Sub-Contractor shall be made by the Bidder without prior approval of the Employer.

2. The truthfulness and accuracy of the statement as to the experience of Subcontractors is guaranteed by the Bidder. The Employer's judgment shall be final as to the evaluation of the experience of Subcontractors submitted by the Bidder.

3. Statement of similar works shall include description, location & value of work, year completed and name & address of the clients.

4. This may include manufacturer(s) who are proposed here and their relevant details to be provided accordingly including make, capacity and salient features to make it particularly suitable for the works. The technology used should also be detailed adequately.

Initials of Signatory to Bid: ……

Appendix C
Instructions to Bidders

Form of Bid Security
(Bank Guarantee)

Guarantee No._____
Executed on _____
Expiry date _____

[Letter by the Guarantor to the Employer]

Name of Guarantor (Bank) with address:_____
Name of Principal (Bidder) with address:_____
_____
Penal Sum of Security (express in words and figures):_____
_____
Bid Reference No._____ Date of Bid Opening _____

KNOW ALL MEN BY THESE PRESENTS, that in pursuance of the terms of the Bid and at the request of the said Principal, we the Guarantor above-named are held and firmly bound unto the _____, (hereinafter called The "Employer") in the sum stated above, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal has submitted the accompanying Bid numbered and dated as above for _____ (Particulars of Bid) to the said Employer; and

WHEREAS, the Employer has required as a condition for considering the said Bid that the Principal furnishes a Bid Security in the above said sum to the Employer, conditioned as under:

(1) that the Bid Security shall remain valid for a period 28 days beyond the period of validity of the Bid;

(2) that in the event of;

- (a) the Principal withdraws his Bid during the period of validity of Bid, or
- (b) the Principal does not accept the correction of his Bid Price, pursuant to Sub-Clause 26.2 (e) & 15.7 of Instructions to Bidders, or
- (c) the Principal is found involved in corrupt and fraudulent practices, or
- (d) failure of the successful Bidder to

  - (i) furnish the required Performance Security, in accordance with Clause 34 of Instructions to Bidders, or
  - (ii) sign the proposed Contract Agreement, in accordance with Clause 35 of Instructions to Bidders,

then the entire sum be paid immediately to the said Employer as liquidated damages and not as penalty for the successful Bidder's failure to perform.

NOW THEREFORE, if the successful Bidder shall, within the period specified therefore, on the prescribed form presented to him for signature enter into a formal Contract with the said Employer in accordance with his Bid as accepted and furnish within twenty eight (28) days of his being requested to do so, a Performance Security with good and sufficient surety , as may be required, upon the form prescribed by the said Employer for the faithful performance and proper fulfilment of the said Contract or in the event of non-withdrawal of the said Bid within the time specified for its validity then this obligation shall be void and of no effect, but otherwise to remain in full force and effect.

PROVIDED THAT the Guarantor shall forthwith pay to the Employer the said sum stated above upon first written demand of the Employer without cavil or argument and without requiring the Employer to prove or to show grounds or reasons for such demand notice of which shall be sent by the Employer by registered post duly addressed to the Guarantor at its address given above.

PROVIDED ALSO THAT the Employer shall be the sole and final judge for deciding whether the Principal has duly performed his obligations to sign the Contract Agreement and to furnish the requisite Performance Security within the time stated above, or has defaulted in fulfilling said requirements and the Guarantor shall pay without objection the sum stated above upon first written demand from the Employer forthwith and without any reference to the Principal or any other person.

IN WITNESS WHEREOF, the above bounden Guarantor has executed the instrument under its seal on the date indicated above, the name and seal of the Guarantor being hereto affixed and these presents duly signed by its undersigned representative pursuant to authority of its governing body.

_____
Guarantor (Bank)

Witness: Signature _____

1. _____ Name _____

_____ Title _____
Corporate Secretary (Seal)

2. _____ _____

_____ _____
(Name, Title & Address) Corporate Guarantor (Seal)

Appendix D to Instructions to Bidders

Domestic Goods (Value added in Pakistan)

[Bidders claiming eligibility for domestic preference should fill in for supply items only, all columns hereunder and provide necessary documentation to substantiate their claim]

Sr. No.	Description of Indigenous Goods	Unit	Qty	Total Price of Goods Ex-Factory (Pak Rs.)	Domestic value added in the manufacturing cost as percentage of Ex-Factory Price	Amount of value addition (Pak Rs.)
1	2	3	4	5	6	7
			Total in columns 5 & 7			

Computations:

A. Total amount of Value Addition (from Col.7) Rs. _____
B. Total Ex-Factory Price of Indigenous Goods (from Col.5) Rs. _____
C. Total DDP Price of imported supply items Eqv. Rs. _____
D. Total Price of supply items [B+C] Eqv. Rs. _____
E. % of value addition = [(A/D)x100] _____%
F. Domestic Preference = (15, 20 or 25)% of B Rs. _____

Notes:

1. The indigenously produced goods for which domestic preference has been claimed and thereby granted, cannot be replaced with goods of foreign origin after award of contract.
2. The claim for domestic preference without a certificate from the Engineering Development Board (EDB) shall not be entertained.

SECTION 2

LETTER AND SCHEDULES OF TECHNICAL BID

SECTION-2

LETTER OF TECHNICAL BID
AND
SCHEDULES TO BID

Letter of Technical Bid

Schedules to Bid

- Schedule A to Bid: Specific Works Data
- Schedule B to Bid: Proposed Organization for the Project & Work Methodology
  - Form 1: Site Organization & Method Statement
  - Form 2: Mobilization Schedule
- Schedule C to Bid: Construction Schedule
- Schedule D to Bid: Personnel
  - Form PER-1: Proposed Personnel
  - Form PER-2: Resume of Proposed Personnel
- Schedule E to Bid: Subcontractors
- Schedule F to Bid: Country of Origin Declaration Form
- Schedule G-1 to Bid: Deviations from Technical Provisions
- Schedule G-2 to Bid: Deviations from Contractual Conditions
- Schedule H To Bid: Specimen JV Agreement
- Schedule I To Bid: Equipment
- Schedule K to Bid Manufacturer's Authorization

LETTER OF TECHNICAL BID

Bid Reference No. _____
Package No. _____

_____
_____
(Name of Works)

To:

_____
_____
_____

Gentlemen,

1. Having examined the Bidding Documents including Instructions to Bidders, Conditions of Contract, Specifications, Drawings, Schedule of Prices and Addenda Nos. _____ for the execution of the above-named Works, we, the undersigned, being a company doing business under the name of and address _____
_____
and being duly incorporated under the laws of _____ hereby offer to execute and complete such Works and remedy any defects therein in conformity with the said Documents including Addenda thereto.

2. We understand that all the Schedules attached hereto form part of this Bid.

3. As security for due performance of the undertakings and obligations of this Bid, we submit herewith a Bid Security in the amount of …… drawn in the favor of, or made payable to the Employer, …… and valid for a period ….. days beyond the period of validity of Bid.

4. We undertake that Price Schedules as per requirements of the Bidding Documents are enclosed with the Price Bid.

5. We undertake, if our Bid is accepted, to commence the Works and to deliver and complete the whole of the Works comprised in the Contract within the time(s) stated in Preamble to the Conditions of Contract.

6. We agree to abide by this Bid for the period of **180** days from the date fixed for receiving the same and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

7. Unless and until a formal Agreement is prepared and executed, this Bid, together with your written acceptance thereof, shall constitute a binding contract between us.

8. We undertake, if our Bid is accepted, to execute the Performance Security referred to in Clause 10 of Conditions of Contract for the due performance of the Contract.

9. We do hereby declare that the Bid is made without any collusion, comparison of figures or arrangement with any other person or persons making a Bid for the Works.

10. We do hereby declare that our firm, including any subcontractors or suppliers for any part of the Contract, have nationalities from eligible countries *[insert the nationality of the Bidder, including that of all parties that comprise the Bidder if the Bidder is a consortium or association, and the nationality of each Subcontractor and Supplier]*.

11. We, including any subcontractors or suppliers for any part of the Contract, do not have any conflict of interest.

12. We are not participating, as a Bidder, in more than one bid in this bidding process.

13. We confirm, if our Bid is accepted, that all partners of the joint venture shall be liable jointly and severally for the execution of the Contract and the composition or the constitution of the joint venture shall not be altered without the prior consent of the Employer. (Please delete in case of Bid from a single firm).

Dated this …… day of ……. 20…

Signature ……... in the capacity of ……. duly authorized to sign the Bid for and on behalf of …….
(Name of Bidder in Block Capitals)
(Seal of Bidder)

Bidder's Address
……
……
……

Witness:

Signature:
……
Name: ……

Address:
……
……
……

Occupation
……

SCHEDULE – A TO BID

SPECIFIC WORKS DATA

1. GUARANTEED CHARACTERISTICS

1.1 Performance Guarantees

The Reference Conditions based on which the Performance Guarantees are provided by the Contractor are specified in Table 1:

Table 1: Reference Conditions

Sr. No.	Parameter	Unit	Value
1	HP steam pressure at steam turbine inlet (before valve)	bar(a)	114.5
2	HP steam temperature at steam turbine inlet (before valve)	°C	560.6
3	HP steam flow at steam turbine inlet (before valve)	kg/h	555425
4	RH steam pressure at steam turbine inlet (before valve)	bar(a)	25.4
5	RH steam temperature at steam turbine inlet (before valve)	°C	560.0
6	RH steam flow at steam turbine inlet (before valve)	kg/h	622872
7	LP steam pressure at steam turbine inlet (before valve)	bar(a)	4.7
8	LP steam temperature at steam turbine inlet (before valve)	°C	305.3
9	LP steam flow at steam turbine inlet (before valve)	kg/h	47357
10	Condenser vacuum pressure	kPa	7.4
11	Generator Power Factor		0.85

The Contractor guarantees that the Guaranteed Gross Power Output (GGPO) of the steam turbine at Reference Conditions shall not be less than the following value:

Guaranteed Parameter	Unit	Value
GGPO	MW	To be filled in by the Bidder

Note 1: 'The minimum acceptable GGPO is 255 MW gross at Reference Conditions. Bids with GGPO below this value shall be rejected as non-responsive.

Note 2: Correction due to ageing of the steam turbine up to successful completion of the performance test of the steam turbine shall not be acceptable and hence not applied at the time of the performance test.

Note 3: GGPO shall be measured on the steam turbine generator terminals less the excitation power of the steam turbine generator.

Note 4: The curves necessary for correcting actual measured performance data from the test conditions to the Reference Conditions shall be submitted by the Contractor for review by the Employer / Engineer. If the Employer / Engineer feels that the correction curves are imbalanced or inaccurate with reference to the parameters guaranteed by the Contractor and other intermediate thresholds, the Employer / Engineer may require the Contractor during course of Bids' evaluation or during execution of the project to rectify the said curves.

1.2 Operating Guarantees

1.2.2 Vibration Guarantee

Steam Turbine & Generator	
Maximum vibration of components:	
Vibration criteria as per ISO 20816-2:2022 (shaft vibrations for steam turbines and generators) and ISO 20816-1:2016 (bearing vibrations). Zone A shall be the acceptance criterion for new equipment; Zone B shall be the maximum permissible during operation	

1.2.3 Noise Guarantees

When tested on site in accordance with the specification / standards, the Plant shall be capable to fulfil the following noise guarantees.

Maximum noise pressure levels measured at 1.5m height		
1 m from ST generator unit	dB(A)	85

2. OTHER TECHNICAL DATA

Please refer to Section 8 of the Bidding Documents

Initials of Signatory to Bid: ……

SCHEDULE – B TO BID

PROPOSED ORGANIZATION FOR THE PROJECT & WORK METHODOLOGY

FORM 1: SITE ORGANIZATION & METHOD STATEMENT

In this form, bidder shall provide the ITS Organization Chart indicating all positions that will be employed in Head Office, Site Office, etc. (whichever applicable) which shall also include key positions indicated in Technical Provisions. Bidder shall also mention the job description of each key position.

The Bidder is required to submit a narrative outlining the method of performing the Works. The narrative should indicate in detail and include but not be limited to:

- The sequence and methods in which he proposes to carry out the Works, including the number of shifts per day and hours per shift, he expects to work.
- The procedure for installation/erection of equipment and transportation of equipment and materials to the site.
- The Contractor shall provide the required area for his construction camp's facilities and staff housing requirements.

Initials of Signatory to Bid: ……

SCHEDULE – B TO BID

FORM 2: MOBILIZATION SCHEDULE

In this form, the bidder shall provide details regarding mobilization of its team in Pakistan along with detailed timeline in accordance with Construction Schedule (Schedule C to Bid).

Initials of Signatory to Bid: ……

SCHEDULE – C TO BID

CONSTRUCTION SCHEDULE

Bidder shall provide a Construction Schedule in a bar-chart/CPM/PERT form showing the sequence of work items by which he proposes to complete the work of the entire Contract. The Schedule should indicate the sequence of work items and the period of time during which he proposes to complete the Works including the activities like designing, schedule of submittal of drawings, ordering and procurement of materials, manufacturing, delivering, construction of civil works, erection, testing and commissioning of Works to be supplied under the Contract.

Initials of Signatory to Bid: ……

SCHEDULE – D TO BID

PERSONNEL

FORM PER-1: PROPOSED PERSONNEL

The Bidder shall provide the details of proposed personnel and their experience record in the relevant Information Forms below for each of the candidate along with recent color photograph.

1.	**Title of position***
	Name
2.	**Title of position***
	Name
3.	**Title of position***
	Name
4.	**Title of position***
	Name
etc.	**Title of position***
	Name

-- Note --

* *Minimum qualification of Project Manager and Site Manager:*
Bachelor in Electrical or Mechanical Engineering with minimum 15 years of relevant experience

*** Minimum qualification of Lead Discipline (Electrical, Mechanical, I&C, Civil):*
Bachelor in relevant discipline Engineering with minimum 10 years of relevant experience

**** Minimum qualification of Planning Engineer:*
Bachelor in Engineering with minimum 10 years of relevant experience

Initials of Signatory to Bid: ……

Form PER – 2: Resume of Proposed Personnel

The Bidder shall provide all the information requested below along with recent color photograph. Use one form for each position.

Position		
Personnel information	**Name**	**Date of birth**
	Professional qualifications	
Present employment	**Name of employer**	
	Address of employer	
	Telephone	**Contact (manager/personnel officer)**
	Fax	**E-mail**
	Job title	**Years with present employer**

Summarize professional experience in reverse chronological order. Indicate particular technical and managerial experience relevant to the project.

From	To	Company/Project/Position/Relevant Technical and Management Experience

SCHEDULE – E TO BID

SUBCONTRACTORS

Form SUBCON: Proposed Subcontractors/Manufacturers for Major Items of Plant and Services

The following Subcontractors and/or manufacturers are proposed for carrying out the item of the facilities indicated. Bidder shall not propose more than three manufacturers for any major item.

Major equipment/Items of Plant to be supplied

Sr. #	Name of Equipment/ Material		Name of Manufacturer	Nationality of Manufacturer
1.	Steam turbine rehabilitation			
2.	Steam turbine generator			
3.	Generator circuit breaker			
4.	Isolated phase bus duct			
5.	DCS upgradation			
6.	Steam turbine control system			
7.	Excitation Transformer for Steam turbine generator			
	Cont.			

Note:

1. The list given above is tentative. Bidder shall provide the list of all material it is offering along with complete information of manufacturers/ subcontractors.
2. The final selection of the Subcontractor/ Manufacturer for each equipment shall be at the discretion of the Employer.
3. No change of Sub-Contractor shall be made by the Bidder without prior approval of the Employer.

4. The truthfulness and accuracy of the statement as to the experience of Subcontractors is guaranteed by the Bidder. The Employer's judgment shall be final as to the evaluation of the experience of Subcontractors submitted by the Bidder.
5. Statement of similar works shall include description, location & value of work, year completed and name & address of the clients.
6. This may include manufacturer(s) who are proposed here and their relevant details to be provided accordingly including make, capacity and salient features to make it particularly suitable for the works. The technology used should also be detailed adequately.

Name of Bidder_____

Signatures of the bidder _____

SCHEDULE – F TO BID

Country of Origin Declaration Form

Name of Bidder _____ Tender Number _____ Page ___ of ___

Item	Description	Country of Origin

SCHEDULE – G-1 TO BID

DEVIATIONS FROM TECHNICAL PROVISIONS

Bidders are required to clearly identify all deviations in Schedule G. Minor deviations of a non-material nature will not result in rejection and will be evaluated per IB 24A. Bidders taking no deviations shall state NONE in Schedule G.

Sr. No.	Clause No. / Section No.	Deviations/Clarifications

[Note**:** Attach additional sheets, if necessary]

Initials of Signatory to Bid: ……

SCHEDULE – G-2 TO BID

DEVIATIONS FROM CONTRACTUAL CONDITIONS

Bidders are required to clearly identify all deviations in Schedule G. Minor deviations of a non-material nature will not result in rejection and will be evaluated per IB 24A. Bidders taking no deviations shall state NONE in Schedule G.

Sr. No.	Clause No. / Section No.	Deviations/Clarifications

Note: Attach additional sheets, if necessary

Initials of Signatory to Bid: ……

SCHEDULE – H TO BID

JV AGREEMENT

SCHEDULE – I TO BID

Equipment

The Bidder shall provide adequate information and details to demonstrate clearly that it has the capability to meet the equipment proposed to be used in carrying out the Works at Site, including number of each kind, make, type, capacity of all equipment, working condition, which shall be deployed by him for Civil Work and Erection, Testing and Commissioning of the Works including requirements indicated in Technical Provisions, using the Forms below. A separate Form shall be prepared for each item of equipment listed, or for alternative equipment proposed by the Bidder.

Item of Equipment		
Equipment Information	**Name of manufacturer**	**Model and power rating**
	Capacity	**Year of manufacture**
Current Status	**Current location**	
	Details of current commitments	
Source	**Indicate source of the equipment** **☐o Owned ☐o Rented ☐o Leased ☐o Specially manufactured**	

Omit the following information for equipment owned by the Bidder.

Owner	**Name of owner**	
	Address of owner	
	Telephone	**Contact name and title**
	Fax	**Telex**
Agreements	**Details of rental/lease/manufacture agreements specific to the project**	

Schedule – K to Bid

MANUFACTURER'S AUTHORIZATION

Date: _____

Bid Reference No.: _____

To: _____
(Name of Employer)

WHEREAS we_____ who are official Manufacturer of _____ (name & description of Goods offered) having factories at (address of factory)_____ do hereby authorize M/s _____ (Name and address of Bidder) to submit a Bid in relation to the Invitation for Bids indicated above, the purpose of which is to provide the following Goods manufactured by us and to subsequently negotiate and sign the Contract:

Description of Goods: _____

_____

_____

We hereby extend our full guarantee and warranty in accordance with Clause 1.1.11 of the General Conditions of Contract, with respect to the Goods offered by the above firm in reply to this Invitation for Bids

Name: _____

In the capacity of: _____

Signed: _____

Duly authorized to sign the Authorization for and on behalf of _____
(Name of Manufacturer)

Date: _____

Note: This letter of authority should be on the letter head of the Manufacturer and should be signed by a person competent and having the Power of Attorney to legally bind the Manufacturer.

SECTION 3

LETTER AND SCHEDULES OF PRICE BID

SECTION-3

LETTER OF PRICE BID
AND
SCHEDULES TO BID

Letter of Price Bid

Schedules to Bid

– Schedule J to Bid: Integrity Pact

LETTER OF PRICE BID

Bid Reference No.: …….
Package No.: …….

……..
……. ……
[Name of Works]

To:
……
……
……

Gentlemen,

1. Having examined the Bidding Documents including Instructions to Bidders, Conditions of Contract, Specifications, Drawings, Schedules to Bid, Schedule of Prices and Addenda Nos. ……. for the execution of the above-named Works, we, the undersigned, being a company doing business under the name of and address …… ……. and being duly incorporated under the laws of …….. hereby offer to execute and complete such Works and remedy any defects therein in conformity with the said Documents including Addenda thereto for the Total Bid Price comprising of Local Currency Component of Pak Rupees ……..….. (Rs. ……) and Foreign Currency Component of …… or such other sum as may be ascertained in accordance with the said Documents.

2. We understand that all the Schedules attached hereto form part of this Bid.

3. We undertake, if our Bid is accepted, to commence the Works and to deliver and complete the whole of the Works comprised in the Contract within the time(s) stated in Preamble to the Conditions of Contract.

4. We agree to abide by this Bid for the period of 180 days from the date fixed for receiving the same and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

5. Unless and until a formal Agreement is prepared and executed, this Bid, together with your written acceptance thereof, shall constitute a binding contract between us.

6. We undertake, if our Bid is accepted to execute the Performance Security referred to in Clause 10 of Conditions of Contract for the due performance of the Contract.

7. We understand that you are not bound to accept the lowest or any Bid you may receive.

8. We do hereby declare that the Bid is made without any collusion, comparison of figures or arrangement with any other person or persons making a Bid for the Works.

9. We confirm, if our Bid is accepted, that all partners of the joint venture shall be liable jointly and severally for the execution of the Contract and the composition or the constitution of the joint venture shall not be altered without the prior consent of the Employer. (Please delete in case of Bid from a single firm).

Dated this ……. day of …….. 2026…

Signature …….. in the capacity of ……duly authorized to sign the Bid for and on behalf of ……
(Name of Bidder in Block Capitals)

(Seal of Bidder)

Bidder's Address
……
……

Witness:

Signature: …….
Name: ……
Address:
……
……
Occupation ……

SCHEDULE – J TO BID

(INTEGRITY PACT)
[To be filled and signed by the Bidder]

DECLARATION OF FEES, COMMISSION AND BROKERAGE ETC. PAYABLE BY THE SUPPLIERS OF GOODS, SERVICES & WORKS IN CONTRACTS WORTH RS. 10.00 MILLION OR MORE

Contract No._____ Dated _____
Contract Value: _____
Contract Title: _____

…… [**Name of Supplier**] hereby declares that it has not obtained or induced the procurement of any contract, right, interest, privilege or other obligation or benefit from Government of Pakistan (GoP) or any administrative subdivision or agency thereof or any other entity owned or controlled by GoP through any corrupt business practice.

Without limiting the generality of the foregoing, [**Name of Supplier**] represents and warrants that it has fully declared the brokerage, commission, fees etc. paid or payable to anyone and not given or agreed to give and shall not give or agree to give to anyone within or outside Pakistan either directly or indirectly through any natural or juridical person, including its affiliate, agent, associate, broker, consultant, director, promoter, shareholder, sponsor or subsidiary, any commission, gratification, bribe, finder's fee or kickback, whether described as consultation fee or otherwise, with the object of obtaining or inducing the procurement of a contract, right, interest, privilege or other obligation or benefit in whatsoever form from GoP, except that which has been expressly declared pursuant hereto.

[**Name of Supplier**] certifies that it has made and will make full disclosure of all agreements and arrangements with all persons in respect of or related to the transaction with GoP and has not taken any action or will not take any action to circumvent the above declaration, representation or warranty.

[**Name of Supplier**] accepts full responsibility and strict liability for making any false declaration, not making full disclosure, misrepresenting facts or taking any action likely to defeat the purpose of this declaration, representation and warranty. It agrees that any contract, right, interest, privilege or other obligation or benefit obtained or procured as aforesaid shall, without prejudice to any other rights and remedies available to GoP under any law, contract or other instrument, be voidable at the option of GoP.

Notwithstanding any rights and remedies exercised by GoP in this regard, [**Name of Supplier]** agrees to indemnify GoP for any loss or damage incurred by it on account of its corrupt business practices and further pay compensation to GoP in an amount equivalent to ten time the sum of any commission, gratification, bribe, finder's fee or kickback given by [name of Supplier] as aforesaid for the purpose of obtaining or inducing the procurement of any contract, right, interest, privilege or other obligation or benefit in whatsoever form from GoP.

Name of Buyer: …… Name of Seller/Supplier: ……
Signature: …… Signature: ……
[Seal] [Seal]

SECTION 4

SCHEDULE OF PRICES - PREAMBLE

SECTION-4

SCHEDULE OF PRICES

Description

1. Preamble to Schedule of Prices

2. Schedule of Prices

–	Schedule No. 1:	Plant & Mandatory Spare Parts Supplied from Abroad
–	Schedule No. 2:	Plant & Mandatory Spare parts supplied from within the Employer's Country
–	Schedule No. 3:	Local Transportation, Insurance and Other Incidental Services
–	Schedule No. 4:	Erection, Civil Works, and Commissioning Services
–	Schedule No. 5:	Grand Summary

1. Preamble to Schedule of Prices

1. The Price Schedules are divided into separate Schedules as follows:

Schedule No. 1:	Plant & Mandatory Spare Parts Supplied from Abroad
Schedule No. 2:	Plant & Mandatory Spare parts supplied from within the Employer's Country
Schedule No. 3:	Local Transportation, Insurance and Other Incidental Services
Schedule No. 4:	Erection, Civil Works, and Commissioning Services
Schedule No. 5:	Grand Summary

2. The Schedules do not generally give a full description of the plant and equipment to be supplied and the services to be performed under each item. Bidders shall be deemed to have read the Technical Provisions and other sections of the bidding documents and reviewed the Drawings to ascertain the full scope of the requirements included in each item prior to filling in the rates and prices. **The entered rates and prices shall be deemed to include for the full scope as aforesaid, including overheads and profit**.

3. If bidders are unclear or uncertain as to the scope of any item, they shall seek clarification in accordance with the Instructions to Bidders in the Bidding Documents prior to submitting their bid.

Units & Abbreviations

4. Units of measurement, symbols and abbreviations expressed in the Bidding Documents shall comply with the System International Units (SI Units).

The following abbreviation shall be used in the Schedules of Prices.

Abbreviation

Pakistani Rupees	PKR
US Dollar	USD or US$
Euro	EUR
Chinese Yuan	CNY
Provisional Sums	PS
Percent	%

Pricing

5. Prices shall be filled in indelible ink, and any alternations necessary due to errors, etc. shall be initialed by the Bidder.

Unless otherwise stipulated in the Conditions of Contract, the rates and prices entered by the Bidder shall be fixed and firm and shall not be subject to adjustment during the performance of the Contract.

6. Bid price shall be quoted in the manner indicated and, in the currencies, specified in the Instructions to Bidders in the Bidding documents.

   Bidders shall provide further breakdown of each item in Schedule of Prices. Bidders shall complete each appropriate column in the respective Schedules against each item, giving the price breakdown as indicated in the Schedules.

   Price given in the Schedules against each item shall be for the scope covered by that item as detailed in the Technical Provisions, Drawings or elsewhere in the bidding documents.

7. Where there are errors between the total of the amounts given under the column for the price breakdown and the amount given under the Total Price, the amounts given under the column for the price breakdown shall prevail and the Total Price will be corrected accordingly, unless in the opinion of the Employer there is an obvious misplacement of the decimal point in the price breakdown or the unit price which results in an abnormally high or abnormally low Total Price, in which case the Total Price as quoted shall prevail and the unit price shall be corrected accordingly.

   Where there are errors between the total amounts of Schedule Nos. 1 to 4 and the amount given in Schedule No. 5 (Grand Summary), the former shall prevail and the latter will be corrected accordingly.

   Where there are discrepancies between amounts stated in figures and amounts stated in words, the amounts stated in words shall prevail.

8. Payments will be made to the Contractor in the currency as specified in the Particular Conditions of the Contract.

9. Items left blank will be deemed to have been included in other items. The TOTAL for each Schedule and the TOTAL of the Grand Summary shall be deemed to be the total price for executing the Works and sections thereof in complete in accordance with the Contract, whether or not each individual item has been priced.

10. Except as otherwise expressly provided under the Conditions of Contract, the unit rates and lump sum amounts entered in the Price Schedules shall be the rates at which the Contractor will be paid and shall be deemed to include the full scope and all costs incurred by the Contractor in the performance of the Works and provision of services, including without limitation: overheads; profit; costs of temporary works; all federal, provincial, and local income taxes, super tax, and withholding taxes on the Contractor's Pakistan-source income assessed through its Permanent Establishment; General Sales Tax and Provincial Sales Tax on services and on locally procured goods and materials; withholding tax deducted by the Contractor as withholding agent from payments to its Sub-Contractors, suppliers, and employees; all other indirect costs; and the costs of accepting the general risks, liabilities, and obligations set forth or implied in the Contract.

11. a) All taxes, duties, levies, cesses, fees, and statutory charges for which the Contractor is responsible under GCC Sub-Clause 53.1 and GCC Sub-Clause 53.2 shall be deemed to be included in the unit rates and lump sum amounts entered in the Price Schedules. Bidders shall not include any separate line item or addition for such taxes.

b) The taxes which are the responsibility of the Employer under GCC Sub-Clause 53.2 and shall **not** be included by Bidders in the unit rates or lump sum amounts of the Price Schedules. These taxes are instead provided for in the Provisional Sums and will be reimbursed by the Employer on actual basis in accordance with GCC Sub-Clause 53.2.

c) The Base Date for the purposes of tax law changes is the date falling twenty-eight (28) days prior to the deadline for submission of Bids. If, after the Base Date, any change in the Laws of Pakistan results in a change in the tax costs borne by the Contractor under sub-paragraph (a) above, the Contract Price shall be adjusted in accordance with relevant provisions of the Contract.

12. The Bidder shall be deemed to have obtained all information as to part clearance facilities and charges, loading and unloading facilities and charges, storage facilities and charges, transportation facilities and charges, congestion and/or other conditions to be expected at Karachi Port and or any other seaport of Pakistan and all requirements related thereto.

The Contractor shall be responsible to make complete arrangement for the transportation of the plant and equipment to the Site.

The Bidder shall be deemed to have included all clearing, forwarding and other incidental costs in this regard in his Bid. The Contractor will have the option to use either Karachi Port or any other seaport of Pakistan.

13. The Contractor shall provide for all parts of the Works to be completed in every respect for commercial operation. Notwithstanding that any details, accessories, etc. required for the complete installation and satisfactory operation of the plant and equipment, are not specifically mentioned in the Specifications/Provisions, such details shall be considered as included in the Contract Price. All charges for the supply of goods, materials, accessories or work not specifically mentioned herein but necessary for the completion and operation of the Works shall be deemed to have been included in the quoted prices.

SCHEDULE OF PRICES

Schedule No. 1. Plant & Mandatory Spare Parts Supplied from Abroad				
Item No.	**Description**	**Country of Origin**	**Foreign Currency Component**	
			%	**USD / EUR / CNY**
1	**2**	**3**	**4**	**5**
A1	One new Steam Turbine Generator (STG) along with Excitation System, AVR etc.			
A2	Rehabilitation and Overhauling of Steam Turbine along with all its auxiliaries and supply of new turning gear etc.			
A3	Upgradation of DCS			
A4	ST Control System			
A5	One new Generator Circuit Breaker for STG			
A6	All other new and rehabilitated equipment and systems as outlined in the Technical Provisions.			
B	Mandatory Spare Parts/Spares required for new and rehabilitated equipment.			
Total of Schedule No. 1 (to be carried to the Schedule No. 5)				

Schedule No. 2. Plant & Mandatory Spare parts supplied from within the Employer's Country

Item No.	Description	Local Currency Component	
		%	PKR
1	2	3	4
A1	One new Steam Turbine Generator (STG) along with Excitation System, AVR etc.		
A2	Rehabilitation and Overhauling of Steam Turbine along with all its auxiliaries and supply of new turning gear etc.		
A3	Upgradation of DCS		
A4	ST Control System		
A5	One new Generator Circuit Breaker for STG		
A6	All other new and rehabilitated equipment and systems as outlined in the Technical Provisions.		
B	Mandatory Spare Parts/Spares required for new and rehabilitated equipment.		
Total of Schedule No. 2 (to be carried to the Schedule No. 5)			

Schedule No. 3. Local Transportation, Insurance and Other Incidental Services

Item No.	Description	Local Currency Component	
		%	PKR
1	2	3	4
A1	One new Steam Turbine Generator (STG) along with Excitation System, AVR etc.		
A2	Rehabilitation and Overhauling of Steam Turbine along with all its auxiliaries and supply of new turning gear etc.		
A3	Upgradation of DCS		
A4	ST Control System		
A5	One new Generator Circuit Breaker for STG		
A6	All other new and rehabilitated equipment and systems as outlined in the Technical Provisions.		
B	Mandatory Spare Parts/Spares required for new and rehabilitated equipment.		
Total of Schedule No. 3 (to be carried to the Schedule No. 5)			

Schedule No. 4a. Erection, Installation, and Commissioning Services (E&M)

Item No.	Description	Local Currency Component	
		%	PKR
1	2	3	4
A1	One new Steam Turbine Generator (STG) along with Excitation System, AVR etc.		
A2	Rehabilitation and Overhauling of Steam Turbine along with all its auxiliaries and supply of new turning gear etc.		
A3	Upgradation of DCS		
A4	ST Control System		
A5	One new Generator Circuit Breaker for STG		
A6	All other new and rehabilitated equipment and systems as outlined in the Technical Provisions.		
Total of Item Nos. A1 to A6			

Schedule No. 4b. Civil & Structural

Item No.	Description	Total Local Currency Component	
		%	PKR
1	2	3	4
B1	All Civil Works related to Steam Turbine (ST) Hall for removal of old STG and installation of new STG etc.		
B2	Civil Works related to all other new and/or rehabilitation works.		
Total of Item Nos. B1 to B2			

Total of Schedule No. 4 (4a+4b) (to be carried to the Schedule No. 5)		

Schedule No. 5. Grand Summary

Item No.	Description	Foreign Currency Component (FCC)	Local Currency Component (LCC)
		(USD / EUR / CNY)	(PKR)
1	2	3	4
1	Total Schedule No. 1 Plant and Mandatory Spare Parts Supplied from Abroad		
2	Total Schedule No. 2 Plant and Mandatory Spare Parts Supplied from Within the Employer's Country		
3	Total Schedule No. 3 Local Transportation, Insurance and other Incidental Services.		
4	Total Schedule No. 4 Erection, Civil Works, and Commissioning Services		
5	Provisional Sums		**1,500,000,000**
Total of Schedule No. 5 (to be carried to the Letter of Price Bid)			

SECTION 5

PREAMBLE TO CONDITIONS OF CONTRACT

SECTION-5

PREAMBLE TO CONDITIONS OF CONTRACT

Commencement Date

Sub-Clause 1.1.1

The date for commencement of Works shall be the date of issue of the Engineer's Order to Commence which shall be issued within seven (7) days after the following conditions have been fulfilled by both Parties:

(i) This Contract Agreement has been duly executed for and on behalf of the Employer and the Contractor.

(ii) The Contractor has submitted to the Employer the Performance Security and the advance payment security acceptable to the Employer.

(iii) The Letter of Credit has been established by the Employer with format agreed with the Contractor.

(iv) The full amount advance payment has been received by the Contractor.

Each party shall use its best efforts to fulfill the above conditions for which it is responsible as soon as practicable but not beyond the respective stipulated periods.

Defect Liability Period

Sub-Clause 1.1.11

The Defect Liability Period shall be **twenty-four (24) months** after the date certified in the Taking-Over Certificate.

Defect Liability Period shall be subject to extension as provided under Sub-Clause 30.4.

The Employer

Sub-Clause 1.1.12.

The Employer is **Central Power Generation Company Limited (CPGCL)**

Its legal successors and permitted assignees represented by:

Address: Chief Executive Officer
Central Power Generation Company Limited (CPGCL),
Thermal Power Station, Guddu, District Kashmore, Pakistan.
Phone: +92-722-691088
Email: genco2_guddu@yahoo.com;
ceo.cpgcl@gmail.com

The Engineer

Sub-Clause 1.1.15.

The Engineer is **[To be designated by the Employer]**

Time for Completion

Sub-Clause 1.1.35

The Time for Completion for the Works is listed below, reckoned from the Commencement Date. The Contractor shall complete the Works to the satisfaction of the Engineer, within the following specified time frame:

Sr. No.	Milestones	Period
1	Taking-Over Certificate	24 months

Confirmation in Writing

Sub-Clause 2.6

(i) If the Contractor shall require the confirmation, it shall be notified to the Engineer within **ten (10) days**.

(ii) The Engineer shall confirm the decision/instruction within **fourteen (14) days**.

Ruling Language

Sub-Clause 5.1.

The version in **English** language (ruling language) shall prevail.

Day to Day Communications

Sub-Clause 5.2.

The language for day-to-day communications is **English**.

Operation and Maintenance Manuals

Sub-Clause 6.6

To be provided by the Contractor within the period as specified in the **Technical Provisions**.

General Obligations

Sub-Clause 8.1

The facilities to be provided by the Employer shall be as stated in **Technical Provisions**.

Programme to be Furnished

Sub-Clause 12.1.

The Programme must be submitted in the form of **Bar chart or Critical Path Method (CPM), the PERT network, or other internationally recognized project scheduling format acceptable to the Employer/Engineer. The native file of the program shall also be submitted.**

Employer's Equipment

Sub-Clause 14.4.

The following Employer's equipment, currently under the Employer's operation, is available to the Contractor for their use, for revival of this Plant:

i. **Steam turbine hall overhead crane after revalidation as per Technical Provisions.**
ii. **Potable and service water system subject to availability and operational requirements of the Employer.**
iii. **Service air system subject to availability and operational requirements of the Employer.**

The Contractor shall pay the Employer a mutually agreed price for the

	use of the above equipment/facilities in accordance with Sub-Clause 14.4 of the Particular Conditions of Contract.
Working Hours	Sub-Clause 18.3. The normal working hours on the Site shall conform to the Employer's working schedule and the existing customs of Pakistan.
Time for Completion	Sub-Clause 25.1 (i) Place of the Project: **Thermal Power Station, Guddu, District Kashmore, Pakistan.** (ii) Period: As per Sub-clause 1.1.35
Earlier Completion	Sub-Clause 26.3 No Bonus for earlier completion shall be paid.
Delay in Completion	Sub-Clause 27.1. Failure to meet the Time for Completion entitles the Employer to liquidated damages as follows: Percentage per day: **0.1% of the Contract Price;** Maximum: **10% of the Contract Price.** For avoidance of doubt, the total aggregate liability of the Contractor for delay in completion (Clause 27.1) and prolonged delay (Clause 27.2) combined shall not exceed 10% of the Contract Price. The Contractor's liability for performance guarantee failure (Clause 27.3) is capped separately at 10% of the Contract Price. The combined maximum aggregate liability under Clauses 27.1, 27.2, and 27.3 shall not exceed 20% of the Contract Price.
Prolonged Delay	Sub-Clause 27.2. Maximum amount recoverable from the Contractor by the Employer shall be 10% of the Contract Price.
Failure to Meet Performance Guarantees	Sub-Clause 27.3. Failure to meet the Performance Guarantees entitles the Employer to recover following sum as liquidated damages (LD) from the Contractor: Percentage: **For each 1% decrease in the Guaranteed Gross Power Output, 5% of the Contract Price shall be charged as liquidated damages. For avoidance of doubt, deviations below 1% will also attract liquidated damages based on the following formula:** Where: GGPO = Guaranteed Gross Power Output AGPO = Actual Gross Power Output

	Maximum: **10% of the Contract Price.**
Terms of Payment	Sub-Clause 33.1 The terms of payment shall be as stated in Particular Conditions of the Contract.
Payment in Foreign Currencies	Sub-Clause 35.1. Payment in foreign currencies shall be arranged as follows: **The foreign currency arrangements for eligible payments under the Contract shall be made in accordance with regulations of Government of Pakistan. Currency of payment is stated under Sub-Clause 33.1 of Particular Conditions of Contract.**
Insurance of Works	Sub-Clause 43.1. The deductible limits in the insurance cover of the Works: **Nil** The risks to be insured shall be as specified in Sub-Clause 43.1 (The Works) and its Additional Conditions in the Particular Conditions of Contract.
Third Party Liability	Sub-Clause 43.3. The amount of insurance against third party liability taken out by the Contractor shall not be less than: **PKR 400,000,000 per any one accident or series of accidents arising out of one occurrence with number of occurrences unlimited.**
Payment on Termination for Employer's Default	Sub-Clause 46.3. The additional amount payable by the Employer on termination shall be limited to the direct costs and losses reasonably incurred by the Contractor as a direct result of such termination, as duly substantiated by documentary evidence, and shall exclude loss of profit, loss of use and all indirect or consequential losses.
Labour, Materials and Transport	Sub-Clause 47.1. **No adjustment shall be applicable for changes in the cost of labour, materials, transport or other costs of execution of the Works.**
Notices to Employer and Engineer	Sub-Clause 49.2. The address of the Employer for notices is: Chief Executive Officer Central Power Generation Company Limited (CPGCL), Thermal Power Station, Guddu, District Kashmore, Pakistan. Email: genco2_guddu@yahoo.com; ceo.cpgcl@gmail.com The address of the Engineer for notices is:

[*To be designated by the Employer*]

Disputes & Arbitration	Sub-Clause 50.4 The arbitration shall be conducted under the Rules of Arbitration of the International Chamber of Commerce (ICC); the seat of the arbitration shall be London, United Kingdom; and the language of the arbitration shall be English.
Applicable Law	Sub-Clause 51.1. The applicable law is **the law of Islamic Republic of Pakistan**.
Procedural Law for Arbitration	Sub-Clause 51.2. The arbitral procedure shall be governed by the ICC Rules and, to the extent applicable, the law of the seat of the arbitration (London, United Kingdom).
Language and Place of Arbitration	Sub-Clause 51.3. The language of arbitration is **English** language. The place (seat) of the arbitration is London, United Kingdom.

SECTION 6

GENERAL CONDITIONS OF CONTRACT

(GCC)

SECTION-6
GENERAL CONDITIONS OF CONTRACT

The Conditions of Contract comprise two parts:

(a) General Conditions of Contract

(b) Particular Conditions of Contract

The General Conditions of Contract used in these Bidding Documents was prepared by the International Federation of Consulting Engineers (Federation Internationale des Ingenieurs-Conseils, or FIDIC), and is commonly known as the FIDIC Conditions of Contract for Electrical and Mechanical Works including Erection on Site. (The used version is the Third Edition 1987, reprinted in 1988 with editorial amendments, Part I – General Conditions.)

The bidders are advised to obtain copies directly from:

FIDIC Secretariat
P.O. Box 86
1000 Lausanne 12
Switzerland

fidic.pub@fidic.org – FIDIC.org/bookshop

SECTION 7

PARTICULAR CONDITIONS OF CONTRACT

(PCC)

SECTION-7

PARTICULAR CONDITIONS OF CONTRACT

The following Particular Conditions of Contract (PCC) shall supplement the General Conditions of Contract (GCC). Whenever there is a conflict, the provisions herein shall prevail over those in the GCC. The clause number of the PCC is the corresponding clause number of the GCC.

1.1 Definitions

1.1.1 *The text of Sub-Clause 1.1.1 is deleted and substituted by the following:*

"Commencement Date" means the date specified in the Preamble to Conditions of Contract.

1.1.2 *The text of Sub-Clause 1.1.2 is deleted and substituted by the following:*

"Conditions" means the Preamble to Conditions of Contract, General Conditions of Contract and Particular Conditions of Contract.

1.1.3 *At the end of Sub-Clause, the following is added:*

"Any subsequent document mutually agreed and signed by the Employer and the Contractor, shall be the part of the Contract."

1.1.5 *The text of Sub-Clause is deleted and substituted by the following:*

"Contract Price means the sum stated in the Letter of Acceptance as payable to the Contractor for the execution and completion of the Works subject to such additions thereto or deductions therefrom as may be made under the provisions hereinafter contained and remedying of any defects therein in accordance with the provisions of the Contract."

1.1.7 The word "technical data" is added before the word "samples" in first line.

1.1.11 The Defects Liability Period is the period mentioned in the Preamble to Conditions of Contract.

1.1.15 *The following is added at the end of Sub-Clause:*

"or any other competent person appointed by the Employer as his replacement."

1.1.21 The word "Letter of Acceptance" is synonymous with the word "Notification of Award".

1.1.23 *The following paragraph is added:*

The word "Goods" is synonymous with the word "Plant."

1.1.27 *The text of Sub-Clause is deleted and substituted by the following:*

"Schedule of Prices" means the completed and priced Schedule of Prices, or any part or individual schedule thereof, submitted by the Contractor with his Bid or revised and mutually agreed and forming a part of the Contract documents.

1.1.33 The word "Tender" is synonymous with the word "Bid" and the word "Tender Documents" is synonymous with the word "Bidding Documents".

1.1.35 *The following is added at the end of Sub-Clause 1.1.35:*

"The Time for Completion shall be regarded as achieved on the date of completion of the Works stated in the Taking-Over Certificate issued or deemed to have been issued in accordance with Clause 29."

1.1.37 The word "Facilities" is synonymous with the word "Works".

The following Sub-Clauses are added:

1.1.38 "Actual Gross Power Output (AGPO)" means the gross electrical power output of the steam turbine at the Reference Conditions, determined during the Tests on Completion.

1.1.39 "Guaranteed Gross Power Output (GGPO)" means the gross electrical power output of the steam turbine at the Reference Conditions, guaranteed to be delivered by the Contractor during the Tests on Completion, as defined in Schedule A to the Bid titled Specific Works Data.

1.1.40 "Month" means calendar month according to Gregorian calendar.

1.1.41 "Operation and Maintenance Manuals" has the meaning described in Sub-Clause 6.6.

1.1.42 "Party" means the Employer or the Contractor, as the context requires.

1.1.43 The word "Part II" stated in FIDIC Conditions of Contract is synonymous with the word "Particular Conditions of Contract.

1.1.44 "Performance Guarantees" means each and all of the guarantees relating to the Plant set out in the Schedule A to the Bid.

1.1.45 "Reference Conditions" has the meaning ascribed to the term in Schedule A to the Bid.

1.1.46 "Taking-Over Certificate" means the certificate to be given by the Engineer to the Contractor in terms of Sub-Clauses 29.1 and 29.2 on completion of the Works. This definition substitutes the definition in Sub-Clause 1.1.32 of the General Conditions of Contract.

1.1.47 "Temporary Works" means all temporary works of every kind (other than Contractor's Equipment) required on Site for the execution and completion of the Works and the remedying of any defects.

1.1.48 "Warranty Certificate" means the certificate against specified goods/equipment, to be issued by the Contractor that the goods/equipment supplied under the Contract are new, unused and incorporate all recent improvements in design and materials unless provided otherwise in the Contract and that the Contractor will be responsible for making good or replacing any defective goods/equipment during the Defect Liability Period.

1.3 **Interpretation**

Text of Clause GCC 1.3 is substituted with following:

"1.3.1 In the Contract, except where the context requires otherwise,

(a) words indicating one gender include all genders;
(b) words indicating the singular also include the plural and words indicating the plural also include the singular;
(c) provisions including the word "agree," "agreed," or "agreement" require the agreement to be record in writing; and
(d) "written" or "in writing" means handwritten, typewritten, printed or electronically made, and resulting in a permanent record.

1.3.2 Incoterms

Unless inconsistent with any provision of the Contract, the meaning of any trade term and the rights and obligations of parties thereunder shall be as prescribed by Incoterms.

"Incoterms" means international rules for interpreting trade terms published by the International Chamber of Commerce (latest edition), 38 Cours Albert 1er, 75008 Paris, France.

1.3.3 Entire Agreement

The Contract constitutes the entire agreement between the Employer and Contractor with respect to the subject matter of Contract and supersedes all communications, negotiations, and agreements (whether written or oral) of parties with respect thereto made prior to the date of Contract.

1.3.4 Amendment

No amendment or other variation of the Contract shall be effective unless it is in writing, is dated, expressly refers to the Contract, and is signed by a duly authorized representative of each party hereto.

1.3.5 Independent Contractor

The Contractor shall be an independent contractor performing the Contract. The Contract does not create any agency, partnership, joint venture, or other joint relationship between the parties hereto. Subject to the provisions of the Contract, the Contractor shall be solely responsible for the manner in which the Contract is performed. All employees, representatives, or Subcontractors engaged by the Contractor in connection with the performance of the Contract shall be under the complete control of the Contractor and shall not be deemed to be employees of the Employer, and nothing contained in the Contract or in any subcontract awarded by the Contractor shall be construed to create any contractual relationship between any such employees, representatives, or Subcontractors and the Employer.

1.3.6 Non-Waiver

(a) Subject to GCC Sub-Clause 1.3.6 (b) below, no relaxation, forbearance, delay, or indulgence by either party in enforcing any of the terms and conditions of the Contract or the granting of time by either party to the other shall prejudice, affect, or restrict the rights of that party under the Contract, nor shall any waiver by either party of any breach of Contract operate as waiver of any subsequent or continuing breach of Contract.

(b) Any waiver of a party's rights, powers, or remedies under the Contract must

be in writing, must be dated, and signed by an authorized representative of the party granting such waiver, and must specify the right and the extent to which it is being waived.

1.3.7 Severability

If any provision or condition of the Contract is prohibited or rendered invalid or unenforceable, such prohibition, invalidity, or unenforceability shall not affect the validity or enforceability of any other provisions and conditions of the Contract.

1.3.8 Country of Origin

"Origin" means the place where the plant and component parts thereof are mined, grown, produced, or manufactured, and from which the services are provided. Plant components are produced when, through manufacturing, processing, or substantial or major assembling of components, a commercially recognized product results that is substantially different in its basic characteristics or in purpose or utility from its components.

1.6 Cost, Overhead Charges and Profit

The last sentence of Sub-Clause 1.6 is deleted and substituted with the following:

"Wherever these Conditions entitle the Contractor to be paid cost together with profit, no separate percentage or amount shall be added on account of profit, which shall be deemed included in the cost recoverable."

2 Engineer and Engineer's Representative

2.1 **Engineer's Duties**

Text of Clause GCC 2.1 is substituted with following:

"The Engineer shall carry out the duties specified in the Contract.

The Engineer may exercise the authority attributable to the Engineer as specified in or necessarily to be implied from the Contract. The Engineer is required to obtain the specific approval of the Employer before carrying out his duties in accordance with the following Clauses of General Conditions of Contract (GCC):

(a) approval of Subcontractor under Sub-Clause 4.1,
(b) certifying any cost under Sub-Clause 14.6,
(c) approval of extension of time under Clause 26,
(d) issuing a Taking–Over Certificate under Sub-Clause 29,
(e) issuing a Defects Liability Certificate under Sub-Clause 30.11,
(f) issuing a Variation Order- under Clause 31,
(g) fixing rates or prices under Clauses 31 and 34,
(h) certifying additional costs under Sub-Clause 44.5 and
(i) certifying additional costs under Sub-Clause 47.2;

Except for such variations pursuant to Sub-Clause 31.1 of the GCC which may be necessary in an emergency affecting safety of life, the Works or of adjoining property.

Except as expressly stated in the Contract, the Engineer shall have no authority to relieve the Contractor of any of his obligations under the Contract."

2.6 **Confirmation in Writing**

(i) *In line 3 after the words "undue delay" the following is added:*

"but not after the number of days mentioned in the Preamble to Conditions of Contract from the instruction or decision."

(ii) *At the end of the Sub-Clause, the following is added:*

"The Engineer shall confirm or otherwise within the number of days mentioned in the Preamble to Conditions of Contract from the receipt of the Contractor's requirement."

2.8 **Replacement of Engineer**

The text of Sub-Clause is deleted and substituted by the following:

"If the Employer intends to replace the Engineer, the Employer shall, not less than 14 days before the intended date of replacement, give notice to the Contractor, of the name, address and relevant experience of the intended replacement Engineer. The Employer shall not replace the Engineer with a person against whom the Contractor raises reasonable objection by notice to the Employer, with supporting particulars."

2.9 **Engineer Not Liable**

Sub-Clause 2.9 is added as follows:

"Approval, reviews and inspection by the Engineer of any part of the Works does not relieve the Contractor from his sole responsibility and liability for the supply of remaining materials and equipment for the Works and parts thereof and complete the remaining erection works and testing and commissioning in accordance with the Contract and neither the Engineer's authority to act nor any decision made by him in good faith as provided for under this Contract whether to exercise or not to exercise such authority shall give rise to any duty or responsibility of the Engineer to the Contractor, any Subcontractor, any of their representatives or employees or any other person performing any of the works."

3.1 **Assignment**

First sentence of Sub-Clause is replaced with following:

"The Contractor shall not assign the Contract or any part thereof, or any right, benefit, obligation or interest therein or thereunder without written consent from the Employer."

4.1 **Subcontracting**

Text of Sub-Clause is deleted in its entirety and replaced with following:

4.1.1 The Schedule E (Form SUBCON) to the Contract Agreement specifies major items of plant and services and a list of approved Subcontractors against each item, including manufacturers. The Contractor cannot subcontract the whole of the Works. Insofar as no Subcontractors are listed against any such item, the Contractor shall prepare a list of Subcontractors for such item for inclusion in such list. The Contractor may, under unavoidable circumstances, propose any addition to or deletion from any such list and shall provide documentary evidences to justify such circumstances. The Contractor shall submit any such

list or any modification thereto to the Engineer for its approval in sufficient time so as not to impede the progress of work on the Works. Such approval by the Engineer for any of the Subcontractors shall not relieve the Contractor from any of its obligations, duties, or responsibilities under the Contract. The Contractor shall be responsible for the acts, defaults and neglects of any Subcontractor, his agents or employees as fully as if they were the acts, defaults or neglects of the Contractor, his agents or employees.

4.1.2 The Contractor shall select and employ its Subcontractors for such major items from those listed in the lists referred to in GCC Sub-Clause 4.1.1.

4.1.3 Notwithstanding above, for items & parts of work not specified in Schedule E to the Contract Agreement, the Contractor shall employ subcontractors with prior approval of Engineer.

4.1.4 Each subcontract shall include provisions which would entitle the Employer to require the sub-contract to be assigned to the Employer under GCC 4.1.5 (if and when applicable), or in the event of termination by the Employer under GCC 45.2.

4.1.5 If a Sub-contractor's obligations extend beyond the expiry date of the relevant Defects Liability Period and the Engineer, prior to that date, instructs the Contractor to assign the benefits of such obligations to the Employer, then the Contractor shall do so.

4.2 *Sub-Clause 4.2 is added as follows:*

No Contractual Relation between Subcontractor and the Employer

Nothing contained in the Contract shall create any contractual relationship or professional obligation between any manufacturer and Employer. Onus of any discrepancy in the manufacture shall be on the Contractor.

4.3 Subcontractor and OEM Warranties

Sub-Clause 4.3 is added as follows:

"The Contractor shall obtain, maintain and enforce all warranties and guarantees given by manufacturers, original equipment manufacturers (OEMs) and Subcontractors in respect of the Plant and the Works. The Contractor shall not, without the prior written consent of the Employer, waive, surrender, reduce, amend, encumber or otherwise compromise any such warranty or guarantee, and any purported waiver, surrender, reduction, amendment or compromise made without such consent shall be ineffective as against the Employer. The Contractor shall ensure that all such warranties and guarantees are capable of assignment to the Employer, and shall assign the same to the Employer upon request in accordance with Sub-Clauses 4.1.4 and 4.1.5."

5.3 **Priority of Contract Documents**

Text of Sub-Clause 5.3 is deleted and substituted by the following:

"Unless otherwise provided in the Contract, the priority of the Contract Documents shall be as follows:

1. The Contract Agreement

2. The Letter of Acceptance
3. Preamble to Conditions of Contract
4. The Particular Conditions of Contract
5. The General Conditions of Contract
6. The Specifications (Technical Provisions)
7. The priced Schedule of Prices
8. The completed Letters of Technical and Price Bids
9. The completed Schedules to Bid (A to K)
10. Any other document forming part of the Contract.

Any deviation from these Bidding Documents that has been accepted by the Employer and recorded in the Contract Agreement or the Letter of Acceptance shall prevail over the corresponding provision of the documents listed above.

5.4 Documents Mutually Explanatory

The following paragraph is added at the end of Sub-Clause:

"The drawings and technical specifications are intended to complement each other, so that any items set forth in either shall be recognized as if duly set forth in both. Any discrepancy which may exist between drawings and the technical specifications shall be referred to the Engineer whose decision as to the true meaning shall be binding, subject to Clause 50."

Sub Clause GCC 5.5 is added as follows:

5.5 "Codes and Standards

Wherever references are made in the Contract to codes and standards in accordance with which the Contract shall be executed, the edition or the revised version of such codes and standards current at the date 28 days prior to date of bid submission shall apply unless otherwise specified. During Contract execution, any changes in such codes and standards shall be applied subject to approval by the Engineer and shall be treated in accordance with GCC Clause 31."

6.1 Contractor's Drawings

The following paragraph is added at the end of Sub-Clause:

"All drawings and documents shall be submitted by the Contractor in accordance with the requirements stipulated in the Technical Provisions."

6.2 **Consequences of Disapproval of Contractor's Drawings**

Full stop is deleted and the following words are added at the end of Sub-Clause:

"for the approval of the Engineer. However, the Contractor shall not be entitled for time extension on this account.

6.6 **Operation and Maintenance Manuals**

Para 2&3 are deleted and the following text is added at the end of Para 1 of Sub-Clause:

"The Operation and Maintenance Manuals shall include full instructions for the operation, servicing and maintenance of the Plant, not only during the period of the Contractor's liability but more particularly during its operating life.

The directions shall be set out simply, clearly and systematically. This may be divided into two volumes if desirable, one for operation and the second for servicing and maintenance (in sub–volumes for major items of Plant).

The operational data shall include a complete physical and functional description of the Plant (in sub–volumes for major items of Plant) and step–by–step procedures for inspection, checking and adjustments for proper operation of the Plant.

The maintenance data shall include complete instructions for routine checks, servicing, maintenance and repair of all parts and for dismantling, handling and re–assembly of all equipment, sub–assemblies and all separate components. The maintenance data shall also include where possible parts catalogues. The lists shall provide all necessary information for identifying the parts and for re–ordering the parts including name of part, part number and catalogue references where applicable, name of manufacturer, size, capacity and other characteristics.

General arrangements, single line diagrams and detailed drawings shall be provided for ready reference in the operation and maintenance instructions.

The manuals shall be printed on ISO paper size A4 (210x297 mm) with offset or equivalent printing strongly bound in a durable stiff cover bearing the title in approved legend. Drawings shall be folded or reduced to 297 mm height. All volumes shall bear on the spine an approved shortened version of the title.

The Contractor shall submit electronic copy of draft manuals for approval to the Engineer prior to producing finished volumes.

The Contractor shall provide three (3) hard copies along with electronic copy of the approved Operation and Maintenance Manuals prior to Taking Over by the Employer. Supplementary Operation and Maintenance Manual shall be provided by the Contractor, if required, to incorporate changes resulting from experience during the operation and maintenance period. The work shall not be considered to be completed for the purpose of taking over until such manual and drawings have been supplied to the Employer."

6.9 **Manufacturing Drawings**

*The words "**Unless otherwise specified in Part-II**" are deleted and the following is added at the end of Sub-Clause:*

"However, the Contractor is required to disclose to the Engineer or the Employer any confidential information necessary to justify the reliability, the efficiency and the operation and maintenance of the Plant supplied by him."

6.10 "As-Built" Drawings

Sub-Clause 6.10 is added as follows:

"The Contractor shall prepare and progressively maintain complete and accurate As-Built drawings and documentation for the Works, including OEM drawings and documents, data sheets, quality and test records, and control system configuration records. Prior to taking over, the Contractor shall supply to the Engineer a complete marked-up ("red-line") set of As-Built drawings recording all changes, modifications and deviations made during the execution of the Works. The Works shall not be considered to be completed for the purposes of taking over, and the Taking-Over Certificate shall not be issued, until the

complete marked-up ("red-line") set of As-Built drawings has been supplied to and accepted by the Engineer. The Contractor shall thereafter supply to the Employer the final As-Built drawings and documentation, comprising six (6) hard copies and editable electronic copies (in native file formats), within ninety (90) days after the issue of the Taking-Over Certificate. The Defects Liability Certificate shall not be issued until the final As-Built drawings and documentation have been supplied to and accepted by the Engineer."

7.2 **Errors by Employer or Engineer**

The Sub-Clause GCC 7.2 is deleted in its entirety and substituted by the following:

"The Employer / Engineer has made available to the Contractor for his information, as part of the Bidding Document, all relevant data in the Employer's possession relating to the Site. The Contractor shall be responsible for verifying and interpreting all such data. The Employer / Engineer shall have no responsibility for the accuracy, sufficiency or completeness of such data. The Employer shall not be liable for any claim or excuse of the Contractor regarding the data made available by the Employer / Engineer, whatsoever, for the completion and performance of the Works. The submission of the design by the Contractor to the Employer / Engineer shall mean that the Contractor has verified any information made available by the Employer and that the Contractor is familiar with the Site conditions in general and, in particular, for the purposes of the transport of plant, construction, installation, erection, execution, start-up, testing and commissioning of the Plant."

8 **Contractor's Obligations**

Text of sub-clause GCC 8.1 is deleted and substituted with following:

8.1 **General Obligations**

(a) The Contractor shall commence the work on the date specified in the Preamble to Conditions of Contract and shall proceed with the same with due expedition and without delay.

(b) Unless otherwise expressly limited in the Technical Provisions, the Contractor's obligations cover the provision of all Works and the performance of all services required for the design, the manufacture (including procurement, quality assurance, testing and delivery) and the installation (including construction, associated civil works and erection), completion, and commissioning of the Plant in accordance with the plans, procedures, specifications, drawings, codes, and any other documents as specified in the Technical Provisions. Such specifications include, but are not limited to, the provision of supervision and engineering services; the supply of labor, materials, equipment, spare parts and accessories; Contractor's Equipment; construction utilities and supplies; temporary materials, structures, and facilities; transportation (including, without limitation, unloading and hauling to, from and at the Site) and storage.

(c) The Contractor shall, unless specifically excluded in the Contract, perform all such work and/or supply all such items and materials not specifically mentioned in the Contract but that can be reasonably inferred from the Contract as being required to complete the Works and test and commission the Plan as if such work and/or items and materials were expressly mentioned in the Contract.

8.2 **Setting Out**

The first three paragraphs are deleted and substituted with the following:

"The Contractor shall be responsible for correctness of position, level and dimensions of the work according to the drawings notwithstanding that he may have been assisted by the Employer/Engineer in setting out the same."

10.1 **Performance Security**

Sub-Clause 10.1 is deleted and substituted by the following:

"The Contractor shall provide a Performance Security in the prescribed Form annexed to these Documents. The said Security shall be furnished by the Contractor within 28 days after the receipt of Letter of Acceptance. The Performance Security shall be of an amount equal to **ten (10) percent of the Contract Price** excluding Provisional Sums in the currency(ies) of the Contract at the option of the bidder, in the form of Bank Guarantee from any Scheduled Bank in Pakistan or from a bank located outside Pakistan duly counter-guaranteed by a Scheduled Bank in Pakistan.

For avoidance of doubt, the Bank Guarantee issued by a foreign bank, without counter guarantee from a Scheduled Bank in Pakistan shall not be considered as an acceptable Bank Guarantee.

The cost of complying with the requirements of this Sub-Clause shall be borne by the Contractor."

10.3 **Claims under Performance Security**

Sub-Clause 10.3 is deleted in its entirety.

The following Sub Clause is added:

10.4 **Performance Security Binding on Variations and Changes**

"The Performance Security shall be binding irrespective of variations and changes in the quantities of the Works or extensions in completion time of the Works, which are granted or agreed upon under the provisions of the Contract."

The following Sub-Clause is added:

10A **<u>Advance Payment Security</u>**

10A.1 The Contractor shall, within 28 days after the receipt of Letter of Acceptance, provide a security in an amount equal to the advance payment calculated in accordance with Clause GCC 33 herein below, and in the same currency or currencies.

10A.2 The security shall be in the form of Bank Guarantee provided in the Bidding Documents or in another form acceptable to the Employer, issued by a Scheduled Bank of Pakistan or from a bank located outside Pakistan duly counter-guaranteed by a Scheduled Bank in Pakistan in favor of the Employer valid for a period twenty-eight (28) days beyond issue of taking over certificate. The amount of the security shall be reduced in proportion to the value of Works executed and shall automatically become null and void when the full amount of advance payment has been recovered by the Employer. The security shall be returned to the Contractor immediately after its expiration.

11.1 **Site Data**

The following text is added at the end of the Sub-Clause:

The Contractor shall satisfy himself as to the nature of the ground, subsurface soil condition, the hydrological and climatic conditions, the form and nature of the Site, the quantities and nature of the Work and materials necessary for the completion of the Works, and the means of access to the Site, the accommodation he may require and in general shall himself obtain all necessary information as to risks, contingencies, and other circumstances which may influence or affect his Bid.

The Employer does not guarantee the correctness of any data/information/drawings either verbal and/or written provided herein nor any interpretations, deductions or conclusions relative to conditions at Site. The Contractor shall form his own opinion of the character of the work and of the materials to be excavated etc. He shall make his own interpretations, and satisfy himself by his own investigations and research regarding all conditions affecting the work to be done. The Contractor shall assume all responsibility for deductions and conclusions as to the nature or conditions of the materials to be excavated and of doing other work affected by the geology at the Site."

11.2 **Sufficiency of Contract Price**

First para of Sub-Clause is substituted as under:

"Subject to Clause GCC 11.1, the Contractor shall be deemed to have satisfied himself of correctness and sufficiency of the Contract Price, which shall cover all his obligations under the Contract and to have taken account of in his Tender:"

The words "(if access has been made available to him)" are deleted from point (c).

Last para of the Sub-Clause reading "The Contractor …whatever source" is deleted.

11.3 Physical Obstructions and Conditions

Sub-Clause 11.3 is deleted in its entirety and substituted with the following:

"The Contractor shall be deemed to have inspected and examined the Site and its surroundings and to have satisfied himself, before submitting his Bid, as to the nature and condition of the Site (including the existing fire-damaged plant, equipment, structures and foundations), the sub-surface conditions, physical obstructions and all other circumstances which may affect the execution of the Works. The Contractor shall bear the entire risk of, and shall not be entitled to any additional cost, extension of time or other relief on account of, any physical obstructions or physical conditions encountered at the Site, whether foreseeable or not."

12.1 **Programme to be Furnished**

The text of Sub Clause is deleted in its entirety and substituted with following:

"The Contractor shall submit to the Engineer for his approval the Programme which shall contain the following:

(a) The order in which the Contractor proposes to carry out the Works (including preliminaries, design, manufacture, required material ordering, delivery to Site, installation, erection and rectifications work, testing, commissioning of the Plant including design and construction of associated civil works and taking–over by the

Employer). The programme so submitted by the Contractor shall accord with the Time of Completion in GCC Sub-clause 25.1 and any other dates and periods specified in the Contract. The programme shall be based on format mentioned in Preamble to Conditions of Contract. The programme shall also include the following:

(i) Employment of local and expatriate labour of various categories;
(ii) Local material procurement; and
(iii) Material imports, if any.

(b) the times when submission and approval of the Contractor's Drawing are required,

(c) the times by which the Contractor requires the Employer:

(i) to provide access to the Site,
(ii) to have obtained consents, wayleaves and approvals necessary for the purpose of the Works.

The programme is to be furnished by the Contractor within twenty-eight (28) days from the date of receipt of Letter of Acceptance and in the form acceptable to the Engineer. The Engineer's proposed changes/modifications may also be incorporated and revised program shall be submitted within fifteen (15) days.

The approval by the Engineer of the Programme shall not relieve the Contractor or the Employer from any obligation under the Contract.

12.3 **Revision of Programme**

Second para of the Sub-Clause is deleted.

Following is added at the end of first paragraph of the Sub-Clause:

"The Contractor shall, at the instruction of the Engineer, prepare and submit to the Engineer a revised program, taking into account the prevailing circumstances, and shall notify the Engineer of the steps being taken to expedite progress so as to attain Completion of the Works within the Time for Completion under GCC Sub-Clause 25.1 or any extension thereof entitled under GCC Sub Clause 26.1."

12.4 *The following Sub-Clauses 12.4 to 12.6 are added:*

Monthly Progress Report

"During the period of the Contract, the Contractor shall submit four (04) sets of reports to the Engineer not later than the 8th day of each month, including:

(i) a construction schedule indicating the progress achieved during the preceding month;

(ii) description of all work carried out since the last report; summary of daily site activities, manpower deployment, major equipment utilized, and significant events for the preceding month;

(iii) description of the work planned for the next forty-two days sufficiently detailed to enable the Engineer to determine his programme of inspection and testing;

(iv) summary of daily job record for the preceding month;

(v) colour photographs to illustrate progress properly dated and captioned, illustrating the progress of the Works and key construction activities; and

vi) summary of HSE (Health Safety & Environment) performance, including statistics, audits, inspections, training conducted, non-conformances, corrective actions, incidents, near misses, accidents, and measures implemented to prevent recurrence

The progress report shall be in a form acceptable to the Engineer and shall indicate: (a) s-curves including percentage completion achieved compared with the planned percentage completion; (b) progress updated programme / schedule (including native file format e.g. XER, MPP etc.); and (c) where any activity is behind the program, giving comments and likely consequences and stating the corrective action being taken."

12.5 **Daily Job Record**

During the period of the Contract, the Contractor shall keep a daily record of the work progress, in soft and hard form, which shall be made available to the Engineer as and when requested.

The daily record shall include particulars of weather conditions, number of men working in different categories, deliveries of materials, quantity, location and assignment of equipment.

12.6 **Protection of the Environment**

12.6.1 The Contractor shall take all reasonable steps to protect the environment (both on and off the Site) and to limit damage and nuisance to people and property resulting from pollution, noise, and other results of his operations.

12.6.2 The Contractor shall ensure that emissions, surface discharges, and effluent from the Contractor's activities shall not exceed the values prescribed by applicable Laws.

12.6.3 The Contractor will ensure that the preparation, design, and implementation of project comply with all applicable laws and regulations of Pakistan relating to environment, health, and safety.

12.6.4 **Environmental Safeguards:**

The Contractor shall (a) establish an operational system for managing environmental impacts, (b) implement all the monitoring and mitigation measures set forth in the initial environmental examination and/or environmental management plan, (c) allocate the budget required ensuring that such measures are carried out, d) submit monthly environmental monitoring reports to the Employer.

13.1 **Contractor's Representative**

Text of Sub-Clause is substituted with the following:

"13.1.1 If the Contractor's Representative is not named in the Contract, then within 14 days of the Commencement Date, the Contractor shall appoint the Contractor's Representative and shall request the Employer in writing to approve the person

so appointed. If the Employer makes no objection to the appointment within 14 days, the Contractor's Representative shall be deemed to have been approved. If the Employer objects to the appointment within 14 days giving the reason thereof, then the Contractor shall appoint a replacement within 14 days of such objection, and the foregoing provisions of this GCC Sub-Clause 13.1.1 shall apply thereto.

13.1.2 The Contractor's Representative shall represent and act for the Contractor at all times during the performance of the Contract and shall give to the Engineer all the Contractor's notices, instructions, information, and all other communications under the Contract.

All notices, instructions, information, and all other communications given by the Employer or the Engineer to the Contractor under the Contract shall be given to the Contractor's Representative or, in its absence, its deputy, except as herein otherwise provided.
The Contractor shall not revoke the appointment of the Contractor's Representative without the Employer's prior written consent, which shall not be unreasonably withheld. If the Employer consents thereto, the Contractor shall appoint some other person as the Contractor's Representative, pursuant to the procedure set out in GCC Sub-Clause 13.1.1.

13.1.3 The Contractor's Representative may, subject to the approval of the Employer which shall not be unreasonably withheld, at any time delegate to any person any of the powers, functions and authorities vested in him or her. Any such delegation may be revoked at any time. Any such delegation or revocation shall be subject to a prior notice signed by the Contractor's Representative, and shall specify the powers, functions, and authorities thereby delegated or revoked. No such delegation or revocation shall take effect unless and until a copy thereof has been delivered to the Employer and the Engineer.

Any act or exercise by any person of powers, functions and authorities so delegated to him or her in accordance with this GCC Subclause 13.1.3 shall be deemed to be an act or exercise by the Contractor's Representative.

13.1.4 The Contractor's Representative shall be present on the Site during all working hours and shall not be transferred from the Site without the consent of the Engineer. The Contractor's Representative shall be a registered professional engineer as defined in the Pakistan Engineering Council Act 1975 (V of 1976)."

13.2 **Objection to Contractor's Employees**

Following sentence is added at the end of Sub-Clause:

"The Contractor shall, where required, promptly appoint a replacement thereof."

13.3 **Subclauses 13.3 to 13.5 are added as follows:**

Staff of Contractor

A reasonable proportion of the Contractor's superintending staff shall have a working knowledge of the English language. The Contractor shall provide and employ only technical personnel who are skilled and experienced in their respective callings and supervisory staff who are competent to adequately supervise the construction activities at

Site in accordance with the requirements mentioned in the Contract.

13.4 **Employment of Local Personnel**

The Contractor shall, to the extent practicable and reasonable, employ staff and labour from sources within Pakistan.

13.5 **Language Ability of Superintending Staff of Contractor**

"A reasonable proportion of the Contractor's superintending staff shall have a working knowledge of the English language."

14.2 **Safety Precautions**

At the end of the Sub-Clause the following is added:

"In order to provide for the safety, health and welfare of persons, and for prevention of damage of any kind, all operations for the purposes of or in connection with the Contract shall be carried out in compliance with the safety requirements of the Government of Pakistan with such modifications thereto as the Engineer may authorize or direct and the Contractor shall take or cause to be taken such further measures and comply with such further requirements as the Engineer may determine to be reasonably necessary for such purpose.

The Contractor shall make, maintain, and submit reports to the Engineer concerning safety, health and welfare of persons and damage to property as the Engineer may from time to time prescribe."

14.3 **Electricity Water and Gas**

The text of Sub-Clause 14.3 is deleted and substituted by the following:

"The Contractor shall be responsible for making his own arrangements for the adequate supply of electricity, water and gas required for the effective performance of his obligations under the Contract. Subject to the aforesaid, the Contractor shall be entitled to use for the purposes of the Works such supplies and services as may be available on the Site. The Contractor shall, before the commencement of the work at Site, seek the approval of the Engineer as to his detailed requirements of electricity, water and gas for the entire Contract period. The Contractor shall pay the Employer at the rates/cost incurred by the Employer. The Contractor shall at his own cost provide any apparatus necessary for such use. The contractor will bear the cost of distribution network for electricity, potable water, telephone, gas and their consumption by his own personnel for the purpose of execution of the Works.

For the avoidance of doubt, it is clarified that the provisions of this Sub-Clause do not apply to gas and backfeed electricity required by the Contractor for performing Tests on Completion and operating the Plant. The provision of gas and backfeed electricity for such purposes will be the responsibility of the Employer."

14.4 **Employer's Equipment**

The text of Sub-Clause 14.4 is deleted and substituted by the following:

"The Employer shall, if the Contractor so requests for the execution of the Works, provide any available equipment of which details are given in the Preamble to Conditions of

Contract. The Contractor shall pay the Employer a mutually agreed price for such use.

The Contractor shall be responsible for the safe working of the Employer's equipment and shall hand over the equipment back to Employer in good and reliable condition."

14.5 **Clearance of Site**

The following paragraph is added at the end of Sub-Clause:

"No usable plant, equipment or material purchased for the Works or construction tools and equipment shall be removed from the Site without written consent of the Employer. After completion of all Work required under the Contract, any equipment material or consumable supplies remaining surplus shall become the property of the Employer except that the Contractor may remove his tools and construction equipment, with the permission of the Employer."

14.6 **Opportunities for Other Contractors**

Following paras are added at the end of Sub-Clause:

"The Contractor shall also arrange to perform its work as to minimize, to the extent possible, interference with the work of other contractors. The Engineer shall determine the resolution of any difference or conflict that may arise between the Contractor and other contractors and the workers of the Employer in regard to their work.

The Contractor shall notify the Engineer promptly of any defects in the other contractors' work that come to its notice, and that could affect the Contractor's work. The Engineer shall determine the corrective measures, if any, required to rectify the situation after inspection of the Works. Decisions made by the Engineer shall be binding on the Contractor."

14.8 **Information for Import Permits and Licenses**

The text of Sub-Clause is deleted and substituted with following:

"The Contractor shall acquire and pay for all permits, approvals, and/or licenses from all local, state, or national government authorities or public service undertakings in Pakistan, which such authorities or undertakings require the Contractor to obtain in its name and which are necessary for the performance of the Contract, including, without limitation, visas for the Contractor's and Subcontractor's personnel and entry permits for all imported Contractor's Equipment. The Contractor shall acquire all other permits, approvals, and/or licenses that are not the responsibility of the Employer under GCC Sub-Clause 17.5 hereof and that are necessary for the performance of the Contract.

The Contractor shall submit to the Employer in good time such details of all Plant and Contractor's Equipment to be imported into Pakistan for which it requires Employer's assistance and identify as to what assistance of the Employer is required for obtaining by the Contractor of all necessary import permits or licenses."

14.9 *The following Sub-Clause GCC 14.9 is added:*

Procurement and Transportation

14.9.1 The Contractor shall procure and transport all materials in an expeditious and orderly manner to the Site. The Contractor shall adequately record the

condition of roads, agricultural land and other infrastructure prior to the start of transporting materials, goods & equipment, and construction.

14.9.2 The Contractor shall at its own risk and expense transport all the materials and the Contractor's Equipment to the Site by the mode of transport that the Contractor judges most suitable under all the circumstances.

14.9.3 Unless otherwise provided in the Contract, the Contractor shall be entitled to select any safe mode of transport operated by any person to carry the materials and the Contractor's Equipment.

14.9.4 Upon dispatch of each shipment of materials and the Contractor's Equipment, the Contractor shall notify in writing to the Employer of the description of the materials and of the Contractor's Equipment, the point and means of dispatch, and the estimated time and point of arrival in Pakistan, if applicable, and at the Site. The Contractor shall furnish the Employer with relevant shipping documents to be agreed upon between the parties.

14.9.5 The Contractor shall be responsible for obtaining, if necessary, approvals from the authorities for transportation of the materials and the Contractor's Equipment to the Site. The Employer shall use its best endeavors in a timely and expeditious manner to assist the Contractor in obtaining such approvals, if requested by the Contractor. The Contractor shall indemnify and hold harmless the Employer from and against any claim for damage to roads, bridges, or any other traffic facilities that may be caused by the transport of the materials and the Contractor's Equipment to the Site.

15.1 **Compliance with Statutes, Regulations**

The text of Sub-Clause is deleted and substituted with following:

"Unless otherwise provided in the Contract, the Contractor shall obtain and pay for all permits, licenses or other privileges, necessary to complete the Works.

The Contractor shall ensure conformance in all respects with the provisions of all federal, provincial, and local laws, regulations or other laws in force in Pakistan or elsewhere including all regulations and by-laws of any local or other duly constituted authority within Pakistan or elsewhere which may be applicable to the performance of the Contract and the rules and regulations of all public bodies and companies whose property or rights are affected or may be affected in any way by the Works or any Temporary Works, and shall give all notices and pay all fees required to be given or paid thereby and shall keep the Employer and Engineer indemnified against all penalties and liability of any kind for breach of any of the same. Provisions to the like effect as those contained in this clause shall be incorporated in all Subcontracts."

15.2 **Compliance with Laws**

The text of Sub-Clause is deleted and substituted with following:

"The Contractor shall comply with the laws of the country of manufacture concerning the manufacture of the Plant, and the Laws of Pakistan where the Plant is to be erected. The laws will include all local, state, national, or other laws that affect the performance of the Contract and are binding upon the Contractor. The Contractor shall indemnify and hold harmless the Employer from and against any and all liabilities, damages, claims, fines, penalties, and expenses of whatever nature arising or resulting from the violation of such laws by the Contractor or its personnel, including the Subcontractors and their personnel."

16.4 *Following GCC Sub-Clauses 16.4 to 16.5 are added:*

License/Use of Technical Information

(a) For the operation and maintenance of the Plant, the Contractor hereby grants a non-exclusive and nontransferable license (without the right to sublicense) to the Employer under the patents, utility models, or other industrial property rights owned by the Contractor or by a third party from whom the Contractor has received the right to grant licenses thereunder, and shall also grant to the Employer a nonexclusive and nontransferable right (without the right to sublicense) to use the know-how and other technical information disclosed to the Employer under the Contract. Nothing contained herein shall be construed as transferring ownership of any patent, utility model, trademark, design, copyright, know-how, or other intellectual property right from the Contractor or any third party to the Employer.

(b) The copyright in all drawings, documents, and other materials containing data and information furnished to the Employer by the Contractor herein shall remain vested in the Contractor or, if they are furnished to the Employer directly or through the Contractor by any third party, including suppliers of materials, the copyright in such materials shall remain vested in such third party.

16.5 **Photographs of Works and Advertisement Prohibited**

Except with the prior written authorization of the Employer the Contractor shall not exhibit or permit to be exhibited any photographs, podcast, social media reporting, unauthorized site visits or advertisement on the Works. Any authorized exhibition shall be immediately removed if the Employer so requires.

17.4 **Consents and Way Leaves**

The Sub-Clause 17.4 is deleted and substituted by the following:

"The Employer shall issue permissions, letters, certificates and provide such other assistance to the Contractor for his obtaining permits-to-work, way leaves and approvals from any other department/authority and right of way from private owners, if required. The Contractor will bear the cost of logistics, fees, etc. for such activities. The Employer, will reimburse the Contractor only the payments made by him in respect of any land compensation for obtaining such way leaves, required for the Works."

17.5 **Import Permits and Licenses**

*The word "**Employer**" is deleted and substituted by the word "**Contractor**" and the following is added at the end of Sub-Clause 17.5:*

"The Employer will provide assistance for this purpose."

18.1 **Engagement of Labour**

At the end of the Sub-Clause the following is added:

"in accordance with the regulations, orders and requirements of the Govt. of Pakistan and the Govt. of Sindh.

The Contractor shall pay rates of wages, and observe conditions of labor, which are not lower than those established for the trade or industry where the work is carried out. If no established rates or conditions are applicable, the Contractor shall pay rates of wages and observe conditions which are not lower than the general level of wages and conditions observed locally by employers whose trade or industry is similar to that of the Contractor.

The Contractor shall inform the Contractor's personnel about their liability to pay personal income taxes in the Country in respect of such of their salaries, wages, and allowances as are chargeable under the Laws for the time being in force, and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such Laws."

18.3 **Working Hours**

The last sentence "The extra cost, ……. of the Contractor." of Sub-Clause is deleted.

Following Sub-Clauses GCC 18.5 to GCC 18.16 are added:

18.5 **Employment of Persons in the Service of Others**

The Contractor shall not recruit or attempt to recruit his staff and labour from amongst the persons in the service of the Employer or the Engineer and vice–versa, unless mutually agreed between the Employer/Engineer and the Contractor.

18.6 **Alcoholic Liquor or Drugs**

The Contractor shall not, otherwise than in accordance with the statutes, Ordinances and Government Regulations or Orders for the time being in force, import, sell, give, barter or otherwise dispose of any alcoholic liquor or drugs, or permit or suffer any such importation, sale gift, barter or disposal by his Subcontractors, agents, employees or labour.

18.7 **Arms and Ammunition**

The Contractor shall not give, barter or otherwise disposeoff to any person or persons, any arms or ammunition of any kind or permit or suffer the same as aforesaid.

18.8 **Festivals and Religious Customs**

The Contractor shall in all dealings with his staff and labour have due regard to all recognized festivals, days of rest and religious or other customs.

18.9 **Disorderly Conduct**

The Contractor shall at all times take all reasonable precautions to prevent any unlawful riotous or disorderly conduct by or amongst his staff and labour and for the preservation of peace and protection of persons and property in the neighborhood of the Works against the same. The Contractor will furnish list of all vehicles or automobiles in use of its employees and the Employers will issue temporary gate pass(es); after due verification of legal ownership and road worthiness.

18.10 **Site Regulations and Safety, Health and Safety, Funeral Arrangements**

(a) The Employer and the Contractor shall establish Site regulations setting out the rules to be observed in the execution of the Contract at the Site and shall comply therewith. The Contractor shall prepare and submit to the Employer, with a copy to the Engineer,

proposed Site regulations for the Employer's approval, which approval shall not be unreasonably withheld. Such Site regulations shall include, but shall not be limited to, rules in respect of security, safety of the Works, gate control, sanitation, medical care, and fire prevention.

(b) The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's personnel. In collaboration with local health authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay are available at all times at the Site and at any accommodation for Contractor's and Employer's personnel, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics.

(c) The Contractor shall appoint an accident prevention officer at the Site, responsible for maintaining safety and protection against accidents. This person shall be qualified for this responsibility, and shall have the authority to issue instructions and take protective measures to prevent accidents. Throughout the performance of the Contract, the Contractor shall provide whatever is required by this person to exercise this responsibility and authority.

(d) The Contractor shall send to the Engineer, details of any accident as soon as practicable after its occurrence. The Contractor shall maintain records and make reports concerning health, safety, and welfare of persons, and damage to property, as the Engineer may reasonably require.

(e) The Contractor shall at all times take the necessary precautions to protect the Contractor's Personnel employed on the Site from insect and pest nuisance, and to reduce their danger to health. The Contractor shall comply with all the regulations of the local health authorities, including use of appropriate insecticide.

(f) In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Government, or the local medical or sanitary authorities, for purpose of dealing with and overcoming the same.

(g) In the event of the death of any of the Contractor's personnel or accompanying members of their families, the Contractor shall be responsible for making the appropriate arrangements for their return or burial.

18.11 **Reporting of Accidents**

The Contractor shall report to the Engineer details of any accident as soon as possible after its occurrence. In the case of any fatality or serious accident, the Contractor shall, in addition to appropriate action required under the law, notify the Engineer immediately by the quickest available means.

18.12 **Compliance by Subcontractors**

The Contractor shall be responsible for compliance by his Subcontractors of the foregoing provisions.

18.13 **Housing for Labour**

Save insofar as the Contract otherwise provides, the Contractor, at its own cost, shall provide and maintain such housing accommodation and amenities as he may consider necessary for all his supervisory staff and labour, employed for the purposes of or in

connection with the Contract including all fencing, electricity supply, sanitation, cookhouses, fire prevention, water supply and other requirements in connection with such housing accommodation or amenities. On Completion of the Works, these facilities shall be handed over to the Employer or if the Employer so desires, the temporary camps or housing provided by the Contractor shall be removed and the Site reinstated to its original condition, all in accordance with the instructions/approval of the Engineer.

18.14 **Supply of Water and Foodstuff**

The Contractor shall, so far as is reasonably practicable, having regard to local conditions**,** provide on the Site, to the satisfaction of the Engineer or his representative, adequate supply of drinking and other water for the use of his staff and labour. The Contractor shall also arrange for the provision of a sufficient supply of suitable food at reasonable prices for the Contractor's Personnel for the purposes of or in connection with the Contract.

18.15 **Prohibition of All Forms of Forced or Compulsory Labour**

The Contractor shall not employ "forced or compulsory labor" in any form. "Forced or compulsory labor" consists of all work or service, not voluntarily performed, that is extracted from an individual under threat of force or penalty.

18.16 **Prohibition of Harmful Child Labour**

The Contractor shall not employ any child to perform any work that is economically exploitative, or is likely to be hazardous to, or to interfere with, the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development.

19.1 **Manner of Execution**

The following is added at the end of Sub-Clause:

"The Contractor shall submit for approval of the Engineer, his detailed method statement(s) for the execution of such items of work as may be desired by the Engineer. Approval of such method statement(s) shall neither relieve the Contractor of his responsibilities under the Contract nor form any basis for claiming additional costs."

19.3 **Uncovering Work**

The following words at the end of second paragraph of Clause 19.3 are deleted:

"and added to the Contract Price"

The following is added at the end of second paragraph of Sub-Clause 19.3:

"In any other case, all costs shall be borne by the Contractor."

The following Sub-Clause 19.4 is added:

19.4 **Use of Pakistani Materials**

The Contractor shall so far as may be consistent with the Contract make the maximum use of materials, supplies and equipment indigenous to or produced in Pakistan and services available in Pakistan or operated in Pakistan provided such materials, supplies, equipment and services shall be of required standard.

20.1 **Independent Inspection**

The following is added at the end of Sub-Clause:

In the case independent inspection is required under the Contract, the Contractor shall bear all expenses in connection with the independent inspection.

20.2 **Inspection and Testing During Manufacture**

Subclause 20.2 is substituted with the following:

a) The Contractor shall carry out, at its own expense, all necessary tests and inspections of the Plant and its components as specified in the Contract. These tests and inspections shall be witnessed by one representative each from the Employer and the Engineer at the manufacturer's works. The Contractor is responsible for providing all reasonable facilities, including laboratories, tools, instruments, machines, samples, etc., as outlined in the specifications or commonly practiced in the trade and industry, to assist the inspectors in conducting the tests and inspections at the Contractor's expense. The Contractor shall fully assist the nominated inspectors in the visa application process by providing all necessary supporting documents and facilitating necessary correspondence with the embassy(ies) to obtain the required visa(s).

b) The cost associated with witnessing tests, pre-shipment inspections, or repeating such activities by the representatives of the Employer and the Engineer shall be borne by the Contractor without imposing any additional charges on the Employer. The cost includes pre-travel arrangements, air travel within Pakistan (if applicable) and to the inspection/testing location, return travel, accommodation in A-class hotels (including boarding and lodging), local transportation, and a daily allowance.

c) The Contractor shall keep the Employer and the Engineer informed the progress of manufacturing and notify the Engineer at least twelve (12) weeks in advance in writing as to when the Plant or any part thereof will be ready for inspection and/or to carry out any test and/or inspection abroad and four (4) weeks' advance notice for any test and/or inspection within Pakistan.

d) The Contractor shall provide the Engineer with a certified report of the results of any such test and/or inspection. If the Employer or Engineer or their designated representatives fails to attend the test and/or inspection, after issuance of "Letter of Waiver" by the Engineer to ensure timely shipment, then the Contractor may proceed with the test and/or inspection in the absence of such persons, and may provide the Engineer with a certified report of the results thereof before shipment. The Goods and any part thereof shall be shipped or delivered only upon issuance of Pre-shipment Inspection Certificate or Waiver to Pre-shipment Inspection.

e) The Engineer may require the Contractor to carry out any test and/or inspection not required by the Contract, provided that the Contractor's reasonable costs and expenses incurred in carrying out such test and/or inspection shall be added to the Contract Price. Further, if such test and/or inspection impedes the progress of work on the Works and/or the Contractor's performance of its other obligations under the Contract, due allowance will be made in respect of the Time for Completion and the other obligations so affected.

f) Any inspection and/or witnessing of tests or the waiving of such tests and/or surveillance by the Employer and Engineer or their two Nos. Representatives shall not relieve the Contractor of its obligations and responsibilities under the Contract regardless of any approval or consent given by the Employer and Engineer.

g) All work covered by the Contract shall be subject to surveillance, testing and inspection by the representatives of the Employer and the Engineer. The Inspectors may require witnessing any or all the tests to be carried out. For such purpose the Contractor shall provide free access at all times during manufacture, assembly and testing to the premises in which the work is being carried out.

h) If any dispute or difference of opinion shall arise between the parties in connection with or arising out of the test and/or inspection of the Plant or part of the Works that cannot be settled between the parties within a reasonable period of time, it may be settled in accordance with GCC Sub-Clause 50.

i) The Contractor shall afford the Employer and the Engineer, at the Employer's expense, access at any reasonable time to any place where the Plant are being manufactured or the Works are being installed, in order to inspect the progress and the manner of manufacture or installation, provided that the Engineer shall give the Contractor a reasonable prior notice.

GCC Sub-Clauses 20.3 and 20.4 are deleted in their entirety.

21.1 **Rejection**

Last para of Sub-Clause reading "If the Engineer requires such Plant…….deducted from the Contract Price" is replaced with following:

"If the Engineer requires such Plant to be retested, the tests shall be repeated under the same terms and conditions without any additional cost to the Employer."

23.1 **Order to Suspend**

Following is added at the end of subclause:

"During such period, the Contractor shall not remove from the Site any Plant or any Contractor's Equipment, without the prior written consent of the Employer."

24.1 **Cost of Suspension**

At the end of the second paragraph after the word "Contractor" the following is added:

"or for the proper execution or for the safety of the Works or Plant unless such necessity results from any act or default of the Engineer or the Employer or in consequence of any of the Employer's Risks under Sub-Clause 37.2."

24.4 **Resumption of Work**

First paragraph of Sub-Clause 24.4 is deleted and substituted by the following:

"If the Contractor chooses not to treat prolonged suspension as an omission or termination under Sub-Clause 24.3, the Employer shall, upon the request of the Contractor, take over

the responsibility for protection, storage, security and insurance of the suspended Works and of the Plant which has been delivered to the Site and which is affected by suspension and the risk of loss or damage thereto shall thereupon pass to the Employer."

25.1 **Time for Completion**

The following words are added at the end of the Sub-Clause:

"mentioned in the Preamble to Conditions of Contract."

26.1 **Extension of Time for Completion**

Paras (c) and (h) of Sub-Clause 26.1 are deleted.

The following is added at the end of Sub-Clause 26.1:

"Timely compliance with the notice requirements of this Sub-Clause shall be a condition precedent to any entitlement of the Contractor to an extension of the Time for Completion. Where the Contractor fails to give notice of his intention to claim an extension of time within the said fourteen (14) days, the Contractor shall not be entitled to any extension of time, the Time for Completion shall not thereby be set at large, and the Contractor's claim shall be absolutely barred."

26.3 **Earlier Completion**

The text of Sub-Clause 26.3 is deleted and substituted with the following:

"The Employer shall not be liable to pay any bonus or additional sum for completion of the Works or any part thereof earlier than the Time for Completion."

Subclause GCC 26.4 is added as follows

26.4 **Rate of Progress**

If for any reason, which does not entitle the Contractor to an extension of time, the rate of progress of the Works or any Section is at any time, in the opinion of the Engineer, too slow to comply with the Time for Completion, the Engineer shall so notify the Contractor who shall thereupon take such steps as are necessary, subject to the consent of the Engineer, to expedite progress so as to comply with the Time for Completion. The Contractor shall not be entitled to any additional payment for taking such steps. If, as a result of any notice given by the Engineer under this Clause, the Contractor considers that it is necessary to do any work at night or on locally recognized days of rest, he shall be entitled to seek the consent of the Engineer so to do. Provided that if any steps, taken by the Contractor in meeting his obligations under this Sub-Clause, involve the Engineer in additional supervision costs, such costs shall, after due consultation with the Engineer and the Contractor, be determined by the Engineer and shall be recoverable from the Contractor by the Employer, and may be deducted by the Employer from any moneys due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Employer.

27.1 **Delay in Completion**

Sub-Clause 27.1 is deleted and substituted by the following:

"If the Contractor fails to deliver the Works, or any part thereof, within the time stated in

Sub-Clause 25.1, or fails to complete the whole of the Works, or, if applicable, any Section within the relevant time prescribed by Sub-Clause 25.1, then the Contractor shall pay to the Employer the relevant sum mentioned in Preamble to Conditions of Contract as liquidated damages for such default (which sum shall be the only moneys due from the Contractor for such default) for every day or part of a day which shall elapse between the relevant Time for Completion as per Contract and the actual date stated in a Taking–Over Certificate of the whole of the Works or the relevant Section, as the case may be, provided that the aggregate amount of such liquidated damages shall in no event exceed the maximum amount specified as in Preamble to Conditions of Contract.

The Employer may deduct the amount of such damages from any monies due or to become due to the Contractor. The payment or deduction of such damages shall not relieve the Contractor from his obligation to complete the Works, or from any other of his obligations and liabilities under the Contract.

The liquidated damages for each day of delay and the maximum amount of liquidated damages shall be the amounts mentioned in the Preamble to Conditions of Contract."

The Parties acknowledge and agree that the rates and maximum amounts of liquidated damages stipulated in the Preamble to Conditions of Contract and in Sub-Clauses 27.1 and 27.3 are a genuine pre-estimate of the loss likely to be suffered by the Employer as a result of the relevant default — including the cost of procuring replacement power and the increased cost of generation during prolonged operation of the Plant in simple cycle — and constitute reasonable compensation for the purposes of section 74 of the Contract Act, 1872, recoverable without proof of actual loss or damage.

Sub Clause GCC 27.3 is added as follows:

27.3 **Failure to Meet Performance Guarantees**

In the event the Contractor fails to meet any of the Performance Guarantees during the Tests on Completion, the Employer may (at its sole and absolute discretion) exercise any or all of the remedies set out in this Contract.

Without prejudice to the generality of the preceding paragraph, in the event the Contractor fails to meet any of the Performance Guarantees, the Contractor shall be liable to pay to the Employer the relevant sum mentioned in Preamble to Conditions of Contract as liquidated damages for such default provided that the aggregate amount of such liquidated damages shall in no event exceed the maximum amount specified as in Preamble to Conditions of Contract.

The Employer may deduct the amount of such damages from any monies due or to become due to the Contractor. The payment or deduction of such damages shall not relieve the Contractor from his obligation to complete the Works, or from any other of his obligations and liabilities under the Contract.

Notwithstanding the foregoing, if the Actual Gross Power Output (AGPO) demonstrated during the Tests on Completion, after all permitted repetition of tests, is less than ninety-eight percent (98%) of the Guaranteed Gross Power Output (GGPO), the Works shall be deemed to have failed the Tests on Completion, and the Employer shall be entitled, at its sole discretion, to reject the Works pursuant to Sub-Clause 28.7 and to exercise the remedies available under Sub-Clause 30.5(c), including termination of the Contract, in addition to recovery of the maximum liquidated damages under this Sub-Clause.

28.1 **Notice of Tests**

*The words "**The Employer**" at the start of Sub-Clause are deleted and substituted with following:*

"As soon as the Plant or any part thereof has, in the opinion of the Contractor, been completed operationally and structurally and put in a tight and clean condition as specified in the Technical Provisions, excluding minor items not materially affecting the operation or safety of the Plant, the Contractor"

28.4 **Facilities for Tests on Completion**

The text of Sub-Clause 28.4 is deleted and substituted with the following:

"Except where otherwise specified, the Employer shall provide free of charge the gas and backfeed electricity as may be reasonably required by the Contractor to carry out the Tests on Completion."

28.6 **Disagreement as to Result of Tests**

The following sentence is added at the end of Sub-Clause:

"The parties shall then proceed in accordance with the procedure set out in GCC Clause 50."

29.2 Taking-Over Certificate

The following is added at the end of Sub-Clause 29.2:

"Where the Works are taken over subject to outstanding items of work, the Taking-Over Certificate shall annex a punch list of such items agreed between the Engineer and the Contractor or, failing agreement, determined by the Engineer, stating for each item a completion deadline and the Engineer's estimate of its value. The Employer may retain, out of any monies due or to become due to the Contractor, an amount equal to two hundred percent (200%) of the Engineer's estimated value of each outstanding item until such item has been completed and signed off by the Engineer."

29.4 Interference with Tests on Completion

The following is added at the end of Sub-Clause 29.4:

"Where the Contractor is prevented from carrying out the Tests on Completion by a cause for which the Employer is responsible, including unavailability of the fuel gas or backfeed electricity which the Employer is required to provide under Sub-Clause 28.4, the Contractor shall be entitled to a corresponding extension of time, and the Works shall be deemed to have been taken over under this Sub-Clause only if such prevention continues for a continuous period exceeding ninety (90) days. Where such prevention by a cause for which the Employer is responsible continues for more than thirty (30) days, the Employer shall bear the reasonable, duly substantiated costs of preservation, protection and maintenance of the Works incurred thereafter until the cause of prevention ceases. Where the Contractor is prevented from carrying out the Tests on Completion by system dispatch, grid or load restrictions, or any other cause for which the Employer is not responsible, the Contractor's sole entitlement shall be a corresponding extension of time under Clause 26, and no such prevention shall give rise to a deemed taking over of the Works or to any payment or compensation. The Tests on Completion shall be carried out as soon as the cause of prevention ceases, in accordance with this Sub-Clause."

30.4 **Extension of Defects Liability Period**

At the end of 4th paragraph of Sub-Clause, the following is added:

"or a mutually agreed period."

30.5 **Failure to Remedy Defects**

In first line after the words "reasonable time" the following is added:

"fixed by the Engineer".

30.9 **Defects in Employer's and Engineer's Design**

The Sub-Clause 30.9 is deleted in its entirety.

30.13 *New Sub-Clause 30.13 is added as herein below:*

Unfulfilled Obligations

"After the Defects Liability Certificate has been issued, the Contractor and the Employer shall remain liable for the fulfillment of any obligation which remains unperformed at that time. For the purposes of determining the nature and extent of any such obligation, the Contract shall be deemed to remain in force."

31.1 **Engineer's Right to Vary**

The following is added at the end of second paragraph:

"No such variation shall in any way vitiate or invalidate the Contract, but the effect, if any, of all such variations shall be valued in accordance with Clause 31. Provided that where the issue of an instruction to vary the Works is necessitated by some default of or breach of Contract by the Contractor or for which he is responsible, any additional cost attributable to such default shall be borne by the Contractor."

31.5 **Record of Costs**

The word "Engineer" in 4th line of Sub-Clause is substituted by:

"Engineer/ Employer".

New Sub-Clauses 31.6 is added as given below:

31.6 **Value Engineering**

The Contractor may, at any time, submit to the Engineer a written proposal which in the Contractor's opinion will reduce the cost of constructing, maintaining or operating the works, or improve the efficiency or value to the Employer of the completed Works or otherwise be of benefit to the Employer. Any such proposal shall be prepared at the cost of the Contractor. However, the Employer is not bound to accept such proposal.

32.1 **Ownership of Plant**

Sub-Clause GCC 32.1 is replaced with following:

"32.1.1 Ownership of the Plant (including spare parts) to be imported into Pakistan shall be transferred to the Employer upon loading on to the mode of transport to be used to send the Plant from the country of origin to the country where Works are to be executed.

32.1.2 Ownership of the Plant (including spare parts) procured in Pakistan shall be transferred to the Employer when the Plant are brought on to the Site.

32.1.3 Ownership of the Contractor's Equipment used by the Contractor and its Subcontractors in connection with the Contract shall remain with the Contractor or its Subcontractors.

32.1.4 Ownership of any Plant in excess of the requirements for the Works shall revert to the Contractor upon completion of the Works or at such earlier time when the Employer and the Contractor agrees that the Plant in question are no longer required for the Works.

32.1.5 Notwithstanding the transfer of ownership of the Plant, the responsibility for care and custody thereof together with the risk of loss or damage thereto shall remain with the Contractor until Risks Transfer Date of the Works or the part thereof in which such Plant are incorporated."

33.1 **Terms of Payment**

33.1.1 The Employer shall pay the Contractor in the following manner and at the following times, on the basis of the price breakdown given in the section on Schedules of Price. Payments will be made in the currencies quoted by the Bidder unless otherwise agreed between the parties. Applications for payment in respect of part deliveries may be made by the Contractor as work proceeds.

(A) TERMS OF PAYMENT

Schedule No. 1. Plant, Equipment and Mandatory Spare Parts Supplied from Abroad

In respect of Plant and Equipment supplied from abroad, the following payments shall be made:

Ten percent (10%) of the total CIF amount as an interest free advance payment through L/C within twenty-one (21) days after receipt of invoice and an irrevocable advance payment security for the equivalent amount made out in favor of the Employer. The advance payment security may be reduced in proportion to the value of the Plant and Equipment shipped and delivered, as evidenced by the shipping documents. The advance payment invoice duly verified by the Employer/Engineer shall be submitted to the negotiating bank.

Seventy percent (70%) of the total or pro rata CIF amount through L/C within forty-five (45) days after receipt of invoices and submission of following documents. The invoice and the requisite documents shall be directly submitted to the negotiating bank:

1. Permission to Deliver issued pursuant to Sub-Clause 22.1 of the General Conditions of Contract.

2. Pre-Shipment Inspection Certificate or Letter of Waiver issued in accordance with Sub-Clauses 20.2 & 20.5 of the General Conditions of the Contract.
3. Shipping documents comprising of
   a) Payment/commercial invoice
   b) Clean on-board bill of lading or airway bill issued by freight forwarder
   c) Certificate or policy of transit and marine insurance from Ex-works to the Project Site, of the portion of the Plant for which certificate of payment is requested
4. Packing List.
5. Certificate of origin, issued by the Contractor
6. Warranty certificate.
7. Any other document as necessary due to statutory requirement.

Ten percent (10%) of the total or pro rata CIF amount upon issue of the Taking Over Certificate through L/C, within forty-five (45) days after receipt of invoice. The invoice, and the Taking Over Certificate issued by the Engineer, shall be directly submitted to the negotiating bank.

Five percent (5%) of the total or pro rata CIF amount upon completion of one (1) year of Defects Liability Period through L/C, within forty-five (45) days after receipt of invoice. The invoice shall be directly submitted to the negotiation Bank.

Five percent (5%) of the total or pro rata CIF amount upon issue of Defects Liability Certificate through L/C, within forty-five (45) days after receipt of invoice. The invoice and the Defects Liability Certificate shall be directly submitted to the negotiation Bank.

Schedule No. 2. Plant, Equipment and Mandatory Spare Parts Supplied from within the Employer's Country

In respect of Plant and Equipment supplied from within the Employer's country, the following payments shall be made:

Ten percent (10%) of the total EXW (Pakistan) amount as an interest free advance payment within twenty-one (21) days after receipt of invoice, and an irrevocable advance payment security for the equivalent amount made out in favor of the Employer. The advance payment security may be reduced in proportion to the value of the Plant and Equipment delivered to the site, as evidenced by shipping and delivery documents.

Seventy percent (70%) of the total or pro rata EXW (Pakistan) amount upon *Incoterm* "Ex-Works," upon delivery to the site within forty-five (45) days after receipt of invoice by the Employer/Engineer upon submission of the following documents:

1. Permission to Deliver issued pursuant to Sub-Clause 22.1 of General Conditions of Contract.
2. Pre-shipment Inspection Certificate or Letter of Waiver issued in accordance with Sub-Clause 20.2 & 20.5 of General Conditions of Contract.
3. Packing List.
4. Warranty certificate.

5. Insurance declaration.
6. Any other document as necessary due to statutory requirement.

Ten percent (10%) of the total or pro rata EXW (Pakistan) amount upon issue of the Taking Over Certificate, within forty-five (45) days after receipt of invoice by the Employer/Engineer.

Five percent (5%) of the total or pro rata EXW (Pakistan) amount upon completion of one year of Defects Liability Period, within forty-five (45) days after receipt of invoice by the Employer/Engineer.

Five percent (5%) of the total or pro rata EXW (Pakistan) amount upon issue of the Defects Liability Certificate, within forty-five (45) days after receipt of invoice by the Employer/Engineer.

Schedule No. 3. Local Transportation, Insurance and Other Incidental Services

In respect of local transportation, Insurance and Other Incidental Services for both the foreign currency (where applicable) and the local currency portions, the following payments shall be made:

Hundred percent (100%) of the total or pro rata local transportation, Insurance and Other Incidental Services amount upon delivery to the Site within forty-five (45) days after receipt of invoice for actual progress of work for the respective month accompanied by the statement of work duly verified by the Employer/Engineer.

Schedule No. 4. Erection, Civil Works, and Commissioning Services

In respect of the services under Schedule No. 4, the following payments shall be made:

Ten percent (10%) of the total Erection, Civil Works and Commissioning Services amount as an advance payment within twenty-one (21) days after receipt of invoice, and an irrevocable advance payment security for the equivalent amount made out in favor of the Employer. The advance payment security may be reduced in proportion to the value of work performed by the Contractor as evidenced by the invoices for installation services.

Seventy percent (70%) of the measured value of Erection, Civil Works and Commissioning Services performed by the Contractor during the preceding month, as certified by the Engineer, will be made monthly within forty-five (45) days after receipt of invoice by the Employer/Engineer.

Ten percent (10%) of the total or pro rata value of Erection, Civil Works and Commissioning Services performed by the Contractor as certified by the Engineer upon issue of the Taking Over Certificate, within forty-five (45) days after receipt of invoice by the Employer/Engineer.

Five percent (5%) of the total value of Erection, Civil Works and Commissioning Services performed by the Contractor as certified by the Engineer upon completion of one year of Defects Liability Period, within forty-five (45) days after receipt of invoice by the Employer/Engineer.

Five percent (5%) of the total value of Erection, Civil Works and Commissioning Services performed by the Contractor as certified by the Engineer upon issue of of the Defects Liability Certificate, within forty-five (45) days after receipt of invoice by the Employer/Engineer.

Any other Amount

Any other amount except Schedules 1, 2, 3 and 4 of Price Schedules to which the Contractor may consider himself to have become entitled, full amount shall be paid against monthly invoices for actual progress during any month against presentation of Certificate of Payment issued by the Engineer.

Currencies of Payment

Foreign currency payments shall be made only in the currencies of the contract which the Contractor has quoted in the Price Schedules for the items quoted in foreign currency, in the Price Schedules, whereas, payments for the items quoted in local currency in the Price Schedules shall be made in Pak Rupees.

(B) PAYMENT PROCEDURES

The procedures to be followed in applying for certification and making payments shall be as follows:

i. Within 14 working days after receiving and application for payment which the Contractor was entitled to make the Engineer shall issue a Certificate of Payment to the Employer showing the amount due, with a copy to the Contractor.

A certificate of payment, other than the Final Certificate of Payment, shall not be withheld on account of:

(a) Defects of minor character which are not such as to affect the use of the Facilities, or

(b) Any part of the payment applied for being disputed. In such case a certificate of payment for the undisputed amount shall be issued.

ii. The Engineer may in any certificate of payment make any correction or modification that should properly be made in respect of any previous certificate.

iii. Except as otherwise provided in the Contract, the amount due to the Contractor under any Certificate of Payment issued by the Engineer pursuant to this Clause, or to any other term of the Contract shall be paid by the Employer to the Contractor within a period of 28 days after such Certificate of Payment has been delivered to the Employer, or in case of the Final Certificate of Payment within a period of 45 days after such Final Certificate of Payment has been delivered to the Employer.

In the event that the Employer fails to make any payment on its respective due date, the Employer shall pay to the Contractor interest on the amount of such delayed payment at the following rate for period of delay until payment has been made in full.

- For Local Currency Payments: KIBOR + 1% per annum
- For Foreign Currency Payments: SOFR + 1% per annum

Deduction shall be made from the net amount payable to the Contractor of any sum(s) in accordance with the prevalent Federal and/ or Provincial laws, provided that no such deduction shall be made from those payments in respect of which the Contractor has obtained exemption under the Law.

iv. The work shall be measured for the units mentioned in Price Schedules according to the Contract as determine by the Engineer from approved drawings, specifications and Contract documents.

v. The Contractor shall make application to the Engineer for the Final Certificate of payment within twenty-eight (28) days after the issue of the Defects Liability Certificate, or if more than one, the last Defects Liability Certificate. The application for the Final Certificate of payment shall be accompanied by a final account prepared by the Contractor. The final account shall give full details of the value of the Plant supplied and work done under the Contract together with:

(a) Such additions to or deductions from the Contract Price as have been agreed, and
(b) All claims for additional payment to which the Contractor may consider himself entitled.

vi. The Engineer shall issue to the Employer with a copy to the Contractor, the Final Certificate of Payment with 28 days after receiving an application in accordance with v. hereof.

If the Contractor has not applied for a Final Certificate of Payment within the time specified in v. hereof the Engineer shall request the Contractor to do so within a further period of 28 days. If the Contractor fails to make such an application, the Engineer shall issue the Final Certificate of Payment for such amount as he deems correct.

vii. A Final Certificate of Payment shall be conclusive evidence of the value of the Facilities, that the Facilities are in accordance with the Contract and that the Contractor has performed all his obligations under the Contract.

Payment of the amount certified in the Final Certificate of Payment shall be conclusive evidence that the Employer has performed all his obligation under the Contract.

A Final Certificate of Payment or payments shall not be conclusive:

(a) To the extent that fraud or dishonesty relates to or affects any matter dealt with in the certificate, or
(b) If any arbitration or court proceedings under the Contract have been commenced by either party after the issue of the Final Certificate of Payment.

viii. If the Facilities or any part thereof are not being carried out to the Engineer's satisfaction and in order to protect the Employer from loss on account of:

(a) Defective work not rectified
(b) Performance Guarantees or other guarantees not met
(c) Claims filed against the Contractor

(d) Failure of the Contractor to make payments due for Plant procured or labour employed by him.
(e) Damage to any other contractor employed by the Employer.
(f) Contractor's non-compliance with the Contract
(g) Any Government dues recoverable from the Contractor if notified by the Government.

The Engineer may notify withholding of such payments or part thereof as may, in his opinion, be related to the aforesaid reasons/grounds. When the reasons/grounds for withholding the payment are removed by the Contractor, the Engineer shall upon being satisfied to that effect issue Certificate of Payment in respect of withheld amounts. The Employer may further deduct from any Certificate of Payment any amount set off in accordance with Sub-Clause 33.14.

ix. All payments in foreign and local currency to be paid from the Employer's own resources.
If the payment is required through L/C, then the charges for establishment of L/C and subsequent charges for modification and extension shall be borne by the Contractor.

An irrevocable L/C shall be opened by the Employer within 90 days from the signing of Contract Agreement provided the Contractor submits requisite information to the Employer for establishing the L/C e.g. Name of Advising Bank, Name, Address and Bank Account Number of Beneficiary etc. within a week time after signing of the Contract Agreement. Unless provided otherwise under State Laws, the L/C opened shall be irrevocable, for payment to the Contractor or beneficiary assigned by him. Any delay in opening of L/C due to reasons on part of the Contractor shall be to the Contractor's account.

x. Customs duties (including Basic, Regulatory, and Additional Customs Duty), import Sales Tax, Federal Excise Duty (FED), and Provincial Infrastructure Development Cess (PIDC) paid by the Contractor on Plant, Equipment, and Mandatory Spare Parts imported under Price Schedule No. 1 that form part of the Permanent Works shall be reimbursed by the Employer on an actual basis, without any allowance for overhead, profit margin, or markup.

All such reimbursements shall be funded exclusively from the Provisional Sums allocated in the Schedule of Prices for this purpose. Employer shall reimburse to the Contractor within ninety (90) days after receipt of a compliant claim supported by original documentary evidence, including verified Goods Declarations (GD), Computerized Payment Receipts (CPR), customs treasury challans, and proof of payment.

Prior to paying any duties or taxes at the port, the Contractor shall notify the Employer in writing of the assessed duty liability at least fourteen (14) days in advance and provide evidence of any applicable tax concessions or Statutory Regulatory Orders (SROs) utilized, in accordance with Sub-Clause 53.2.

The Contractor shall remain solely responsible for coordinating customs clearance, offloading at the port, port storage, inland transportation, insurance, and site delivery. All port charges, demurrage, loading/unloading costs, and handling fees shall be borne by the Contractor and shall not be reimbursable from Provisional Sums.

To avoid delays in customs clearance and prevent demurrage or storage charges, the Contractor shall notify the Employer, the Engineer, and the Insurance Company by letter or email with full shipment details at least fifteen (15) days before the arrival of the Plant at the port of entry. The Contractor shall deliver the following documents to the Employer and the Engineer at least fifteen (15) days prior to arrival:

- Copies of the Contractor's invoice showing Goods description, quantity, unit price and total amount.
- Original and four copies of the negotiable clean, on board bill of lading marked "freight prepaid" and four copies of non-negotiable bill of lading.
- Copies of the packing list identifying contents of each package.
- Insurance certificate.
- Manufacturer's or Supplier's Warranty certificate.
- Pre-shipment Inspection Certificate or Letter of Waiver and Permission to Deliver.
- Certificate of origin

Any additional expenses, demurrage, or port storage charges resulting from the Contractor's failure or delay in submitting the requisite shipping documents shall be strictly for the Contractor's account.

xi. General Sales Tax (GST) and Provincial Sales Tax (PST) paid by the Contractor on Plant, equipment, and Erection, Civil Works and Commissioning Services supplied from within Pakistan that form part of the Permanent Works shall be reimbursed by the Employer on an actual basis.

All such reimbursements shall be funded from the Provisional Sums allocated in the Schedule of Prices. Payment shall be processed by the Employer within thirty (30) days after receipt of a compliant claim, provided that:

1. The Contractor is registered with the relevant federal (FBR) and provincial (e.g., SRB) tax authorities.
2. The claim is supported by original, valid tax invoices issued in the Contractor's name that comply with the Sales Tax Act 1990 or applicable provincial tax laws.
3. The documentation is sufficient to entitle the Employer to claim the corresponding input tax credit from the relevant tax authority.

No reimbursement shall be made for GST or PST levied on temporary works, consumables, Contractor's Equipment, or administrative overheads.

xii. The procedures to be followed in applying for certification and making payments shall be as follows:

Sr. No.	Description	Payment Method
1.	Plant, Equipment and Mandatory Spare Parts Supplied from Abroad	Letter Of Credit at Sight (L/C) *
2.	Plant, Equipment and Mandatory Spare Parts Supplied from within the Employer's Country	Direct Disbursement

3.	Local transportation	Direct Disbursement
5.	Erection, Civil Works and Commissioning	Direct Disbursement
6.	Custom Duties and taxes (Schedule No. 1a)	To be paid by the Contractor and reimbursed by the Employer via Provisional Sums
7.	Local Sales Tax (GST/PST) on Permanent Works (Schedules 2, 3 & 4)	To be paid by the Contractor and reimbursed by the Employer via Provisional Sums

*** Foreign Contractor** shall be paid by the Employer through irrevocable Letter of Credit opened in favour of the Contractor in a bank in its country, upon submission of documents specified herein.

*** Local Contractor** shall be paid foreign currency component through inland letter of credit opened in favour of contractor in equivalent Pak Rupees on parity rate (interbank TT selling) prevailing on the date of Bill of Lading. The date of bill of Lading should fall within the proposed schedule of delivery updated at the time of contract as per committed completion period. For Local currency component, local Contractor shall be paid through direct payment.

Sub-Clauses 33.1.2 to 33.1.5 are added.

33.1.2 **Retention of Payment**

If at any time any payment would fall due for Works or part of Works and, if there shall be any defect in part of such Works in respect of which such payment is proposed, the Employer may retain the whole or any part of such payment. Any sum retained by the Employer pursuant to the provisions of this Clause shall be paid to the Contractor after the said defect is removed.

33.1.3 **Payment Where Taking-Over Certificate Issued for Section or part of Works**

If any section or part of the Works shall be taken-over separately under Clause 29 (Taking-Over) hereof, the payments herein provided for on or after Taking-Over shall be made in respect of the section or part taken-over and reference to the price shall mean such part of the price as shall, in the absence of agreement, be apportioned thereto by the Engineer.

33.1.4 **Extra Payment**

No extra payment in respect of overtime, additional materials, or special conditions or hardship shall be claimed by the Contractor unless otherwise provided in the Contract or such payments have been previously authorized in writing by the Engineer or the Employer.

33.1.5 **Breakdown of Lump Sum Items**

For the purposes of statements to be submitted in accordance with Sub-Clause 33.1 hereof, the Contractor shall submit to the Engineer, within twenty-eight (28) days after the receipt of the Letter of Acceptance, a breakdown for each of the lump sum items contained in the Bid. Such breakdowns shall be subject to the approval of the Engineer.

Sub-Clauses 33.2 to 33.11 are deleted

Sub-Clauses GCC 33.12 and GCC 33.13 are added as follows:

33.12 **Withholding of Payment**

If the Works or any part thereof are not being carried out to the Engineer's satisfaction and in order to protect the Employer from loss on account of:

(a) defective work not rectified
(b) guarantees not met
(c) claims filed against the Contractor
(d) failure of the Contractor to make payments due for Plant procured or labour employed by him.
(e) damage to any other contractor employed by the Employer.
(f) Contractor's non–compliance with the Contract
(g) any Government dues recoverable from the Contractor if notified by the Government

The Engineer may notify withholding of such payments or part thereof as may, in his opinion, be related to the aforesaid reasons/grounds. When the reasons/grounds for withholding the payment are removed by the Contractor, the Engineer shall upon being satisfied to that effect issue Certificate of Payment in respect of withheld amounts. The rights under this Sub-Clause are in addition to, and shall not limit, the Employer's right of set-off under Sub-Clause 33.14.

33.13 **Payment Not Equivalent to Acceptance of Works**

No payment made by the Employer shall be deemed to constitute acceptance by the Employer and / or the Engineer of the Works or any part(s) thereof.

33.14 **Employer's Right of Set-Off**

The following Sub-Clause 33.14 is added:

"Without prejudice to any other right or remedy of the Employer under the Contract or at law, the Employer may set off against any amount due or becoming due to the Contractor under the Contract any amount which the Employer claims in good faith from the Contractor under or in connection with the Contract, including, without limitation, any claim for liquidated damages under Sub-Clauses 27.1 or 27.3, any claim in respect of defects or damage to the Works or to the Employer's existing plant and property, any claim under an indemnity given by the Contractor under the Contract (including Sub-Clauses 40.1 and 53.6), and any costs, losses or expenses incurred or reasonably expected to be incurred by the Employer as a result of any breach or non-performance by the Contractor.

Before making any set-off, the Employer shall give notice to the Contractor stating the amount to be set off and the grounds of the claim in reasonable detail. The exercise of the Employer's right of set-off shall not require the consent or agreement of the Contractor, nor any prior certification by the Engineer, nor any prior determination or award, and shall not be suspended or affected by the existence of any dispute concerning the underlying claim. If the Contractor disputes any set-off, the dispute shall be resolved in accordance with Clause 50, and any amount finally found not to have been properly set off shall be paid to the Contractor together with financing charges calculated in accordance with Sub-Clause 33.1(B) from the date the amount would otherwise have been payable.

Amounts set off in accordance with this Sub-Clause shall not be treated as amounts unpaid or overdue for the purposes of Sub-Clause 33.1(B), Sub-Clause 46.1 or any other provision of the Contract conferring rights or remedies on the Contractor for non-payment, and the exercise or non-exercise of the right of set-off shall not prejudice or waive any other right or remedy of the Employer."

34.1 Procedure for Claims

The following is added at the end of Sub-Clause 34.1:

"Timely compliance with the notice and particulars requirements of this Sub-Clause shall be a condition precedent to any entitlement of the Contractor to additional payment. Where the Contractor fails to give notice of his intention to claim within the said twenty-eight (28) days, or to submit full and detailed particulars within the said one hundred and eighty-two (182) days, the claim shall be absolutely barred, and the Engineer shall reject it pursuant to Sub-Clause 34.2."

35.3 **Rates of Exchange**

The text of Sub-Clause 35.3 is deleted.

36.4 **Payment against Provisional Sums**

Sub-Clause 36.4 is deleted and substituted by the following:

"Provisional Sum if any will be expended on the direction of the Engineer through Variation Orders which would be valued in accordance with the provisions of Clause 31 of the Conditions of Contract."

37.2 **Employer's Risks**

The text of Sub-Clause 37.2 is deleted and substituted by the following:

"The Employer's Risks are:

(a) (Insofar as they relate to Pakistan) war and hostilities (whether war be declared or not), invasion, act of foreign enemies

(b) (Insofar as they relate to Pakistan) rebellion, revolution, insurrection, military or usurped power or civil war

(c) ionizing radiation or contamination by radioactivity from any nuclear fuel, radio-active toxic explosives or other hazardous properties of any explosive nuclear assembly or nuclear components thereof

(d) pressure waves caused by aircraft travelling at sonic or supersonic speed

(e) (Insofar as they relate to Pakistan) riot, commotion or disorder, unless solely restricted to the employees of the Contractor or of his Subcontractors

(f) use or occupation of the Work or any part thereof by the Employer

(g) fault, error, defect or omission in the design of any part of the Works by the Engineer, Employer or those for whom the Employer is responsible for

which the Contractor has disclaimed responsibility in writing within a reasonable time after the receipt of such design

(h) the use or occupation of the Site by the Works or any part thereof, or for the purposes of the Contract: or interference, whether temporary or permanent with any right of way, light, air or water or with any easement, way leaves or right of a similar nature which is the inevitable result of the construction of the Works in accordance with the Contract

(i) the right of the Employer to construct the Works or any part thereof on, over, under, in or through any land

(j) damage (other than that resulting from the Contractor's method of construction) which is the inevitable result of the construction of the Works in accordance with the Contract

(k) the act, neglect or omission or breach of contract or of statutory duty of the Engineer, the Employer or other contractors engaged by the Employer or of their respective employees or agents."

39.2 **Loss or Damage Before Risk Transfer Date**

The words "by arbitration under Clause 50" are deleted and substituted by the words

"by the Engineer, whose determination shall be subject to Clause 50".

39.4 **Duty to Minimize Delay**

New Sub-Clause 39.4 is added as given below:

"Each Party shall at all times use all reasonable endeavors to minimize any delay in the Performance of the Contract as a result of Risks.

The Contractor shall give notice to the Employer and vice versa the Employer shall give notice to the Contractor in case of foreseeable delay by the Risks.

40.1 *The following paragraph is added at the end of Sub-Clause 40.1:*

"If any proceedings are brought or any claim is made against the Employer that might subject the Contractor to liability under GCC Sub-Clause 40.1.1, the Employer shall promptly give the Contractor a notice thereof and the Contractor may at its own expense and in the Employer's name conduct such proceedings or claim and any negotiations for the settlement of any such proceedings or claim.

If the Contractor fails to notify the Employer within 28 days after receipt of such notice that it intends to conduct any such proceedings or claim, then the Employer shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify the Employer within the 28-day period, the Employer shall make no admission that may be prejudicial to the defense of any such proceedings or claim.

The Employer shall, at the Contractor's request, afford all available assistance to the Contractor in conducting such proceedings or claim, and shall be reimbursed by the Contractor for all reasonable expenses incurred in so doing."

40.2 **Employer's Liability**

*The text of Sub-Clause 40.2 from the words "**or of death or personal injury**" to the end of the Sub-Clause, is deleted and substituted by the following*:

"..... (other than the Works) or of death or personal injury to the extent caused by any of the Employer's Risks listed in paragraphs (f), (g), (h), (i), (j), and (k) of Sub-Clause 37.2 but not otherwise."

42.1 **Limitations of Liability**

Following Sub-Clause 42.1 (c) is added at the end of GCC 42.1:

"(c) in case of criminal negligence or willful misconduct."

42.6 **Foreseen Damage**

Sub-Clause 42.6 is deleted in its entirety.

43.1 **The Works**

The Contractor shall at its expense take out and maintain in effect, or cause to be taken out and maintained in effect, during the performance of the Contract, the insurances set forth below in the sums and with the deductibles and other conditions specified. The identity of the insurers and the form of the policies shall be subject to the approval of the Employer, such approval not to be unreasonably withheld.

(a) Cargo Insurance
Covering loss or damage occurring, while in transit from the supplier's or manufacturer's works or stores until arrival at the Site, to the Facilities (including spare parts therefore) and to the construction equipment to be provided by the Contractor or its Subcontractors.

Amount
Full replacement value at Site.

Deductible limits
Contractor to indemnify for amount of deductibles

Parties insured
In the joint names of Contractor and Employer

From-To
Warehouse to Warehouse

(b) Installation All Risks Insurance

Covering physical loss or damage to the Facilities at the Site, occurring prior to Operation Acceptance of the Facilities, with extended maintenance coverage for the Contractor's liability in respect of any loss or damage occurring during the Defect Liability Period while the Contractor is on the Site for the purpose of performing its obligations during the defect liability period.

Amount
Full replacement value at site

Deductible limits

Contractor to indemnify for amount of deductibles.

Parties insured
In the joint names of Contractor and Employer

From-To
Commencement of Work at Site until expiration of Defects Liability Period.

(c) Third Party Liability Insurance

Covering bodily injury or death suffered by third parties (including the Employer's personnel) and loss of or damage to property (including the Employer's property and any parts of the Facilities that have been accepted by the Employer) occurring in connection with the supply and installation of the Facilities.

Amount
Rupees 400,000,000 for any one accident or series of accidents arising out of one accident with number of accidents unlimited.

Deductible Limits
Contractor to indemnify for amount of deductibles

Parties Insured
In the joint names of Contractor and Employer

From-To
Commencement of Work at Site until expiration of Defects Liability Period.

Insurance Policy shall include a cross liability clause such that the insurance shall apply to the Contractor and to the Employer as separate insured.

(d) Automobile Liability Insurance
Covering use of all vehicles used by the Contractor or its Subcontractors (whether or not owned by them) in connection with the supply and installation of the Facilities. Comprehensive insurance in accordance with statutory requirements.

(e) Workers' Compensation
In accordance with the statutory requirements applicable in any country where the Facilities or any part thereof is executed.

(f) Employer's Liability
In accordance with the statutory requirements applicable in any country where the Facilities or any part thereof is executed.

(g) Other Insurances
The Contractor is also required to take out and maintain at its own cost the following insurances:

The Employer shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to this Clause, except for the Workers' Compensation and Employer's Liability Insurances, and the Contractor's Subcontractors shall be named as co-insureds under all insurance policies taken out by the Contractor, except for the Cargo, Workers' Compensation and Employer's Liability Insurances. All insurer's rights of subrogation against such co-insureds for losses or claims arising out of the performance of the Contract shall be waived under such policies.

Additional Conditions (Insurance)

Sub-Clause 43.1.1 Insurance of the Facilities

The risks to be insured are:

(i) Fire, smokes, explosion, falling objects, earthquake, perils of the sea, tempest, impact by aircraft or land vehicle, aircraft and other aerial devices or articles dropped therefrom, lightning, strike, riot, civil commotion, escape of water, inundation, rain, snow, landslides, flood, act of God, vandalism or malicious damage, windstorm or hail storm, pandemic and;

(ii) Collision, upset, overturn, derailment, stranding or sinking of an automobile or any conveyance of a common carrier by land, water or air in which the Plant or any part thereof is being carried including overland transportation in Pakistan from port of entry to the Site, and

(iii) Theft, burglary or attempted theft of burglary, and

(iv) Any loss or damage during pre-erection storage, and

(v) Loss or damage to the Works resulting from faults in construction, erection, or workmanship, and

(vi) Accidental physical loss or damage to the Employer's existing functional plant and surrounding property arising out of the Contractor's operations, including during the installation, testing, and commissioning of the Works, and

(vii) Liability for third-party property damage, including damage to the connected grid, arising out of the execution of the Works, including its installation, testing, and commissioning, regardless of whether explicit negligence is proven, and

viii) Any other sudden and unforeseen event such as loss or damage due to collapse etc. on site, transport of items to be erected, and

(ix) Actions of the Employer in the operation of Plant or part thereof on behalf of the Contractor, and

(x) Terrorism

Sub-Clause 43.1 (a) Cargo Insurance of Plant and Equipment

(1) The Contractor shall in the joint names of the Contractor and Employer, obtain Cargo All Risks Insurance to cover loss or damage to the Plant or part thereof during transport.

(2) The insurance for each consignment of Plant or part thereof shall attach from the time the Plant or part thereof leaves the warehouse or place of storage and terminate after ninety (90) days on its completion of unloading at the Site or until insurance survey whichever occurs first. Upon arrival of each consignment at the Site, the Contractor shall, immediately arrange insurance survey by the insurance company.

(3) The sum insured for imported Plant or part thereof shall be for its full replacement value at the Site i.e. 100% CIF value for each consignment of the Plant or part thereof plus not less than 30% of CIF value at the Site to cover any additional costs resulting from loss or damage thereof.

(4) The Insurance Policy for imported Plant etc. shall be on “All Risks” basis and shall not be limited to the attachment/endorsement of follow clauses:

(a) Institute Cargo Clauses (A)
(b) Institute War Clauses (Cargo)
(c) Institute Strike Clauses (Cargo)
(d) Institute Cargo Clauses (Air) excluding sending by post
(e) Institute War Clauses (Air Cargo) excluding sending by post

(f) Institute Strike Clauses (Air Cargo)
(g) Special Replacement Clauses (Air)
(h) Institute Theft, Pilferage and Non-delivery Clauses

Sub-Clause 43.1 (b) Installation All Risks Insurance

(1) The Contractor shall insure the Facilities or part thereof in the joint names of the Contractor and Employer.
   (a) From the date following the completion of the first unloading at the Site of the Plant or part thereof and other materials (to be used for construction or erection) and from commencement of work at Site until the Risk Transfer Date against any loss or damage caused by any of the Contractor's risks and any other risks specified in Sub-Clause 43.1 hereof and
   (b) During the Defects Liability Period against any loss or damage which is caused either:
      (i) By the Contractor in completing any outstanding work or complying with his obligations under Clause 42.1, or
      (ii) By any of the Contractor's risks and other risks specified in Sub-Clause 43.1 hereof which occurred prior to the Risk Transfer Date.

(2) The sum insured shall be the full replacement value at the Site, which includes:
   (a) (i) FOB value of imported Plant to be erected
      (ii) Ex-factory value of Indigenous Plant to be erected, if any
   (b) Freight and insurance including local transport
   (c) Customs duties and taxes etc.
   (d) Cost of erection
   (e) Cost of civil engineering work including escalation
   (f) Clearance of debris, maximum @ 5% of minimum amount of Third Party Liability Insurance

   Plus 30% to cover any additional costs resulting from loss or damage thereof.

43.2 **Contractor's Equipment**

Sub-Clause 43.2 is deleted and substituted by the following:

"The Contractor shall insure the Contractor's Equipment for its full replacement value while on the Site against all loss or damage caused by any of the Contractor's Risks."

43.7 **Remedies on the Contractor's Failure to Insure**

*In 3rd line after the word, "**purpose**", the expressions- "**and reasonable costs including the man-hours costs of Employer's Personnel**" are added.*

New Sub-Clauses 43.9 to 43.12 are added as follows:

43.9 **Currency of Insurance**

"All policies of Insurance of the Plant shall provide for payment of indemnity to be made in such amounts as will allow making good of loss of or damage to the whole or any part of the Works."

43.10 **Contractor to Notify**

"It shall be the duty of the Contractor to notify the insurers of any such insurances referred to above of any matter or event which by the terms of such insurances are required to be so notified. All formalities in connection with insurance survey(s) shall be the sole responsibility of the Contractor. The Contractor shall indemnify and keep indemnified Employer against all loss, claims, demands, proceedings, costs, charges and expenses whatsoever arising out of or resulting from any default by the Contractor in complying with the requirements of this Sub-Clause whether as a result of the avoidance of any such insurance or otherwise.

In case of any insurance claim, the Contractor shall pursue the insurance claim if any, till such time final settlement of such insurance claims is effected."

43.11 **Procurement of Insurance Policies**

The Contractor shall procure and submit the insurance cover under this Clause before Date of Commencement.

43.12 **Insurance Company**

All insurances shall be affected with National Insurance Corporation (NIC) of Pakistan or any other insurance company operating in Pakistan and acceptable to the Employer.

44.1 Definition of Force Majeure

The text of Sub-Clause 44.1 is deleted and substituted with the following:

"Force Majeure means any of the following events or circumstances, to the extent that it is beyond the control of the parties and could not have been prevented or overcome by the exercise of due diligence: (a) war and hostilities (whether war be declared or not), invasion, act of foreign enemies, mobilization, requisition or embargo; (b) ionizing radiation or contamination by radio-activity from any nuclear fuel or from any nuclear waste, radio-active toxic explosives or other hazardous properties of any explosive nuclear assembly or nuclear components thereof; (c) rebellion, revolution, insurrection, military or usurped power and civil war; (d) riot, commotion or disorder, except where solely restricted to the employees of the Contractor or of his Subcontractors; and (e) acts of terrorism.

For the avoidance of doubt, the following shall not constitute Force Majeure: (i) adverse weather or climatic conditions of whatsoever nature, including rainfall, flooding, storm, lightning, heat or humidity, and their direct consequences, the Contractor's sole remedy in respect thereof being an extension of time under Sub-Clause 26.1(b) in the case of exceptional adverse weather conditions; (ii) strikes or labour disputes solely restricted to the employees of the Contractor or of his Subcontractors; (iii) shortage or unavailability of, or delay in the delivery of, materials, equipment or labour; and (iv) insufficiency of funds or inability to make any payment."

44.6 **Damage Caused by Force Majeure**

At the end of the Sub-Clause 44.6 the following text is added:

"However, the Contractor shall put up his claim to the Employer / Engineer with full details and justification."

44.8 **Payment on Termination for Force Majeure**

Text in sub-para (c) is deleted and para (d) and (e) are re-numbered as (c) and (d).

New Sub-para (e) shall be added as follows:

In calculating any monies due from the Employer to the Contractor, account shall be taken of any sum previously paid by the Employer to the Contractor under the Contract, including any advance payment paid pursuant to Sub-Clause 33.1 (Terms of payment) of the Contract Agreement.

45.2 **Contractor's Default**

The following paragraph is added at the end of Sub-Clause 45.2.

"Upon receipt of the notice of termination under this Sub-Clause, the Contractor shall, either immediately or upon such date as is specified in the notice of termination,

(a) cease all further work, except for such work as the Employer may specify in the notice of termination for the sole purpose of protecting that part of the Works already executed, or any work required to leave the Site in a clean and safe condition;
(b) terminate all subcontracts, except those to be assigned to the Employer pursuant to paragraph (d) below;
(c) deliver to the Employer the parts of the Works executed by the Contractor up to the date of termination;
(d) to the extent legally possible, assign to the Employer all right, title and benefit of the Contractor to the Works and to the Plant as of the date of termination, and, as may be required by the Employer, in any subcontracts concluded between the Contractor and its Subcontractors; and
(e) deliver to the Employer all drawings, specifications and other documents prepared by the Contractor or its Subcontractors as of the date of termination in connection with the Works.

The Employer or such other contractor may use for such completion any Contractor's Equipment which is upon the Site as he or they may think proper, and the Employer shall pay the Contractor a reasonable compensation for such use."

45.4 **Payment after Termination**

The text of Sub-Clause is replaced with following:

"The Employer shall not be liable to make any further payments to the Contractor until the Works have been completed. When the Works are so complete, the Engineer shall certify the total cost of such completion of Works.

The Employer may recover the extra cost of such completion, as certified by the Engineer, from any sums otherwise due and payable to the Contractor and/or by disposing of the Contractor's Equipment and stores taken over by the Employer under this Clause or as otherwise provided by law. If there is no such extra cost the Employer shall pay any balance due to the Contractor."

In calculating extra cost of such completion, account shall be taken of any sum previously paid by the Employer to the Contractor under the Contract, including any advance payment paid pursuant to Sub-Clause 33.1 (Terms of payment) of the Contract.

New Sub-Clause 45.6 is added as follows:

45.6 **Integrity Pact**

If the Contractor, or any of his Subcontractors, agents or servants is found to have violated or involved in violation of the Integrity Pact signed by the Contractor as Schedule-J to his Bid, then the Employer shall be entitled to:

(a) recover from the Contractor an amount equivalent to ten times the sum of any commission, gratification, bribe, finder's fee or kickback given by the Contractor or any of his Subcontractors, agents or servants;
(b) terminate the Contract; and
(c) recover from the Contractor any loss or damage to the Employer as a result of such termination or of any other corrupt business practices of the Contractor or any of his Subcontractors, agents or servants.

The termination under Sub-Para (b) of this Sub-Clause shall proceed in the manner prescribed under Sub-Clauses 45.2 to 45.5 and the payment under Sub-Clause 45.4 shall be made after having deducted the amounts due to the Employer under Sub-Para (a) and (c) of this Sub-Clause.

46.1 **Employer's Default**

The comma and the word "or" at the end of paragraph (d) of Sub-Clause 46.1 are deleted and substituted by period (.)

Paragraph (e) of Sub-Clause 46.1 is deleted.

46.3 **Payment on Termination for Employer's Default**

The words "including loss of profit" in the second paragraph of Sub-Clause 46.3 are deleted.

48.1 **Customs and Import Duties**

The Contractor shall pay all customs, import duties and taxes in consequence of the importation of the plant and Employer will reimburse it on actual basis.

Following Sub-Clauses 48.3 to 48.4 are added:

48.3 **Port Charges and Port Congestion**

The Contractor shall be deemed to have obtained all the information regarding facilities and charges, in respect of port clearance, loading and unloading, storage, transportation, congestion and confirmed the requirements thereof at his own responsibility and all such costs and charges are deemed to be included in the rates and prices of the Schedule of Prices.

48.4 If any tax exemptions, reductions, allowances, or privileges may be available to the Contractor in Pakistan, the Employer shall use its best endeavors to enable the Contractor to benefit from any such tax savings to the maximum allowable extent.

49.1 **Notice to Contractor**

The following is added at the end of Sub-Clause 49.1:

"For the purposes of Sub-Clause 49.1 the Contractor shall, immediately after receipt of Letter of Acceptance, intimate in writing to the Employer and the Engineer by registered

post, the address of his principal place of business or any change in such address during the period of the Contract."

50 **Disputes & Arbitration**

Clause 50 is deleted and in its place the following Sub-Clauses 50.1 to 50.5 are inserted:

50.1 If a dispute of any kind whatsoever arises between the Employer and the Contractor in connection with, or arising out of, the Contract or the execution of the Works, whether during the execution of the Works or after their completion and whether before or after repudiation or other termination of the Contract, including any dispute as to any opinion, instruction, determination, certificate or valuation of the Engineer, the matter in dispute shall, in the first place, be referred in writing to the Engineer, with a copy to the other party. Such reference shall state that it is made pursuant to this Clause. No later than the fifty sixth (56) day after the day on which he received such reference, the Engineer shall give notice of his decision to the Employer and the Contractor. Such decision shall state that it is made pursuant to this Clause.

Unless the Contract has already been repudiated or terminated, the Contractor shall, in every case, continue to proceed with the Works with all due diligence, and the Contractor and the Employer shall give effect forthwith to every such decision of the Engineer unless and until the same shall be revised, as hereinafter provided in an amicable settlement or in an arbitral award.

In any case where the Conditions of Contract provide that the decision of the Engineer is to be final and conclusive, such decision shall not be referable to arbitration under this Clause nor shall the same be questioned in any other form of proceedings whatsoever.

50.2 If either the Employer or the Contractor be dissatisfied with a decision of the Engineer or if the Engineer fails to give notice of his decision on or before the fifty sixth (56) day after the day on which he received the reference, then either the Employer or the Contractor may, on or before the twenty eighth (28) days after the day on which the said period of fifty six (56) days expired, as the case may be, give notice to the other party to commence arbitration, as hereinafter provided, as to the matter in dispute. Such notice shall establish the entitlement of the party giving the same to commence arbitration, as hereinafter provided, as to such dispute and, subject to Sub-Clause 50.5, no arbitration in respect thereof may be commenced unless such notice is given.

If the Engineer has given notice of his decision as to a matter in dispute to the Employer and the Contractor and no notification of intention to commence arbitration as to such dispute has been given by either the Employer or the Contractor on or before the twenty eighth (28) day after the day on which the parties received notice as to such decision from the Engineer the said decision shall become final and binding upon the Employer and the Contractor.

50.3 Where notice of intention to commence arbitration as to a dispute has been given in accordance with Sub-Clause 50.2, arbitration of such dispute shall not be commenced unless the parties have first attempted to settle such dispute by mediation before a single mediator. Either party may initiate the mediation by written request to the other party. The mediator shall be appointed jointly by the parties within twenty-one (21) days of such request, failing which the mediation shall be conducted in accordance with the ICC Mediation Rules.

The mediation shall be concluded within ninety (90) days from the date of notification of the Engineer's decision or, where no decision is given, from the expiry of the period for such decision under Sub-Clause 50.1, unless the parties otherwise agree in writing. If the dispute has not been settled by mediation within that period, or if either party fails or refuses to participate in the mediation, either party may commence arbitration in accordance with Sub-Clause 50.4.

The mediation shall be private, confidential and conducted on a without-prejudice basis, and nothing said, disclosed or produced in the mediation shall be admissible in any arbitration or other proceedings, except a settlement agreement signed by both parties.

50.4 Any dispute in respect of which:

(a) the decision, if any, of the Engineer has not become final and binding pursuant to Sub-Clause 50.1 and

(b) the dispute has not been settled by mediation pursuant to Sub-Clause 50.3

shall be finally settled, unless otherwise specified in the Contract, under the Rules of Arbitration of the International Chamber of Commerce (ICC), by one or three arbitrators appointed in accordance with the said Rules. The seat of the arbitration shall be London, United Kingdom, and the language of the arbitration shall be English.

The governing law of the Contract shall remain the law of the Islamic Republic of Pakistan.

The said arbitrator(s) shall have full power to open up, review and revise any decision, opinion, instruction, determination, certificate or valuation of the Engineer for the purpose of obtaining said decision pursuant to Sub-Clause 50.1. No such decision shall disqualify the Engineer from being called as a witness and giving evidence before the arbitrator(s) on any matter whatsoever relevant to the dispute.

50.5 Where neither the Employer nor the Contractor has given notice of intention to commence arbitration of a dispute within the period stated in Sub-Clause 50.1 or 50.2 and the related decision has become final and binding, either party may, if the other party fails to comply with such decision, and without prejudice to any other rights it may have, refer the failure to arbitration in accordance with Sub-Clause 50.4. The provisions of Sub-Clauses 50.1 to 50.3 shall not apply to any such reference."

Following clauses 52 to 57 are added:

52 Liens

Each contractor, for himself and for any persons directly or indirectly responsible to him, and for his or their material, equipment and employees, and for all other persons performing any labor or furnishing any labor or material for any/or all of the Work covered by his Contract, will be required to release or waive, to the full extent permitted by law, all mechanical and other liens, for or on account of the Work done or equipment and material furnished hereunder and the improvements or structures herein same may be incorporated,

and the land to which they are appurtenant shall at all times be free and clear of all such liens.

53 Taxes and Duties

53.1 Contactor-Borne Taxes

All taxes not expressly stated as Employer-borne, including income tax through the Contractor's Permanent Establishment (PE), General Sales Tax and Provincial Sales Tax on services and locally procured goods (other than taxes reimbursable under Sub-Clause 53.2), and all WHT obligations of the Contractor as withholding agent, are deemed included in the Contract Price.

53.2 Employer-Borne Taxes (Reimbursable)

The Employer shall reimburse the Contractor, against documented claims for the following taxes and levies paid by the Contractor in respect of Plant specified in Schedule of Price No. 1 that is to form part of the **Permanent Works** only (and excluding, for the avoidance of doubt, all Contractor's Equipment, temporary works, consumables, and construction plant):

(a) Customs Duty (including Basic Customs Duty, Regulatory Duty, and Additional Customs Duty) assessed under the Customs Act 1969 and applicable notifications at the time of importation;

(b) Sales Tax on import, assessed under the Sales Tax Act 1990 at the rate applicable at the time of filing of the Goods Declaration, provided that: (i) the Contractor is registered with FBR for Sales Tax purposes; and (ii) the Employer is able to claim input tax credit on the basis of the Contractor's tax invoice in accordance with the Sales Tax Act 1990. Reimbursement shall be made only through the Employer's WEBOC system;

(c) Federal Excise Duty, if assessed on the imported goods under the Federal Excise Act 2005;

(d) General Sales Tax and Provincial Sales Tax on Plant specified in Schedules of Price Nos. 2, 3, and 4 that is to form part of the Permanent Works, at the applicable rate, provided that: (i) the Contractor is registered with the relevant federal and provincial tax authorities; (ii) the Employer is able to claim input tax; and (iii) the claim is supported by valid tax invoices in the Contractor's name. Reimbursement for Schedule 2, 3, and 4 items shall be made within 30 days of a compliant claim; reimbursement for Schedule 1 items shall be made within 90 days of a compliant claim;

(e) Provincial Infrastructure Development Cess (PIDC).

All Plant specified in Schedule 1 shall be imported in the name of the Employer. The Contractor shall act as the Employer’s clearing agent and shall file all Goods Declarations under the Employer's NTN and WEBOC account. Customs duty and import taxes shall be paid by the Contractor on behalf of the Employer and reimbursed in accordance with this Sub-Clause.

All Schedule 2 Plant and Equipment shall be procured by the Contractor acting as the Employer’s authorised procurement agent, and all purchase orders and tax invoices for Schedule 2 items shall be issued in the name of the Employer against the Employer's Sales

Tax Registration Number (STRN). The Contractor shall ensure that all Schedule 2 suppliers are registered persons under the Sales Tax Act 1990 and issue compliant tax invoices in the Employer's name. The Contractor shall pay the full invoice value including GST to Schedule 2 suppliers on behalf of the Employer and reimbursed in accordance with this Sub-Clause.
All reimbursements under this Sub-Clause 53.2 shall be made: (i) on actual basis without overhead, profit margin, or markup; (ii) against presentation of acceptable claims supported by original documentary evidence; and (iii) from the Provisional Sums provided in the Schedule of Prices for this purpose. Customs duty payments shall be made by the Contractor through the Employer in accordance with the arrangements set out in PCC Sub-Clause 33.1.

The Contractor shall, before paying any tax listed in this Sub-Clause 53.2, make reasonable efforts to identify and utilize all applicable exemptions, concessions, or reduced rates available under any Statutory Regulatory Order (SRO), Presidential Order, or bilateral agreement applicable to power sector projects or to the Employer as a public sector entity. Any exemption obtained shall reduce the Employer's reimbursement obligation accordingly. The Contractor shall notify the Employer in writing of any available exemption at least 14 days before the relevant import transaction and shall apply for such exemption unless the Employer directs otherwise in writing.

Except where the Contractor produces a certificate from the relevant tax authorities for Nil/reduced withholding of taxes, the Employer shall be entitled to make deductions for withholding taxes from its respective payments to the Contractor (i) as may be required under the applicable Laws of the Country; or (ii) where the Contractor has provided a certificate from the relevant tax authorities for Nil/reduced withholding, at such reduced rates of withholding, provided that the Employer shall submit to the Contractor the relevant tax payment receipt and documentation that evidences the relevant deductions by the Employer on account of taxes.

The Contractor hereby confirms and warrants that:

(a) it has established, or shall establish within 30 days of the Commencement Date, a Permanent Establishment (PE) in Pakistan for the purposes of the Income Tax Ordinance 2001, through which all onshore operations under this Contract shall be conducted;

(b) it shall, within 60 days of the Commencement Date, provide the Employer with a certificate from the Commissioner Inland Revenue confirming the registration of its PE, its National Tax Number (NTN), and its active enrollment on the FBR IRIS portal;

(c) all payments received from the Employer in respect of Schedules 2, 3, and 4 of the Schedule of Prices shall be declared as income of the Contractor's PE and included in the PE's annual income tax return filed with FBR; and

(d) it shall maintain complete books of account in Pakistan for PE operations and shall make such books available to the Employer or its appointed auditor upon 14 days' written notice, to the extent necessary to verify the Contractor's tax compliance under this Clause 53.

53.3 Tax Exemptions

If any tax exemptions, reductions, allowances, or privileges may be available to the Contractor in Pakistan, the Employer shall use its best endeavors to enable the Contractor

to benefit from any such tax savings to the maximum allowable extent. Further, any Tax Treaties will be considered between Employer's country and Contractor's country (if applicable).

53.4 Change in Tax Law

For the purpose of the Contract, it is agreed that the Contract Price specified in Contract Agreement is based on the taxes, duties, levies, and charges prevailing at the date 28 days prior to the date of bid submission in Pakistan (hereinafter called "Tax" in this GCC Subclause 53.4). If any rates of Tax are increased or decreased, a new Tax is introduced, an existing Tax is abolished, or any change in interpretation or application of any Tax occurs in the course of the performance of Contract, which was or will be assessed on the Contractor, Subcontractors, or their employees in connection with performance of the Contract, an equitable adjustment of the Contract Price shall be made to fully take into account any such change by addition to the Contract Price or deduction therefrom, as the case may be, in accordance with GCC Clause 47.2 hereof.

53.6 Contractor's Tax Indemnity

In the event that the Contractor's tax status, PE position, or tax registration status differs from the confirmations and warranties made under this Clause 53, or it is determined by FBR, a court, or any competent authority that the Employer has failed to deduct WHT at the correct rate as a consequence of inaccurate information provided by the Contractor, the Contractor shall be solely responsible for all resulting tax liabilities, penalties, default surcharges, and additional taxes.

The Contractor shall indemnify, defend, and hold harmless the Employer, its directors, officers, and employees from and against any and all taxes, liabilities, damages, costs, penalties, fines, expenses, and legal fees arising from or related to: (a) any non-compliance by the Contractor with its tax obligations under the Laws of Pakistan; (b) any misrepresentation or inaccuracy in the Contractor's confirmations under Sub-Clause 53.2; or (c) any failure by the Contractor to establish or maintain its PE in Pakistan in accordance with Sub-Clause 53.2.

The indemnity in Sub-Clause 53.6 shall survive the expiry or termination of this Contract for a period of six years, or such longer period as may apply under the limitation provisions of the Income Tax Ordinance 2001 or other applicable legislation of Pakistan.

In the event of any inconsistency between Sub-Clause 33.1 and this Clause 53 in respect of taxes, duties or levies, this Clause 53 shall prevail.

54 Liability of the Contractor

The Contractor or his Subcontractors or assigns shall follow strictly, all relevant labour laws including the Workmen's Compensation Act and the Employer shall be fully indemnified for all claims, damages etc. arising out of any dispute between the Contractor, his Subcontractors or permitted assigns and the labour employed by them.

55. Joint and Several Liability

If the Contractor is a joint venture of two or more persons, all such persons shall be jointly and severally bound to the Employer for the fulfilment of the terms of the Contract and shall designate one of such persons to act as leader with authority to bind the joint venture. The composition or the constitution of the joint venture shall not be altered without the prior consent of the Employer.

56. Details to be Confidential

The Contractor shall treat the details of the Contract as private and confidential, save in so far as may be necessary for the purposes thereof, and shall not publish or disclose the same or any particulars thereof in any trade or technical paper or elsewhere without the prior consent in writing of the Employer or the Engineer. If any dispute arises as to the necessity of any publication or disclosure for the purpose of the Contract, the same shall be referred to the decision of the Engineer whose decision shall be binding, subject to Clause 50.

57. Security of the Contractor's Personnel

The Contractor shall be responsible for the safety and security of their personnel at all times during the period of the Contract. The Contractor shall follow all advices and standard operating procedures issued, from time to time, by the Government of Pakistan, provincial and local government(s), and relevant law enforcement agencies and authorities related to the safety and security of personnel in general, and foreigners in particular. Any costs incurred for this are deemed to be covered in the Contract Price.

SECTION 8

STANDARD FORMS

(SF)

Section 8 – Standard Forms

This Section contains the data sheets which are to be completed by the Bidder and submitted as part of his Bid.

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1. Mechanical

1.1 Fire Protection and Detection System (Newly added equipment in the existing system)

No	Item	Unit	Value/Descript.
1	**Design Codes/Standards**		
2	**All Equipment FM/UL approved**		
3	**System design criteria**		
3.1	Largest fire risk (identify)		
3.2	Total water flow to feed largest risk area	l/min	
3.3	System design flow requirement	l/min	
3.4	System operating/minimum pressure	bar g	
4	**Pipe material (above/below ground)**		
5	**Cable Penetration Seals**		
5.1	Manufacturer		
5.2	Type of sealing system		
6	**Pipe Penetration Seals**		
6.1	Manufacturer		
6.2	Type of sealing system		
7	**Fire Retardant Coating**		
7.1	Manufacturer		
7.2	Type of coating system		
8	**Fire Detection and Fire Alarm System**		

No	Item	Unit	Value/Descript.
8.1	Manufacturer		
8.2	Model / Type		
8.3	Local panels	no.	
9	**Automatic Sprinkler System**		
9.1	Manufacturer		
10	**Water Spray Fixed Systems**		
10.1	Manufacturer		

2. Electrical

2.1 Steam Turbine Generator

No.	Item	Unit	Value/Description
1	**ST Generators MKA**		
1.1	Guarantee Data: see relevant tables	-	-
2	**Main Design Data**		
2.1	Manufacturer	-	
2.2	Type	-	
2.3	Generator capacity		
2.3.1	Rated capacity at IEC conditions at class B temperature rise	MVA	
2.3.2	Max. continuous rating (MCR) at design Site ambient conditions at class B temperature rise	MVA	
2.4	Rated voltage	kV	
2.5	Voltage range	±%	5
2.6	Rated power factor (lagging)	-	0,85
2.7	Rated frequency	Hz	50
2.8	Insulation class stator/ rotor	-	F/F
2.9	Cooling system	-	-
2.9.1	Max. c.w. inlet temperature	°C	
2.9.2	Max. c.w. outlet temperature	°C	
2.9.3	Max. c.w. requirements	m3/h	
2.9.4	MCR with one cooler out of service (Temperature rise class F)	MVA	

No.	Item	Unit	Value/Description
3	**Losses**		
3.1	Total losses at 110 % load	kW	
3.2	100% load	kW	
3.3	75% load	kW	
3.4	50% load	kW	
3.5	25% load	kW	
4	**Enclosed Characteristics Generator Curves and Drawings**		
4.1	Unbalanced load versus time diagram	Drwg. No.	
4.2	Generator capability diagrams & V-Curves	Drwg. No.	
4.3	No-load and short circuit curves	Drwg. No.	
4.4	Site ratings versus ambient temperature of:	Drwg. No.	
4.4.1	Turbine output		
4.4.2	Generator capacity		
4.4.3	Unit transformer capacity		

No.	Item	Unit	Value/Description
4.5	Transfer function diagram of excitation control	Drwg. No.	
4.6	Generator dimension and weights	Drwg. No.	
5	Generator Resistance/ Reactances/ Capacitance referred to Rated Capacity		
5.1	Synchronous reactance (saturated)	Xd%/Xq %	
5.2	Sub-transient reactance (saturated)	X’’d %	
5.3	Transient reactance (unsaturated)	X’d%	
5.4	Negative phase sequence reactance	X2%	
5.5	Zero phase sequence reactance	X0%	
6	Generator Time Constants		
6.1	No load time constant	TdO	
6.2	Transient time constant	T’d	
6.3	Sub-transient time constant	T’’d	
7	Generator Excitation System		
7.1	Type		
7.2	Manufacturer		
7.3	Ratio rated voltage/ ceiling voltage	p.u.	
7.5	Ratio rated current/ impulse current	p.u.	

No.	Item	Unit	Value/Description
7.6	Response time for 2% step change in error signal	s	
7.7	Maximum generator field current following a three-phase short circuit at generator terminals at rated output	A	
7.8	Maximum generator field voltage during worst case pole slip	V	
7.9	Momentary overvoltage at generator terminals upon rejection of generator rated output	%	
7.10	Time for generator voltage to be restored within 2 per cent of nominal preset value following rejection of generator rated output	s	
8	Excitation transformer		
8.1	Rated power	kVA	
8.2	Cooling method		
8.3	Vector group		
8.4	Rated current (secondary)	A	
8.5	Rated voltage (primary/secondary)	V	
8.6	Short circuit voltage	%	
9	Automatic Voltage Regulator (AVR)		
9.1	Manufacturer		
9.2	Type		
9.3	Number of auto channels		
9.4	Accuracy regulation	%	

2.1.1 Excitation System for Steam Turbine Generators

No.	Item	Unit	Value/Description
1	**Generator Excitation System**		
1.1	Type		Static excitation
1.2	Manufacturer		
1.3	Ratio rated voltage/ ceiling voltage	p.u.	
1.5	Ratio rated current/ impule current	p.u.	
1.6	Response time for 2% step change in error signal	s	
1.7	Maximum generator field current following a three-phase short circuit at generator terminals at rated output	A	
1.8	Maximum generator field voltage during worst case pole slip	V	
1.9	Momentary overvoltage at generator terminals upon rejection of generator rated output	%	
1.10	Time for generator voltage to be restored within 2 per cent of nominal preset value following rejection of generator rated output	s	
2	**Excitation transformer**		
2.1	Rated power	kVA	
2.2	Cooling method		
2.3	Vector group		
2.4	Rated current (secondary)	A	
2.5	Rated voltage (primary/secondary)	V	

2.6	Short circuit voltage	%	

2.1.2 Automatic Voltage Regulator for Steam Turbine Generators

No.	Item	Unit	Value/Description
1	**Automatic Voltage Regulator (AVR)**		
1.1	Manufacturer		
1.2	Type		
1.3	Number of auto channels		
1.4	Accuracy regulation	%	

2.2 Electrical Control System

No.	Item / Technical Data	Unit	Value/Description
1	**Transformer AVR**		
1.1	Manufacturer		
2	**Synchronization Systems**		
2.1	Manufacturer		

2.3 Isolated Phase Bus-duct

No.	Item / Technical Data	Unit	Value/Description
1	Phase Isolated Busbars and Bus ducts		
2	Voltage between phases of three phase circuit	kV	
3	Phase conductor material		

4	Phase conductor cross sectional area	mm^2	
5	Phase enclosure material		
6	Phase enclosure cross sectional area	mm^2	
7	Phase enclosure outside diameter	Mm	
8	Minimum spacing between phase conductor and Enclosure	Mm	
9	Insulating medium		
10	Rated voltage	kV	
11	Rated current (phase conductor)	kA	
12	Rated current (enclosure)	kA	
13	Specification to which IPB or bus duct will be manufactured and tested		

3. I&C

3.1 Instrumentation and Control

No.	Item	Unit	Value/Description
1	**General Features**		
1.1	DCS Manufacturer		
1.2	DCS Type		
1.3	Version		
1.4	Does DCS contain plant protection system as subsystem?	Y/N	
1.5	System availability MTBF/(MTBF+MTTR)	%	
1.6	Microprocessor type of processing module		
1.7	Max. possible number of process stations on the bus	(nos)	
1.8	Max. possible/offered number of curves	(nos)/(nos)	
1.9	Allowed supply voltage variations	%	
2	**Remote Process Bus (highway)**		
2.1	Max. number of participants	(nos)	
2.2	Bus communication type		
2.3	Overvoltage & noise immunity	Y/N	
3	**Binary Inputs**		
3.1	Overvoltage & noise immunity acc. to IEC recommendation 255-4, class II	Y/N	
3.2	Time stamp at the I/O level	Y/N	

No.	Item	Unit	Value/Description
3.3	Time resolution of binary inputs for SOE signals	ms	
3.4	Time resolution of alarms and events generated by the system	ms	
4	**Analogue Inputs**		
4.1	A/D resolution (only bits carrying process information)	bit	
4.2	Overvoltage and noise immunity acc. to IEC 255-4 recommendations/class II	Y/N	
4.3	Time resolution of signal limit values	ms	
5	**Operator workstations**		
5.1	No of workstations		
5.2	No of LCD monitors per workstation		
5.3	Screen diagonal	inch	
5.4	Image resolution	pixel x pixel	
5.5	Image frequency	1/s	
5.6	Number of colours	(nos)	
5.7	Operating device (optical mouse, trackball, keyboard)		
5.8	Operating system /version		
5.9	Operating system software / version		
6	**Engineering workstations**		

No.	Item	Unit	Value/Description
6.1	No of workstations		
6.2	No of LCD monitors per workstation		
6.3	Screen diagonal	inch	
6.4	Image resolution	pixel x pixel	
6.5	Image frequency	1/s	
6.6	Number of colours	(nos)	
6.7	Operating device (optical mouse, trackball, keyboard)		
6.8	Operating system / version		
6.9	Operating system software / version		
7	**Security measures**		
8	**Extent of storage facilities**		
8.1	Medium		
8.2	Capacity		
9	**Sequence of events**		
9.1	Manufacturer/type		
9.2	Integrated with the DCS	Y/N	
9.3	Resolution of time stamping	ms	
9.4	Resolution of scan cycle	ms	

No.	Item	Unit	Value/Description
9.5	Number of points		
9.6	Storage capacity/medium		
10	**DCS application software packages**		
10.1	Give full technical details of all packages and licenses supplied with the DCS		
10.2	Give full technical details of the DCS response times		
10.2.1	Time for change at input to display on Operator workstation		
10.2.2	Time for change at operator workstation to output actuation		
10.2.3	Resolution of time tagging of inputs		
11	**Human Machine interface**		
11.1	Number/type of mimic displays		
11.2	Number/type of alarm displays		
11.3	Number/type of trend displays		
11.4	Number of operation configurable displays		
11.5	Number/type of reports		
11.6	Number of operation configurable reports		
12	**Steam turbine C&I package**		
12.1	Manufacturer/supplier		

No.	Item	Unit	Value/Description
12.2	Control systems - type and redundancy		
12.3	Protection systems - type and redundancy		
12.4	Interface with DCS		
12.5	Hardwired		
12.6	Serial link (level of redundancy)		

SECTION 9

TECHNICAL PROVISIONS

Section 9 – Specifications –

Technical Provisions

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Abbreviation & Definition

AC	Alternating Current
AVR	Automatic Voltage Regulator
BMCR	Boiler Maximum Continuous Rating
CCC	Construction Completion Certificate
CCPP	Combined Cycle Power Plant
CCR	Central Control Room
CMMS	Computerized Maintenance Management System
CT	Current Transformer
DC	Direct Current
DCS	Distributed Control System
DGA	Dissolved Gas Analysis
DLC	Defect Liability Certificate
DLP	Defect Liability Period
DMS	Document Management System
DPT	Dye Penetrant Test
EPC	Engineering Procurement Construction
FAT	Factory Acceptance Test
FATP	Factory Acceptance Test Procedure
FEM	Finite Element Method
GCB	Generator Circuit Breaker
GGPO	Guaranteed Gross Power Output
GPO	Gross Power Output
GT	Gas Turbine
HEI	Harbin Electric International
HMI	Human Machine Interface
HP	High Pressure
HRSG	Heat Recovery Steam Generator
I&C	Instrumentation and Control
I&T	Inspection and Testing
IEC	International Electrotechnical Commission

IP	Intermediate Pressure
IPB	Isolated Phase Busbar
IR	Insulation Resistance
ISO	International Organization for Standardization
ITP	Inspection Test Plan / Inspection and Test Program
KKS	Kraftwerks-Kennzeichen System (Power Plant Identification System)
LP	Low Pressure
LV	Low Voltage
MCC	Motor Control Centre
MCR	Maximum Continuous Rating
MV	Medium Voltage
NDT	Non-Destructive Testing
NTP	Notice to Proceed
O&M	Operation and Maintenance
OEM	Original Equipment Manufacturer
OWS	Operator Workstation
PAUT	Phased Array Ultrasonic Testing
PLC	Programmable Logic Controller
PMD	Pakistan Meteorological Department
PPL	Pakistan Petroleum Limited
PSS	Power System Stabiliser
PTW	Permit to Work
PVC	Polyvinylchloride
QA/QC	Quality Assurance / Quality Control
RCC	Reinforced Cement Concrete
RIO	Remote Input/Output
RSC	Reference Site Conditions
RT	Radiographic Testing / Examination
SAT	Site Acceptance Testing
SER	Sequence of Events Recorder
SES	Static Excitation System
ST	Steam Turbine

STG	Steam Turbine Generator
TOC	Taking Over Certificate
UDH	Unit Highway Data Bus
VT	Voltage Transformer / Visual Weld Inspection
WBS	Work Breakdown Structure

LIST OF ANNEXURES

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1. INTRODUCTION

These Technical Provisions provide an introduction to the Project and specify the minimum technical requirements that must be followed by the Contractor.

The 747MW Combined Cycle Power Plant (CCPP) at Guddu (the "Plant") is located beside the second-largest barrage in Sindh and is approximately 50 km away from the bordering city of Punjab, situated on National Highway "Sadiqabad," and just 14 km away from the bordering city of Sindh, situated on Indus Highway "Kashmore." It is approximately 600 kilometers from Karachi Port.

The Plant comprises two Gas Turbines (GTs) of about 255 MW each, two Heat Recovery Steam Generators (HRSGs), and one Steam Turbine (ST) of about 261 MW (also termed as ST-16) and was commissioned in 2014.

The Plant utilizes indigenous gas for power generation supplied by M/s Pakistan Petroleum Limited (PPL) from the gas field of Kandkot.

During a fire incident on July 10, 2022, the ST, steam turbine generator (STG), and related auxiliaries suffered different degrees of damage. After the incident, integrity assessment was carried out by M/s Harbin Electric International (HEI), China, who submitted reports, annexed as **Annex-1** with these Technical Provisions.

The initial assessment of the ST foundation and ST Hall structure/building was also conducted after the fire incident, and the preliminary report is attached as **Annex-2**. The inspection report only highlights the initial investigations based on a conditional survey and preliminary testing. However, the Contractor shall be responsible for undertaking a comprehensive and detailed assessment of ST & STG foundation mentioned in subsequent sections and submit the detailed assessment report along with proposed rehabilitation measures and modification works for approval by the Employer/Engineer.

Some available drawings are made part of these documents to understand the extent of the scope and damages. The list is attached as **Annex-3**. It will be the Contractor's sole responsibility to conduct their survey to confirm that the site installation/construction, related to the scope of services to be provided by the Contractor, is as per available drawings/documents and also conduct the survey where As-built drawings/documents are not available. Furthermore, the Contractor will also be responsible for arranging/obtaining OEM drawings/documents from their respective equipment supplier.

During execution of the Works, the Plant will be running in simple cycle mode. Concurrently, the Contractor shall continue to work on the scope under this contract without disturbing the operation of gas turbines in simple cycle during such period. The Employer shall retain control of Plant operation, Permit-to-Work (PTW), equipment isolation and release of operating systems. The Contractor shall comply with the Employer's approved PTW and isolation procedures. Where operational restrictions imposed by the Employer prevent the Contractor from executing planned activities, the resulting delay shall be dealt with in accordance with the applicable provisions of the Contract.

The Contractor will undertake all interconnection works for making the steam turbine, generator, control system (DCS & ST Controller), their allied equipment/auxiliaries and all other works mentioned in the subsiding paras functional for which a maximum of eight (08) weeks ("**Combined Cycle Restoration Period**") would be available. Cycle Restoration Period will start from the day gas turbine is shut down for interconnection works and will end on when the Taking Over Certificate is issued. All testing and

commissioning activities including the Tests on Completion will be performed by the Contractor during the Combined Cycle Restoration Period.

For avoidance of doubt, it is clarified that the Combined Cycle Restoration Period shall commence only after the Employer confirms that the GTs, HRSGs, steam/condensate systems, cooling water system and grid are fully ready for combined cycle operation, in accordance with Section 5 (Employer's Responsibilities). Any delay in the execution, completion, or readiness of the Scope of Work assigned to the Employer, or of any systems, facilities, utilities, or interfacing equipment under the Employer's responsibility that affects the restoration of Combined Cycle operation, shall constitute an Employer-caused delay. Accordingly, the Contractor shall be entitled to a corresponding extension of the Combined Cycle Restoration Period.

The main parameters of the Steam Turbines ST-16, STG and HRSGs are described below:

SPECIFICATION AND PRINCIPAL PARAMETERS

Steam Turbine (ST-16):

Manufacturer:	Harbin Turbine Company Ltd.
Model:	LN260-11.45/2.55/0.47/560/560/305
Type:	Triple Pressure Re-heat double cylinder (1 HP&IP, 1LP)
Rotating Speed:	3000 rpm
Capacity:	261MW (Gross)
Main Steam Pressure:	114.5bar
Main Steam Temperature:	560.6 °C
Exhaust Steam back Pressure:	6.4kPa
Rated Main Steam Flow:	555.425t/h

Steam Turbine Generator (STG):

Manufacturer:	Harbin Electric Machinery Company Ltd.
Model:	QFSN-280-2
Voltage:	20kV
Cooling Type :	Hydrogen-Water

HRSG

High Pressure Parts:

Steam Flow at BMCR:	278.992 T/h
Steam outlet pressure:	12.02 MPa
Steam outlet temperature:	563.6℃

Reheat Parts:

Steam Flow at BMCR:	312.729 T/h
Steam outlet pressure:	2.65 MPa
Steam outlet temperature:	563℃
Cold reheat flow:	270.280 T/h
Cold reheat temperature:	360.5℃

Low Pressure Parts:

Steam Flow at BMCR:	21.676 T/h
Feed water temperature:	41.1℃
Steam outlet temperature:	308.7℃
Steam outlet pressure:	0.5 MPa

2. PROJECT OVERVIEW

2.1 Summary of Rehabilitation Work

M/s HEI was hired by Employer to perform integrity assessment of ST and STG. After integrity assessment, HEI submitted integrity assessment report of ST and STG. This report is part of the Technical Provisions for inspection results, recommendations for corrective actions and/or replacement of different equipment/parts/structures etc.

As per integrity assessment report, following is the line of action for rehabilitation of the steam turbine and generator. The Contractor will be responsible to make rehabilitations/replacements as per this report; as mentioned in the preceding paras and also those not covered by this report & paras but required to make the ST, STG and DCS fully functional upto the best possible performance level.

Note:

The Bidders are advised to have meeting with Employer and site visit(s) of Plant to make them familiar with the extent of Scope of work before submitting their Bids.

2.2 Scope of Works

The Scope of Works of the Project comprises, but shall not be limited to, the complete engineering, supply of drawings/documents/other required information, construction, manufacture, shop testing, packing and marking, delivery, insurance, transport from shop to Site, loading and unloading, storing at Site, checking on completeness, erection, connection to existing equipment and facilities, functional testing, start-up, commissioning, optimisation, reliability testing, acceptance testing; handing over in satisfactory condition for commercial operation on the dates specified in and subject to the terms and conditions of the Contract, technical support to Employer and Defect Liability Period (DLP) of 24 months. The Contractor shall be responsible on an EPC/turnkey basis for the complete Works defined in these Technical Provisions, including all equipment, systems, auxiliaries, interfaces, modifications, testing, commissioning and services necessary for completion and safe, reliable operation of the Contractor's Scope of Work. Equipment, systems and facilities expressly identified as being outside the Contractor's Scope of Work shall remain the responsibility of the Employer..

The scope of Works is generally divided into the following broad categories for restoration of the Plant:

1. Design, supply, installation, testing and commissioning of new systems, equipment and parts for rehabilitation of the Plant.
2. Systems/ equipment /parts to be overhauled / repaired and existing structures / foundations etc. to be rehabilitated/strengthened/modified where needed.
3. Systems/equipment/parts to be inspected/tested by EPC Contractor and replaced with new one or repaired/overhauled, where essentially required, to ensure the O&M requirements, plant integrity and reliability of Plant.

4. Equipment/parts/materials to be provided for new, rehabilitated and existing systems.
5. Spare parts/consumables to be provided/supplied for new, existing and rehabilitated systems.

The Contractor will conduct inspections on priority basis and prepare list of systems/equipment/parts to be replaced or overhauled/rehabilitated so that these systems/equipment/parts may be ordered by the Contractor in timely manner for replacement or overhauling work. This list will be submitted to Employer/Engineer for approval.

The Integrity Assessment Report of the Steam Turbine (ST) and Steam Turbine Generator (STG) form an integral part of the Technical Provisions.

This report contains the results of inspections, condition assessments, recommendations for corrective actions, and requirements for repair, rehabilitation, replacement, strengthening, modification, or refurbishment of various equipment, components, systems, and associated auxiliaries. The Contractor shall be deemed to have reviewed and fully considered these reports while preparing its proposal and executing the Works.

All recommendations, corrective measures, replacements, repairs, rehabilitations, and other actions identified in the aforementioned report shall be included within the Contractor's scope of work, whether specifically referenced elsewhere in the Contract Documents or not and shall be completed to restore the facilities to safe, reliable, and intended operational condition.

The Scope of Works defined in these Technical Provisions, including the applicable recommendations of the Integrity Assessment Report and additional works identified through the Contractor's inspections and tests that are necessary for the safe, reliable and intended operation of the Contractor's Scope of Work, shall collectively constitute the Contractor's Scope of Work. In case of conflict or inconsistency, the specific requirements of these Technical Provisions shall prevail unless expressly stated otherwise..

Before preparing their Bids, the Bidders will be required to visit the Plant site and have meeting with Employer to make them fully conversant with the extent of new and overhauling/rehabilitation work.

Some main drawings of each discipline are made part of these documents. Contractor is required to get detailed As-built drawings/documents and OEM drawings/documents from Employer during execution of the Contract.

Unless otherwise expressly specified in the Contract Documents, the Contractor shall use the approved As-Built Drawings of the existing plant as the primary design basis for all design, engineering, rehabilitation, replacement, modification, and installation works to be performed under these Technical Provisions.

The Contractor to survey the site and confirm that existing work already done at site is as per As-Built drawings/documents/data, available with the Employer.

Design of new systems/equipment, their work procedure, drawings/documents and timeline etc. shall be submitted for review and approval by Employer/Engineer.

Extent and detail of overhauling/rehabilitation works, their work procedure, drawings/documents and timeline shall also be submitted for review and approval by Employer/Engineer.

Redundancy shall be ensured in all the newly supplied systems/equipment, if plausible.

All the instruments, gauges, flowmeters and safety valves under steam turbine, steam turbine generator and its allied auxiliaries shall be calibrated before putting in operation.

All existing equipment, parts, and materials of mechanical, electrical, and instrumentation systems that are replaced with new ones shall become the property of the Employer. Additionally, all parts and materials removed during rehabilitation work shall also be the property of the Employer.

The Contractor shall exercise utmost care in dismantling, removing, temporarily storing, handling, loading, transporting, and unloading area(s) designated by the Employer.

The Employer will identify designated area(s) within the boundary of TPS Guddu for the disposal of discarded materials.

Furthermore, the Employer will designate distinct area(s) within the boundary of TPS Guddu for storing equipment and materials that are partially damaged but can be refurbished and utilized again in the future.

Special Note:

"Timelines and the plans/procedures of rehabilitation/overhauling work for all the systems /equipment/structures/foundations etc. shall be submitted to Employer/ Engineer for their approval, before proceeding for the rehabilitation/overhauling/repair/replacement works & arrangement of material accordingly. The Contractor shall provide warranty for the rehabilitation/overhauling work performed and shall be liable until the expiry of warranty/defect liability period."

2.2.1 Summary of Scope of Works

The Scope of Work shall include but not limited to the following:

1. Steam Turbine rotor shafts, blades, seals, casings, bolts, bearings etc. have suffered different degrees of damages as per detail given in integrity assessment report. These will be repaired/replaced with new one as per the integrity assessment report and condition assessed by Contractor during execution of work at site.

2. New turning gear will be supplied.

3. Overhauling of Steam Turbine alongwith allied equipment.

4. Steam Turbine Generator is damaged to the irreparable extent; hence, existing STG will be replaced with new STG of same footprint and specifications. New generator shall include complete hydrogen cooling system, lubrication system, bearings, brush assembly for excitation etc.

5. The Contractor shall perform the complete assessment, rehabilitation, strengthening & modification works of complete ST and STG foundation to rectify the damages and to suit the requirements of newly installed STG.

6. Study shall be conducted by the Contractor for safe removal of existing STG and placement of new STG on its foundations with minimum removal and/or displacement of existing equipment/parts/structure members and re-instatement of the same to their original position. Study report shall be submitted to Employer/Engineer for their approval.

7. Contractor shall ensure that all safety measures /temporary support arrangements are made for the existing structure (structural members, floor, etc.) during the removal, maintenance & placement of Generator and other heavy components inside ST Hall. The design calculations /computer model analysis of the provided temporary arrangements and its impact on the existing structure, shall be submitted by Contractor for Employer/Engineer review.

8. Replacement of Generator Circuit Breaker (GCB) for Steam Turbine Generator including instrument transformers, disconnecting switch, earthing switches, capacitors etc.

9. Complete replacement of excitation system and AVR for Steam Turbine Generator

10. The damaged portion of the Isolated Phase Busbar (IPB), from the ST generator terminal to the GCB, shall be replaced. This includes the generator neutral grounding transformer, micro-positive pressure device, and associated components.

11. Testing of all peripheral equipment and devices essential for system integration, including power transformers etc., as well as testing of all allied equipment and devices, such as protection systems, synchronizers, and incoming breakers etc.

12. Main and Auxiliary transformers testing (protection testing, oil testing, and other related tests) shall be conducted by the Contractor.

13. Replacing damaged control, power, and instrument cables to restore them to their design condition.

14. The Contractor shall drain, clean, flush (as required), and replace the steam turbine (ST) and steam turbine generator (STG) lube oil and hydraulic oil with new oil in accordance with the OEM's recommendations and approved procedures. The Employer shall supply the initial (first) fill of lube oil and hydraulic oil. Any additional oil required for refilling or topping up during oil flushing, system cleaning, testing, commissioning, or until successful completion and handover of the plant shall be supplied by the Contractor at no additional cost to the Employer. The Contractor shall be responsible for maintaining the required oil quality and quantity throughout the execution of the Works.

15. All field cables and instruments are burnt during fire incidents for STG, ST and auxiliaries. So, Contractor shall install new field instrumentation and cables for STG, ST and auxiliaries.

16. Fire detection and Water-based firefighting protection shall be provided for the ST and STG bearings in accordance with NFPA 850 and other applicable standards. The Contractor shall install the complete firefighting system, including all associated piping, valves, nozzles, supports, and accessories, by taking a tie-in from the nearest available firefighting connection within the ST Hall.

17. The new ST / STG Control System along with whole Control (DCS Emerson Ovation) system needs upgradation. Controllers, power supplies, switches, ports, hubs, networking modules, operator workstations, OPC servers need to be upgraded with latest version of Emerson Ovation system. All turbine control logic, generator control logic, process control logic, protection functions, trip logics, alarm sequences, permissive logic, set points, controller tuning parameters, and protection settings shall remain identical, except where logic adaptations, set point

modifications, and controller tuning are required by the OEM to accommodate the integration and safe operation of the newly supplied STG and excitation system unless otherwise instructed or approved in writing by the Employer/Engineer during the design review process.

18. Contractor to rehabilitate Bentley Nevada 3500 vibration monitoring system. Currently, field instrumentation is damaged whereas Bentley Nevada 3500 panel is in healthy condition.

19. Hydrogen gas leakage detection systems are required for new water & hydrogen cooled ST Generator.

20. Testing of all the equipment located outside the designated scope of work boundary but necessary for system integration and requiring interfacing. This includes items such as Power Transformers, Protection Systems, Synchronizers, and incoming breakers etc.

21. The Contractor shall repair / revalidate the ST hall crane from third-party and get certificate before using the crane for lifting purposes.

22. Replacement/Repair of all valves of ST, STG and its allied auxiliary system.

23. Contractor shall prepare As-built drawings of newly supplied and rehabilitated systems/equipment.

24. 10% Spares for Ovation for new and rehabilitated systems.

25. Rehabilitation, furnishing and maintenance of temporary facilities during the Project (upto the completion of DLP) including electric power & water supplies, drainage, fencing, lighting, distribution, telephone, internet, sanitary facilities, site security, offices, accommodation, tools, plants and supplies etc.,

26. The Contractor shall prepare and submit the detailed steam blowing procedure, including acceptance criteria, sequence of activities, safety requirements, and operating parameters, for the review and approval of the Employer/Engineer.

27. The Contractor shall be responsible for planning, supervising, and executing the steam blowing of the HRSG, main steam piping up to the Steam Turbine (ST) inlet valves, steam bypass system, and associated auxiliary steam piping in accordance with the approved steam blowing procedure.

28. During steam blowing, the Contractor shall provide qualified commissioning and testing personnel to support the Employer in the operation, monitoring, data recording, and assessment of the plant throughout the steam blowing process. Plant operation during steam blowing shall be carried out by the Employer with the support of the Contractor's commissioning and testing team. The Employer assumes liability for the structural and mechanical integrity of the equipment outside the scope of the current contract i.e., HRSG and existing piping during steam blowing. Any delays or repairs caused by the failure of such equipment during this activity shall entitle the Contractor to an Extension of Time.

29. Performance of all Tests on Completion identified in these Technical Provisions including but not limited to pre-commissioning tests, commissioning tests, trial run, reliability test run and performance test of the steam turbine to determine the Gross Power Output (GPO).

30. Development of performance correction curves to correct net power output and net heat rate of the Plant (in combined cycle mode on fuel gas) to reference site conditions at both once through and cooling tower operation mode.

31. Development of Heat Balance Diagram (in combined cycle mode on gas fuel) to reference site conditions, at both once through and cooling tower operation mode.

32. Development of part load heat rate correction curve of the Plant in combined cycle mode on gas fuel.

33. Development of complex start-up curves, both for simple cycle and combined cycle mode of operation.

34. Performance testing of the Plant in combined cycle mode after rehabilitation for information.

35. Services including design and project management services, inspection and testing services, technical support and provision of warranty engineers during the Defect Liability Period,

36. All other materials, equipment, and services required for a complete and operational Steam Turbine, Steam Turbine Generator, DCS and their allied auxiliaries in accordance with the intent described and specified herein.

37. Rehabilitation of any works which is not expressly specified in the scope but are vital for the safe operation of ST, STG, DCS, Steam Turbine Controller and their allied auxiliaries shall be responsibility of the Contractor.

38. Testing and commissioning of the rehabilitated systems/equipment.

39. Submission of rehabilitation and commissioning reports in line with the works carried out.

3. SITE CONDITIONS

The Contractor shall physically check the site areas prior to submitting their bid offer and starting the design works. Neither the Employer nor the Engineer shall in any way be held responsible for the accuracy of information provided or for any interpretations, conclusions or assumptions made by the Contractor resulting from this information. It shall be the Contractor's sole responsibility to obtain the information required for his needs.

3.1 Location

The Project site is situated beside the second largest barrage of Sindh & near about 50 km away from the bordering city of Punjab situated on National Highway "Sadiqabad" & just 14 km away from the bordering city of Sindh Situated on Indus highway "Kashmore". It is approximately 600 kilometres from Karachi Port. Plant Location Layout is attached as *Drawing # 33-F6311Z-Z0101*.

3.2 Climate

The climate of Plant area is sub-tropical, hot and arid. Rahim Yar Khan which is about 60 km from the Plant area is the nearest climate station, which is operated and maintained by Pakistan Meteorological Department (PMD). Climate station of Rahim Yar Khan provides a fair representative estimate for the climate parameters of the Plant Area.

For all rehabilitation, replacement, modification, new and design works under the Contract, the Contractor shall adopt the original plant design basis and climatic design parameters as reflected in the approved As-Built Drawings, original design documents, and other relevant records made available by the Employer, unless otherwise specified in the Contract Documents or instructed by the Employer/Engineer.

For working conditions, the Contractor shall obtain the latest meteorological and climatic data from the Pakistan Meteorological Department (PMD) or other relevant statutory authority. The Contractor shall be responsible for verifying the suitability of such data for the intended purpose. The Contractor shall use the original as-built climatic data as the baseline. Where the latest PMD data indicates more extreme conditions, the PMD data shall supersede the as-built data for the design of all new and rehabilitated systems.

Any revision to the original climatic design basis shall be subject to the prior review and written approval of the Employer/Engineer.

3.3 Site Topography

Existing general layout of the Plant Site is attached as **Annex-4**. Contractor is advised to have a detailed site visit before submitting their Bid to make them fully conversant with the site area, roads layout, and pipe bridge/racks etc. so as to plan the transportation of plant equipment and goods within the Plant area.

3.4 Geotechnical Data

At the engineering stage, geotechnical investigation shall be carried out by Contractor for confirming and establishing the sub-soil conditions of the existing plant areas requiring rehabilitation works.

As a new Steam Turbine Generator (STG) will be supplied under the rehabilitation scheme, the foundation design of ST & STG must be re-evaluated/verified considering the revised loading requirements.

Report of geotechnical Investigations shall be submitted to Employer/Engineer for their approval.

3.4.1 Requirements for Geotechnical Investigation

Contractor shall be responsible to submit the technical specifications & methodology of geotechnical investigations indicating the scope of investigation works, number and location of boreholes, applicable Standards, sampling techniques, in-situ & laboratory-testing requirements, chemical analysis etc. for Employer/Engineer review/approval.

The requirements such as pile capacity evaluation for existing structures, construction methods, remedial measures required for sub-soil/foundations etc. shall be finalized based on the geotechnical investigations and incorporated in the detailed report.

The Contractor shall prepare reports giving all data obtained from the geotechnical surveys and the criteria, recommendations and conclusions established from the data. The reports shall be submitted for review by the Employer/Engineer.

3.5 Transportation to the Site

The site is generally accessible from the main Indus Highway and connected with the main N-5 road from Sadiqabad. The Motorway M-5 (Multan-Sukkur) nearest interchange is located at a distance of around 15 Km from the site.

The transportation system inside Pakistan from the major ports to the proposed site shall be evaluated during execution stage to ensure safe and undamaged transport of all equipment to the project site.

The Contractor shall submit a suitable transport concept / methodology keeping in view available lifting capacities e.g., at the receiving port(s), geometric and structural capacities of roads / bridges required for over-land transport to site, suitable transport vehicles etc. to Employer/ Engineer for review / approval.

It shall be the responsibility of the Contractor to carry out independent verification of the various typical site constraints / obstructions etc. and the suggested solutions. The Contractor shall not claim any additional compensation for the required preparatory works along the route for transportation of equipment.

Additionally, the Contractor shall also be responsible for assessing the Plant Internal Infrastructure, including the roads, access points, and related clearances, considering the transportation of equipment from and to the site. Contractor shall be responsible for undertaking all temporary measures or relocations required to facilitate equipment transportation and restoring the site to its original condition thereafter.

3.6 Grid Code

The generating equipment supplied by the Contractor shall meet all relevant requirements as specified in the Grid Code 2023 available on the regulator, NEPRA website.

3.7 Reference Conditions

The following Reference Conditions shall be valid for the Performance Guarantees:

Sr. No.	Parameter	Unit	Value
1.	Main Steam pressure at steam turbine inlet	bar (a)	114.5
2.	Main Steam temperature at steam turbine inlet	°C	560.6
3.	Main Steam flow at steam turbine inlet	t/h	555.425
4.	Reheat Steam pressure at steam turbine inlet	bar (a)	25.4
5.	Reheat Steam temperature at steam turbine inlet	°C	560
6.	Reheat Steam flow at steam turbine inlet	t/h	622.872
7.	LP Steam pressure at steam turbine inlet	bar (a)	4.7
8.	LP Steam temperature at steam turbine inlet	°C	305.3
9.	LP Steam flow at steam turbine inlet	t/h	47.357
10.	Condenser vacuum pressure	kPa	7.40
11.	ST generator power factor	-	0.85

3.8 Reference Site Conditions

The following Reference Site Conditions (RSC) were selected for when the Plant was originally constructed:

Sr. No.	Parameter	Unit	Value
1	Barometric pressure	bar(a)	1.013
2	Ambient dry bulb temperature	°C	30
3	Relative humidity	%	50
4	Generators' power factor	-	0.85

The Contractor will consider the above RSC to prepare performance correction curves of overall combined cycle on cooling modes i.e., once through and cooling tower.

3.9 Fuel Gas

The Plant utilizes indigenous gas for power generation supplied by M/s Pakistan Petroleum Limited (PPL) from the gas field of Kandkot.

Kandkot gas specifications are attached with the Technical Provisions as **Annex-5**.

4. GENERAL PROJECT REQUIREMENTS

4.1 General Design Consideration

All components of the Project shall be designed, manufactured, installed, and shall be suitable and complete in every respect for continuous operation of the Plant at base load, as well as at part loads, and shall exhibit high availability and reliability.

All component of the Project shall be well-proven and built to internationally recognised standards.

Unless otherwise expressly specified in the Contract Documents, the Contractor shall use the approved As-Built Drawings of the existing plant as the primary design basis for all design, engineering, rehabilitation, replacement, modification, and installation works to be performed under these Technical Provisions.

The Contractor shall verify the accuracy and completeness of the available As-Built Drawings against the actual site conditions before commencing the detailed design. Any discrepancies identified shall be promptly notified to the Employer/Engineer for review and resolution. Such verification shall not relieve the Contractor of its obligations under the Contract.

Notwithstanding the foregoing, the Employer/Engineer reserves the right, at its sole discretion, to revise or modify the design basis of any system, equipment, component, or structure where such changes are considered necessary due to operational experience, failure history, reliability enhancement, safety considerations, maintainability, or compliance with applicable codes and standards, unless otherwise expressly stated elsewhere in the Contract Documents.

Without limitation to the above, where any material, component, or equipment has experienced failure, excessive degradation, or unsatisfactory performance during the operation of the plant, the Employer/Engineer shall have the right, during the design review stage, to require the Contractor to adopt alternative materials, revised specifications, upgraded designs, or equivalent or superior engineering solutions. The Contractor shall incorporate such changes into the final design without objection, provided such changes are within the overall scope of the Works. No such adjustment to the Contract Price and/or Time for Completion shall be provided to the Contractor under design change.

The Contractor shall ensure that all revised designs, materials, and engineering solutions are fully compatible with the existing plant systems, satisfy the specified design life and performance requirements, and comply with the applicable codes, standards, and manufacturer's recommendations.

All component of the Project shall be designed to permit unconstrained operation of the Plant over the full range of ambient conditions. The design and materials of major items shall be proven by evidence of the minimum compatible ambient conditions, environmental considerations within the context of existing plant.

The Contractor/sub-contractors of major items of Project shall fulfill the minimum criteria as outlined below:

- In case of Steam Turbine rehabilitation, the Contractor/sub-contractor for steam turbine overhauling / rehabilitation must have successful experience in the design and manufacturing of at least five (05) steam turbines rated 250 MW (gross) or higher. The successful experience of steam turbines shall include a minimum of 24,000 hours commercial operation.

- In case of steam turbine generator, the Contractor/sub-contractor for steam turbine generator must have experience in the design and manufacturing of at least five (05) generators of 320 MVA or higher rating. The successful experience of generator shall include a minimum of 24,000 hours commercial operation.

- For other major equipment/plant items, the suppliers must have at least fifteen (15) years of business on international projects outside their home countries with similar equipment designed according to international standards. The equipment offered for this Project shall be proven and must have been in commercial operation for at least 3 years.

The newly installed equipment shall be designed for a lifetime of 240,000 operating hours over a period of 30 years.

The SI system of units shall be used in all applicable documentation for design, drawings, diagrams, instruments, etc.

4.2 Safety in Design

The Contractor shall design all component of the Project to allow it to be constructed, installed, commissioned, operated, and maintained in a prudent and safe manner, and in full compliance with relevant health and safety at-work orders, related acts, regulations, codes, and statutory requirements.

4.3 Capacities of Power Generation Equipment

The parameters of steam turbine, steam turbine generator and HRSGs are given as **Annex-6** for operation of Plant before the fire incident in July, 2022. These parameters are provided for information only.

4.4 Standards and Codes

The Contractor shall ensure that the engineering, design, construction, and testing of all equipment, facilities, components and systems, which are proposed for the Plant shall be in accordance with local legislation and internationally recognised standards and codes as per their latest editions. No alternative standards shall be accepted.

The performance test for combined cycle shall be according to ASME PTC-46. The test to verify the Performance Guarantees shall be conducted in accordance with ASME PTC 6.2.

Unless otherwise specified in the Contract Documents or instructed by the Employer/Engineer, the Contractor shall carry out the design, rehabilitation, replacement, modification, and installation of all systems, equipment, structures, and components in accordance with the original design codes, standards, and specifications adopted for the Plant. Where the original codes or standards have been superseded or are no longer applicable, the Contractor shall notify the Employer/Engineer and obtain written approval before adopting the latest applicable editions or equivalent internationally recognised codes and standards.

4.5 Contractor's Responsibilities

The Contractor shall be responsible for the design, installation, construction, rehabilitation, testing and commissioning of the Project, including coordination of its sub-suppliers' designs.

As the Plant can fundamentally affect health and safety, it is considered vital that health and safety considerations are incorporated into the design process at the earliest stage.

The Contractor's design responsibilities extend beyond the construction phase, and shall also take into consideration operation, maintenance, and eventually decommissioning. All equipment shall be easily accessible for operation and maintenance.

The Contractor shall carry out appropriate risk / hazard assessments and shall reasonably mitigate the risks to health and safety. Where risks remain, these should be identified to the Employer.

Although the Contractor may divide its scope of work in various lots, the Contractor is fully responsible for any and all interconnections whatsoever between separate lots to ensure full compliance with the Contract as an EPC / turnkey contractor.

Wherever in the various parts of these Technical Provisions limits of supply are mentioned, these are in no case meant to limit or exclude equipment, supplies, or services required to form a complete, safe and modern facility.

4.6 Hazardous Areas and Substances

The design and arrangement of the Plant shall be such that the extent of any hazardous area is minimised. The requirements concerning security and safety shall be appropriately applied.

Equipment and processes that are associated with a potential explosion hazard shall be located at a distance as far as possible from other buildings and equipment, to limit the consequences of an explosion. Where separation by distance is impracticable, the hazardous plant components shall be located in a protective enclosure.

The Contractor shall take into account any special requirements concerning the nature, handling, and storage of all classified substances including fuels, oils, gases, and chemicals. Containment of 110% of maximum fixed installed inventory and/or tank containers/drums shall be installed. For flammable gases, areas shall be classified to an approved standard and the necessary certified equipment shall be provided.

The Contractor shall provide Material Safety Data (MSD) sheets for items of the Plant and consumables which could be potentially hazardous, along with recommendations for containing or reducing the hazard during an emergency.

4.7 Language

English language shall be used in all technical correspondence between the Contractor and the Employer and the Engineer, and whenever anything is required under the terms of the Contract to be written, marked, or printed.

Warning and safety notices, plant labels and rating plates and all permanent or temporary notices around the Plant shall be in English.

Operation manuals shall be in English. The training programme shall be in English.

4.8 Plant Numbering System

Equipment numbering for each newly installed item of Plant, labels, nameplates etc. shall be in accordance with the Kraftwerk Kennzeichen System (KKS) and follow the as built drawings and already implement plant numbering system. Each equipment item, whether supplied directly by Contractor or a Supplier or Sub-Contractor shall be uniquely identified by KKS. For specific packages like STG a numbering system according to proven OEM standard may be accepted.

All the above stated labels shall be made of stainless-steel plates (3”x 2” inch). The KKS including name of the equipment, shall be engraved on the plates. The labels shall hang through stainless steel wires with each equipment. The DCS and a Computerized Maintenance Management System (CMMS), if use of any such system is planned by the O&M operator, shall utilise the same numbering system.

4.9 Equipment Identification

Instruction plates, nameplates, and labels shall be fitted before commissioning on all apparatus requiring indication of operation and should be of such a size as to be legible at operational levels.

All labels, instrument/equipment tags, nameplates, etc. shall be of stainless steel.

All instruction plates, nameplates, and labels shall be in English. All safety instructions and warnings, nameplates of main equipment shall be in English too.

4.10 Corrosion Protection and Painting

The Contractor shall take into account the corrosion problems to be encountered at the location of the Plant, especially with equipment installed outdoors.

4.10.1 Painting

The Contractor shall submit the names of the proposed paint supplier and a quality assurance program for the Employer’s/Engineer’s review. The supplier of the painting system shall be selected from well proven painting manufacturers.

The Contractor shall consider de-rusting and painting of damaged paint of the rehabilitated systems, equipment, pipelines and parts etc.

In order to achieve the maximum durability, one or more of the following methods of surface preparation shall be followed, depending on the surface condition of metals as instructed by Employer/Engineer:

- Manual or hand tool cleaning
- Mechanical or power tool cleaning
- Blast cleaning (Sand Blasting)

Mill scale, rust, rust scale and foreign matter shall be removed fully to ensure that a clean and dry surface is obtained.

The Contractor shall do de-rusting/sandblasting, painting and colour coding for the newly installed equipment and pipelines. The colour coding shall match the already applied coding for the Plant. Standards for painting shall comply with ISO 12944 (category C4, durability in excess of 15 years) with the need for minor remedial work, only during the intervening period.

All protective coating procedures shall be provided prior to any application.

The finish colour shall be selected from among the paint manufacturer's standard colour. Finish painting of non-insulated piping and equipment shall be applied suitably for safety, or for protection from the elements. Piping, valves, piping specialities and equipment to be insulated shall be subject to prime coating.

The following inspection and testing shall be performed on the coating:

- Visual Inspection of Surface Profile
- Wet and Dry Film Thickness
- Spark Testing

4.11 Insulation

Insulation shall be in accordance with the as built design basis and internationally recognised standards.

The Contractor shall repair any insulation and cladding damage for all the rehabilitated systems, equipment, piping, parts and shall provide new insulation and cladding of the similar or better specification for the newly installed systems, piping, equipment and parts etc.

Cladding for newly supplied and rehabilitated equipment shall comply with the latest OEM drawings. Where OEM drawings are unavailable, the original as-built drawings shall govern.

4.12 Vibration

The equipment to be supplied under this contract shall be designed and constructed to minimise the effects of vibration. Where vibration exists, this shall be reduced to the minimum that can be achieved by good design, and careful balancing in the case of rotating equipment. The following requirements shall be applicable:

- The amplitude of vibration of rotating equipment when measured on the bearing housings under steady state conditions at the designed operating speeds shall not exceed the values given in the Zone B band of ISO 20816 and shall be expected to achieve values within the Zone A band when new and operating at the design point.

- For large high-speed machinery (for example: steam turbines generators) direct measurement of shaft vibration shall be provided.

4.13 Project Administration

All correspondence, communications, and submissions relating to the contract shall be in the English language.

The Contractor shall have a liaison officer fluent in the English language for routine administration with the Employer/ Engineer at the site.

For all documents, goods, materials, maintenance equipment, spare parts, instruments, etc. to be handed over to the Employer, the Contractor shall obtain a signed receipt by an authorised representative of the Employer that the goods, etc., have been received in a satisfactory condition as required under the Contract.

4.14 Project Documentation

4.14.1 Requirements for Document Management System (DMS)

For all work to be performed under the Contract, the Contractor shall establish and maintain a comprehensive computer-based Document Management System ensuring that for each individual Project Document the identification, revision, status and location, at all phases of the Work, continuously is being tracked. The system shall be used during the complete Project to manage all the Project related data. All information shall be handled as structured data that adheres to a well-defined object-oriented data model.

The Document Management System (DMS) shall support different user levels with appropriate rights adapted to the specific function and related access rights the different individuals are supposed to execute. The DMS system shall reside on a properly protected, independent, and safe computer system with sufficient capacity to handle the parallel access from up to 30 users from all over the world. Access of the DMS shall be provided via the Internet. No specific software installations shall be required on the Project participants' client computers. Password protected access to the system and the data handled shall be made available by the Contractor, to the Employer and to the Engineer for their specific actions like creation, review, comment and/or approval, etc. as per agreed procedures.

The system shall include all Project Documents, including all sub-contractors' and all vendors' Project documents.

All Document Management System related expenses, including all additional charges (user accounts, data storage, license, and access path fees, etc.) shall be borne by the Contractor.

All Project communication shall be handled via this tool.

The Document Management System shall support all the different workflows necessary for a proper, well organized and efficient execution of the works, like:

- Project Quality System including guidelines, procedures, approvals and certificates
- Project correspondence
- Project reporting and follow-ups including progress measurement and invoice verification

- Project Planning, Engineering, Implementation, Erection, Commissioning, Testing
- Design review with all the different parties involved
- Document preparation, approval, release and distribution

The Contractor shall provide access to the DMS during all Project phases until the end of the defect liability period/issue of the DLC.

All the correspondence except those related to financial matters shall be uploaded on DMS. All the design drawings/documents, contract documents, codes & standards etc. shall also be uploaded on DMS

At the end of this period, two complete sets of all Project Documents including correspondence and drawings shall be submitted in electronic form to the Employer and to the Employer's Engineer.

4.14.2 Project Quality and Document Control

The Contractor shall prepare and submit a Project Quality and Document Control Plan for the review and approval of the Employer/Engineer prior to commencement of the Works.

The Plan shall, as a minimum, include:

- Project quality management procedures and quality assurance/quality control (QA/QC) requirements.
- Document control procedures, including document identification, numbering, revision control, approval workflow, distribution, transmittal, and retention.
- Organization and classification of all project documents, drawings, manuals, reports, calculations, records, and correspondence.
- Requirements for document preparation, formatting, drawing sizes, document templates, and quality standards.
- Procedures for document review, approval, updating, supersession, and archiving.
- Requirements for electronic document management, file naming conventions, storage, backup, security, and retrieval.
- Schedule and format for submission of documents, drawings, reports, and deliverables to the Employer/Engineer.
- Responsibilities of the Contractor's personnel for quality management and document control throughout the execution of the Contract.

The Contractor shall implement and maintain the approved Project Quality and Document Control Plan throughout the duration of the Contract and shall ensure that all project documentation is prepared, reviewed, maintained, and submitted in accordance with the approved procedures.

4.14.3 Documents Submission and Approval Procedure

The Contractor shall simultaneously submit all drawings and documents through the Document Management System (DMS), together with one (1) hard copy to the Employer and one (01) hard copy to the Engineer for review.

The date of receipt shall be the date on which the Contractor's transmittal letter and the complete set of drawings/documents are received by the respective recipient through the DMS and/or in hard copy. Submissions received on or before 12:00 noon on a Working Day shall be deemed to have been received

on that Working Day. Submissions received after 12:00 noon, or on a non-Working Day, shall be deemed to have been received on the next Working Day.

The review period specified under the Contract shall commence from the deemed date of receipt. Following completion of the review, the Employer and/or the Engineer shall issue their review comments, status, and disposition through the DMS. The Contractor shall incorporate all review comments and resubmit the revised drawings/documents in accordance with the requirements of the Contract.

4.14.4 Engineering Drawings and Documents

All new and revised drawings and documents shall be prepared using the approved original As-Built Drawings and their specifications as the basis. For rehabilitation and modification works, the Contractor shall, wherever practicable, revise and update the existing As-Built Drawings rather than prepare new drawings, ensuring that all modifications are clearly identified and accurately reflected in the final As-Built documentation.

Submission of Engineering Drawings and Documents

The Contractor shall submit, within the stated periods, design drawings, design data, schedules, manuals, etc. to the Employer and Engineer, as listed below. Items marked with (A) shall be for approval and with (I) for information.

Note:
The following schedule is not considered complete and shall be extended if it is found to be necessary during the course of the Project.

Submission Time	Document / Deliverable	Status
Within 2 Weeks after NTP	Confirmation Letter for Mobilization for Detailed Site & Plant Inspection (Start of Inspection Window)	I
	Confirmation Letter for Mobilization for As-Built Site Surveys and Site Installation Drawings	A
	Detailed Plan and Layout of Temporary Offices, Residences, Engineer/Contractor Facilities, Construction & Storage Areas	A
	Three (03) Sets of Complete Contract Documents for Employer alongwith soft copy	I
	Three (03) Sets of Complete Contract Documents for Engineer along with soft copy	I
Within 4 Weeks after NTP	Complete Project Schedule (Level-03, Primavera P6 Native File & PDF)	A
	DMS Operational and Ready for Document Submission	I
	Detailed Inspection Plan for Systems/Equipment/Parts to be Replaced, Rehabilitated or Overhauled	A
	Detailed ST & STG Foundation Assessment Plan and Methodology	A
Within 8 Weeks after NTP	List of Systems/Equipment/Parts to be Replaced, Rehabilitated or Overhauled	A
	Quality Assurance Programme	A
	Project Quality and Document Control Document	A

Within 10 Weeks after NTP	Inspection & Test Plan (ITP)	A
	Final List of Systems/Equipment/Parts to be Replaced or Rehabilitated	A
	Operational Risk Study	A
	Block Diagrams for Main I&C Systems	A
	Instrument List with Vendor Details	I
	Piping & Instrumentation Diagrams (P&IDs)	A
	List of New and Modified Pipes & Valves	A
	DCS System Description	A
Within 16 Weeks after NTP		
	Control & Operation Philosophy	A
	Functional Logic & Interlock Diagrams including Protection Schemes	A
	Instrumentation List	A
	Instrument Loop Diagrams (ILDs)	I
	Measuring Point List	I
	Alarm List	A
Within 18 Weeks after NTP	List of Site Tests	A
Within 24 Weeks after NTP	Performance Test Procedures & Test Methods	A
	Steam Turbine Performance Correction & Degradation Curves/Tables	A
	Heat Balance Diagrams (Once-Through & Cooling Tower Modes)	A
	Start-up Curves (Simple Cycle & Combined Cycle)	A
	Complete DCS Engineering Documentation	A
	Final Arrangement Drawings of New & Rehabilitated Plant Components	A
Latest 3 Weeks Prior to Commissioning	Construction Completion Certificates	A
	Commissioning & Site Testing Programmes and Procedures	I
	Recommended Spare Parts List	I
	Preliminary O&M Manuals (Printed & Electronic)	I
Two (2) Months Prior to Unit Start-up	Start-up Manuals (3 Copies for Employer, 1 Copy for Engineer & Electronic Copy)	I
	Performance Correction Curves & Part Load Heat Rate Correction Curves	A
Within 3 Months after TOC	Final As-Built Drawings (5 Copies for Employer, 1 Copy for Engineer & Electronic Copy)	I
	Final O&M Manuals (5 Copies for Employer, 1 Copy for Engineer & Electronic Copy)	I
	Rehabilitation Report	A
	Commissioning Report	A
Within First 7 Days of Each Month	Monthly Project Progress Report	I
	Updated Drawing List showing Submission, Approval & Revision Status	I
Within 3 Months Prior to DLC	Updated Final Documentation including O&M Manuals & As-Built Drawings	I
	Updated Final As-Built Drawings	I

4.14.5 Design Approval

General

Contractor shall submit a list of drawings, documents & data with submission sequence and timeline for the approval of the Employer/Engineer, within three (03) weeks from the effective date.

Drawings, calculations, specifications, data sheets, lists, reports, or any other document subject to the Engineer's approval, review, or comment shall be submitted as per sequence and timeline in accordance with above mentioned approved list and shall be approved or commented within 14 working days after receipt of the hard copies of the drawings / documents by the Engineer.

Should the Engineer's approval comments be delayed, the Contractor may proceed with the design. Any manufacturing work carried out prior to such approval will be strictly at the Contractor's risk and expense if changes should be required later on.

A transmittal letter, listing clearly the documents along with subject/title, shall accompany documents submitted for approval/information. The Project specific drawing number shall appear on the transmittal.

In case where the approval of drawings / documents is urgently required, to allow the Contractor to meet the time schedule, the Contractor's transmittal letter should clearly state this fact. The Contractor may request the Employer / Engineer to approve drawings at the Contractor's office in the interest of expediency. If it is convenient to do so, the Employer / Engineer may agree to such a procedure at the expense of the Contractor. The Contractor shall bear all expenses such as visa processing, round trip international and domestic air travel, hotel accommodation (including meals and incidentals), daily allowance, all internal transportation etc. for each of the visits by the Employer's and Engineer's representative(s).

Categories for Approval

The Engineer shall provide their comments or return one copy of the drawing/document received to the Contractor, marked with one of the following notations within the period mentioned above:

- Cat. 1 - Approved
- Cat. 2 - Approved except as noted
- Cat. 3 - Not Approved
- Cat. 4 - For Information Only.

These categories shall be interpreted as follows:

- Category (1) denotes "Approved" in which case this approval refers only to the submitted document with the relevant index number. Category (1) authorizes the Contractor to proceed with the Work based on the relevant documents.

- Category (2) denotes an approval in principle, however, with the reservations or comments marked by the Engineer on the document itself or noted in a separate document. After revision, the document has to be re-submitted for final approval. Category (2) also authorizes the Contractor to proceed with the Work in compliance with the Engineer's reservations/comments.

  Note: "*In order to ensure that the work is completed in accordance to the approved drawings, the Contractor and its sub-contractors shall use signed and stamped drawings at site."*

- Category (3) denotes "Not Approved" indicating that the drawing contains important deviations from the Contract and must be revised and resubmitted for approval before proceeding with the manufacture or erection.

- Category (4) is classifying the documents as “for information only” because either no approval is required or the documents are considered as preliminarily under hold until specific preconditions will have been fulfilled or the submission of design details is required. Although in case of documents are not subject to approval, the Engineer may raise objections or make comments.

Any approval of the Contractor’s drawings/documents does not relieve the Contractor from any of its contractual obligations.

In case of more than two unsuccessful attempts to pass the approval procedure for design/drawing and documents, the Contractor shall compensate the additional approval work according to actual time and work spent, as per the standard man-days rate provided by the Employer/Engineer.

4.14.6 As-Built Drawings

The Contractor shall produce as-built drawings of the entire new and rehabilitated/overhauled Works, documenting the final design after completion of installation and commissioning. The as-built drawings shall show all modifications and changes made during the installation and commissioning phase while the latest revision representing the current status to be incorporated into the respective approved design drawings.

A full set of all final as-built drawings in print and in electronic format of any discipline shall be handed over before latest 3 months after the issuance of the TOC.

Wherever existing plant equipment is changed, tied-in to or in any other way has been modified this clearly shall be documented in the as built drawings.

The final "as built" drawings shall be issued by the Contractor through the DMS, in print and in electronic format. Once completed, they shall be incorporated/referenced into the O&M manuals and shall be filed in separate "as built drawing" books.

4.14.6.1 Electronic Format and As-Built Drawings

For permanent storage and for on-line reference, the drawings shall be supplied in electronic format through the DMS and the latest versions of the documents shall additionally be provided as PDF files. Relevant drawings shall be submitted in addition in editable e.g. AutoCAD (*.dwg) format.

4.15 Maintenance and Spare Parts

4.15.1 General

The Contractor shall provide complete details of maintenance and spare parts requirements for new and rehabilitated/overhauled equipment. These shall include the routine maintenance and the major inspection and overhaul programmes needed in order to achieve the required Plant availability and performance.

The maintenance requirement documentation shall include, but not be limited to:

- Lists of spare parts, line-item pricing, sales source information, consumable items, and special tools for each type of maintenance activity. (These lists shall include the price of each item which shall remain fixed up to 12 months after the issuance of the Taking Over Certificate.),

- Frequency between planned maintenance activities,

- Duration of each major inspection and maintenance activity in terms of man-hours and target elapsed time, inclusive of supervisory levels and with details of required labour grades,

- Complete detailed description of each maintenance activity necessary to carry out maintenance.

The planned maintenance outage programme shall include for statutory inspections that need to be carried out in accordance with the appropriate local regulations.

4.15.2 Contractor's Warranty Staff

The Contractor shall provide, as a minimum, two (02) warranty engineers throughout the Defects Liability Period.

These engineers shall be suitably qualified and have considerable experience in the operation and maintenance of similar plant. They shall be located on site and be available at all times to respond to any maintenance and operation issues. The engineers shall be able to access support expertise in other fields if necessary.

4.15.3 Operational Spares, Consumables and Chemicals / Lubricants

The Contractor shall provide five percent (5%) of the total of newly supplied and rehabilitated equipment of the, or a minimum of two (2) items (whichever is greater), for all operational spares and consumables required for two (2) years of continuous operation.

These parts shall have been delivered to the site prior to the operation of any newly supplied or rehabilitated equipment of Plant. The Contractor shall promptly replenish any spares used during the Defects Liability Period (DLP).

A comprehensive list of power plant auxiliaries is attached for reference in **Table 4.16-3** mentioning equipment requiring spares for the smooth operation of the facility. The attached list of plant auxiliaries is not exhaustive and shall be supplemented later on as required.

The Contractor shall replace at its own expense all spares taken from the Plant stores and used during construction, commissioning, testing and defects liability period.

If the Employer establishes, based on their O&M experience of the Plant, that the two (2) years operational spares and consumables delivered by the Contractor would be inadequate for operations of the Plant for two(2) years, then it shall re-evaluate and it might require the Contractor to increase the quantities of items delivered.

Table 4.16-3- Non-Exhaustive List of Power Plant Systems Requiring Operational Spares, Consumables and Chemicals/Lubricants

Sr #	Operational Spare Parts
1.	ST & STG parts and associated auxiliaries' parts
2.	All the newly supplied valves
3.	DCS parts
4.	ST, STG and Its allied auxiliaries instrumentation
Sr #	**Operational Consumables**
1	**Steam Turbine & Steam Turbine Generator**
1.1	Filters, Lube Oil and Greases
2	**DCS**
2.1	Fuses
3	**PLC's**
3.1	Fuses

Note: *The above lists of systems are illustrative and not exhaustive. The Contractor shall get approval of the Employer regarding comprehensive list of spare parts and consumables.*

4.15.4 Recommended Spare Parts

The Contactor shall submit two (02) years recommended spare parts list for all the new and rehabilitated equipment. Spare parts list will be submitted to Employer for their approval.

The price of recommended spare parts is not included in the Contract Price. However, the Contractor shall be bound to supply recommended spare parts as per the quoted price and as per the list approved by Employer.

These are items for which the Contractor anticipates that demands may arise through breakdowns which could jeopardise the availability or safety of the plant. The Contractor shall state the proposed stock holdings for such items together with the prices of each.

Spares list shall be in the format of a schedule including the following data:

- Description,
- Identification,
- Ordering code
- Name of OEM
- Point of Origin
- Price

- Delivery Time (Weeks)

The Contractor may acquire, with the approval of the Employer, spares from Plant stores during construction, installation, commissioning, testing and defects liability period. However, all these spares shall be replaced with new one, by the Contractor at its own expense before the end of Defects Liability Period.

4.16 Quality Assurance

This section covers the technical requirements for inspection and testing of material, parts, equipment, and workmanship of the plant during manufacture, assembling, and erection to demonstrate compliance with the Technical Provisions, codes, and standards.

The Contractor shall submit for Employer's review quality management systems and quality plans covering all equipment and works. The Contractor shall provide evidence of accreditation to an International Assurance Standard equal to ISO 9001.

The Contractor shall perform all necessary planning to ensure that Quality Assurance arrangements are implemented.

The Contractor shall detail the overall quality system for the Contract in a quality assurance program.

4.16.1 Third Party Certification

The Contractor shall arrange for an independent third party to certify the design, materials, and construction of the equipment in its scope to comply with legal requirements and for insurance purposes. The certification shall include, amongst others, all pressure vessels and lifting equipment, including slings, and shall cover both fabrication at the manufacturer’s works and tests at Site.

All costs associated with the third party certification shall be borne by the Contractor. The third party organisation shall be internationally recognised and approved by the Employer.

4.17 Inspection, Testing and Commissioning

4.17.1 General

This specification contains the technical requirements for Inspection, Testing (I&T) and commissioning of material, parts, equipment and workmanship of the plant during manufacture, assembling, erection, commissioning and upon completion to demonstrate compliance with the specification, codes and standards to ensure overall reliability of plant operation and performance.

The whole of the works supplied under this Contract shall be subject to visual, dimensional, material, non-destructive, hydraulic, functional, and performance inspection and tests by the Engineer during manufacture, erection and commissioning, at the manufacturers' works and/or on site. The works may also be subject to inspection and test by independent inspection authorities in accordance with the approved Inspection Plan.

The Contractor shall prove that its material and/or equipment complies with the requirements of the Contract.

Main plant equipment shall be subject to a performance test (if applicable as per international standards and Prudent Utility Practices) to prove that reliability, operation and performance conform to the requirements of this specification. Plant items and equipment shall be assembled and complete as far as possible prior to the commencement of works performance tests.

4.17.2 Expenses

All shop and field-testing certifications, reporting, and assuring of engineering quality verification and documentation of the Works in accordance with the technical specifications and the Contractor's testing programme shall be performed by the Contractor at its expense. If tests indicate non-compliance with the terms of the Contract, the Contractor shall, at its own expense, make all necessary repairs and perform additional test(s) required to indicate compliance with the terms of the Contract.

4.17.3 Codes and Standards

Where no specific code or standard is mentioned, the various items of plant, parts, material and equipment shall be tested in accordance with the relevant American, British or German standards. IEC standards are compulsory for the electrical equipment.

4.17.4 Formal Requirements for I&T

4.17.4.1 Inspection and Test Program (ITP)

The Contractor shall establish, document and implement a Quality Control Program in accordance with the requirements of the ISO 9000.

Implementation of this program shall cover all fabrication, installation, and commissioning activities on and off the Project site.

Inspection and test plans shall be prepared for all major items of equipment, plant and systems defining the Quality Control and inspection activities to be performed to ensure that the design, manufacture, construction, erection, commissioning and completion of the plant complies with the contract. ITPs shall be submitted defining relevant inspection and test points for all stages of manufacturing, construction, erection, commissioning and completion.

Inspection and Test Plans shall be submitted for Employer/Engineer approval and shall include the following information as a minimum:

1. Company’s name, Contract number and title
2. Contractor’s order number
3. The identification of the item/activity to be inspected or tested
4. The sequence of operations prior to, during, and after inspections and tests
5. The identification of the specification, drawing, or procedure for each of the above operations.

6. The acceptance criteria, with reference to the appropriate technical specification, in-house, national, or international standard and relevant clause number for each of the above operations.

7. The inspection and test activities the Contractor has nominated for its intervention points.

8. Provision for intervention points nominated by the Company.

9. Provision for intervention point acceptance by other parties involved.

10. Inspection and Test records shall be generated for each operation (as applicable).

11. Date when inspection/test had been performed

12. Reference to inspection/test report.

The Inspection and Test Plan (ITP) for the individual tests shall consider the requirements in section.

It is to be noted that where OEM ITPs are available for any equipment/systems, the Contractor shall prepare the ITPs for that specific equipment/system under the guidance of OEM provided plans.

Requirements of a Third-Party Inspection shall be indicated in a similar manner prior to the submission of the inspection plan to the Company for approval. The approved Third Party Inspection requirement shall be included in the inspection program stated above.

The Contractor shall not commence work until the Quality Control Plans (ITPs) are approved.

If any operation in a Quality Control Plan (ITP) plan requires change, the Contractor shall revise the plan and resubmit for approval as above.

Waiving of any tests shall not release the Contractor of its responsibility to fully meet the requirements of the Contract.

4.17.4.2 Requirements for Workshop I&T

4.17.4.2.1 General

The Engineer and/or Employer authorised representatives are irrevocably entitled to visit the workshops of the Contractor or its subcontractors at any time giving 2 months' notice for abroad and 3 days' notice within Pakistan to inspect the works performed in connection with this Project and to monitor the progress of work, scrutinise related documents such as suborders or work orders and to take photos as may be deemed adequate to the judgement of the said persons to document the actual status of work. Subcontractors' confidentiality requirements, however, will be respected.

4.17.4.2.2 Engagement of Third Party

The Contractor will engage, at its cost, a reputed international firm as third party to witness the inspections & testing at manufacturers' works. The Employer may nominate such firm or ask the Contractor to propose suitable firms to the Employer / Engineer for approval. Prior to each inspection, the Contractor

will obtain CVs of proposed inspector(s) from the third party and submit to the Employer / Engineer for approval.

After completing the inspection, the third party inspection firm will provide its report which will be submitted to the Employer / Engineer for review and approval.

4.17.4.2.3 Notifications and Witnessing

In addition to third party inspectors as detailed in the foregoing article, at their discretion, the Employer and the Engineer will participate in all or in a selected number of the specified workshop tests.

If the Employer / Engineer does not attend, then the Contractor shall perform the test duly witnessed by the third party inspection firm and submit a certified copy of the results to the Employer / Engineer.

The Contractor or sub-contractors as specified under the contract for the performance of the tests shall provide labour, materials, water, air, electric power, fuel, shop, apparatus and all necessary equipment for the performance of the said acceptance tests. If the equipment passes the tests, the Employer / Engineer shall give the Contractor a certificate testifying to this.

All these test documents have to be submitted to the Engineer in due time before the tests are performed. Test procedures for workshop tests shall be submitted not later than 90 days prior to the scheduled tests. The Contractor should notify Employer / Engineer well before the workshop test dates giving due consideration to time required by Employer / Engineer for their internal approvals as well as the time required by relevant Embassies in processing the visa applications.

Inspection sheets with Subject, attendance, result and comments shall be signed by all parties, and distributed immediately after the tests.

The Contractor shall bear all expenses such as visa processing, round trip international and domestic air travel, hotel accommodation (including meals and incidentals), daily allowance, all internal transportation etc. for each of the visits by the Employer's and Engineer's representative(s) to witness these tests. For each FAT, the Employer and Engineer shall each nominate one representative for attendance. The total number of person-trips for all FAT visits by the Employer's and Engineer's representatives shall not exceed twenty-four (24) person-trips.

4.17.4.3 Factory Acceptance Tests

At least the following FATs shall be performed and witnessed by representatives of third party inspection firm and by representatives of the Employer / Engineer. All the expenses to attend these tests by Employer's / Engineer's representatives, as stated in the preceding paras, shall be borne by Contractor.

Test No	Category	Equipment	Component	Activity
1.	Electrical	ST generator	Rotor	Balance, over speed and electrical tests
2.	Electrical	ST generator	Stator	Flux Test
3.	Electrical	ST generator	Complete	Final tests

Test No	Category	Equipment	Component	Activity
4.	Electrical	ST generator	ST Excitation System	FAT
5.	Electrical	ST GCB	GCB	FAT
6.	I&C	DCS	DCS Software	FAT
7.	I&C	DCS	DCS Hardware	FAT
8.	I&C	Steam Turbine Controller	Steam Turbine Controller Software	FAT
9.	I&C	Steam Turbine Controller	Steam Turbine Controller Hardware	FAT
10.	Mechanical	Steam Turbine	HP Rotor	Over speed tests
11.	Mechanical	Steam Turbine	LP Rotor	FAT

Note: *The above list of workshop test is not exhaustive and shall be supplemented later on as required*.

4.17.4.4 Requirements for Site I&T

4.17.4.4.1 General

The Engineer is irrevocably entitled to inspect any equipment under erection or commissioning at site at any time without prior announcement to document the actual status of work. The Contractor shall prepare a comprehensive site I&T programme and submit the same to Engineer for review / approval.

The equipment to be supplied under the Contract shall be tested at Site during erection, cold function (loop) checks and tests, pre-commissioning, commissioning, optimisation, trial run, reliability test and performance / acceptance test. These tests shall prove whether the equipment meets the requirements of the Contract and the safety conditions, whether it has been built and / or erected with satisfactory workmanship, whether the equipment is in conformity with the prevailing standards and regulations as well as with state-of-the-art technology and satisfies the specified operational requirements. All tests shall be carried out by the Contractor's personnel in the presence of the Employer / Engineer.

Where manufacture or finishing is done at Site, tests and inspections shall be conducted as a re-placement for an appropriate workshop test.

All tests are to be accompanied by the test records signed by all parties. In case of tests involving also activity of other Contractors all remarks and comments shall be placed in the test record signed by all participants.

4.17.4.4.2 Notifications and Witnessing

Test procedures for site tests shall be submitted not later than four weeks prior to the scheduled tests, including all necessary drawings, excerpts of applicable standards, etc. for Employer/Engineer's approval.

Erection and commissioning work on major items of the plant shall not be continued without the approval given by the inspection report, or by permission in writing. If the Contractor continues with erection

without waiting for the Engineer's decision, it shall be required to dismantle the respective parts to make them accessible for inspection.

4.17.4.4.3 Construction Completion Certificate (CCC)

When a system or part of a system is completely erected, the Contractor shall notify in writing the Employer and Engineer that an inspection shall take place to determine that the concerned system is installed according to the Contract and to the approved documents and drawings.

The Contractor shall provide CCC for all the system before starting of pre-commissioning/commissioning activities. Without approval from Employer/Engineer, the Contractor shall not be allowed to proceed further with commissioning.

The following milestones are strictly requiring a CCC:

- Start of Blowing Out of Steam Pipes System
- Start of lube oil flushing for Steam Turbine and Generator
- First Steam admission to Steam Turbine
- First Synchronisation of Steam Turbine

4.17.5 General Technical Requirements for I&T

4.17.5.1 Non-Destructive Material Tests

The following inspection and test shall be performed on all the site welds, as a minimum, according to the corresponding standards:

- Visual Weld Inspection (VT)
- Radiographic Examination (RT)
- Ultrasonic Examination (PAUT)
- Magnetic Particle Test (MT)
- Dye Penetrant Tests (PT)

The above-mentioned NDT techniques shall be applied for the following systems/auxiliaries, as specified below. Further, 100% Visual examination shall also be done.

Sr. No	Systems/Auxiliaries	NDT Requirements
1.	HP Steam System	100% RT/PAUT and 100% Hardness Test (HT), 100% PMI

2.	IP & Reheat Steam System	100% RT/PAUT and 100% Hardness Test (HT), 100% PMI
3.	LP Steam System	20% RT
4.	Lube Oil System	20% RT
5.	Control/Hydraulic Oil System	50% RT
6.	Tie-in Joints	100% RT
7.	Hydrogen Piping	100% RT

4.17.5.2 Welds

The welds and the welding procedure documents shall be fully detailed and shall indicate clearly, which item it covers. The weld procedure documents shall be in accordance with ASME Codes. The following documents and actions shall be considered:

- Procedure Review
  - Weld Procedure Documents
  - Weld Procedure Qualification Tests
- Welders Qualification
- Pre-weld Inspections
- Post-weld Inspections
  - Quality Requirements for Welds
  - Mandatory Inspection
- Post-weld Heat Treatment
- Weld Repairs
- Special Requirements for Site Welds
  - Weld maps of all systems
  - Execution of Welds on Site
  - Quality Control of Welds and Materials
  - Non-destructive Examinations

4.17.5.3 Mechanical Component Tests

The following tests and inspections shall be considered at factory and after installation at site:

Balancing and Vibrations

The vibration levels shall comply with the requirements of ISO 10816 and ISO 7919 as applicable and shall cover:

a) Balancing

b) Blade Vibration Frequencies

c) Over speed Tests

d) Heat Instability Tests

The above tests shall be performed by the OEM in accordance with procedure based on International Standards and/or proven OEM standard.

1. <u>Metal Piping</u>

The Contractor shall test as follows:

a) Inspection of materials and dimensions used on the basis of the field manual to be supplied by the Contractor for verification of pipe marking and information on materials

b) Main steam (HP) piping systems shall be non-destructive tested in accordance with the following requirements:

   i. 100% RT or ultrasonic testing of circumferential and longitudinal welded seams in accordance with ASME standard.

   ii. 100% DPT of branch welded seams and fillet welds,

   iii. 100% Hydrostatic testing of ready-installed piping systems by means of water in accordance with ANSI B31.1 (Power Piping Code).

2. Unless specified otherwise, piping and equipment shall be field tested in accordance with the following requirements:

a) Associated lube and seal oil systems which could be impaired by the presence of water shall be tested with lube oil.

b) Piping systems shall be flushed until lines are thoroughly cleaned of loose scale and debris.

c) Gauges used for testing shall be installed as close as possible to the low and high point of the piping system.

d) Vents and other connections which can serve as vents shall be open during filling so that air is vented prior to applying test pressure to a system.

e) A strainer shall be installed in the fill line to minimise the possibility of foreign matter being introduced into the system during the pressure test and flushing operation.

f) Generally, all the piping systems shall be hydrostatically tested. Pneumatic testing of piping is acceptable only if specified in approved drawings.

g) In special cases, Pneumatic testing of piping at site is acceptable only if approved by the Employer.

4.17.6 I&T Requirements for Systems

The I&T plan shall include new and rehabilitation work. The Site I&T Program shall include, but not limited to, the following major equipment/system including the auxiliaries:

- Steam Turbine
- Lubricating and Seal oil System
- Generator
- IPB and MV & LV cables
- Transformers
- Protection system
- I&C Equipment

4.17.7 Tests on Completion

4.17.7.1 Tests on Completion Sequence

The Contractor shall carry out the Tests on Completion after submission of the required documents (As-built documents, Operation and Maintenance Manuals and the issuance of the Construction Completion Certificate) for the relevant system.

For the avoidance of doubt, the Tests on Completion under this Contract shall be limited solely to the systems, equipment, components, and facilities that are newly installed, replaced, rehabilitated, modified, or otherwise included within the Contractor's Scope of Work under this Contract. No Tests on Completion shall be required for any existing systems, equipment, or facilities that are not part of the Contractor's scope, except where such testing is necessary to demonstrate the proper integration, interface, or operation of the Contract Works with the existing plant.

The tests on completion shall be carried out in the following sequence:

- Pre-commissioning tests, which shall include the appropriate inspections and (cold or dry) functional test to demonstrate that each item of plant can safely undertake the next stage,
- Hot commissioning tests, which shall include the specified operational tests to demonstrate that the works or section can operate safely and as specified, under all available conditions,
- Trial runs, which shall demonstrate that the unit is able to operate under nominal conditions for 24 hours,
- Initial Operation, which shall demonstrate the unit’s all operating conditions and capabilities such as min load, max load, load rejection, automatic start of stand-by units and etc., for 5 days.
- Reliability test, which shall demonstrate that the unit is able to operate under variable conditions continuously at dispatcher/client request for seven (7) days,
- Performance test, which shall demonstrate that the Actual Gross Power Output (AGPO) of the Steam Turbine is equal to or greater than the Guaranteed Gross Power Output (GGPO).

After the Construction Completion Certificate is signed for a relevant system, the system is released for commissioning to perform the Site test, loop checks, cold function tests and later on the hot function tests. Contractor shall prepare and submit commissioning test procedures for each system in advance.

Commissioning shall only be allowed to start after review/approval of commissioning procedures by Employer/Engineer. The Contractor shall provide schedule and ITP for commissioning of systems in advance.

4.17.7.2 Cold Commissioning Tests

Cold commissioning tests shall be performed for the new and rehabilitated systems belonging to the plant. The tests shall include the checks of safety features, protection, alarms, interlock values, etc. for each system/sub-system/equipment.

4.17.7.3 Hot Commissioning Tests

After successful completion of the cold commissioning tests, commissioning of the sub-systems and auxiliaries may start according to commissioning procedures. Hot commissioning tests shall be performed for all major system/equipment.

Hot commissioning tests shall be carried out to demonstrate that the plant can perform, under the steady state and transient operating conditions required by the Contract.

The hot commissioning test completion shall demonstrate the unit/plant operational behaviour under standard, extreme and special conditions. At least the following tests shall be included:

- Changeover to standby under different conditions
- Trip/runback conditions
- Critical functional tests
- Load variations.
- At least two (02) hour run test of pumps under normal conditions.

After the first synchronisation of a unit the Contractor shall start with the optimisation of the concerned generation unit, including the optimisation of the closed loop controls, the verification and finalisation of the open loop controls, live tests of certain protections, load run backs, automatic change-over of stand-by equipment, change-over of supplies.

4.17.7.4 Trial Run and Initial Operation

After the hot commissioning tests and optimisation are completed, the Contractor shall confirm the successful completion in writing and the unit shall perform a 24 hours continuous Full Load Run operation under nominal conditions.

After having satisfactorily completing all Preliminary and Functional Tests on the various plant components or systems and the Trial Run of the integrated plant, and after the relevant test protocols have

been complied by the Contractor and approved by the Employer/Engineer, the Contractor shall notify the Employer/Engineer that the plant/unit is ready for the start of a continuous Initial Operation for generation unit and its auxiliaries or for other equipment/installation.

4.17.7.5 Reliability Test

4.17.7.5.1 Prerequisites and Duration

After the Contractor receives the Engineer's acknowledgment that the plant is ready for service and has successfully completed Initial Operation, the Contractor may commence the Reliability Test Run (RTR) within a maximum of two (2) days. The Contractor is permitted to perform minor reconditioning and adjustments during this interim period.

The RTR shall last for seven (7) continuous days (168 hours) and shall encompass the steam turbine, its auxiliaries, and all other newly installed or rehabilitated equipment in combined cycle operation.

4.17.7.5.2 Operating Parameters

Operation of the Plant during the RTR shall be the responsibility of the Contractor, with the Employer providing operating staff to assist. During the 7-day RTR, the generating unit must achieve a consecutive 72-hour period of operation at base load. For the remaining duration, the generating unit shall follow the load pattern finalized by the Employer/Engineer in consultation with the Independent System & Market Operator (ISMO). The steam turbine and auxiliary equipment must operate continuously in accordance with prevailing network power requirements. No tests on individual components or systems shall be performed during this period.

4.17.7.5.3 Interruption and Restart Protocols

No shutdowns are permitted during the RTR unless caused by events beyond the Contractor's control. If the RTR is interrupted due to a failure, defect, or reason within the Contractor's responsibility, the test shall be aborted. The RTR shall restart from the beginning only after the Contractor has rectified the cause of the interruption to the full satisfaction of the Employer/Engineer.

4.17.7.5.4 External Trips and Root Cause Investigations

Any tripping of the steam turbine caused by a fault in the gas turbine, its auxiliaries, or any other non-Contractor equipment shall not constitute an RTR failure. In such events, the RTR time clock shall pause. The test shall not restart from the beginning; instead, it shall resume from the exact point of interruption once the specified combined cycle load is achieved again.

In the event of any steam turbine trip during the RTR, the parties shall jointly investigate the root cause within 24 hours. If the root cause is traced to the Contractor's rehabilitated scope, the RTR shall restart from the beginning. If the root cause is confirmed as non-Contractor equipment, the RTR shall remain paused until combined cycle operation is restored. The Engineer's determination of the root cause shall be final, subject to GCC Clause 50.

Any interruption, delay or inability to complete the Reliability Test attributable to equipment, systems, utilities or conditions outside the Contractor's Scope of Work shall not constitute a failure of the

Contractor's Reliability Test and shall be dealt with in accordance with the applicable Extension of Time provisions of the Contract.

4.17.7.5.5 Maintenance and Standby Equipment

Routine adjustments, cleaning of filter elements, and other minor actions prescribed in the operation manuals are permitted, provided the Contractor notifies the Employer/Engineer in advance.

The Contractor may switch over to redundant or standby equipment, provided they notify the Employer/Engineer in advance with the specific reasons for the switch. However, the Contractor must resolve the issue and restore the primary equipment to full availability within 24 hours of the switch-over. If the primary equipment is not repaired and made available within this 24-hour window, it shall be classified as an interruption, and the RTR must be restarted from the beginning.

4.17.7.6 Performance Tests

4.17.7.6.1 Prerequisites and Procedure

Upon the successful completion of the Reliability Test Run (RTR) and subsequent approval by the Employer/Engineer, the Contractor shall execute the Performance Tests. The performance tests shall be carried out in strict accordance with the approved Performance Test Procedures and the latest editions of the following standards:

- Steam Turbine: ASME PTC 6.2
- Overall Plant (Combined Cycle): ASME PTC 46

The following performance tests shall be executed:

- Steam Turbine Performance Test: To determine the Actual Gross Power Output (AGPO) of the Steam Turbine for the direct verification of the Guaranteed Gross Power Output (GGPO).
- Combined Cycle Performance Test: The Combined Cycle Performance Test shall be carried out to establish the power output and heat rate of the integrated combined cycle plant for information and assessment of overall plant operation. No separate commercial performance guarantee shall apply to the Combined Cycle Performance Test. Equipment outside the Contractor's Scope of Work shall not itself be subject to a performance guarantee under this Contract.

The successful completion of the Reliability Test Run, the Performance Tests or any other test or inspection under the Contract shall not discharge, dilute or qualify the Contractor’s obligation that the Works are completed and shall not constitute acceptance of any latent defect or of any non-conformity not apparent from such tests

4.17.7.6.2 Boundary Limits and Correction Curves

The ST Guaranteed Gross Power Output (GGPO) is strictly bounded by the ST inlet valves. During the test, the AGPO shall be corrected to the Reference Conditions (as defined in Section 3.7) utilizing the Contractor’s approved correction curves.

The correction curves must account for any deviations in the actual steam flow, steam pressure, and steam temperature delivered by the Employer's existing Heat Recovery Steam Generator (HRSG) to the Steam Turbine inlet boundary limits.

4.17.7.6.3 Acceptance Criteria and Zero Tolerance

Zero tolerance shall be applied to the Performance Guarantees. There shall be no negative allowance or deviation permitted from the GGPO. Furthermore, the calculated instrument and measurement uncertainty as defined by ASME PTC 6.2 shall not be used to artificially inflate the Contractor's test results to meet the Performance Guarantees. The corrected test result itself must strictly equal or exceed the GGPO.

Where the actual boundary conditions deviate from the Reference Conditions beyond the ranges covered by the approved correction curves, or where such boundary conditions cannot be established at the Reference Conditions due to the condition or availability of the Employer's equipment (HRSG, condenser, cooling tower, grid), the Performance Guarantees shall not be applicable for that test run.

4.17.7.6.4 Records, Reports, and Re-testing

The Contractor shall submit a Preliminary Performance Test Report to the Engineer within three (3) days following the conclusion of the test run. This preliminary report shall contain sufficient raw data and initial calculations to determine if the test was broadly successful.

The Final Performance Test Report, containing a complete thermodynamic analysis, calibration certificates, and final corrected results, shall be submitted for approval within fifteen (15) days of test completion.

If the AGPO does not meet the GGPO, the Contractor and Employer/Engineer shall investigate the cause of the shortfall. Where the shortfall is attributable to the Contractor's Scope of Work, the Contractor shall undertake the necessary corrective measures at its cost and repeat the Performance Test. Where the shortfall is demonstrated to be attributable to equipment, systems or conditions outside the Contractor's Scope of Work, the Contractor shall not be responsible for correction of such deficiency, and the Performance Test shall be repeated after the relevant Employer-side conditions have been restored.

4.17.8 Taking Over Certificate (TOC)

4.17.8.1 General

After the successful Reliability Test Run and the successful execution of the Performance Tests a final Inspection/walkdown shall be arranged between the Contractor, Employer, Engineer, and all deficiencies shall be recorded in a Punch List (list of deficiency to be resolved).

4.17.8.2 Procedure of Issuing the TOC

The Contractor shall notify Employer upon the completion of the works including satisfactory completion of the tests in writing, and shall request to the Employer/Engineer to issue the Take Over Certificate.

The Employer shall within 30 calendar days after receipt of such notice, conduct inspection of the works and either issue the Taking Over Certificate to the Contractor or notify the Contractor of the unfinished portions of the works or specify deficiencies which shall be completed by the Contractor before the issuance of such certificate.

Minor defects, errors or omissions recorded in the Punch List which do not prevent the plant and auxiliary installations from continuous safe and reliable operation shall not be considered as a cause for postponing issuance of the Taking Over Certificate. In this case the Certificate shall be issued with a Take Over Defects List of the minor open items attached, along with a mutually agreed schedule for correction and/or resolution of those items. However, the Contractor shall take minimum possible time for the resolution of those items and the Employer/Engineer shall not issue Defect Liability Certificate until all the open points has been corrected/resolved.

The date of the Taking Over Certificate is the starting date of the respective Defects Liability Period.

However, issuance of the Taking Over Certificate does not constitute final acceptance of the Works or acknowledgement by Employer that the Contractor has satisfactorily completed performance of its obligations under the Contract.

The Contractor shall submit all test reports, marked-up (as-built) drawings and other relevant documents prior to the issue of TOC. The Contractor shall supply to the Employer/Engineer a complete, legible set of red-lined (marked-up) drawings, all test reports and other relevant documentation. The Works shall not be considered complete for the purposes of taking over, and the Taking-Over Certificate shall not be issued, until all such red-lined drawings and preliminary documentation have been supplied to and verified by the Engineer.

The Taking Over Certificate shall enclose all certificates issued before the Taking Over Certificates.

4.17.9 Warranty - Defects Liability Period (DLP)

The Contractor warrants during Defects Liability Period (also referred to as Warranty Period) that all plant furnished and work performed under the Contract shall be free from defects in title, design, materials, and workmanship and shall conform in all respects to Technical Specifications and the terms of the Contract.

Prior to the start of the Defects Liability Period, Contractor shall perform a warranty inspection of the plant, to determine if any defects or nonconformity exists.

Should the Warranty Inspection reveal any defects or nonconformity, Contractor shall perform all redesign, repairs, replacement and tests necessary to correct the said defect or nonconformity.

Upon receipt of written Employer’s notice by Contractor of any defect or nonconformity in any part of the plant, or works during the Defects Liability Period, the defect or nonconformity except for normal wear and tear, shall be redesigned, repaired, or replaced by Contractor at a time acceptable to Employer.

All costs incidental to such redesign, repairs, replacement, and testing, including the removal, replacement, and reinstallation of equipment and materials necessary to gain access, shall be borne by Contractor. Contractor warrants such redesigned, repaired, or replaced works against defective design, materials, and workmanship for a period of 24months from the date of such repair or replacement of works. Should Contractor fail to promptly make the necessary redesign, repairs, replacement, and tests, Employer may perform or cause to be performed the same at Contractor's expense. Contractor and its surety or sureties, if any, shall be liable for the satisfaction and full performance of the warranties as set forth therein.

The foregoing warrants are exclusive and in lieu of all other warranties whether written, oral or implied. There is no implied Warranty of Merchantability or Implied Warranty of Fitness for purpose.

Not later than three (3) months after the date of the Taking-Over Certificate, the Contractor shall submit to the Employer the final As-Built Drawings and final Operation and Maintenance (O&M) Manuals in the formats and quantities specified in the Contract. Completion of this obligation shall be a condition precedent to the release of the payments linked with the Defects Liability Period.

4.17.10 Defect Liability Certificate

The Contractor may notify Employer to issue the Defect Liability Certificate at any time after the end of the Defects Liability Period provided the Contractor has satisfactorily performed its obligations under the Contract. Such notice shall be in writing.

If Contractor replaced or renewed any portion of the works, during the Defects Liability Period, the obligations of the Contractor shall continue, and the right of the Contractor to apply for a Defect Liability Certificate, other than the portions replaced or renewed, shall not be affected. After the Contractor has ceased to be under any obligation in respect to the portions replaced or renewed, the Contractor may apply for Defect Liability Certificate in respect to the works or portions replaced or renewed.

Within 30 calendar days after the delivery of such notice Employer/Engineer shall verify the completion of the Works and either issue to the Contractor the Defect Liability Certificate indicating the date on which the Works were completed, or specify the deficiencies, which are required to be completed by the Contractor before the issue of such certificate. Upon completion of specified deficiencies, the Contractor shall notify Employer/Engineer in writing and Employer/Engineer shall, within 30 calendar days of the date of receipt of such notice either issue a Defect Liability Certificate or give the Contractor notice of the failure to repair the specified deficiencies. In the latter instance, the foregoing procedure with respect to such specified deficiencies shall be repeated.

In accordance with the provisions of the above paragraph, the Contractor may request and Employer/Engineer shall issue a Defect Liability Certificate for any portion of the Works for which a separate Taking Over Certificate Date is provided.

The issue of the complete Defect Liability Certificate signed by Employer/Engineer indicates that the Contractor has performed all of its obligations and shall be deemed to constitute the completion of the Works.

4.18 Project Scheduling

4.18.1 General

The Contractor will develop a Project Time Schedule or Project Programme using Primavera P6 and submit the xer and pdf files of the Programme to the Engineer for review and approval. The Engineer would review this Programme and closely following up on all activities. The Engineer would also analyse the schedule, e.g. on room for improvement, criticality of activities, etc. and advise the Contractor accordingly. The Programme, shall also allow to judge on the progress of works in the frame of Invoice Verification. It is therefore essential for the success of a Project that the Contract Programme complies with certain minimum requirements as further detailed hereunder.

It is further essential this Programme to be made available to the Engineer allowing to fully interrogate and analyse this schedule.

4.18.2 Schedule Structure and Composition

The Project shall have a work breakdown structure (WBS). This is required, in order, to categories the activities into different codes that relate them to the Project. The codes shall act, as tags or attributes of each activity to allow the programme to be grouped, summarized, and filtered in or out of the display in soft copy.

The Contractor shall develop a WBS based on the Activity Code function. This Contractor will assign relevant codes to each activity in a time scheduling software tool (e.g. Primavera).

The WBS shall have a hierarchal structure to be developed by the Contractor breaking down the Project tasks into definable and recognizable activities of manageable and logical headings. The Contractor shall ensure that this is a fully integrated and co-ordinated structure, which is arranged under at least four levels.

These should be, as follows:

- Level 1: key phases of the Project;
- Level 2: Project systems, as described in scope of works;
- Level 3: key disciplines;
- Level 4: sections or areas of Projects.

The Contractor shall ensure that contract schedule has clearly identified all the Project key deliverables, milestones and have shown these within the WBS. The design and engineering phase of the schedule, shall show for each system and discipline the relevant design activities, which are clearly identified and sequenced in order of their priorities, leading to submission of corresponding drawings, studies, and reports etc.

The procurement and manufacturing phase shall indicate the dates for placing of order with sub-contractors and suppliers for each system, discipline and show the interrelationship between these and their relevant predecessors from the design and engineering phase.

The schedule shall also show all dates of placing order for material and equipment, their corresponding delivery periods and detailed design within their manufacturing period, arrival dates at port of importation, custom clearance and the transportation to site.

The construction and erection phase shall show for each system, discipline and area of construction clearly defined activities that are linked to their relevant predecessors from the design and engineering and the procurement and manufacturing phases.

The programme shall have a measurable finish point for each group of activities, which is identified and indicated in the schedule by a Milestone event with a designated zero duration.

4.18.3 Periodical update

Periodical update of schedule according to deliverables and visual inspection during supervision activities is a comparison of planned stage and current status of the Project.

- **Programme updates**

The Contract schedule will require updating and status. As a consequence of this process, there is potential for creation of three versions of the contract schedule. These are as following:

- Contract Schedule (baseline);
- Contract Schedule (current);
- Contract Schedule (recovery).

Contract Schedule (baseline) - this shall be the approved contract schedule, as previously stated shall not be changed or altered without approval and it will remain unstated.

Contract Programme (current) - this shall be the same version, as Contract Schedule (baseline) but set up by the Contractor at the end of each month with the same activities' logic links or their original durations as in the Contract Schedule (baseline). The Contractor after each set up the schedule shall carry out time analyse to establish the new position of the programme. An electronic unfiltered copy of this programme shall also be included in the Monthly Report.

Contract Schedule (recovery) - if after time analysis the Contractor find the key contract dates are overrun by more than one calendar month, it shall then make appropriate changes to the logic and resource level of the activities with the negative total float, in order to maintain the original key dates.

This adjusted schedule shall be labelled, as Contract Schedule (recovery). The Contractor shall note all the changes that are made to each activity and log these, describing each change and the reason for it. An electronic unfiltered copy of this recovery schedule including these logs shall also be included in the Monthly Report.

4.18.4 Schedule review

The review of Contractor’s schedule in accordance to consistency, time schedule logic and contractual agreed baseline shall be done by the Engineer.

4.18.5 Progress report

Contractor’s Monthly Progress Report shall be based on the Contract schedule. A typical content for Contractor’s Report should comprise the following aspects to allow Engineer a swift review:

4.18.5.1 Progress of Design and Engineering

Contractor’s narrative and explanation, as to the reason(s) for any variance between planned and actual and the corrective actions it has taken to resolve this. Contractor’s brief overview on the status of submissions and approval and any relevant actions taken to resolve any design problems encountered during the reported period.

Contractor's full list of drawings and other documents submitted for approval, drawings which were approved by Employer/Engineer and drawings issued for construction in the reported period, all with respective approval status. Contractor's list of the critical issues relevant to this section including S-curve of the overall planned cumulative progress compared to actual cumulative progress.

4.18.5.2 Procurement and Manufacture

Contract's brief overview on the status of procurement and any relevant actions taken to resolve manufacturing, shipment and delivery problems encountered during the reported period. Contractor's full list of procurement activities, which were completed in the last reported period and a new list of procurement activities planned for the next report period with reference to the relevant Contract Programme. This shall include detailed material flow chart. Contractor's critical issues relevant to this section including S-curve of the overall planned cumulative progress compared to actual cumulative progress.

4.18.5.3 Commissioning and Handovers

Contractor's brief overview on the status of commissioning phase noting any relevant actions taken to resolve any related problems, which had been encountered during the reported period.

Contractor's list of commissioning activities from the primavera programme, which have been completed during the reported period and four weeks look-head programme for the next reporting period. Contractor's list of the critical issues relevant to this section including S-curve of the overall planned cumulative progress compared to actual cumulative progress.

4.18.6 Health, Safety and Environment

Contractor shall highlight occurrence of any incident in this report period compared to the previous report period noting any improvement trend or otherwise and state any actions taken to better this situation.

4.18.6.1 Health and Safety

All components of the Project shall be constructed, installed and commissioned and be operable and maintainable in full compliance with relevant health and safety at work orders, all related acts, regulations, codes and statutory requirements of the Laws of Pakistan and of the World Bank, whichever is stringent.

The Contractor shall submit a Health and Safety Plan for all relative preliminary health and safety documentation prior to commencing work on the Site.

The Health and Safety Plan shall have method statements, which will include, but not be limited to, working methods, plant utilisation, construction sequence and safety arrangements.

The Contractor's key duties are to:

- Develop and implement the Health and Safety Plan, including rules for management of the construction work;

- Ensure that Sub-Contractors and workers comply with the health and safety plan;

- Monitor health and safety performance of Sub-Contractors and given directions as appropriate;
- Arrange for competent and adequately resourced Sub-Contractors to carry out the work where it is subcontracted;
- Ensure the co-ordination and co-operation of Sub-Contractors;
- Obtain from Sub-Contractors the main findings of their risk assessments, the steps to be taken to control and manage the risks, including method statements for all aspects of the work;
- Ensure that Sub-Contractors and workers have information about risks on Site and that there are co-ordinated arrangements for workers to discuss health and safety and offer advice to the Contractor;
- Ensure that all workers are properly informed, consulted and trained on health and safety issues;
- Make sure only authorized people are allowed onto the Site;
- Pass information to the Owner for the health and safety file.

4.18.6.2 Hazards

The Contractor shall be fully responsible for identifying and mitigating all hazards and take precaution against such hazards as are related to the Owner's occupation and use of the Site, and which are known or expected to be present on it.

The Contractor shall warn and instruct its workmen and all other persons (including visitors) under its control as to the hazards and precautions to be taken. Such instruction shall be in the Contractor's Safe Systems of Working or other documents issued under this Design Specification.

The Contractor shall remain alert to the possibility of other hazards, and if they occur he shall give instruction in accordance with the aforementioned procedure.

The Contractor shall design the plant and exercise care to minimise as far is reasonably practicable all risks and consequences of the following potential hazards:

a. Falling from heights

b. Falling into water

c. Entanglement with machinery

d. Tripping over permanent obstacles or temporary obstructions

e. Slipping on greasy or icy walkways

f. Falling objects

g. Asphyxiation

h. Explosion

i. Contact with dangerous substances

j. Electric shock

k. Mistakes in operation

l. Variable weather conditions

m. Lifting excessive weights

n. Traffic operations

4.19 Training

The Contractor will provide training to the Employer's staff who shall be suitably experienced and qualified on the safe, reliable, and efficient operation and maintenance of the components of the Project supplied by the Contractor in accordance with the standards set out in the Specifications. The Contractor will use its best endeavours so that such personnel are able to operate and maintain the Plant without further assistance of the Contractor to the level where operational competence shall be achieved by no later than the date of the commencement of commissioning. Training shall be conducted at similar combined cycle power plant and / or manufacturing facility (Off shore training) and at job site in classroom facilities using audio visual aids, handbooks and manuals (on Shore training). All cost for training including providing training material is included in the Contract Price.

4.19.1 Offshore Training

The Contractor shall provide the offshore training of 5 man-months (5 Persons for 30 days) mainly covering the steam turbine generator and instrumentation and control systems.

4.19.2 On Shore Training

The Contractor shall provide the onshore training of 20 man-months (20 Persons for 30 days). Training shall include but not be limited to the following,

- Steam Turbine Generator Operation and Maintenance.
- Instrumentation and Control Systems
- Combined Cycle Operation
- Power Plant Electrical System (Excitation System, Generator Protection System)

In addition to above the on-site practical training throughout the commissioning period will be given to the Employer's staff.

4.20 Site Installations

4.20.1 Construction Power and Electricity

The Contractor shall be responsible for making their own arrangements for the adequate supply of electricity required for the construction and installation phase of the Works. The Contractor shall provide electric power for their construction activities, site offices, and accommodations by installing generators or, subject to Employer approval, by drawing from the Employer's grid via Contractor-installed transformers, tariff meters, and necessary accessories.

The Contractor shall make similar arrangements to provide uninterrupted electric power to the Employer and Engineer site offices. If the Contractor draws temporary construction power from the Employer, the Contractor shall pay for the consumed electricity at a mutually agreed rate. In case of any breakdown, load shedding, or interruption of the Employer's power supply, the Contractor shall maintain backup generators to carry out the works and power all site offices. The Employer shall not be liable for any delays or costs arising from power supply interruptions.

4.20.2 Construction Water

The Contractor shall provide and arrange their own potable and non-potable water supply for all construction activities, civil works, and domestic use at site offices and accommodations. All costs associated with construction water supply shall be borne by the Contractor. If the Employer supplies raw or potable water for construction purposes, the Contractor shall pay for it at a mutually agreed rate

4.20.3 Commissioning Utilities (Power and Demineralized Water)

Notwithstanding Clauses 4.20.1 and 4.20.2, the Employer shall provide, free of charge to the Contractor, the necessary electrical auxiliary power (via the unit auxiliary transformer) and demineralized water required for flushing, steam blowing, cold commissioning, hot commissioning, synchronization, and performance testing of the permanent plant equipment. The Contractor shall coordinate with the Employer in advance to ensure the timely availability of the station auxiliary power and demineralized water systems.

5. EMPLOYER'S RESPONSIBILITIES

The Employer shall, at its own cost and responsibility, ensure that all existing plant systems, facilities, utilities, and interfacing equipment outside the Contractor's Scope of Work are fully rehabilitated, operational, tested (where applicable), and made available in a condition suitable for execution of the Works, pre-commissioning, commissioning, Tests on Completion, and performance testing. The Employer shall be responsible for, including but not limited to, the following:

1. Making available the Gas Turbine(s), HRSG(s), main steam system, reheat steam system, steam bypass system, and all associated piping up to the Steam Turbine inlet valves in a fully operational condition.

2. Ensuring the availability and operability of the condenser, circulating water system, cooling water system, cooling towers, once-through cooling system, condensate system, feedwater system, deaerator, boiler feed pumps, condensate extraction pumps, gland steam system, vacuum system, drain and vent systems, and all other balance-of-plant systems required for safe operation of the Steam Turbine.

3. Ensuring that all electrical systems outside the Contractor's Scope of Work, including switchyard, grid interconnection, station service system, auxiliary transformers, unit transformers, protection systems, synchronizing facilities, and grid availability, are ready for synchronization, commissioning, and performance testing.

4. Making available all plant utilities, including electrical power supplies, instrument air, service air, demineralized water, raw water, cooling water, potable water, hydrogen, compressed air, lubricants (first fill where specified), chemicals, fire protection system, and drainage system, specifically for the commissioning, testing, and operation of the permanent plant equipment. Utilities required for general construction activities and site installations shall be the Contractor's responsibility as defined in Clause 4.20.

5. Completing all rehabilitation, maintenance, repairs, inspections, statutory certifications, and testing of equipment not included within the Contractor's Scope of Work but necessary for safe and reliable operation of the Plant.

6. Ensuring the readiness and operability of all interfacing systems, equipment, instrumentation, communication networks, control systems, and auxiliary facilities necessary for the successful integration of the rehabilitated Steam Turbine, Steam Turbine Generator, DCS, and associated auxiliary systems.

7. Providing unrestricted access to the Work Areas and ensuring that all interfacing systems are isolated, released, or made available in accordance with the approved project schedule.

8. Providing all temporary and permanent operational personnel necessary for operation of the Plant during steam blowing, commissioning, trial operation, and Tests on Completion, with technical support from the Contractor where specified.

9. Suppling one (1) initial volumetric fill of lube and hydraulic oil for final operation. All sacrificial oil required for flushing, chemical cleaning, and subsequent top-ups prior to the Taking Over Certificate shall be supplied by the Contractor.

10. Ensuring that the existing plant conditions do not prevent or delay the Contractor from carrying out the Works. Any delay arising from the unavailability, malfunction, incomplete rehabilitation or failure of systems, equipment, utilities or facilities under the Employer's responsibility shall constitute an Employer-caused delay and shall entitle the Contractor to the Extension of Time and other contractual relief to which it is entitled under the Contract. Such entitlement shall apply to the Combined Cycle Restoration Period and any other affected contractual milestone.

    For the avoidance of doubt, the Contractor's guarantees, commissioning obligations, Tests on Completion, reliability tests, and performance tests shall be applicable only after the Employer has confirmed that all interfacing systems and balance-of-plant equipment outside the Contractor's Scope of Work are fully operational and available for integrated plant operation. Accordingly, the date on which the Employer confirms readiness of the relevant Employer-responsible systems shall constitute the earliest date from which the Contractor's applicable commissioning, Reliability Test Run and Performance Test obligations shall commence, subject to the Contractor having completed the prerequisites within its Scope of Work.

11. The Employer shall ensure that all statutory approvals, permits, environmental clearances, fuel supply arrangements, cooling water availability, and grid dispatch permissions necessary for commissioning and performance testing are obtained in a timely manner.

12. The Employer shall be responsible for any repair, rehabilitation, replacement, or modification of equipment outside the Contractor's Scope of Work that may be identified during commissioning or performance testing as defective, unavailable, or incapable of supporting the operation of the rehabilitated Steam Turbine, Steam Turbine Generator, and associated systems.

6. TECHNICAL REQUIREMENTS - CIVIL

6.1 General

This section covers the design, construction, supply and testing of all civil works required for the rehabilitation of the Plant.

The civil works referred to here must be performed in such a manner that the high standards of quality and required functionality are fully achieved. All material shall be new and of best quality suitable for working under all the conditions, variations in temperature and load encountered in service without undue distortion or deterioration or the occurrence of undue stresses in any part, such as to affect the efficiency and reliability of the Plant.

The Contractor is not allowed to use the works, materials or furniture or parts thereof for temporary or execution purposes without the written consent of the Employer.

The scope of civil works for the project shall include, but not limited to the following:

- Site Investigations, surveys, and soil analysis of the existing plant area required for rehabilitation works, along with any other necessary studies/investigations, as deemed necessary by the Contractor;
- Design for all civil works (incl. structural analysis, calculations, design drawings, shop drawings, working and finishing drawings etc.), required under rehabilitation scope;
- As-built survey of existing foundations, structures, buildings and facilities within the rehabilitation scope;
- Preparation and development of construction & laydown areas, if required;
- Removal of all debris, underground obstacles (if any) and surplus materials to approved dumping locations;
- Earthworks, excavation and backfill, if need arise;
- Structural assessment of existing turbine and equipment foundations, and their complete rehabilitation, strengthening and modifications works as detailed in scope of work;
- Demolishing and disposal of the existing buildings/structures, if/as required;
- All ancillary works, preparatory measures and installations necessary for the execution of civil works, such as but not limited to: fencing, signs, scaffoldings, safety measures etc;
- Reinforced concrete works, retrofitting/strengthening, including concrete repair materials, repair mortars, grouts, and associated materials;
- Relocation & reinstatement of any existing underground piping, cabling structure/obstacles, equipment foundations and above-ground installation etc., if any, which may interfere with the rehabilitation scope;
- All civil works required for additional/new equipment, trenches, support structures etc. to be provided for rehabilitation scheme as per design requirement;

- Any existing roads or paved areas damaged by construction traffic or due to any other reason attributable to the Contractor shall be repaired, repaved and reinstated to original condition by the Contractor;

- Repair works including concrete grouting & coating, epoxy treatment, cleaning and re-painting of concrete surfaces, etc.;

- Site organization works for the entire Project execution phase including but not limited to:

    - Preparation of all temporary and permanent surfaces.

    - Temporary buildings for offices; stores; workshops; sanitary installations; canteen and kitchen, first aid station, etc. offices for the staff of the Employer/ Engineer.

    - Open area for construction & erection yard, temporary maintenance works etc.

    - Security installation on the site, including temporary fencing, walkthrough gates etc.

    - Access roads and outdoor storage facilities, where required.

    - Temporary water and uninterrupted electricity supply.

    - Sewage and storm water drainage systems for the construction sites.

    - Final cleaning of the temporary and permanent plant sites to the full satisfaction of the Engineer.

    - Housekeeping and cleaning of the sites during construction and equipment erection/ testing works.

6.2 Temporary Site Installation and Preparatory Works

6.2.1 Site preparatory works

The site preparatory works include preparation of the Plant site, including also the surfaces allocated for temporary activities of the site organization.

6.2.2 Areas to be cleared

The Contractor shall clear all materials, debris, vegetation, etc., from the areas required for the temporary works and accesses, but shall take all reasonable precautions to prevent damage to existing infrastructure and other facilities in the zone which do not need to be cleared.

All trees and vegetation in the areas needed for the execution of works, including rubbish and objectionable materials not designated to remain, shall be felled, stumped, stacked or disposed off. The Employer, however, reserves the right to take over all trees removed from a defined area for his own use.

6.2.3 Disposal of cleared materials

Materials removed during clearing operations shall be buried in designated disposal areas or otherwise disposed of as approved by the Employer.

6.2.4 Contractors' temporary site office and residence buildings

The Contractor shall be responsible to construct and develop its temporary facilities including site offices, residences and other structures. A suitable area for the construction of the temporary facilities near the Site will be provided by Employer. However, all developmental activities relevant to area including, clearing, levelling, grading, finishing, and infrastructure development shall be responsibility of the Contractor.

The Contractor will be responsible to Construct, fully furnish and maintain its offices during the duration of the Project. At the end of the Project, Contractor will hand over their offices including furniture, office equipment and all other equipment/items/installations etc. in as it is condition to the Employer, and nothing will be removed from their office.

At the completion of the works, all the Contractor's temporary buildings, structures, and equipment except Contractor's office & residences and Engineer's office & residence, must be removed from the site to the Employer's/Engineer's approval and the site returned to its original state. All resulting debris shall be removed to an approved dumping area to the Employer's satisfaction.

The Contractor shall protect all material against corrosion, mechanical damage or deterioration during storage and erection on site. The protection shall be to the approval of the Employer and his nominated Engineer.

The Contractor is to provide at site, the first aid station including an ambulance fitted with all essential facilities. The station shall be made available for the use of all personnel who shall be employed on the site for overall Project works.

Temporary latrines and ablutions

The temporary toilets and ablutions shall be provided for the use of the Contractor and his sub-contractors.

The Contractor shall also include in his Contract the disposal of the sewage resulting from all temporary toilet and ablution facilities.

Temporary electricity and water supplies

The supply of electricity and water for all temporary site installations, including the Contractor's and Engineer's site offices and residences, as well as for general construction works, shall be provided and managed by the Contractor in strict accordance with Clause 4.20.

Temporary security fencing including gates and barriers

Galvanized fencing of 2.5 m minimum height, including barbed wire, shall be provided around the temporary facilities, and open storage areas. Vehicle gates and pedestrian gates adjacent to the gatehouse shall also be provided.

6.2.5 Engineer's Site Office, Accommodation and Transportation

6.2.5.1 General

The Contractor shall be responsible to develop the fully furnish site office & Residences, fulfilling all the requirements as detailed hereunder, and handover for the use of Engineer's staff within two (02) months from Notice to Proceed (NTP). A suitable area near the Site shall be provided by Employer for construction of temporary offices and residences for the Engineer's Staff.

During construction of Engineer's office & residences, Contractor will arrange and provide temporary office & residences with all the facilities as mentioned in the following paras for Engineer's staff. After the construction/furnishing of Engineer's office & residence is complete, Contractor will make shifting of all the furniture, office equipment, Engineer's staff belongings etc. to the new office.

Layout of Engineer's site office showing offices, meeting hall, Kitchen & messing facility, prayer room, tearoom, ablution area, bathroom, office furniture, lighting etc. shall be submitted for Engineer's approval. Drawings for civil, architectural, electrical, plumbing, and drainage works for newly constructed facilities will also be submitted for approval.

The entire area for the Engineer's facilities shall be properly fenced and provided with access control measures, including gates, guard house, etc. ensuring complete security for the staff. The Contractor shall be responsible and arrange a well reputed security company to provide 24/7 security for Engineer's site office & residence. All office meetings between Employer, Engineer and Contractor at site shall be arranged and managed by the Contractor.

Contractor will provide the following to Engineer, free of cost, for their office during the Contract upto the end of DLP:

1) Uninterruptible supply of electricity, gas, hot & cold water, internet/WiFi connections
2) Supply of office equipment, furniture, other installations/items, office supplies, soap, hand wash, toilet paper, tissue boxes and all other cleaning and janitorial supplies for both offices & residence shall be provided by the Contractor.
3) Complete maintenance of offices, office equipment, furniture (office & residence) and all other equipment & installations/items
4) Bottled drinking water, tea, and coffee.
5) All supporting staff including office boys, tea boys, sweepers, security guards etc.
6) All the bathrooms, tea rooms, kitchen and ablution areas shall be provided with electric water heaters (geysers).
7) Solid and liquid waste disposal system including its ultimate disposal as approved by Employer/Engineer

The extent of these specifications is to provide the installations, material, equipment and services specified herein to be fully complete in every respect. All the installations, material, equipment and services which are not specifically mentioned in these specifications, but which, in the opinion of the Engineer, are usual or necessary for the satisfactory completion of installations, material, equipment and services, shall be deemed to be included in these specifications and shall be provided by the Contractor without extra cost to the Employer.

All the offices & residences for Engineer's use including their furniture, office equipment and all other equipment/items/installations etc. will be the property of Employer. Employer will take over these areas on as it is basis, at the end of DLP and Contractor will not remove or take away anything.

6.2.5.2 Engineer's Site Office and Transportation

Contractor will establish a fully furnished and fully air-conditioned (heat and cool split type air conditioners) office areas for the exclusive use of a minimum of ten (10) Engineer's staff. The site office will include sufficient number of office furniture, office equipment, photocopiers, printers, laptops, projector, LEDs etc. for Engineer's staff as mentioned in the Table 6.2.5.2-1. Contractor shall be responsible for all the maintenance and replacement of office furniture, office equipment and all other equipment/items/installations throughout the duration of Contract upto the end of DLP.

The Contractor shall be responsible for providing uninterrupted electricity, gas, hot & cold water and internet/WiFi facilities along with sufficient supplies of tea, coffee, snacks and bottled drinking water for Engineer's staff, visitors and for all the participants of meetings to be held in the office. Soap, hand wash and all other cleaning and janitorial supplies shall be provided by the Contractor. All supporting staff to run the offices including office boys, tea boys, sweepers, security guards etc. in adequate numbers will be provided by the Contractor.

Engineer's site office will comprise the following spaces as the minimum. Some more spaces may be added during review and approval:

1) One (1) Chief Resident Engineer office
2) Four (4) offices for Senior Engineers
3) One (1) office/hall having total four (04) engineering workstations for Engineers.
4) One (1) big size office for admin staff and storing drawings, documents & material samples. Sufficient no. of racks, cabinets, drawing tables and chairs shall be provided as approved by the Engineer.
5) One (1) meeting room with HD Projector and Conference call device having HD Camera, LED Screen, microphone and speaker for data presentation and online meetings. Conference table with capacity of 20 chairs and 10 additional chairs shall be provided.
6) One (1) Pantry room
7) A fully functional messing facility with kitchen, cold & dry storage (provided with all equipment such as burners, stoves, ovens, hot plates, sinks, refrigerators, freezers, storage containers, etc.) along with a dining hall for capacity of 16 persons
8) Washroom having at least two (2) Eastern and two (2) Western WCs.

Number and arrangement of office spaces, office furniture, office equipment etc. will be finalized during Engineer's review and approval. All the office spaces will be adequately heated/air-conditioned. The building (brick masonry works) and its finishes shall be of good quality and shall be subject to approval of the Engineer.

A fully carpeted and fully air-conditioned (heat and cool split type air conditioners) prayer room shall be provided having capacity of 20 persons to say their prayer. Ceiling fans shall also be provided in the prayer room. An ablution area for four (4) persons close to the prayer room shall also be provided with electric water heaters (geysers). Vacuum cleaner shall be provided for carpet cleaning.

Each office room shall have adequate lighting and power points. A Internet/WiFi network shall be installed. The internet speed shall be adequate enough to cater the load of 10+ engineers/staff and online video conferences. The offices, meeting room, tea room/kitchen, prayer room, ablution area and toilets shall be fully furnished and equipped. The kitchen sink, ablution area and toilet wash basins shall have hot and cold water supply.

Total twelve (12) laptops as detailed in the following Table 6.2.5.2-1 shall be provided for Engineer's personnel equipped with usual business software package (Word, Excel, Power Point, Outlook, Visio, Adobe Acrobat) on every machine and two machines with CAD, MS Project and Primavera software. Complete maintenance of all the laptops, other office equipment and all other equipment/items/installations shall be the Contractor's responsibility.

The Contractor shall include in his scope the office supplies including printer/photocopy machine toners (colour and B&W), papers, all other stationery items, soap, hand wash, toilet paper, tissue boxes and all other cleaning & janitorial supplies etc. as well as maintenance and cleaning of complete site office including all offices, prayer room, team room/kitchen, mess, ablution area, toilets, guard room and the site roads etc. Sufficient number of fire extinguishers shall also be provided in the site office.

Sun shaded car parks for 8 cars, a temporary elevated water tank and a septic tank with cesspool shall be included as well. Sun shaded car parks for four vehicles for visitors shall be provided.

At the minimum, the following furniture, office equipment, other items and supplies, etc. shall be provided and maintained by the Contractor throughout the duration of the Contract until the end of DLP. Contractor will get approval of Engineer for all the furniture, office equipment, other items and office supplies before purchasing.

Table 6.2.5.2-1: Furniture, Office Equipment and Supplies for Engineer's Site Office

Sr. No	Item Description	Qty	Remarks
1.	Office table	-	1 senior manager tables 5 manager tables 4 Engineers workstations
2.	Desk chair	12	
3.	Visitor chairs	25	
4.	Sofa & sofa chairs	-	For seating capacity of total 8 persons
5.	LED 42" with HDMI cable connection	1	For CRE office
6.	Box file rack	10	
7.	Meeting room table for 20 persons	1	
8.	Meeting room chairs	30	
9.	HD Projector	1	For meeting room
10.	Conference call device having HD Camera, microphone and speaker	1	For meeting room
11.	Table for drawings review	2	
12.	Shelves in Library	6	As per requirement
13.	Filing Cabinets 4 drawer	8	
14.	Kitchen worktop, cabinets	-	As per requirement
15.	Kitchen table	1	
16.	Kitchen chairs	3	

Sr. No	Item Description	Qty	Remarks
17.	Photocopy/Scaning Machine Industrial grade A3-A4 size (55 p/m) from HP, Ricoh, Canon etc.	1	
18.	Supply of HP EliteBook 16" Laptop equipped with the latest generation Intel Core Ultra 7 processor, 64 GB DDR5 5600 MHz RAM, at least 2 TB PCIe Gen4 NVMe M.2 high-speed SSD, and integrated Intel Arc Graphics, pre-installed with a registered and licensed version of Windows 11 Pro 64-bit; the package includes a companion 27" 4K UHD (3840 x 2160) IPS LED monitor, a 2-meter premium HDMI 2.1 cable, an HP dual-mode precision wireless keyboard and mouse combo, a heavy-duty padded laptop carrying bag, and pre-installed licensed copies of Microsoft Office 365 Professional, Adobe Acrobat Pro, and enterprise-grade HP Wolf Security.	6	
19.	2TB external hard disc for data backup	2	
20.	Laser Printer (Black and White, DIN A3)	1	
21.	Laser Printer (Black and White, DIN A4)	3	
22.	Laser Printer (Colour, DIN A4)	1	
23.	Kitchen cabinets, equipment, stoves, burners, ovens, SS countertops, Sinks, storage areas	Lot	As per requirement. Proposal to be submitted for Engineer's review/approval.
24.	Telephone	10	Local telephone and extension system for internal use
25.	Large size refrigerator	1	
26.	Water dispenser	2	
27.	Microwave Oven	1	
28.	Coffee/Espresso Machine (Industrial Type)	1	
29.	Electric kettle	2	
30.	Kitchen utensils crockery cutlery	-	For mess, office use, visitors and meetings
31.	Office supplies	-	As per requirement

Sr. No	Item Description	Qty	Remarks
32.	Extension wires	-	As per requirement

Note: *The list is not exhaustive and will be supplemented later as per actual requirement.*

The Contractor shall provide the following vehicles for use of Employer/Engineer's personnel.

For Employer:

- One (01) fully loaded Toyota Hilux Revo V A/T 4x4
- One (01) fully loaded Sedan Car (1800CC) with automatic transmission

- For Engineer:

- One (01) fully loaded Toyota Hilux Revo V A/T 4x4
- One (01) fully loaded Sedan Car (1800CC) with automatic transmission
- One (01) fully loaded Toyota Hiace Commuter Dual AC (16 seaters) with automatic transmission

Contractor will handover above stated brand new vehicles to the Employer/Engineer within one month of NTP. All the vehicles shall be registered in the name of Contractor and fully insured before handing over to Employer. The Employer / Engineer will themselves arrange, for all the above vehicles, their fuel, drivers and routine maintenance (lube/engine oil, air/oil filters and tuning only).

All other types of maintenance, parts replacement and other expenses including but not limited to engine overhauling, spare parts replacement, tyres replacement, registration renewal, payment of insurance premium, denting & painting etc. will be the Contractor's responsibility. Contractor will immediately provide the above services on request of Employer / Engineer. During these services when the vehicles are not available with the Employer / Engineer for their use, Contractor will provide temporary replacement of these vehicles. At the end of DLP, all these vehicles will be returned to the Contractor on as it is basis.

6.2.6 Engineer's Accommodation

The Contractor will establish a fully furnished and fully air-conditioned (wall or split type air conditioners, and electric heaters) single status accommodation at site for the exclusive use for a minimum of 15 Engineers / staff of Engineer. The Contractor shall also maintain the accommodation throughout the duration of the Contract including Defects Liability Period and shall be responsible for providing / arranging electricity, gas & water facilities. The Contractor will also be responsible for arranging drinking water, uninterrupted power supply and internet. The Contractor shall also be responsible for providing mess facility to Engineer's personnel through the duration of the Contract including DLP. All supporting staff to run the accommodation including office boys, cooks, kitchen helpers, sweepers etc. in adequate numbers will be provided by the Contractor. The Contractor will also provide the laundry facility for Engineer personnel free of cost.

As minimum the room shall be equipped with Bed (including side tables & mattress), wardrobe, study table with chair, and furnishing items including curtains, bedding, etc.

The Contractor will also establish and maintain recreational facilities and spaces for use of Engineer personnel including but not limited to gym, indoor sports (table tennis, billiard / snooker etc.) as well as outdoor game facilities (badminton and basketball courts etc.).

The rooms and their finishes shall be of good quality and shall be subject to the approval of the Engineer.

All buildings and equipment provided in accordance with this requirement shall be made available within eight (08) weeks following the commencement of the works at the site and must not be removed without the prior approval of the Employer. During construction of Engineer's facilities, Contractor will arrange and provide temporary office & accommodation with all the facilities as mentioned in the preceding paras for Engineer's staff.

6.2.7 Laydown Areas for Contractor's Use

Lay down areas for the rehabilitation works will be designated by Employer within the premises of Guddu Power Complex. Contractor shall be responsible for preparation and development of the designated areas including removal of all debris, vegetation, fill material, underground obstacles (if any) and other surplus material to the approved dumping locations.

6.3 Underground Facilities Surveys

The underground facilities survey shall be carried out by the Contractor on relevant parts of the existing plant area requiring rehabilitation.

The scope of work shall include detection of the underground facilities (cables, pipes, etc.) distribution within the specified range, including buried depth, direction and facility type.

Before the exploration, the existing underground facility & as-built plans in the work area shall be collected by the Contractor. According to the actual situation of the site, the suitable method shall be devised and adopted for exploration. However, the facility shall be reinstated by the Contractor to the original condition after exploration works.

6.4 Earthwork

Earthworks, including excavation, filling, backfilling, grading and compaction, shall be carried out as required for the Works, including temporary installations and works within the existing plant area. All earthworks shall be executed in accordance with the approved drawings, site conditions and applicable standards.

The Contractor shall be responsible for the safe execution of earthworks, including provision of necessary shoring, dewatering, disposal of unsuitable/excess excavated material, and compaction of fills and backfills. Reuse of excavated material shall be subject to its suitability and approval by the Employer/Engineer.

6.5 Scope for Rehabilitation Scheme

The following is a brief description of the major scope of civil works for the project.

6.5.1 Rehabilitation of ST and STG Foundation and allied auxiliaries

6.5.1.1 General

During the fire incident, the ST foundation and some adjacent facilities/auxiliaries inside the ST Hall incurred varying degree of damages. Furthermore, based on the assessment results, it has been determined that the existing Steam Turbine Generator also needs to be replaced with a new one of similar footprint area.

Contractor shall be required to conduct a comprehensive safety assessment of the complete steam turbine and generator foundations, including associated auxiliary foundations/supports, cable trays, racks, pipe supports, and other components that have sustained damage. The turbine foundation shall also be evaluated for potential thermal effects resulting from the fire incident, including elevated concrete temperatures, thermal expansion and deformation of reinforcement, and associated thermal stresses. The assessment shall also determine any heat-induced deterioration or loss of concrete strength, stiffness, bond, and reinforcement properties, and its effect on the structural integrity and serviceability of the foundation.

A complete testing scheme including destructive and non-destructive testing as per the international codes & standards shall be devised by Contractor to evaluate the as-built strength of the existing structures/foundations and submitted for review/approval. Based on the results of the inspection & assessment, the structural design analysis shall be made and a comprehensive program for the strengthening, rehabilitation, retrofitting/modifications and repair works shall be developed and executed by the Contractor. Refer to provisions of Section 6.6.2 for further details in this regard.

Contractor shall also be responsible for all the modification works required in the existing foundation to make it suitable for the safe and reliable operation of the ST & STG over the design period, considering the loading requirements of the new Generator. It shall be Contractor's obligation to ensure that the installation and operation of new generator does not impart any distress in the existing foundation, turbine auxiliary foundations and other related facilities inside the ST Hall.

6.5.1.2 Design Requirements

Contractor shall be required to completely acquaint itself and obtain all the design conditions/parameters of existing turbine and perform the new detailed structural & geotechnical design analysis for the complete foundation considering the loading requirements of the new generator as per prevailing/applicable codes.

A FEM based computer model for the foundation shall be prepared by the Contractor based on the as-built survey performed by Contractor and the detailed design calculations along with computer model shall be submitted for Employer/Engineer review and approval. A static and dynamic analysis as per the International design codes and OEM Guidelines shall be performed by the Contractor. It shall be designed to accommodate all ancillary equipment associated with the steam turbine generator in accordance with the approved general arrangement. Provisions shall also be made in the design for the jacking, levelling, and setting of the steam turbine generator. Further, refer to provisions of Section 6.6.3 for further details in this regard.

6.5.2 Painting and Coating Works for Concrete Foundation

Due to fire incident and smoke, the painting & coating for the steel supporting structures, cable trays, racks, pipe supports, piping etc. is also damaged at various location around STG Foundation area/basements. The deposition of thick smoke deposits is also observed on concrete surfaces (beams, slab, columns, walls Etc.) on and adjacent to the ST foundation and structural steel members inside the ST Hall.

Contractor shall be required to assess the damaged coatings of the steel structure around foundation area and submit the report with proposed remedial measures for Employer/Engineer review and approval. Based on the assessment results, a suitable repair method along with new painting/coating system for the damaged areas shall be proposed and implemented by the Contractor, subject to approval by Employer/Engineer.

Further, Contractor shall also be required to clean the smoke deposits from all the surfaces and check for the damaged coating, which shall be rectified as per approved procedure. The black smoking layers shall also be removed from the concrete surfaces of STG Foundation and nearby facilities, and it shall be rectified by the application of suitable surface finishing technique.

6.5.3 Repair of Screed layer of Turbine Foundation and Operating Floors of ST Hall

It is noted that the concrete topping/screeding layer & floor finish provided at the top of ST & STG Foundation is damaged at various locations. Contractor shall be required to chip off the damaged layer and provide the new topping layer as per the design requirement. The provision of concrete bonding agent between the old & new concrete shall also be considered in the design.

6.5.4 Generator Removal/Installation methodology & modifications works

It is envisaged that the removal of existing generator and subsequent installation of the new generator on the existing foundation may require certain temporary arrangements, such as strengthening of structural members, removing & dismantling relevant portions of the structure and claddings, and relocating/reinstatement of the other facilities, etc. both inside and outside the ST Hall.

The details of all the temporary measures shall be included in the detailed study for Generator removal and installation to be performed by the Contractor and a comprehensive report shall be submitted for Employer/Engineer review and approval.

It shall be ensured that the study, including any proposed temporary measures, is supported by suitable design calculations and computer model analyses to confirm that the ST Hall structure and allied facilities are safe under all the anticipated temporary/erection stage loads.

Contractor shall also ensure that all safety measures /temporary support arrangements are made for the existing structure (structural members, floor, etc.) during the removal & placement of Generator and other heavy components inside ST Hall. The design calculations /model analysis of the proposed temporary arrangements to be provided /installed by Contractor shall be submitted for Employer/Engineer review.

In case any distress is produced in the building / structure component during the lifting of generator, the Contractor shall be fully responsible to reinstate it to original condition, within the currency of project.

6.5.5 Cable Trenches/Tunnel & Ducts

6.5.5.1 Scope of Work

It is envisaged that the majority of existing cable trenches/cable tunnels in the plant area will be reused for cable routing. However, construction of new cable trenches and duct banks of adequate sizes may be required as per the approved cable routing plan and Electrical drawings for the rehabilitation scheme as per design requirements.

Furthermore, if relocation or modification of existing trenches is necessary to accommodate additional cables or meet the cable routing requirements of the rehabilitation scheme, the Contractor shall be fully responsible to undertake the works.

It is clarified that the Contractor is responsible for reinstating all damages incurred to the existing facilities during the rehabilitation works.

6.5.5.2 General Requirements

Cable trenches/tunnels, ducts shall be constructed of concrete appropriately sized for earth and hydrostatic pressures, and live loads applied by vehicles, cranes or cable installation equipment. Manholes or access points shall be placed at practical intervals to enable ease of inspection, maintenance, and cable installation.

Cable crossings under roads and other services shall be installed in underground reinforced concrete duct banks or laid in culverts under roads. Duct banks shall have PVC or steel conduits and encased in reinforced concrete. Manholes with removable covers shall be provided as necessary to facilitate cable pulling.

All the trenches, manholes, catch basins and pits shall be doubly reinforced. All the trenches, manholes, catch basins and pits shall also be provided with identification numbers and properly displayed in the field.

The bottom of trench shall be provided with a suitable longitudinal slope. The cable trenches/tunnels shall be provided with the sump pits at appropriate locations and connect it through pipe drains to the existing storm water drainage system. In case, the bottom level of trench/sump does not permit the gravity flow into the drainage system, the permanently installed sump pumps of appropriate capacity shall be provided for such areas/trenches.

The precast covers shall not be more than 300mm in width and shall not be more than 65 kg. Lifting hooks shall be provided in the precast covers. Trenches shall be given a slope of 1:50 in the direction perpendicular to the run of the trenches. Angle of size 50x50x6mm (minimum) with lugs shall be provided in the edges of RCC cable trenches supporting cover, edges of trench walls, edges of manhole supporting, supporting edges of precast RCC cover and, any other place where breakage of corners of concrete is expected.

6.5.6 General Scope of Work

All civil works for addition of new/uprated equipment, trenches and support structures etc. to be provided for rehabilitation works, and necessary as per system design requirement shall be included in Contractor's scope.

As the new electrical cables, piping & other related installations shall be routed through the existing plant area and components, Contractor is required to fully acquaint itself with the existing site conditions and perform all the surveys for underground & aboveground existing facilities to finalize the layout, design and methodologies of rehabilitation works accordingly. Refer to section 6.3 of the document in this regard.

It is hereby clarified that all the works related to relocation, modifications and reinstatement of any existing facility (above-ground & underground) which may interfere with the works or required to complete the rehabilitation scope, shall be the responsibility of Contractor.

6.6 General Technical Requirements for Design and Rehabilitation works

This section is describing the general technical requirements, quality standards, required functions and certain philosophies for the design and execution of rehabilitation works, but is in no case a detailed specification. Therefore, the requirements are not limited to the descriptions hereafter, items not mentioned shall be in the same best quality range as for the entire works of the Project.

6.6.1 Demolition and Dismantling Works

6.6.1.1 General

The scope comprises the demolition, dismantling, disposal and site preparation at the existing plant area for buildings/structures and different above ground & underground facilities, required as per rehabilitation scope. It also includes the removal from site of all demolished & dismantled materials either to be sold off to others or to be disposed in an approved manner. The demolition material/equipment shall not be used for construction of the project.

Contractor shall devise a comprehensive program and procedure for the demolishing works and submit for Employer/Engineer approval before the start of works. It shall minimum include the following:

- A detailed plan including type of the structures which are required to be dismantled or demolished
- Site safety, signage and barricading requirements
- PTW requirements and access to site area
- Method and equipment for dismantling demolishing works and disposal of demolished material by Contractor to the designated areas
- Obtaining approvals and consents from relevant authorities
- Hazard identification and Risk Assessment for demolition works with respect to health and safety requirements

The Contractor shall ensure the safety and integrity of the existing structures & facilities located near the demolishing areas. Any damage/distress imparted to existing structure/facility during the dismantling/demolition process shall be repaired /reinstated to the original condition.

All resources related to site demolition activities including necessary tool, equipment, manpower, Electrical connection, lighting, etc. shall be arranged by Contractor at his own cost and responsibility.

6.6.1.2 Safety

The Contractor shall develop an appropriate safety management plan and take all necessary safety and other precautions to protect property and persons from damage, injury, or illness arising out of the performance of the works.

It is to be noted that some of the demolition works under the Contract may take place on an operational/established site area. The Contractor shall take account of the operational requirements when working.

The Contractor shall have a written safety work procedure and or Standards to cover the different types of activities such as excavation, use of ladder & platforms, working at elevated locations, use of mobile cranes, working in confined area, Electrical works and Safe handling and storing of pressurized gas cylinders etc. Contractor shall plan appropriate number of training sessions to communicate the safety protocols and loss prevention requirements to its employees and subcontractors. CPGCL shall conduct regular safety audits and meetings to ensure the safety procedures are intact to the satisfactory level.

In the absence of safety work procedures / standard of the contractors, the contractor shall adhere to site safety procedures during construction phase.

6.6.1.3 Structural Hazard Determination

All structural forms that are to be demolished or dismantled shall be identified, where possible complex items such as building/structures shall be subdivided into Identifiable units capable of independent structural analysis, e.g. roofs, suspended floors etc.,

Elements of structures that are stability sensitive should be identified. This shall apply particularly when the sequence of demolition/dismantling works is critical to maintaining stability, e g. stressed skin structures, cantilevered structures. An incorrect sequence in the removal of these parts could result in premature and unplanned collapse.

A sequence of operations should be established which allows debris to be cleared on a regular basis so that floors do not become overloaded and horizontal pressures on walls is avoided.

Consideration shall be given to causes of structural instability. This could include interruption of a load, the redistribution of loads, loading from temporary structures. The effect of weather shall also be considered.

Consideration shall also be given to the condition of the structure. The age of structure is often a significant feature to be considered. All material shall be carefully inspected.

Concrete shall be examined for, amongst other defects, deformation, spalling and corrosion of reinforcement and concrete repairs any of which could lead to premature collapse. Steel and iron work should be inspected for deformation, corrosion, missing fasteners, site welded amendments etc.

6.6.2 Structural Assessment and Rehabilitation Works

6.6.2.1 General

It is planned to rehabilitate the existing Steam turbine and equipment foundations of the existing Plant.

Contractor shall investigate/check the adequacy of the existing foundation and other facilities by performing detailed visual assessment, testing and structural analysis. Based on the results of investigations/assessment, the rehabilitation, strengthening and modifications measures shall be implemented by Contractor to ensure safety, functionality & reliability of the foundations over the design period.

Visual inspection, survey, testing etc. for the complete structure/foundations including all above ground & underground areas and components shall be undertaken. The Contractor shall thoroughly evaluate & acquaint itself with the current condition of the structures/foundation and finalize the methodology & scope of assessment and rehabilitation works accordingly, and submit for Employer/Engineer review/approval.

All temporary works including necessary tools, equipment, manpower, accessories, dewatering pumps, and generator etc. required during the site surveys, inspections, testing and rehabilitations shall be arranged by the Contractor.

The scope of work for the structural evaluation shall minimum include the following.

6.6.2.2 Visual Inspection of Foundation and other Facilities

Contractor shall carryout the conditional survey for the visual inspection of structures & foundation to identify the areas of distress. During this inspection all physical data such as geometry, thickness measurements, environmental impact, level of deterioration and eventual crack pattern pertaining to all walls, columns, pedestals, beams, slabs and other members etc. shall be recorded.

The following minimum information shall be included in the visual inspection report to be submitted by Contractor for approval:

- Observation of any settlements and deflections
- Surface conditions of the structural elements and members
- Observation and reasons of cracks including width, depth and crack patterns
- Mapping of defects, cracks, observations etc.
- Photographic survey of the defects & irregularities with cross references

6.6.2.3 Preparation and verification of As-Built Drawings

The detailed as-built survey of the foundations & structures which are to be rehabilitated shall be executed by Contractor to prepare and confirm the as-built drawings. The measurements of the structure including dimensions, heights, thickness of walls and sizes of beams and columns shall be recorded. The existing steel reinforcement shall also be assessed and recorded in the as built drawings

Contractor shall also be responsible to obtain the existing as-built data and drawings from the Employer and verify their correctness and relevance at the site.

6.6.2.4 Destructive and Non-Destructive Testing

Contractor shall carry out the destructive and non-destructive testing for existing structure as per relevant codes/Standards to assess the existing strength of structural materials. Contractor shall submit the complete methodology along with the detailed testing scheme for approval.

Cores shall be extracted by drilling from critical locations of the foundation. The number, frequency and locations for the extracted cores shall be subject to review/approval of Employer/Engineer and selected in such a way that the reliable & representative evaluation of the existing structural strength could be made for the entire structure.

Several non-destructive tests are also available for estimating the in-situ strengths and shall be implemented as per the requirements/type of structure. Non-destructive tests must be correlated with the testing of a sufficient number of core samples to confirm their reliability.

The testing scheme for steel structural members shall also be developed as per the relevant code guidelines and submitted for Employer/Engineer review.

6.6.2.5 Testing of Steel Reinforcement

In order to test the strength of the reinforcement in the structure to be rehabilitated, the non-rusted reinforcement samples shall be obtained. The tensile strength of the rebar shall be tested and shall be used for analysis and design purposes.

6.6.2.6 Bearing Capacity & Geotechnical Design Evaluation of Existing Structure

The geotechnical investigation works near the existing buildings/areas/facilities which are to be rehabilitated shall be executed by the Contractor to obtain/re-validate the latest/current geotechnical parameters and evaluate the bearing/pile capacities to verify the geotechnical design of the foundations.

6.6.2.7 Structural Analysis and Design Verification

Based on the above-mentioned data and findings, a 3D computer model of the turbine foundations (ST & STG) shall be established using internationally recognized (English language) engineering software (ETABS, SAP2000, and STAAD, etc.)

The strength of the materials based on testing results and estimations shall be used in the calculations/model. Appropriate reduction factors for the material strength shall be applied considering the uncertainty/variability in results and corrosion allowance for the reinforcing bar.

The structure shall be checked against all the anticipated loadings and the design of all members/ components and foundations shall be checked as per the applicable design codes. The deflections, settlements and other serviceability criteria for the structures and foundations shall also be evaluated and checked against the allowable limits.

The estimated design life for the structure shall also be predicted based on the concrete carbonation depth method.

6.6.2.8 Rehabilitation and strengthening works

The scope of work for rehabilitation, strengthening, repair, alteration, retrofitting etc. for the equipment/turbine foundation and supporting structures shall be decided based on the results of analytical structural evaluation, design calculations and visual inspections/conditional surveys.

Any modification works required in the structure & foundations including dismantling, reconstruction etc. to meet the installation & operational requirements of new equipment/components shall also be included in the Contractor's scope.

6.6.3 Design consideration for Equipment foundations

Foundations supporting operating plant and equipment will be designed for both static and dynamic loads based on equipment operational loading information and design criteria. Pertinent information about equipment such as the footprints, weights, anchorage requirements, nature of equipment, whether rotating or vibrating, static or dynamic loading criteria or any special recommendations by equipment manufacturers shall be considered in the design of equipment foundations.

Amplitudes of vibration under operating conditions shall not exceed the limits specified by the manufacturer of the equipment and shall not exceed the values which could cause damage or excessive wear of equipment.

The design of the foundations shall take due account of differential settlement and dynamic loadings either from earthquake or rotating machinery.

The contactor shall state the allowable vibration limit (acceleration, velocity, displacement) for continuous operation for each rotating machine supplied and ensure the compliance of actual values with the allowable ones during the design stage.

All the anchor bolts, baseplates etc. shall be protected with non-shrink grout material after installation of the equipment. For vibrating/dynamic equipment, the grout type specified by the OEM shall be used for anchorage & fixing. Contractor shall also be required to assess/inspect the anchorage & grouting of existing equipment (ST & its auxiliaries) and submit the assessment report to Employer/Engineer for review. In case damage or distress is noted, it shall be removed & replaced with the approved quality grout material.

6.6.4 Corrosion Protection

The requirement of corrosion protection for above and below ground structure that would be required particularly for metal (structural steel, iron, etc.) and concrete works shall be evaluated. Further whenever structures are likely to be exposed to corrosive environment due to storage of chemicals or due to any

other reasons, special measures including chemical resistant coatings & surface treatments shall be considered.

All embedded parts, anchor bolts, edge protection angles etc. shall be corrosion protected by hot-dip galvanising according to the latest revision of the applicable ISO standards, i.e. ISO1461 or ISO 14713.

A comprehensive scheme for the corrosion protection and painting/coating system ((including colour selection) for different components shall be prepared by the Contractor in line with the applicable codes and submitted for Employer/Engineer review/approval.

6.6.5 Edge Protection

All concrete edges, where breakage of concrete corners are expected shall be provided with hot dip galvanized angles of minimum size L 50x50x6 with lugs for edge protection e.g. all-round the cut-outs/ openings in floor slabs, edges of drains supporting grating covers, edges of. RCC cable/pipe trenches, trenches supporting covers, edges of manholes supporting covers and supporting edges of precast covers, etc.

6.6.6 Structural Steel works

All the steel structure members shall be hot rolled type. Pre-engineered steel members shall not be used at all. Steel structures shall be designed in accordance with the requirements of latest edition of AISC, Manual of Steel Construction. The structures shall be designed to support the specified loading and shall be adequate for the intended function of the structure.

A working scheme shall be prepared before the commencement of the erection works for the steel structure. It shall also contain rules for safety precautions. The anchor bolts used for the fastening of steel structures shall be set in a designed position and grouted along with foundations.

6.6.7 Quality Assurance and Quality Control

Inspection and testing plans for the material, equipment, and workmanship related to civil works shall be developed to ensure compliance with the Employer’s Requirements, codes, and standards.

Quality management systems and quality control plans covering all material, equipment and workmanship related to civil works shall be made to ensure compliance with the Contract requirements, codes and Standards.

6.6.8 Selection and Approval of Materials

Construction & finishing materials, finishes schemes, paint selection & colour scheme, decorative patterns etc. shall be approved by Employer/Engineer from samples and manufacturers' catalogues and technical documents submitted by Contractor

It must be ensured that the pre-qualification documents and technical specifications for all the materials is obtained from minimum 3 well renowned vendors having relevant, proper and valid process and quality control certifications.

The minimum lag time required for material approvals, procurement & delivery shall be considered in planning of execution activities.

6.6.9 Samples, Testing and Inspection

The Employer/Engineer may request at any time to test or inspect samples of construction materials and workmanship proposed and the Contractor shall furnish these immediately. When the Employer/Engineer has approved the samples, material and workmanship not corresponding in quality and character with the approved samples shall be rejected.

The costs of all sampling and testing to be conducted either on the Site or in an approved laboratory shall be borne by the Contractor. Before commencing the construction works, all construction materials shall be tested in the laboratory. If the test results are found unsatisfactory the Contractor shall not be allowed to use those materials.

6.7 Structural Work

This section sets forth the minimum design and construction requirements for the structures and foundations for the power plant and all other facilities. Design and construction requirements shall comply with current engineering practices and prevailing applicable codes. The foundation system shall be as per approved detailed geotechnical investigation.

6.7.1 Design Loading

All structures and all parts thereof shall be capable of withstanding code stress and deflection limits within prescribed settlements. Some basic types of loadings have been indicated below, however any other loadings not indicated but found necessary to be considered during detailed engineering and design verification shall also be adopted by the Contractor.

6.7.1.1 Dead Load

Dead load shall be considered as the weight of all material-forming a permanent part of the structure and all fixed service equipment. Dead loads shall include the operating weight of all vessels and equipment, structures, insulation, piping, electric conduit and cable tray.

6.7.1.2 Live Load

Imposed (live) loads shall consist of uniform live loads and equipment live loads, hang load and dust load. Uniform live loads are assumed unit loads which are sufficient to provide for movable and transitory loads, such as the weight of people, portable equipment and tools, planking and small equipment, or parts which may be moved over or placed on floors during maintenance operations.

Laydown/maintenance areas in the turbine hall shall be investigated for concentrated loads resulting from equipment components to be stored during erection and maintenance operation. Where live load allowance is inadequate to permit storing of such equipment components, the design live load shall be increased to permit such use. Vehicular load such as forklifts etc. shall also be considered.

The design of all structures shall also be checked for loads resulting from construction activities. Loading from construction activities whether of short or long duration, shall be considered as live load.

6.7.1.3 Piping, Conduit and Cable Tray Loads

The actual concentrated loads or equivalent line Ioads shall be applied to the structural elements. Load due to internal pipe pressure, cable trays, friction loads due to thermal movement etc. shall be considered.

Pipe hanger loads for the major piping systems, such as the main steam, reheat steam, feed water and cooling water systems, shall be specifically determined and located.

6.7.1.4 Impact and Dynamic Loads

Impact loads shall be added to other loads for components supporting reciprocating or rotating machines, elevators, hoists, cranes, or other equipment creating dynamic forces. Impact load shall be applicable as per relevant Codes or specified by the Equipment manufacturers as applicable.

6.7.1.5 Equipment Load

All equipment loads, dead, live and dynamic loading, shall be obtained from Supplier's certified drawings by the Contractor. The load location that produces the largest stresses and deflections shall be used in the analysis and design verification.

Structures and foundations for heavy vibrating equipment including turbines, generators, reciprocating engines and centrifugal compressors and large pumps, will be calculated for response to vibrations and also forces with unbalanced moments. Such structures and foundations will be analysed by recognised methods of dynamic analysis and designed to ensure safe, smooth and trouble-free operation under any conditions.

6.7.1.6 Wind Load

Basic wind speed for the computation of wind pressure shall be 44.4m/s, considering 3 sec gust wind speed at 10 meters above ground.

Wind loads for both overall building stability and local effects on building components shall be calculated.

6.7.1.7 Seismic Load

The design of all buildings, structures and foundations shall be re-checked against the earthquake parameters confirmed/approved in geotechnical & geological investigations to be undertaken by the Contractor as well as the relevant design provisions considered in the original design.

6.7.1.8 Temperature Load

The temperature extremes and effects of differential temperature or temperature changes shall be considered in the design of the structures. The parameters used shall be based on meteorological data or equipment operating conditions as appropriate. A temperature differential of 50°C shall be considered as a minimum. The structure shall be designed to withstand stresses due to temperature variation.

6.7.1.9 Crane Loads

Load of Monorails, Cranes and their supporting members shall be applied as simple spans and their maximum centreline deflection shall be limited to the value recommended by the trolley Contractor or in accordance with customary industrial practice.

6.7.1.10 Test & Equipment Upset Load

These include blowout piping load, hydrostatic pipe load, and flooded equipment load caused by pre-operational tests. These also include loads due to probable mechanical upset conditions or equipment malfunctions including, but not limited to, thermal transients, unbalanced rotations and water hammer etc.

6.7.1.11 Miscellaneous Loads

Miscellaneous loads shall be defined as loads that do not fit into the categories listed in this section. Typical miscellaneous loads are loads, during erection, maintenance and repair or forces due to creep, shrinkage, or settlement.

6.7.2 Serviceability Requirements

Anticipated deflections at service loading shall be considered in design verification and modification stage and shall not result in inadequate performance or loss of normal functioning of cranes, cladding, finishes, or other associated elements.

The design of foundations for all structures and equipment shall be such that differential and total settlements or other movements shall not exceed acceptable limits. Settlement limits shall be determined by the sensitivity of structures and equipment such that the functionality of the structure/components is not impacted.

6.7.3 Load Combinations

The different load combinations shall be taken as per stipulation of relevant International codes and in case of special structure, other relevant standards shall also be followed. The design of structures and foundations shall be checked for the critical load combinations including dead and live loads, wind, seismic, erection forces, secondary stresses, impact, temperature and shrinkage etc.

All structures shall be designed for all possible load combinations that it can experience during its life time. However, the worst load combination shall be adopted for checking the design of the buildings/structures.

6.8 Concrete Work

6.8.1 General

Concrete work shall, as a minimum, be designed, specified, and installed in accordance with applicable ACI requirements. Reinforced concrete structures and foundations shall be designed in accordance with the applicable provisions of latest edition of ACI 318, "Building Code Requirements for Reinforced Concrete.".

6.8.2 Material

The concrete design mix, as well as the type and proportions of all constituent materials, shall be selected in order to ensure adequate strength and durability with respect to the environmental and exposure conditions. The design mix shall produce a workable concrete that conforms to applicable ACI requirements or those of other international standards approved by the Employer/Engineer. The design mix shall be tested for compliance and documented for required strength and characteristics before use in permanent works.
Contractor shall conduct and document material tests and concrete break tests as appropriate during all phases of the work to ensure the quality and consistency of the concrete used. Contractor shall ensure strict enforcement of all maximum permissible water-cement ratios for all concrete. All grout shall be flowable, non-shrink and non-metallic natural aggregate, or as recommended by equipment manufacturers. The mix design test should be conducted in approved laboratory.

6.8.3 Execution of Work

In executing the work, the Contractor shall conform to all applicable ACI requirements with regard to

- Design and installation of formwork
- Cutting, bending and placing of reinforcing bars
- Mixing, placing, finishing and curing of concrete.

Construction joints shall be located where the strength and serviceability of the structure is least impaired. Provision shall be made for transfer of shear and other forces through the joints as required. Waterstops shall be provided in construction joints in walls and slabs where necessary to maintain watertight integrity of the structure.

6.8.4 Minimum Cover

Minimum clear concrete cover shall be provided to reinforcing or embedded steel as indicated in relevant codes. Severe exposure conditions shall be assumed unless otherwise specified. For durability the minimum concrete follows:

a. Concrete above ground any reinforcing bar shall be as
   - Internal Faces of Slab 25mm
   - Internal Faces of beams and walls 30mm
   - Exposed faces of slabs, beams and walls 40mm
   - All faces of columns 40mm

b. Concrete Below ground (including piles)
   - Faces in contact with soils including binding concrete 75 mm
   - All other faces (e.g. internal faces of basement wall) 50 mm

6.8.5 Other Requirements

The Contractor shall formulate and provide as part of the quality assurance (QA) programme a system to monitor the quantity and quality of the concrete used. The programme shall include the submission of monthly reports to the Employer summarising the previous month's results of the QA programme. Concrete shall have surface finishes specified according to the relevant codes and standards.

6.8.6 Tests

In order to control the quality of concrete to be placed, samples of concrete for testing shall be taken and cylinder made as and when directed by the Employer. Tests shall be done in accordance with BS1881 or equivalent Standards approved by the Employer.

a. Slump test
b. Compression test

For each grade of concrete, six test cylinders conforming to ACI or equivalent shall be prepared for each 30 cubic metres of concrete in each day's work. Three cylinders shall be tested on the 7th day and the remaining three on the 28th day. The slump and compression tests shall be carried out and the results shall submit to the Employer/Engineer in written form. If the test results of concrete cylinders are found unsatisfactory, the concreting works shall be rejected.

The cost of preparing, storing and transporting test specimens to the place of testing and testing shall be borne by the Contractor.

6.8.7 Cement

The type of cement shall for the below-ground construction shall be selected based on the Geotechnical investigation report & groundwater testing results and ordinary Portland cement complying with ASTM C-150 or other approved standard shall be used for above ground construction.
When required by the Employer/Engineer, the Contractor shall obtain for him the manufacturer's test certificate & third party testing report of the cement batch. All cement shall be stored dry in a well-ventilated and weatherproof building. The cement shall be furnished either in bulk or in bags from the cement factory approved by the Employer/Engineer.

6.8.8 Admixture

The Contractor may use water-reducing, set-retarding agents and high strength admixtures as per ASTM C- 200, ASTM C-494, BS 5075 or equivalent but the use of admixture must have the prior approval of the Employer/Engineer.

6.8.9 Water

The water used for making concrete, mortar and grout shall be clean, fresh and free from salt, oil, organic-matte any other deleterious substance. The water used in mixing and curing concrete shall be tested by methods described in AASHTO test method T-26.

6.8.10 Aggregate

The fine and coarse aggregates shall be durable, non-reactive hard materials complying with ASTM C-33 or internationally accepted standards approved by the Employer. All aggregates shall be washed prior to use in order to remove clay sit, dust and adherent materials. The aggregates shall be stored on drained concrete paved areas in such a manner that intermingling of different sizes and types of aggregates is prevented. The stock piles of the aggregates shall be protected from rubbish or windblown or dust.

Coarse and fine aggregates shall be well graded within the standard limits and shall be subject to following minimum tests:

- Flakiness and Elongation Index
- Aggregate crushing value
- Los Angeles Abrasion Test
- Sodium Sulphate test
- Water absorption test

6.8.11 Concrete Mixing

All concrete except where specifically approved by the Employer/Engineer shall be mixed in weigh batch mixing machines. The machine shall have a water storage tank with a gauge so that a predetermined quantity of water can be injected direct into the mixer drum. Hand mixing of concrete will not be permitted. The Contractor shall take all precautions to protect the concrete from the effects of injurious materials. All concrete shall be produced in a mechanical batching plant, except where localized mixing is approved by the Engineer for minor repairs.

For localized brownfield structural repairs and foundation strengthening, the use of pre-packaged high-strength non-shrink epoxy or cementitious grouts mixed via localized mechanical mixers is acceptable, subject to Engineer approval.

6.8.12 Placing

The concrete shall be placed in the positions and sequences indicated on the approved drawings immediately after mixing under the supervision of the Employer or his representative.
Prior to placing the concrete all deleterious substance such as organic matter, standing water, flowing water, wood fragments shall be removed from the surface against which the concrete is to be placed. When concrete is to be placed against a construction joint or adjacent to a set surface the whole surface shall be thoroughly roughened and provided with bonding agent. It shall be cleared of all loose and foreign matter and washed with water immediately before fresh concrete is placed.

The concrete shall be fully compacted throughout the layer and shall be thoroughly worked against the formwork and around the reinforcement without displacing it. Unless otherwise directed by the Engineer, approved power driven vibrators of the immersion type shall be used. Vibrators shall penetrate to the full depth of the concrete layer and shall re-vibrate that layer to ensure that the successive layers are well knitted together. The placing of concrete shall not be permitted under the following conditions unless specifically approved by the Employer/Engineer:

a. If it rains
b. If it is poorly illuminated during night work
c. If ordered to stop by the Employer or his representative

6.8.13 Transportation

Ready mixed concrete shall be transported speedily to the point placing by means that shall be approved by the Engineer and which shall give little chance for segregation of materials. Generally, the transportation of ready mixed concrete shall be limited to within one hour. Concrete delivered in excess of the time limit shall be rejected. When concrete is observed to have segregated or started solidifying at the transportation of placing, it shall be rejected and replaced.

6.8.14 Curing

Concrete shall be protected during the first stage of hardening from the harmful effects of sunshine, drying winds, hot weather and rain or running water. All concrete shall be properly protected and maintained during the curing period. Curing membranes, sprinkler application of water and ponding shall be acceptable as appropriate for the curing of concrete. The concrete shall generally be wet cured for at least 21 days. The curing method for concrete shall be submitted to the Engineer for approval. Gas turbine, steam turbine, generator, HRSG and main stack foundations must be wet cured for 28 days.

6.8.15 Formwork and Timber

Formwork and timbering shall be so designed and constructed that the required finishes in concrete works are achieved. Formworks shall be constructed accurately to the required shape, position and level and

shall have sufficient strength to withstand the compaction pressure. The materials to be used for formwork shall be approved by the Engineer.

Forms shall be removed without damage to the concrete. The use of form oil or other release agents shall be subject to the approval of the Engineer.

The removal time of formwork and timbering shall be as follows

a.	Vertical sides excepting beams:	3 days
b.	Vertical sides of beams:	7 days
c.	Soffits for span 8 m or less:	18 days
d.	Soffits for span over 6m:	21 days

6.8.16 Finish and Repair of Concrete

6.8.16.1 General

The classes of finishes and the requirement for finishing concrete surfaces shall be as specified in this clause or as shown on the approved drawings. Surface irregularities in finishes shall be distinguished from construction tolerances, which are allowable deviations from established lines, grades and dimensions, as described herein.

Surface irregularities are designated "abrupt" and "gradual" for purposes of classifying finishes. Offsets resulting from displaced, misplaced, or mismatched forms or by loose knots in forms, or other similar forms of defects shall be considered "abrupt" irregularities and will be checked by direct measurement. All other surface irregularities shall be considered "gradual" irregularities and will be measured as a departure from the testing edge of three meter plate.

Finishing of concrete surfaces shall be performed only by skilled workmen.

Concrete surfaces shall be free from imperfections such as honeycombs and cracks. The contractor shall at his own expense repair honeycombs, cracks and irregularities promptly as directed by the employer.

6.8.16.2 Concrete Construction Tolerances

Variations in alignment, grade and dimensions of the structures from the established alignment, grade and dimensions shown on the approved drawings shall be within the tolerances specified in the relevant codes. Concrete work that exceeds the tolerance limits specified herein may be required by the Employer to be remedied or removed and replaced by the Contractor.

6.8.16.3 Repair of concrete

The Contractor shall repair at his own expense the imperfections of concrete surfaces and the irregularities which do not meet the allowance specified in the preceding item. Repairing works shall be performed and completed within 24 hours after the removal of forms in accordance with the direction of the Employer.

6.8.17 Reinforcing Bars

The reinforcing bars for all reinforced concrete works shall be deformed steel bars as per ASTM A-615, Grade 60 or equivalent. Dimensions, shapes, tensile strength, yield point and other mechanical properties of the reinforcement bars shall comply with relevant approved standards. 3rd party laboratory testing for the different lots of reinforcing steel shall be undertaken by Contractor and provided for Employer/Engineer review.

The physical properties of the deformed reinforcement bars shall have the following values

Yield point: ≥ 410 MPa
Ultimate tensile strength: ≥ 700 MPa

Reinforcement bars shall be stacked off the ground on sufficient supports to prevent distortion of the bars. All reinforcement must be free from oil, grease, paint, dirt, loose scale or rust at the time of concreting. Prior to fabricating and placing the reinforcement, the Contractor shall prepare a bar bending schedule and drawings for submission to the Employer for approval.
Reinforcement shall generally be bent cold by an approved means to the dimensions shown on the approved bar bending schedule and shall be rigidly fixed in the positions shown on the approved reinforcement drawings using annealed soft black iron binding wire to prevent movement during concreting.

The Employer/Engineer shall have the right to select at any time samples of reinforcement bar for testing for compliance with the Specifications. The spacer blocks, prior to using, shall be submitted to the Engineer approval.

7. TECHNICAL REQUIREMENTS – MECHANICAL

7.1 Steam Turbine Unit (ST)

The steam turbine installed in Plant is manufactured by Harbin Turbine Company Limited (HTC) (Model LN260-11.45/2.55/0.47/560) commissioned in December 2014. It consists of a middle reheat condensing steam turbine unit, single axis, double cylinder double exhaust steam, high, intermediate & low pressure cylinder and reverse arrangement on flow passage.

ST unit installed at turbine hall of the Plant consists of one (1) triple pressure steam turbine and one generator whose generation capacity is 261 MW. The specifications of the installed steam turbine are as follows:

Rated power	261 MW
HP main valve front steam Pressure	114.5 bar
HP main valve front steam Temperature	560.6 ℃
Rated main steam flow	555.425 t/h
HP cylinder exhaust Pressure	29.03 bar
HP cylinder exhaust Temperature	362.5 ℃
Rated HP cylinder exhaust flow	538.070 t/h
IP combined valve front reheat steam Pressure	25.4 bar
IP combined valve front reheat steam Temperature	560.0 ℃
Rated reheat steam flow	622.872 t/h
LP steam intake Pressure	4.7 bar
LP steam intake Temperature	305.3 ℃
LP steam flow	48.57 t/h
Rated LP cylinder exhaust flow	685.24 t/h
LP cylinder exhaust Pressure	6.4 KPa

Due to fire incident on July 10, 2022, the unit is damaged and is not in operation since then. To assess the damage caused by incident happened at ST-16, the Employer engaged M/s Harbin Electric International (HEI).

Subsequent to the incident, the HEI team conducted a comprehensive assessment of the steam turbine, generator, and associated auxiliaries' components at the site. M/s HEI furnished an integrity assessment report, appended as **Annex-1**, specifically addressing the steam turbine and steam turbine generator unit. This report encompasses a detailed exposition of the inspection outcomes derived from HEI's assessment.

As per inspection report, following is the brief of the damages/deficiencies recorded and recommendations given by HEI. Detailed assessment report is to be reviewed by Contractor to fully understand the condition of steam turbine and auxiliaries.

1. DC, AC & start oil pump test module overfire. Recommendation is to replace the module and the connecting lines.
2. Cleaning of the bearing box and pipe and replacement of lubricating oil and filter.

3. Replacement of the hydrogen system pipelines and valves which were exposed to fire.
4. Bearing #2 upper half of the bush has rolling marks, the lower bearing surface/ babbitt material has fallen off. The whole bearing bush and the floating ring shall be replaced.
5. Bearing #3 upper bearing surface/ babbitt material and half of the shaft tile has fallen off. Bearing bush shall be replaced.
6. The shaft tile oil block plate bolt, and the oil block ring bolt has fallen off. Installation of bolts and replacement of the floating ring.
7. Bearing #4 upper half of the bush has fallen off, and the oil sealing ring has melted. The complete bearing bush and floating ring shall be replaced.
8. The low-pressure inner cylinder heat shield fallen off and needs to be replaced.
9. Cat claw bolt of HP inner cylinder is broken which needs to be replaced.
10. Top of blade is worn off of sub final medium pressure (IP) rotor (stage 9) and needs to be replaced.
11. The high-pressure rotor is heavily corroded and scaled, and the foreign body accumulates at the top of the grade IP 1st blade, and the foreign body strikes in the HP 6th stage impeller. Clean up, polishing and replacement is required.
12. The maximum bending of the HP-IP rotor axis is 0.10mm, and the bending of the IP side rotor is large. The medium pressure side partition and rotor have light blue over temperature overheating traces. Rotor shall be replaced.
13. The clearance of the sealing ring and the thrust tile sealing ring exceeds the standard, and the thrust clearance is 0.42 (standard 0.28-0.38). The clearance of bearing # 1 and # 2 exceeds the standard and bearing #3 and #4 bearing oil seal ring is damaged. Main oil pump and the thrust tile seal rings shall be replaced alongwith bearing 1 to 4 oil seal rings.
14. HP：The top steam sealing clearance, partition steam seal, middle balance ring steam seal, and end steam seal wear, and the steam seal clearance exceeds the standard, the spring blade loses its elasticity for a long running time. Replacement of all steam sealing blocks and accessories, and re-insert the leaf top steam sealing teeth is required.
15. LP: The steam seal and end steam seal of the low pressure rotor partition plate are seriously corroded, the spring sheet lost its elasticity, and the leaf top steam seal clearance exceeds the standard. Replacement of all steam seals and accessories are required.
16. The water erosion of the generator and turbine side final blade of the low pressure rotor is serious, and there are obvious erosion traces at the top and root. Rotor to be sent to the factory to replace the blades. After the blade replacement, the rotor's dynamic balancing test shall be carried out.
17. The low pressure inner cylinder has large deformation, the clearance of the without bolts inner cylinder is 1.2mm, and the maximum clearance after tightening 1 / 3 bolts is 0.90mm (required <0.10). Rotor to be sent to the factory for processing on the upper casing, the lower casing site grinding combined surface. Under normal circumstances, both the upper and lower cylinders need to return to the factory, but the lower cylinder can be manually polished and levelled according to the plane of the upper cylinder. The binding surface of the upper cylinder requires mechanical levelling, and the accuracy requirement are high. According to the plane of the upper cylinder, and then the binding surface of the lower cylinder is made by manual grinding.
18. During visual inspection of the partition plate, it was found out that there were foreign body strike marks in the static blades of the partition plate, low pressure steam intake to the first stage, reverse level 4, high pressure level 6, etc., the colouring inspection of mechanical damage parts, no cracks, do not affect the use. LP first stage partition (forward and reverse) needs to be replaced, and the remaining partitions need to be repaired on site.
19. Low pressure rotor shaft diameter wear has scratches & dents. Shaft diameter welding polishing treatment is required.
20. In the process of lifting the upper high pressure diaphragm, the bolt is broken due to the positioning key, and the positioning key has fallen off. Supplementation of the positioning keys and bolts.

21. During NDT inspection of bolts, LP and HP bolts has been found which are damaged and unqualified. Spare parts shall be prepared according to 20% of the total bolts.

The summary of bearings of steam turbine and generator is as follows:

Bearing Number	Location	Visual Result	NDT result	Recommendation
1j	HP(T)	NOT OK	NOT OK	Replace with new
1t	HP	OK	OK	Thrust bearing condition is fine，however clearance gap is increased. Rotor needed to replace so bearing will also be required to be replaced.
2j	HP(G)	NOT OK	NOT OK	Replace with new
3j	LP(T)	NOT OK	NOT OK	Replace with new
4j	LP(G)	NOT OK	NOT OK	Replace with new
5j	GE(T)	NOT OK	NOT OK	Replace with new
6j	GE(G)	NOT OK	NOT OK	Replace with new

Steam Turbine overhauling was overdue and couldn't be performed due to the fire incident. The Contractor shall perform overhauling of steam turbine and its allied equipment along with its rehabilitation.

The Contractor shall be responsible for identifying, arranging, providing, and mobilizing all special tools, equipment, and accessories required for the proper, safe, and timely execution of the Scope of Work. All special tools required for the execution of the Works shall be brought to Site by the Contractor.

Any special tools already available at Site and identified by the Employer may be provided to the Contractor for use in the execution of the Works. The Contractor shall be responsible for the proper care, custody, safe use, and protection of all such Employer-provided tools during the period of use.

Upon completion of the Works, the Contractor shall hand over to the Employer all special tools procured, arranged, or brought to Site by the Contractor specifically for the execution of the Scope of Work, together with any special tools provided by the Employer, in good and serviceable condition, subject to normal wear and tear. Any loss or damage attributable to the Contractor shall be repaired or replaced by the Contractor at its own cost.

For avoidance of doubt, the Contractor upon completion of works shall provide and hand over the required special tools to the Employer and the Contractor shall not be entitled to any additional payment on account thereof.

The Contractor shall be responsible to remove all damages/defects/deficiencies mentioned by HEI in its assessment report and comply with recommendations given by M/s HEI. The Contractor shall also

conduct its own assessment at bidding stage and remove any other defects/damages/deficiencies, not mentioned in the attached inspection report, which shall jeopardize the safe and reliable operation of Steam Turbine, its auxiliaries and power plant.

The rotors shall be dynamically balanced in the factory so that the maximum effective vibration magnitudes do not exceed the recommended values under steady running conditions at all loads.

The maximum vibration velocities at the bearings shall not exceed the requirements of ISO 10816.

7.1.1 Lubricating System

Following the assessment conducted by M/s HEI, it has been identified that the lubricating oil system of the steam turbine and generator has incurred damage as a result of the fire incident. Specifically, the AC, DC, and main oil pumps, as well as the connected piping and inline equipment have been affected. The comprehensive details of these findings have been outlined in the assessment report submitted by M/s HEI. Consequently, it is imperative for the Contractor to conduct a thorough inspection and evaluation of the system to ascertain the extent of the damages and subsequently proceed with the necessary rehabilitation measures.

Furthermore, it is crucial to ensure that the material utilized for the piping and inline items aligns with the same stainless steel (SS) grade as the previously installed components.

The Contractor shall drain and replace the steam turbine (ST) and steam turbine generator (STG) lube oil and hydraulic oil with new oil in accordance with the OEM's recommendations and approved procedures. The Employer shall supply the initial (first) fill of lube oil and hydraulic oil. Any additional oil required for refilling or topping up during oil flushing, system cleaning, testing, commissioning, or until successful completion and handover of the plant shall be supplied by the Contractor at no additional cost to the Employer. The Contractor shall be responsible for maintaining the required oil quality and quantity throughout the execution of the Works.

Complete flushing of lubrication system including piping, coolers and oil tank shall be carried out by the Contractor until the flushing criteria is met according to OEM standards.

The Contractor shall also carry out flushing of hydraulic circuit until the flushing criteria is met according to OEM standards.

7.1.2 Turning Gear

Turning gear and its associated equipment has been completely damaged in the fire incident. The Contractor shall supply new turning gear system with complete accessories. The make and model of the turning gear should be same as already installed.

7.1.3 Steam Turbine and Generator Auxiliaries

The Contractor shall be responsible for the detailed condition assessment, inspection, rehabilitation, repair, replacement (where required), testing, pre-commissioning, commissioning, and successful integration of all Steam Turbine (ST) and Steam Turbine Generator (STG) auxiliary systems.

The Contractor shall determine the extent of rehabilitation required based on site inspections, testing, OEM recommendations, and the approved Integrity Assessment Report, and shall ensure that all such

auxiliary systems are restored to a safe, reliable, and fully operational condition in accordance with the Contract requirements.

7.1.4 Steam Blowing

The Contractor shall be responsible for planning, supervising, and executing the steam blowing of the HRSG, main steam piping up to the Steam Turbine (ST) inlet valves, steam bypass system, and associated auxiliary steam piping in accordance with the approved steam blowing procedure.

The Contractor shall prepare and submit the detailed steam blowing procedure, including acceptance criteria, sequence of activities, safety requirements, and operating parameters, for the review and approval of the Employer/Engineer prior to commencement of the steam blowing activities.

The Employer shall be responsible for all temporary modifications, temporary installations, removal and reinstallation of permanent equipment in the HRSG area.

While installation of temporary piping, silencers, target holders, steam blowing devices, and any other temporary works required to facilitate steam blowing for steam piping, bypass system and steam turbine in accordance with the approved procedure shall be the responsibility of the Contractor.

The Employer shall ensure that the Gas Turbine(s), HRSG(s), and all associated steam piping up to the Steam Turbine inlet valves and steam bypass valves are fully erected, tested, commissioned as necessary, and made available in a condition suitable for carrying out the steam blowing activities.

During steam blowing, the Contractor shall provide qualified commissioning and testing personnel to support the Employer in the operation, monitoring, data recording, and assessment of the plant throughout the steam blowing process. Plant operation during steam blowing shall be carried out by the Employer with the support of the Contractor's commissioning and testing team.

All the materials/spare parts required for the removal and restoration of instruments and inline equipment shall be included in the scope of work of the Contract.

7.2 Overhead Crane

The Contractor shall rehabilitate and then revalidate the ST hall overhead crane from third-party, get certificate and provide certificate to Employer before doing any lifting operations.

The specifications of overhead crane are as under:

TYPE	QD	**WORKING GRADE**	A3
LIFTING CAPACTITY	90/20 T	**SPAN**	25.6 m
MAIN LIFTING SPEED	0.16-1.6 m/min	**MAIN LIFTING HEIGHT**	25 m
AUXILLARY LIFTING SPEED	0.6-6 m/min	**AUXILLARY LIFTING HEIGHT**	27 m
CRANE TRAVELLING SPEED	3-30 m/min	**PRODUCTION NO.**	112031352

TROLLEY TRAVERSING SPEED	1.05-10.5 m/min	**MANUFACTURE DATE**	2011-10
EQUIPMENT CODE	411010A2120113245	**LICENCE NO.**	TS2410A21-2012
MAKE	WEI HUI GROUP – HENAN WEIHUA HEAVY MACHINERY STOCK CO.LTD		

Contractor shall also get third party certification for all lifting tools. Riggers and crane operators should be certified.

7.3 Valves

The Contractor shall carry out the complete inspection, condition assessment, rehabilitation, replacement or repair, overhaul, testing, and commissioning of all valves associated with the Steam Turbine (ST) including drains.

The scope shall include replacement of defective internal parts, actuators, gearboxes, seals, gland packings, seats, stems, and other components, or complete valve replacement where rehabilitation is not technically feasible, to restore all valves to their original design and operational performance.

7.4 Insulation

Thermal insulation shall be provided for steam turbine, piping, valves and any other auxiliaries as per OEM standards. Thermal insulation shall be completed with cladding on the steam turbine, piping, valves and other auxiliaries according to OEM drawings and instruction manuals.

7.5 Firefighting System

Fire protection and firefighting system shall be provided as per NFPA requirements to protect life, property and equipment.

The Contractor shall provide fire detection and firefighting system for the bearing areas of steam turbine and steam turbine generator, as per NFPA requirements. The Contractor shall use the existing firefighting pump house for providing fire water to newly installed equipment/piping.

All newly supplied equipment/system components of complete fire detection, protection and firefighting system shall be **FM approved & UL Listed.**

The instrumentation of the system like pressure/temperature gauges/transmitters, level gauges/transmitters and Motor Operated Valves (MOVs)/solenoid /pneumatic actuators shall be provided where required.

The detection and fire alarm, fire protection and fire-fighting systems shall include the following:

- Spray Water Deluge System
- Fire Protection Systems

- Fire Alarm & Detection System

The Contractor shall install the complete firefighting system, including all associated piping, valves, nozzles, supports, and accessories, by taking a tie-in from the nearest available firefighting connection within the ST Hall. The Contractor shall ensure that the system is properly designed, installed, tested, and commissioned in accordance with the applicable codes, standards and the requirements of the Employer.

The system shall be initiated via the trip system upon receipt of an electrical signal from the fire detection and alarm system control unit. Manual initiation shall be provided adjacent to the deluge valve for the system.

The signals shall be integrated to DCS and Master Alarm Annunciation System. Automatic fire fighting and turbine trip initiation shall be based on 2oo2 or 2oo3 control logic from the instruments / detectors installed in the steam turbine/generator bearing areas. A single detector alarm shall generate a fire alarm to the DCS and Master Alarm Annunciation System but shall not initiate automatic suppression release or turbine trip. The Contractor shall submit turbine protection control philosophy to the Employer / Engineer for approval.

Water spray systems shall be provided in accordance with NFPA 15. Design parameters shall be in accordance with the recommendations of NFPA 850.

Each water spray system shall be provided with a listed system actuation valve. System isolation valves shall be provided upstream and downstream of the system actuation valves.

Manual water spray systems shall be initiated by manual release units situated at the deluge valve stations.

Deluge valve stations shall be located with sufficient separation from the risk they protect.

Special Fog nozzles (fixed-fog nozzle/adjustable nozzle) shall be used to produce fog/mist.

The water application rate for all water spray systems shall be in accordance with the relevant NFPA codes.

For reference, the installed fire water pump specifications are provided as follows:

Capacity	1224 m^3/h
Head	100 m
RPM	1485
Make	KSB Double Entry Centrifugal Pump (SB2401/210NA02)

8. TECHNICAL REQUIREMENTS - ELECTRICAL

8.1 Steam Turbine Generator

As a result of fire incident, damage occurred to the Steam Turbine Generator along with allied equipment as detailed in integrity assessment report (**Annex-1** of the Technical Provisions).

The Contractor shall be responsible for the removal of the damaged generator and its allied damaged auxiliaries/equipment.

Following the removal of damaged generator and damaged auxiliaries/ equipment, the Contractor shall be responsible for the supply, installation, testing and commissioning of the new generator and its auxiliaries /equipment/allied accessories ensuring compliance with the applicable codes and standards in existing configuration, summarized as follows:

- One ST generator with neutral grounding transformer and grounding resistors
- Isolated busbar for interconnection to the GCB, SA&VT cubicle and Excitation transformer.
- Generator auxiliary cubicles with all switches, bus-bars, current transformers etc. as per requirement.
- Three cubicles on ground floor containing surge arrestor and voltage transformers.
- Static excitation system for unit generator and digital automatic voltage regulator.

Before undergoing execution of the work, the Contractor shall be required to conduct a comprehensive Generator Placement Study on existing foot prints. Upon completion of the study, the Contractor shall submit the findings to the Employer/Engineer for approval before commencement of the actual work.

The damaged generator along with its allied parts/equipment/auxiliaries shall be removed from its foundation, shift/place at designated area and subsequently, a new generator with the same footprint will be procured and installed. The replacement generator will be manufactured based on the identical specifications necessary to seamlessly replace the damaged generator.

The Contractor shall ensure the new STG mechanical interfaces, terminal box locations, and dynamic loadings are fully compatible with the existing rehabilitated civil foundations and Isolated Phase Busbar alignments, without requiring major structural deviations.

The existing generator's specifications are tabulated below:

Type	QFSN--280-2	Rotating speed	3000r/min	phase	3
Stator Connecting Mode	YY	stator outgoing	6	leading phase running capabilty0.95 leading	rated power continuous
Rated P	280MW	Rated V	20KV	Rated Current	9509.3A
Cooling Medium Parameters					
Hydrogen P	0.3MPa	Hydrogen purity	98%	Oxygen content	≤1%
Allowable deviation	±0.02MPa	Min.purity	95%	inside hydrogen humidity	-5 ~ -25℃
stator winding inside cooling water					
rated intake water P	0.2MPa	Intake water T	40 ~50℃	Copper compound content	100mg/L
max. intake P	0.25MPa	intake water flow	30$m^{3/}$/h	20 ℃conductivity	0.5~1.5us/cm

		Allowable deviation	±3m$^{3/}$h	20℃CPH value	7~8
20 ℃Chardness	<2ug/L	20 ℃Cammonia content	• micros cale		
hydrogen cooler circulating water					
inlet water T	20~38℃	Rated inlet water P	0.2MPa	inlet max. water P	0.25mpa
hydrogen cooler water P drop		0.04MPa		Hydrogen cooler number	2set/total 4 Piece
single hydrogen cooler rated water flow		100m$^{3/}$h			
generator reactance and per-unit value					
vertical synchronization reactance	152.57%	horizontal synchronization reactance	151.2%	Short circuit ratio	0.62
negative sequence resistance	2.17%	positive sequence resistance	0.198%	zero sequence resistance	0.21%
vertical transient reactance	18.2 %	Horizontal transient reactance	28.6 %	negative sequence reactance	14.56 %
vertical super-transient reactance	15.35 %	Horizontal super-transient reactance	13.8 %	zero sequence reactance	7.0 %
static winding leakage reactance	10.98%	rotating winding leakage reactance	9.74%	static excess load	1.86%
stator per-slot conductor number	2	stator per-phase serial number of turns	9	Stator capacity	Non-insert rotor78M3 with rotor 73M3
stator winding open circuit is rotor winding transient time constant				9.67 s	
three-phase, two-phase or single short circuit is transient time constant				0.035 s	
three-phase short circuit transient time constant		1.15s	negative loadbearing (static value) (transient value)		10 % 10 s
two-phase short circuit transient time constant		1.89s	generator critical rotating speed (non-connecting ST)		1290 rpm (1） 3453rpm （2）
single-phase short circuit C transient component time constant				2.21 s	

These specifications are preliminary and the Contractor is responsible to conduct further investigations/study, to ensure the replacement generator precisely meets the requirements. The name plate of the existing generator is attached **Annex-7** of these Technical Provisions for ready reference.

8.1.1 Design Considerations

The generator shall be of the 3-phase, 50Hz, synchronous, hydrogen cooled type. The generator capacity shall match with the existing ST output. The design power factor of the generator shall be same as of existing damaged generator.

The final ST generator capacity shall be according to the ST unit capacity at reference site conditions. The generator voltage will be 20 kV (in accordance to the existing voltage levels)

The connections between the generator line terminals, the generator circuit breaker, the related excitation transformer, SA&VT cubicle as well as for the generator neutral shall be performed through enclosed three-phase isolated busbar system.

The generator shall be equipped with a complete static excitation and automatic voltage regulation system that has proven reliable operation at all expected service conditions.

The design shall be such as to meet the following conditions and requirements:

- The synchronous generator with its associated auxiliaries shall be capable to deliver its maximum continuous rating (MCR) without detrimental spot heating within the limits of the permissible temperature rises,
- The rotor winding is to be manufactured of hard-drawn silver alloy copper and shall consist of flat coils wound on the edge, fully insulated against each other and against the rotor body,
- Cooling system- Hydrogen and Water.
- Multifunctional digital protection equipment designed for redundant generator protection is meticulously configured and thoroughly tested
- Re-calculation and re-configuration of redundant digital protection equipment already installed for generator protection,
- Operation with MCR at rated frequency and the rated voltage without exceeding the temperatures limits,
- To withstand a metallic short circuit when operating at rated voltage and load without detrimental effect to the windings or other components for a duration of 3 seconds,
- To withstand, when operating at rated no-load voltage, the connection to the superior network through the generator step-up transformer even in case of a phase angle displacement of 90 degrees,
- In conjunction with its excitation system the generators shall operate satisfactorily at every load (within the stability limits),
- All components of the generator shall be designed and constructed in such a manner that undue or harmful vibrations are eliminated and that at no operating condition avoidable noise will occur,
- Generators and related cooling systems shall be designed to class F and operated to maintain internal heating within insulation class B limits throughout the entire operational range and throughout the ranges of ambient temperatures,
- A generator capability diagram according to IEC 60034-3, clause 13 for operation at IEC conditions shall be provided,
- All generator auxiliaries shall be integrated/interfaced into the unit sequential control system (DCS system). Local control of all AC/DC motors shall be affected from one local board, incorporating also all inter-locking criteria as well as start/stop signals as required for the relevant motor starters accommodated in motor control centres (MCC). Moreover, all analogue and binary measuring and control signals for remote services shall be brought by serial interface via redundant remote bus system to the entire DCS monitoring devices.

Prior to delivery, the Generator shall undergo a Factory Acceptance Test (FAT) at the manufacturing facility. The FAT shall be conducted in accordance with mutually agreed upon specifications and procedures, which shall be provided for approved by the Employer/Engineer. The FAT shall demonstrate Generator's compliance with the technical specifications, performance criteria, and quality standards.

Upon successful completion of the FAT, the Contractor shall provide the Employer/Engineer with a detailed FAT report documenting the test results, deviations, if any, and any corrective actions taken.

In the event that the Generator fails to meet the specified criteria during the FAT, the Contractor shall be responsible for rectifying any deficiencies identified and shall bear all costs associated with retesting until the Generator meets the requirements.

8.1.2 Generator Tests

The Contractor shall carry out following tests in the presence of Employer/Engineer:

- Automatic voltage regulator setting and adjusting in stand still condition and with the generator running at no load.
- Open and short circuit tests on generator.
- Stator earth fault.
- Negative phase sequence.
- Generator transformer over-current and earth fault.
- Automatic voltage regulator droop.
- Reactive capability.

8.1.3 Generator Condition Monitoring and Diagnostic System

In consideration of the existing online device for generator condition monitoring and diagnostics, the Contractor shall embed and configure a similar protective mechanism within the new generator. This detection feature shall be integrated with existing On-line Detection Device of Generator Rotor Winding Short Circuit system.

The Contractor shall provide documentation detailing the incorporation and configuration of the existing system, including any necessary adjustments made to ensure compatibility with existing system. Furthermore, the Contractor shall conduct thorough testing and validation procedures to confirm the functionality and reliability of the protection mechanism prior to handover.

8.1.4 Excitation System and Automatic Voltage Regulator

The existing excitation system including excitation transformer was declared damaged during integrity assessment. Therefore, new excitation system shall be supplied, installed and commissioned by the contractor. The existing excitation system shall be dismantled and shifted to the Employers designated location/warehouse.

The Contractor shall be fully responsible for the replacement of the excitation system and Automatic voltage regulators (AVR) for Steam Turbine Generator. The Contractor shall ensure that the replacement and installation activities are carried out in accordance with the technical requirements, best industrial practices, and applicable regulations.

Static excitation system for the ST generator (SES), with excitation transformer, feeding rotor directly from thyristor bridges via brushes shall be provided. This newly installed system shall be capable of providing a sufficient margin of stability under all steady and transient load conditions.

A complete digital voltage regulator and associated components mounted in a free-standing dustproof metal-enclosed cubicle shall be furnished. The interior of the housing shall be painted white and shall be provided with a light and switch for illumination. All equipment mounted inside the housing shall be completely wired with all instruments, meters and control leads wired to terminal blocks for external connections. All major items of equipment shall be identified with engraved nameplates. Inside the housing, all required equipment shall be mounted and wired such as, but not necessarily limited to, the following:

- Latest and proven state of the art technology

- High availability due to redundant AVR
- Complete static excitation package incl. essential components such as transformer, thyristor assemblies, microprocessor-based voltage regulators for control / supervisory manual and automatic, LV and HV connections, etc but not limited to.
- Instrument transformers
- Field breaker, de-excitation, over voltage protection
- Aux. excitation system with external AC and DC power supply for initial excitation, commissioning, protective relay setting, and conducting test runs.

The Contractor shall integrate new excitation system with associated excitation switchgear. Necessary refurbishment and testing of associated excitation switchgear shall also be performed by the Contractor. The entire excitation system shall be installed in existing air-conditioned control room nearby the turbine generator unit; field installed cubicles shall be accommodated in IP 32 protection class.

8.1.4.1 Excitation System

The generator shall be equipped with a complete static excitation and voltage regulation system that has proven reliable operation at all expected service conditions. This system shall be capable of providing a sufficient margin of stability under all steady and transient load conditions. Communication with the Ovation DCS system is Unit Highway Data Bus (UDH)

It shall gain, together with the voltage regulator described below, a very sensitive and quick-acting control of the generator voltage and reactive power.

The replacement excitation system shall adhere to the exact specifications of the original system installed, including but not limited to voltage ratings, frequency response, control features, and compatibility with existing infrastructure. The replacement system must perform all functions and operations equivalent to the original excitation system, ensuring seamless integration and operation within the existing setup.

The excitation shall be affected by a static system with controlled semi-conductors, with the excitation power supplied by an excitation transformer connected to the generator terminals.

To improve the stability of the network, the system shall be equipped with Power System Stabiliser (PSS). The scope of supply shall include all devices for the excitation system including the required dry type excitation transformer, current transformers, rectifier assembly, AVR, etc.

Main functions of the excitation system shall be to provide variable DC current with short time over-load capability, quick-acting control of the generator voltage with suitable accuracy and reactive power respectively, ensure stable operation with network, contribution to transient stability sub-sequent to a fault, communicate with the DCS by bus and to keep machine within permissible operating range.

The replaced system must comply with all relevant standards, codes, and regulations applicable to excitation systems, ensuring safety, reliability, and compatibility with the existing excitation system. The Contractor shall be responsible for the installation, testing, and commissioning of the replacement excitation system, ensuring proper functioning and performance in accordance with manufacturer's recommendations and industry best practices.

8.1.4.2 Automatic Voltage Regulator (AVR)

Automatic Voltage Regulator (AVR), along with its manual control equipment, shall be installed. The automatic voltage regulator shall be of a precise and reliable voltage regulation and shall ensuring that

the generator produces electricity with minimal fluctuations in voltage, regardless of environmental conditions or changes in electrical load.

The control system shall employ a fast response digital automatic voltage regulator, which shall be responsive to the average value of the three generator phase voltages and to any other signal necessary to maintain steady state and transient stability. The AVR shall be complete in all respects with proven hardware and software / firmware, shall have self-diagnostic features and shall be easily programmable. The type and make of digital AVR shall be acceptable to the Employer/ Engineer.

The regulating equipment shall be free from voltage drift and temperature errors and insensitive to frequency variations between 47 and 53 cycles per second and shall maintain the generator terminal voltage within ±0.5% of the pre-set value over the whole load range of the generator.
When the generator is subjected to a sudden loss of the maximum continuous output at rated power factor, the equipment shall be capable of limiting the generator transient over voltage to a value not exceeding 120% of the rated voltage and shall restore the voltage up to a maximum deviation of 2% of the nominal pre-set value within three (3) seconds.

The equipment shall include all necessary components to ensure that in the event of a component failure of the automatic system including fuse failure, the excitation circuit is automatically switched over from automatic to manual control.

Furthermore, the control and excitation system are to be provided with:

- quadrature droop parallel running compensation (adjustable 0-10%)
- under-excitation or load angle limitation with adjusting device
- time-graded limitation of the maximum excitation current.
- power system stabilizer (PSS)

A voltage reference adjuster function shall be included in the digital AVR being capable of adjusting the voltage between 90% and 110% of the rated voltage under all permissible load conditions and to keep this value automatically constant during operation of AVR.

For manual adjustment of the generator voltage, a similar function shall be provided to adjust the excitation so as to start with about 10% of the generator no-load voltage up to 110% rated voltage. Moreover, this feature must have sufficient fine control between 90% and 110% of the generator no- load voltage to ease manual and automatic synchronization. The manual excitation control shall be free from hunting.
Push buttons for voltage raise / lower functions shall be available at the AVR cubicle.

The manual and the automatic control system shall follow accurately the operating equipment to prevent the increase or decrease in excitation upon transfer from automatic to manual control, or vice versa.

The FAT shall be conducted at the manufacturer's facility and shall involve a comprehensive series of tests and inspections as mutually agreed upon by the Employer/Engineer. These tests shall include, but not be limited to, functionality tests, performance tests, safety tests, and reliability tests. The Excitation System and AVR shall be deemed to have passed the FAT if they meet all specifications and demonstrate satisfactory performance. In the event that the Excitation System and AVR fail to meet the acceptance criteria during the FAT, the Contractor shall be responsible for rectifying any deficiencies identified during testing at its own cost. The Contractor shall promptly undertake the necessary corrective actions and retest the equipment until it meets the requirements.

8.1.4.3 Excitation Transformer

The existing excitation transformer shall be removed and a new transformer shall be supplied, installed and commissioned.

The replaced transformer shall meet all requirements of the excitation system. It shall be of the dry-type. Design shall be in accordance with the following specifications, as far as applicable.

Class H insulation material shall be used with the windings impregnated and cast under vacuum into moulds of glass fibre reinforced epoxy resin. The windings shall not absorb any humidity. The insulation material shall be barely inflammable and self-extinguishing.

The transformer shall be designed for natural air cooling and be housed in a steel sheet or aluminium sheet enclosure of adequate mechanical strength. The transformer shall be sized for the rated capacity of generator such that all excitation system requirements are fulfilled under all possible operating conditions. Transformer sizing calculations shall be submitted for Engineer's approval.
The HV terminals shall have flanges for connection (phases and enclosure) to the encapsulated generator busbars. Phase segregation must be ensured at the HV bushings. The LV terminals shall be covered by the hood described above and be provided with flat copper bars enabling the connection.

Beside the requirements of the Transformer Specification at least the following accessories shall be provided:

- one (1) off-load tap changer with setting range as existing transformer
- three (3) twin-core current transformers at the HV side
- one (1) single-core current transformer at the LV side
- three (3) resistance type temperature detectors (Pt 100) inserted in the LV winding, for local and remote temperature measuring
- LV temperature monitoring device applying several sensors, with separate contacts for warning and tripping.

The transformer and its related equipment shall be subjected to acceptance tests to be performed at the Contractor's workshop in order to verify the conformity with the guaranteed and other design data. These tests shall include the following measurements, evaluations, etc.:

- Measurement of winding resistances
- Measurement of voltage ratio on all steps and check of phase displacement
- Measurement of no-load loss and current
- Measurement of short-circuit impedance and load loss
- Measurement of impedance voltage and short-circuit losses
- Insulation resistance measurements test
- Full wave impulse voltage withstand test
- Separate-source AC withstand voltage test
- Induced AC withstand voltage test
- Partial discharge measurement
- Noise level measurement (this test may be waived if test certificates of similar transformers can be submitted).
- Determination of errors and accuracy of built-in current transformers
- Functional tests of all electrical control and supervisory equipment
- Visual inspection

The following tests, as a minimum, shall be performed at the Site.

- Visual inspection
- Megger test (all windings against each other and against earth).
- Functional test of all control and protection equipment.
- Confirmation of vector group

8.2 Generator Circuit Breaker

The Contractor shall conduct thorough testing of the existing GCB to confirm its integrity for potential use as a spare component. Upon confirmation of integrity, the Contractor shall ensure the proper storage of the existing GCB as designated by the Employer.

The Contractor shall undertake the responsibility for the safe removal of the damaged GCB from its current location and arrange its transportation and shifting to the designated storage or disposal location as specified by the Employer. The Contractor shall be liable for any damages or losses incurred due to negligence or inadequate performance during the replacement process.

The Contractor shall procure a new generator circuit breaker that meets the requirements specified by the existing system (See electrical single line diagram, drawing No. 33-F6311Z-D0101-01 for details). The new GCB shall be of suitable specifications to seamlessly integrate with the existing system without compromising its functionality or performance.

The generator circuit breaker shall be of SF6 type, single pole insulated but with a common drive, metal clad, frame mounted. The GCB shall be integrated in the generator busduct system and must be provided with current transformers, voltage transformers, capacitors, surge diverters, disconnectors and earthing switch as specified in the existing system. The control box must be for installation in the hall and contain sufficient terminals for remote connection.

The generator circuit breaker must be able to interrupt the short circuit, the capacity must be sufficient for a rated generator/transformer capacity. The operation condition in the machine hall with a temperature of 60°C must be considered.

The new GCB shall adhere to the technical specifications and standards mandated by the existing system requirements. Any deviations from the specified requirements must be approved by the Employer/Engineer in advance.

The existing GCB technical specifications are as below:

System Data:

1. Rated frequency:	50Hz
2. Maximum operating voltage:	23kV
3. Maximum operating current at 40°C:	10500A
4. Rated power-frequency withstand voltage:	60kV
5. Rated lightning impulse withstand peak voltage:	125kV
6. Rated voltage for the motor drives:	3x 400VAC
7. Capacitors on transformer/generator side:	130nF/130nF
8.Total weight of the circuit breaker system	4600kg

Circuit Breaker

1. Rated maximum voltage:	23kV
2. Rated continuous current:	10.5kA
3. Rated full-wave impulse withstand peak voltage:	150kV
4. Rated short-circuit duty cycle:	CO-30min-CO
5. Rated short-circuit current, symmetrical:	80kA
6. DC component:	75%
7. Close, latch and carry current (peak value):	220kA
8. Short-time current, 3s:	80kA
9. Assigned out-of-phase switching current:	40kA
10. Rated interrupting time:	68ms
11. Rated operating SF6-density:	40.7kg/m3
12. Total SF6 quantity for 3 phases:	11kg

Operating Mechanism of the Circuit Breaker

1. Rated control voltage for closing and tripping coils:	220VDC
2. Rated voltage for pump motor drive:	220VDC
3. Closing and tripping current:	1.5A
4. Current of the pump motor drive:	3.2A

Disconnector

1. Rated voltage:	23kV
2. Rated normal current:	10500A
3. Rated power-frequency withstand voltage:	80kV/88kV
4. Rated lightning impulse withstand peak voltage:	150kV/165kV
5. Rated peak withstand current:	220kA
6. Rated short-time withstand current. 3s:	80kA

Earthing Switch(es)

1. Rated voltage:	23kV
2. Rated power-frequency withstand voltage:	80kV
3. Rated lightning impulse withstand peak voltage:	150kV
4. Rated peak withstand current:	220kA
5. Rated short-time withstand current, 1s:	80kA

The Contractor shall ensure that the installation and testing of the new GCB shall be carried out in compliance with international standards and regulations.

Testing

The Contractor shall conduct a comprehensive Factory Acceptance Test (FAT) on the Generator Circuit Breaker (GCB) prior to its shipment. The FAT shall be performed in accordance with the mutually agreed upon test procedure, which shall include but not be limited to the following:

- Verification of GCB design and construction compliance with relevant technical specifications, standards, and regulations.
- Functional testing of all GCB operating mechanisms, including but not limited to closing, opening, and tripping operations.
- Verification of auxiliary and control circuits functionality.
- Verification of interlocks and safety features.

The Generator Circuit Breaker (GCB) shall be deemed acceptable if it satisfactorily passes all tests as per the agreed-upon FAT procedure and meets all specified performance criteria. Any deviations from the

acceptance criteria shall be promptly addressed by the Contractor to the satisfaction of the Employer/Engineer.

8.3 Busbar System and Generator Neutral Earthing

The existing busbar arrangement from the Generator terminal to the Generator Circuit Breaker (GCB) including branches/taps was damaged during the incident.

The Contractor shall undertake the complete dismantling of the damaged IPB, including its branches/taps for SA&VT and the excitation transformer. Subsequently, the Contractor shall arrange for the transportation and shifting of the dismantled IPB to the designated location as specified by the Employer.

The Contractor shall procure a new IPB that meets the specifications required for the system. The new IPB shall be of appropriate size, capacity and configuration to seamlessly replace the damaged section of the IPB.

The new IPB shall conform to the technical specifications and standards prescribed for the system. Any deviations from the requirements must be approved by the Employer prior to installation.

Following the installation of the new IPB, the Contractor shall conduct testing to verify the integrity and functionality of the IPB, including its branches/taps.

The Contractor shall be liable for any damages or losses incurred due to negligence or inadequate performance during the replacement process.

8.3.1 Isolated Phase Busbar

The following equipment with all required auxiliaries shall be supplied, installed and commissioned (See electrical single line diagram, drawing No. 33-F6311Z-D0101-01):

- One (1) three-phase, single-phase isolated busbar system for connection between the generator and the generator circuit breaker with tie branches/taps as required for connection of:
  - excitation transformer
  - potential transformers
  - surge diverters
  - earthing switches
  - shorting devices
  - generator circuit breaker

The corresponding components have also to be supplied and installed in metal clad cubicles. The generator circuit breaker shall be integrated in the busduct system.

- One (1) set of equipment as required for performance of the neutral connections to be provided in the generator neutral terminal box
- One (1) set of generator current transformers (line and neutral side)
- One (1) compressed air system for busbar pressurization including 2 x 100% compressor units

Specifications and basic parameters of the existing IPB:

Main circuit isolated-phase bus:	
Rated voltage	20kV
Max. voltage	24kV
Rated current	10000A
Max. environment temperature	60°C

Absolute elevation	≤1000M
Earthquake intensity	≤8
Dimension of bus	600×12mm
Enclosure dimension	1150×8 mm
Phase-phase distance	1500mm
Branch circuit isolated-phase bus:	
Rated voltage	20kv
Max. voltage	24kV
Rated current	1600A
Max. environment temperature	60℃
Absolute elevation	≤1000M
Earthquake intensity	≤8
Dimension of bus	100×10
Enclosure dimension	650×5
Phase-phase distance	1100 mm

Tests:

On a sample in the workshop:

- dielectric test with power frequency voltage
- impulse test

On the whole system at site:

- dielectric test with power frequency voltage
- heat run test with rated system currents to check specified temperature rises and to determine hot spots (on one insulation only)
- system tightness test

8.3.2 Compressed Air System

The compressed air system for busbar pressurisation got severely affected by the fire incident and required to be replaced along with the damaged busbar section. The replacement of the damaged compressed air system shall comprise of compressor unit including air dryers, filters, receivers, coolers, controls and piping as required to ensure optimal functionality for the specified busbar systems. Provisions shall also be made to connect the compressed air system to the instrument air system as emergency supply.

8.3.2.1 Compressor

One compressor shall be heavy duty, oil-free with carbon rings, driven by electric motors and provided with intercoolers and aftercooler.

Compressor shall be capable of continuous operation under the specified service conditions, without injurious heating and shall operate without objectionable noise or vibration. Sufficient flywheel effect shall be incorporated in the compressor to ensure steady and smooth operation under intermittent loading and unloading conditions.

The Contractor shall furnish intake air filter and silencer, necessary gauges and all accessories and controls required for complete air compressor unit. The Contractor shall also furnish suitable industrial type thermometers and relief valves. The relief valve shall be factory set and shall be of ample size to protect the compressor in case of failure of the automatic controls.

The air valves shall be of the plate or flat strip type and shall be designed to produce a large effective area and to be quiet in operation. All moving parts of the compressor shall be completely enclosed in a dust proof, oil-tight housing. Automatic lubrication systems shall be provided.

8.3.2.2 Air Receivers

Compressor shall be provided with an air receiver. Both receivers shall be suitably interconnected and valved such that one is the duty receiver and the other the standby receiver. Each air receiver shall have sufficient capacity to:

- run the plant for 1 hour without recharging
- to enable the standby compressor to come into operational service without any reduction in air supply

All air receivers shall be furnished with factory set safety valves, pressure gauges and bottom drains. Drains shall be connected by pipework in order to safely and neatly dispose off drained water.

8.3.2.3 Air Dryers and Filters

Compressor system shall be provided with two full capacity air dryers with automatic reconditioning facilities, if required. The dryers shall be interconnected and valved in such a way that either one can supply all of the busbar system air requirements.

The compressed air shall be sufficiently dry to prevent condensation occurring in the busbar air system under any operating conditions of temperature and pressure.
All filters for the busbar systems air shall be provided as required.

8.3.3 Generator Neutral Earthing

One (1) set of generator neutral earthing devices (See electrical single line diagram, drawing No. 33-F6311Z-D0101-01) complete in all respects including:

- Neutral earthing transformer
- Load resistor
- NGR current transformer

to be installed in metal clad cubicle

8.4 Restoration of Protection System

The Steam Turbine Generator (STG) protection/measurement's secondary circuits have been significantly impacted by the fire incident, necessitating a complete replacement of the secondary circuits in between burnt equipment and the protection/measuring cabinet.

The Contractor shall remove the damaged equipment including items such as cables, instrument transformers and cable trays (if required) and shall replace with new cables and instrument transformers etc. The replacement cables, instrument transformers and cable trays shall be of the same specs or better to the existing ones.

In alignment with the new Steam Turbine Generator (STG) requirements and the updated grid code, the protection settings shall be revised. This revision shall ensure the efficient and effective operation of the protection system in compliance with relevant standards and regulations. The Contractor shall also perform testing and commissioning the restored Generator protection system.

Testing of existing protection devices and measuring devices are also in the scope of the Contractor to ensure the healthiness of the Generator protection devices. These protection devices include but not limited to generator protection, circuit breaker failure, main transformer protection, generator transformer unit protection, auxiliary transformer protection, excitation transformer protection. Post-replacement, the Contractor shall undertake comprehensive testing of the restored protection system This process shall include verification of protection settings, examination of existing protection and measuring devices, functionality testing, circuit verification and calibration of measuring devices to guarantee the integrity and reliability of the system.

8.5 Replacement of Damaged Cabling for Steam Turbine Generator and Allied Systems

The Contractor shall undertake the removal and replacement of all damaged control and power cables, cable terminals, cable racks, conduits, cable fixing material etc. associated with the steam turbine generator and allied systems/equipment. It shall cover all equipment whether specified or not to form a complete, safe and reliable system. This replacement is necessitated due to damages incurred during the fire incident.

The Contractor shall be responsible for removing the damaged cables from the marshalling kiosk or connecting cabinet to the respective equipment. All such activities related to the removal of damaged cabling and installation of new cables shall be conducted in compliance with applicable laws, regulations, and industrial practices ensuring full functionality and safe operation of the plant.

The Contractor shall conduct a thorough assessment to determine the extent of damage to the cables and the necessary replacements required for steam turbine generator and associated CTs and VTs, generator protection, synchronization system, generator circuit breaker, micro pressure device for busbar, measuring devices and generator excitation system etc.

The replacement work shall require approval from the Employer/Engineer before commencement.

Upon removal of damaged cables, the Contractor shall carefully label and document the terminals and connections, facilitating seamless rewiring during installation of new cables.

The removal of cables shall include disconnection from terminals at both ends, with utmost attention paid to preserving the integrity of the equipment and associated systems.

All replacement cables shall meet industrial standards and project requirements for material quality, insulation, and electrical characteristics.

The Contractor shall conduct thorough testing and inspection of the installed cables to ensure proper functionality and adherence to safety standards.

8.5.1 General Requirement

The Contractor shall maintain detailed records of the removal, replacement, and testing for all cables, including but not limited to terminal configurations, cable types, and testing results. Documentation shall be provided to the Employer/Engineer upon completion of the work for review and record-keeping purposes.

The cable schedule to be submitted to the Engineer shall indicate, the cable numbers, cable diameter, cable length, voltage, number of cores, conductor size, termination and connections at each end and cable route.

The Contractor shall be responsible for any defects, failures, or non-compliance related to the removal and replacement of damaged cabling, including associated costs for rework or repairs.

All multi-core I&C cables or fieldbus cables installed inside and outside the buildings shall be completely protected by means of closed cable trays, flexible conduits. The individual cables to the instruments shall be protected as far as practicable. Cable Trays shall be perforated type having at least 400 mm distance to other cable trays (install above or below). Cable glands/conduits shall be used from instrument to cable trays. Cable tags shall be printed/label on each cable after 3-meter distance and protected from weather and harsh industrial condition.

There shall be no welding allowed on cable trays, proper bolts and screw shall be used to fix the cable tray. Cable tray for I&C in electrical shaft shall be separate from electrical cable trays.

Segregation between the different types and voltage levels must be maintained. On cable trays, MV/LV control cables shall be laid on separate racks. In general cable and cable racks shall be provided with marking of the cable and tie number at certain distances.

Power and control cables shall be steel armoured.

The conductor cross section of each newly replaced cable shall be adequate for carrying the prospective fault current determined by the next relevant short circuit protection device when operating under the specified load conditions without deterioration of the dielectric properties. The Contractor shall prove the correct design by means of a short circuit calculation.

Cables laid/replaced directly in the ground, the whole or part of their length, shall be of the highest thermal stability and mechanical strength type. They shall be single wire or tape armoured. The outer sheath or serving shall be P.V.C.

The polyvinylchloride (P.V.C) used for cable sheathing shall be of the type known as “high temperature” or “heating-resisting”. The P.V.C. compound and the plasticizers shall be such as to give a cable life of at least 10 years when operating at a temperature of 85°C.

Cable conductors shall comprise stranded, annealed, high conductivity copper conductors laid up and rendered smooth and free from defects likely to injure the insulations. Under no circumstances will cable through joints be accepted, unless a previous written approval has been obtained from the Engineer for each joint required.

8.5.1.1 Shielding and Grounding System

Grounding, shielding and treatment of the common reference shall form a uniform system for the whole I&C systems and DC supply throughout the plant.

To avoid double earthing of cable shields by earth fault or by erroneous connection a systematic shielding network with easy checking possibility shall be realized. Applicable standards shall be considered.

The grounding of all cable shields shall be done systematically in the Electronic Room in the relevant cubicles on an isolated bar with disconnect able connections. All isolated shielding bars of the individual cubicles shall be connected to a central earthing bar situated in the Electronic Room easily accessible for maintenance. DCS earthing should be separate from plant earthing system and have no connection in between.

8.5.1.2 Labels, Tags, Plates and Inscriptions

The Contractor shall supply and install for electrical / I&C equipment all labels, tags, name, ratings, instruction and warning plates necessary for the identification of the works, to allow safe and correct operation, easy testing and efficient maintenance.
Material and size of all label-, tag-, plate-, and inscription categories shall be according to the Employer's Requirements in the mechanical section.

The identity of the manufacturer and the year of manufacture shall be provided throughout the length of the cable. Letters and numerals, if applied on the outer sheath, shall be raised and shall consist of upright block character.

8.5.1.3 Cable List

The Contractor shall submit all the technical data pertaining to each type and kind of newly replaced power and control cable under by the Contract, giving the following information as minimum:

- Item and code number
- Description and location
- Manufacturer and catalogue
- Type of cable, insulation serving, armouring and sheathing
- Cross sectional area in mm2
- Current carrying capacity in Amps
- Derating factor/ambient temperature
- Grouping factor
- Length in meters
- Type of cable termination
- Maximum short circuit capacity in k Amps
- Voltage drops
- Cable Color Coding: For 0.4kV Motors (Red, Yellow, Blue & Black for neutral)

8.5.1.4 Cable Sealing and Drums

The ends of the cables shall be sealed against the ingress of moisture, dirt and insects and the end projecting from the drum shall be adequately protected against mechanical damage during transportation, intermediate storage and site handling. Wooden cable drums shall be lagged with closely fitting battens.

8.5.1.5 Cable Laying

Generally, cables shall be laid in already installed cable trays and cable trenches, unless specified otherwise.

In the event that additional cable trays or trenches are deemed necessary for the laying of cables, it shall be the responsibility of the Contractor to provide and install the required additional cable trays and associated accessories. This includes any supports, brackets, or fittings required for proper installation.

The Contractor shall also undertake all related civil works essential for cable installation. This includes the placement of conduits, switch boxes, etc., as well as closing of slots and holes in walls, ceiling and floors are to be done by the Contractor.

All newly installed trays, supports, ladders, etc., shall be of hot-dip galvanized steel elements. New Cable trays, where needed, shall be of the ladder type with horizontal spacing and shall be rigidly fixed on supporting steel structures, masonry or galvanized racks and cable trenches.

Cables laid on trays or racks shall be properly fixed or clamped, with smooth finished split pieces with bore diameter to suit the cable. Supports and racks shall be arranged as far as practicable for the easy removal of any cable without disturbing other cables or threading cables through supports or racks.
Cables tapped or branched from general raceways and directed to the relevant equipment shall, if necessary, be protected over their entire length by galvanized heavy steel conduits sealed at their ends against ingress of water.

Control and power cables shall be laid separately (min. distance 300 mm).

Special precaution shall be taken to ensure that no closed iron magnetic circuit is formed around single core cables laid in single or trefoil formation, or around any cable liable to carry unbalanced load currents.
The pulling and fixing of cables and the making of all terminations shall be strictly in accordance with the manufacturer's instructions, using the recommended tools and appliances for the purpose.

The following conditions shall be observed when using cable trenches:

- Cable trench covers, where needed, shall be removed in sections, according to the progress of work
- Removed covers shall be stored in such a way that they do not create a hazard to people or traffic at site
- Cables lying in open trenches for more than two weeks shall be protected against sun radiation
- Open trenches shall be properly secured by red warning tapes both sides along the trench
- Any cover or cable/cable tray having been damaged during handling shall be replaced by the Contractor.
- Cable trenches shall be cleaned from dirt, sand, etc. before closing
- Trenches shall be closed as soon as possible to avoid excessive ingress of dirt and damage.

8.5.1.6 Cable Terminations and Accessories

At all terminations of wires of newly laid/replaced cables, the insulation shall be neatly stripped without nickling the strands of the conductors. Cable lugs for power cables shall be of adequate size. Cable glands or clamps shall be fitted in all cases to prevent any stress being borne by the conductors or the terminals. The sealing compound and sleeving used in terminations shall be selected to suit the service temperature conditions under which the cable is to operate.

Where cable terminations are likely to be disturbed for maintenance purposes, some slack cable in a loop or other suitable form is to be allowed at a convenient place in the run.

8.5.1.7 Tests

Newly laid/replaced cables shall be workshop tested in accordance with applicable standards. The minimum scope of tests shall include:

- measurement of insulation resistance
- measurement of sheathing and protecting layers thicknesses

Test certificates, proving that each cable type to be used has successfully passed all special and type tests as required by the applicable standards during the last 12 months before award of contract. Otherwise, these tests have to be repeated on sample sections. Further, measurement of insulation resistance of newly laid / replaced power cables shall also be checked at Site.

8.6 Detailed Assessment / Testing of Steam Turbine Main and Auxiliary Transformers

The Contractor shall carry out comprehensive diagnostic testing of the Steam Turbine Main Power Transformer and Auxiliary Transformer to evaluate its electrical, mechanical, thermal, and insulation condition. The assessment shall identify any deterioration, defects, or abnormal conditions affecting the transformers' reliability and recommend corrective actions where necessary. The Contractor shall submit detailed test procedure to the Employer / Engineer for review / approval.

These tests shall include but not limited to the following:

- Visual inspection
- Dielectric test of oil
- Insulation Resistance (IR)
- Winding Resistance Measurement
- Dissolved Gas Analysis (DGA)
- Functional test of all control and protection equipment
- Vector group confirmation
- Transformer Cooling System tests

Upon completion of the assessment, the Contractor shall submit the final detailed technical report and present the findings, conclusions, and recommendations to the Employer / Engineer.

9. TECHNICAL REQUIREMENTS - CONTROL AND INSTRUMENTATION

As a result of the fire incident, ST/STG field instrumentation got damaged along with control cables installed at ST Hall. ST/STG vibration system field instrumentation& cabling was found to be completely damaged; however, control panels remained safe as they are installed in controlled environment.
Following the removal of damaged equipment, the Contractor shall be responsible for the supply, installation and commissioning of the new ST/STG Control system, fire damaged instruments/ control equipment, replacement of damaged cables and rehabilitation of vibration control system (Bentley Nevada 3500) ensuring compliance with the applicable codes and standards.

The existing control philosophy (interlocks, protections, start/stop sequences, analog control loops, open loop controls etc.) shall be preserved and realized in the as-repaired configuration. No major modification to control logic or philosophy shall be undertaken unless explicitly requested by the Contractor and approved by the Employer / Engineer.

The scope of works includes but not limited to the following:

- Replacement of existing ST control system with State-of-the-art latest and proven ST / STG Control System compatible with Plant DCS (Emerson Ovation) with OEM support / product life cycle of minimum ten (10) years.
- Upgradation of existing DCS (Emerson Ovation) with OEM support / product life cycle of minimum ten (10) years.
- Provision of a unified plant data logging facility with accurate time stamping to a common time reference to produce accurate sequence of events logs and plant data trends
- Repair / Replacement / Relocation/rerouting of all damaged field instrument and control cables from field to panels if required (at main control panel room)
- Installation, testing and commissioning of new Hydrogen gas detectors for new ST Generator which got damaged during fire incident
- Rehabilitation of Vibration Control System (Bentley Nevada 3500) along with new field instrumentation/vibration sensors / Cables.
- .

Before undergoing execution of the work, the Contractor shall be required to conduct a comprehensive study on existing DCS/ST control system and I&C related plant equipment. Upon completion of the study, the Contractor shall submit the findings to the Employer/Engineer for approval before proceeding to commencement of the actual work.

The Contractor will carry out a study of existing control system configuration, control logics, protection logics, open loop controllers, closed loops controller, start-up/shut down sequences and set points/threshold etc. and will upgrade existing DCS/ST Control with latest and proven-state-of-the-art control system, reflecting the most recent advancements in the instrumentation and control of modern power plants, including hardware, software, and operational principles. Through the upgrade, the Contractor will ensure that all existing control logics, start/stop sequences, protection logics, alarms, and closed-loop controllers are seamlessly replicated / incorporated in the newly installed ST/STG control system and upgraded DCS system Any changes to the existing control philosophy will require prior approval of the Employer/Engineer.

Pre-Bid Survey

In order to ensure realistic scope and full visibility of actual on-site damage, remaining useable equipment and required restoration scope for competitive bidding, a comprehensive pre-bid survey is required to be conducted. Pre-bid survey report will be a part of Contractor's bid which includes detailed scope of work, damage assessment matrix, detailed methodology, control philosophy preservation plan etc. No claim for additional costs arising from incomplete or inadequate site survey shall be entertained after bid submission.

9.1 Steam Turbine Control

The Steam Turbine control system shall include all necessary control functions such as governor control, start-up/shut-down sequence control, and auxiliary equipment control.

ST Control System shall be compatible with the DCS. The diversity of makes and types shall be kept to a minimum.

The same redundancy and reliability requirements as for the DCS shall apply for ST Control System and the features shall be similar. All individual process alarms and system status alarms shall be forwarded to the DCS. The alarm and status signals of parameters important for the generation shall also be forwarded. The systems shall be monitored on the DCS workstations with own mimic(s). Hardware and software failures during data transmission shall be monitored and alarmed. All individual process failure alarms shall be audible and popup on the HMI screen as well.

9.2 DCS Upgradation

The scope of this project comprises the **repair, renovation, restoration, and selective upgradation of the existing DCS** for 747 MW CCPP Guddu to improve system reliability, maintainability, cybersecurity, and long-term operational support. The objective is to replace obsolete hardware and software components with a modern, OEM-supported DCS platform while preserving the existing plant operating philosophy and process functionality.

The upgraded DCS shall retain the existing control philosophy, including all interlocks, protections, start/stop sequences, analog control loops, and operator interfaces, unless otherwise specifically approved by the Employer / Engineer. The Contractor shall execute the migration with minimum plant outage, ensuring compatibility with newly installed / existing field instrumentation and control equipment, and shall provide all engineering, supply, installation, configuration, testing, commissioning, documentation, training, and post-commissioning support. The proposed DCS shall be based on proven, state-of-the-art technology with a minimum OEM product support and life cycle commitment of ten (10) years. The upgraded system shall enhance system availability, diagnostics, cybersecurity, maintainability, and spare parts availability while ensuring safe, reliable, and uninterrupted operation of the generating unit. All work shall comply with applicable international standards and good engineering practices.

The Contractor shall perform integrated loop checking, I/O mapping, and functional testing across the new ST/STG controllers and the existing equipment to ensure seamless combined cycle integration.

The current software level of the DCS is Ovation 3.3.1 and consists of the hardware listed in the below table:

Sr. No	Hardware Type	Description	Network Type
1	Database/Engineering Server	DELL PC	Fast Ethernet
2	Engineering Workstation (DEH)	DELL PC	Fast Ethernet
3	Historian Server	DELL PC	Fast Ethernet
4	Operator Workstation	DELL PC	Fast Ethernet
5	Operator Performance Calculation Workstation (DEH)	DELL PC	Fast Ethernet
6	Redundant Controllers(Including power supply)	OCR400 G02	Fast Ethernet
7	Routers switches	Cisco 2960	Fast Ethernet
8	Printers	Fuji	Fast Ethernet
9	Media Convertors		Fast Ethernet

The major scope related to DCS under this contract includes but not limited to the following, is summarized hereunder:

Summary of DCS Upgradation Scope

Item	Description
System Hardware	• Ovation controller upgrade • Power supply upgrade • Ovation workstation replacement • Network architecture replacement
System Software	• Upgrade the current Ovation system software to the latest/proven software release at time of project implementation

9.2.1 System Hardware Upgradation

The existing Ovation system DCS hardware that has been identified for replacement with the most recently validated version of the hardware is listed hereunder.

9.2.1.1 DCS Controller

The new latest DCS controller shall be mounted in the existing controller cabinet in place of the existing DCS controller. The new controller shall provide faster control execution, enhanced security, and increased memory.
Notes:

1. This upgrade shall consist of replacing the existing controller and the existing backplanes.
2. The existing RIOs, IO modules and cables can be re-used unless otherwise noted.

9.2.1.2 DCS Power Supplies

The DCS power supply retrofit kit shall be mounted directly in the existing controller cabinet in place of the existing DCS power supplies. The new power supplies shall provide fan-less operation with increased auxiliary power output and improved power efficiency. Longer power cables, if required, for some installations shall be supplied by the Contractor.100% dual Redundant power supplies shall be provided with each controller to power up the node.

9.2.1.3 Workstations

The Contractor shall replace all existing Operator Workstations (OWS) with new, latest / state-of-the-art Operator Workstations fully compatible with the upgraded Ovation Control System (DCS). The proposed workstations shall be designed, configured, and licensed to support all existing operator functions, including process monitoring, control, alarm management, historical trending, graphics display, event logging, reporting etc. The new workstations shall be integrated seamlessly with the upgraded DCS without requiring any modification to the existing control philosophy or process logic.

Notes: -

1. The Contractor will use existing power cable from PDP Cabinet to Computer.
2. The Contractor will use existing network cable from Network Cabinet to Computer and Controller.
3. Any type of Cable (Optical Fiber, Cat5E, Earth) supply, laying & termination work shall also be under the Contractor’s Scope.

9.2.1.4 Network – Fast Ethernet

The existing Ethernet switches and routers will be replaced with the most recently validated Fast Ethernet switches and routers. The new hardware will be placed in the existing network cabinet(s).

9.2.1.5 System Software Up-gradation

The Ovation system software will be upgraded from the current level to the latest/proven software level. The workstations will be loaded with the operating system that is compatible with the upgraded Ovation software level.

9.3 Field Mounted Equipment Requirements

The field instruments/control equipment which got damaged due to fire incident, shall be replaced with new instrumentation along with field cabling, cables trays, piping, socket, Junction Boxes, switches, ports, HUBs etc. All instrumentation to be supplied/replaced under the contract shall be of similar or better class / accuracy / output type / range as well as of proven and reliable design with all materials of construction suitable for the intended application. The design shall facilitate an easy maintenance and repair of the components.

All instrumentation to be supplied/replaced under the contract (instruments, gauges, transmitters, cables, cables trays, piping, socket, Junction Boxes, switches, ports, HUB's etc.) shall be from reputed / renowned vendors and manufactured based on international standards and shall be selected only after obtaining approval from the Employer / Engineer.

Materials for instrumentation and control equipment, including piping materials, which are ex-posed to the measured media, shall be compatible with the conditions of the selected media and with the piping material.

Piping, tubing, fittings, and wiring shall be arranged so that any instrument or device and isolation valve may be removed or serviced without disturbing the piping, tubing, or wiring associated with other instruments.

Instrument brackets or accessories for surface or pipe mounting shall be supplied with each field mounted instrument e.g. pressure and temperature gauges.

The Contractor shall replace all fire damaged instrumentation with new(approved) state-of-the art instrumentation.

Measuring instruments shall not be installed higher than 1.2 to 1.6m above floor level for ease of termination and field device communication.

Any type of welding on instrument impulse lines shall not be acceptable. Proper fitting type impulse lines should be used for instruments.

Several units of the same type shall be strictly identical. Mounting of field instruments shall be similar between similar units.

Junction boxes shall be used to connect the field-mounted instruments with multi-core cables to the process stations, if conventional cabling is used.

All equipment mounted in cabinets, the cabinets themselves and junction boxes shall be identified with nameplates of durable and material, e.g. stainless steel.

The output of electronic devices shall be short-circuit proof. In case of short circuit, the component shall not be damaged and no interactions to the inputs shall occur.

The measurements, wherever necessary, shall be provided with automatic pressure or temperature correction. In case of ambient temperature effect on the accuracy, thermal compensation shall be provided to minimize the effect of ambient temperature variation.

All instruments / sensors shall be insensitive to vibrations and shocks.

Electronic transmitters shall be of the indicating type. Transmitters which have no indication shall be supplemented with process connected direct gauges to facilitate local measurement or control in the event of transmitter failure.

Instrument calibration shall be witnessed and verified by third party at the Site in the presence of Employer/Engineer. Valid calibration. Certificate shall be also provided to the Employer/ Engineer before system energization.

9.4 Damaged Control Cables

The Contractor shall carry out complete replacement / relocation / re-routing of all fire damaged control cables associated with the ST/STG and DCS. The scope shall include, but not be limited to:

- Detailed site survey and verification of existing cable routes.
- Identification, tagging, and removal of damaged control cables.
- Supply, installation, termination, testing, and commissioning of new control cables.
- Replacement of cable glands, ferrules, cable lugs, identification markers, and accessories.
- Restoration of cable trays, conduits, and cable supports.
- Integration with the existing DCS/PLC/ST Control System without affecting existing plant functionality

9.5 H2 Leakage Detectors

The Contractor shall supply, install, test, commission, and integrate a complete Hydrogen Leakage Detection System for new hydrogen-cooled Steam Turbine generator. The system shall continuously monitor hydrogen concentration at critical locations and provide early warning of hydrogen leakage to ensure personnel safety and reliable generator operation. Hydrogen detection System shall be connected to DCS.

9.6 Vibration Measurement System

During the fire incident, field instrumentation /cabling of vibration monitoring /control system (Bentley Nevada 3500) got damaged. The Contractor shall restore / rehabilitate Bentley Nevada 3500 system for protection and predictive maintenance in accordance with relevant international standards. The signals shall be forwarded to the DCS and other systems, like Computerized Maintenance Management Systems (CMMS), where they are stored and used for further evaluation and calculation purposes. Suitable indication shall be supplied in the CCR for each measurement. All field instruments and cables need to be replaced with new ones.

.

9.7 Event Recording System

The Events recording system shall be an integral part of DCS. Plant parameters as required for this purpose shall be displayed and recorded in order to assist the operation staff in determining faults and plant supervision.

The cause of a unit trip shall be analysed by the provided pre and post trip information.

The internal clock of SER and alarm/events recording/ DCS system shall be synchronized automatically with the station master clock.

The events/alarm recorder function of DCS shall be provided to record:

- the change of state of important plant parameters
- alarms and trips
- operator actions

9.8 Control System Testing

The Contractor shall be responsible for carrying out all testing activities necessary to demonstrate that the upgraded Distributed Control System (DCS) complies with the technical specifications, approved design documents, and functional requirements. The testing program shall include, but shall not be limited to, Factory Acceptance Testing (FAT), Site Acceptance Testing (SAT), Loop Checking, Functional Testing, Integrated System Testing, Commissioning, and Performance Verification.

9.8.1 Factory Testing

Steam Turbine Control System and DCS shall undergo Factory Acceptance Testing at the OEM's manufacturing facility prior to shipment. The FAT shall be witnessed by the Employer / Engineer’s representatives.

The Contractor shall submit a detailed Factory Acceptance Test Procedure (FATP) at least 90 days prior to FAT. A comprehensive FAT Report shall be submitted after completion of testing.

9.8.2 Site Testing

After the ST Control System and DCS have been completely installed / upgraded, the Contractor shall perform a complete functional test using all final system programs and simulated inputs for the complete system including the interface and controls of all proprietary/packaged systems. The site testing shall include all tests specified for the factory testing and shall include all requirements of commissioning. The site testing shall also demonstrate that the system can accurately measure each type of system input. The results of all field tests shall be documented and submitted to the Engineer. Employer/ Engineer shall witness and approve all site testing activities.

ANNEX-1

Integrity Assessment Report of ST and STG

哈尔滨电气国际

哈电集团 HARBIN ELECTRIC CORPORATION

HARBIN ELECTRIC INTERNATIONAL COMPANY LIMITED

客户服务中心

Customer Service Center

Assessment Report

Integrity Assessment of Turbo Generator of Unit-16 of 747MW CCPP Guddu



Submitted by

Harbin Electric International Company Limited

April, 2023

POWER IS STRENGTH PGCL GUDDU GHCL

NESPAK

哈电集团 HARBIN ELECTRIC CORPORATION

CEC ENERGY CHINA TEPC

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Inspection report of Gudu Power Plant in Pakistan

1 Project Overview

Unit-16 installed at turbine hall of 747MW CCPP Guddu consists of 1 triple pressure steam turbine and one generator whose generation capacity is 261MW. Due to incident happened in July 2023 the unit is not in operation.

To assess the damage caused by incident happened at unit-16, CPGCL awarded contract to M/s Harbin Electric International (HEI) whereas M/s National Engineering Services Pakistan (NESPAK) was awarded to provide their consultancy services throughout the project.

Steam Turbine (ST):

Model: LN260-11.45/2.55/0.47/560/560/305

Type: Triple Pressure re-heat double cylinder (1 HP& IP, 1 LP)

Rotating Speed: 3000rpm

Capacity: 261MW (Gross)

Manufacturer: Harbin Turbine Company Ltd.

Steam Turbine Generator (STG):

Model: QFSN-280-2

Manufacturer: Harbin Electric Machinery Company Ltd.

Voltage 20kV

Cooling Type: Hydrogen-Water

2 Project Period

The timeline of integrity assessment of the Turbo-Generator unit-16 is 30 days. Within this timeline HEI has to assess and submit final inspection report, parts replacement list, loss assessment & preparation of repair plan (Annexure 1- Actual VS Planned Schedule).

3 Work Scope

1. **Dis-assembly and clean of generator**

1.1 Disassembly of neutral point soft connection of generator; (Already damaged)
1.2 Remove the generator excitation busbar; (Already damaged)
1.3 Remove the acoustic brush holder; (Completed)
1.4 Remove the generator end cover, inner end cover, seal seat and bearing bush; (Completed)
1.5 Remove the generator rotor; (Completed)
1.6 Clean the STG rotor and stator (According to the HEC standard, the Rotor and Stator all damaged, no need to clean, the manufacture cetificate attached)
1.7 Inspection of cooler, excitation system, outlet Pt, neutral point, CT and et; (Completed)

2. Inspection and test of generator stator

2.1 Inspect stator condition according to OEM technical specifications; (Completed)

2.2 IR and PI of stator 3 phase winding (Note: After failure of stator IR test, it is of no use to carry out PI test. Hence, not performed.)

2.3 DC resistance of stator 3 phase winding (Note: The generator insulation is not qualified. Therefore, it is of no use to carry out DC resistance test. Hence, not performed.)

2.4 DC high voltage withstanding and current leakage measurement (Note: The generator insulation is not qualified, the stator cold water pipe is damaged, and the water cannot be connected, so this experiment cannot be carried out.)

2.5 Stator core magnetization test; (Completed)

2.6 AC high voltage withstand test (Note: The generator insulation is not qualified, the stator cold water pipe is damaged, and the water cannot be connected, so this experiment cannot be carried out)

3. Inspection and test of generator rotor

3.1 Inspect general condition of generator according to OEM technical specification; (Completed)

3.2 IR test; (Completed)

3.3 DC resistance measurement; (Completed)

3.4 Rotor AC impedance measurement (Note: The RSO experiment proves that the inter-turn short circuit of the generator rotor exists, and this experiment cannot be performed.)

3.5 RSO; (Completed)

3.6 Rotor ventilation test (Note: The experiment proves that there is an inter-turn short circuit in the generator rotor, and there is a lot of oil and toner inside the rotor, this experiment cannot be carried out)

3.7 Rotor sealing test (Note: The experiment proves that the generator rotor has a short circuit between turns, and this experiment cannot be carried out.)

4. Dis-assembly Steam Turbine

4.1 Preparation before commencement; (Completed)

4.2 Remove thermal control instrument; (Completed)

4.3 Removal the decoration plates; (Completed)

4.4 Scaffold construction and insulation removal; (Completed)

4.5 Remove gas cylinder; (Completed)

4.6 Remove bolts and lifting outer cylinder; (Completed)

4.7 Remove bolts and lifting inner cylinder; (Completed)

4.8 Dis-assembly and lifting upper stationary blade ring, balance ring and inlet ring; (Completed)

4.9 Remove steam sealing sleeve; (Completed)

4.10 Data measurement of steam seal clearance, thrust clearance and flow clearance; (Completed)

4.11 Recheck the shafting center and the outer circle runout of the coupling for the full real cylinder; (Completed)

4.12 Remove Coupling, data measurement the clearance of bearing; (Completed)

4.13 Remove ST rotor; (Completed)

4.14 Dia-assembly the bearings; (Completed)

4.15 Data measurement of lower cylinder, lifting the lower steam sealing; (Completed)

4.16 Lifting the lower cylinder; (Completed)

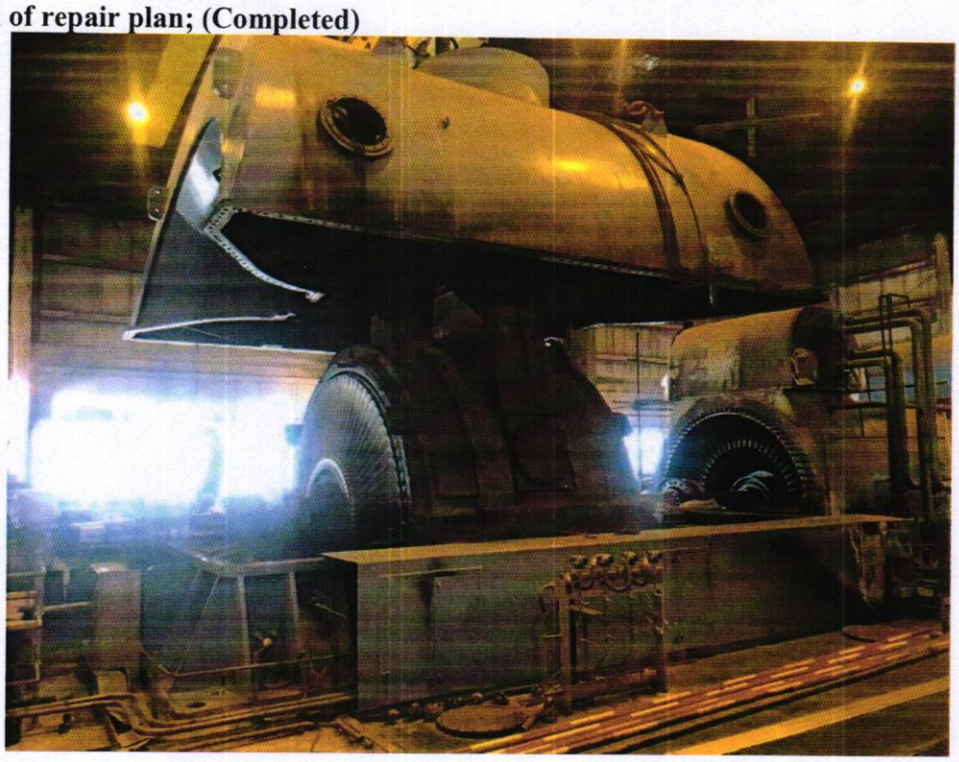
4.17 Clean steam blocks, remove injector; (Completed)

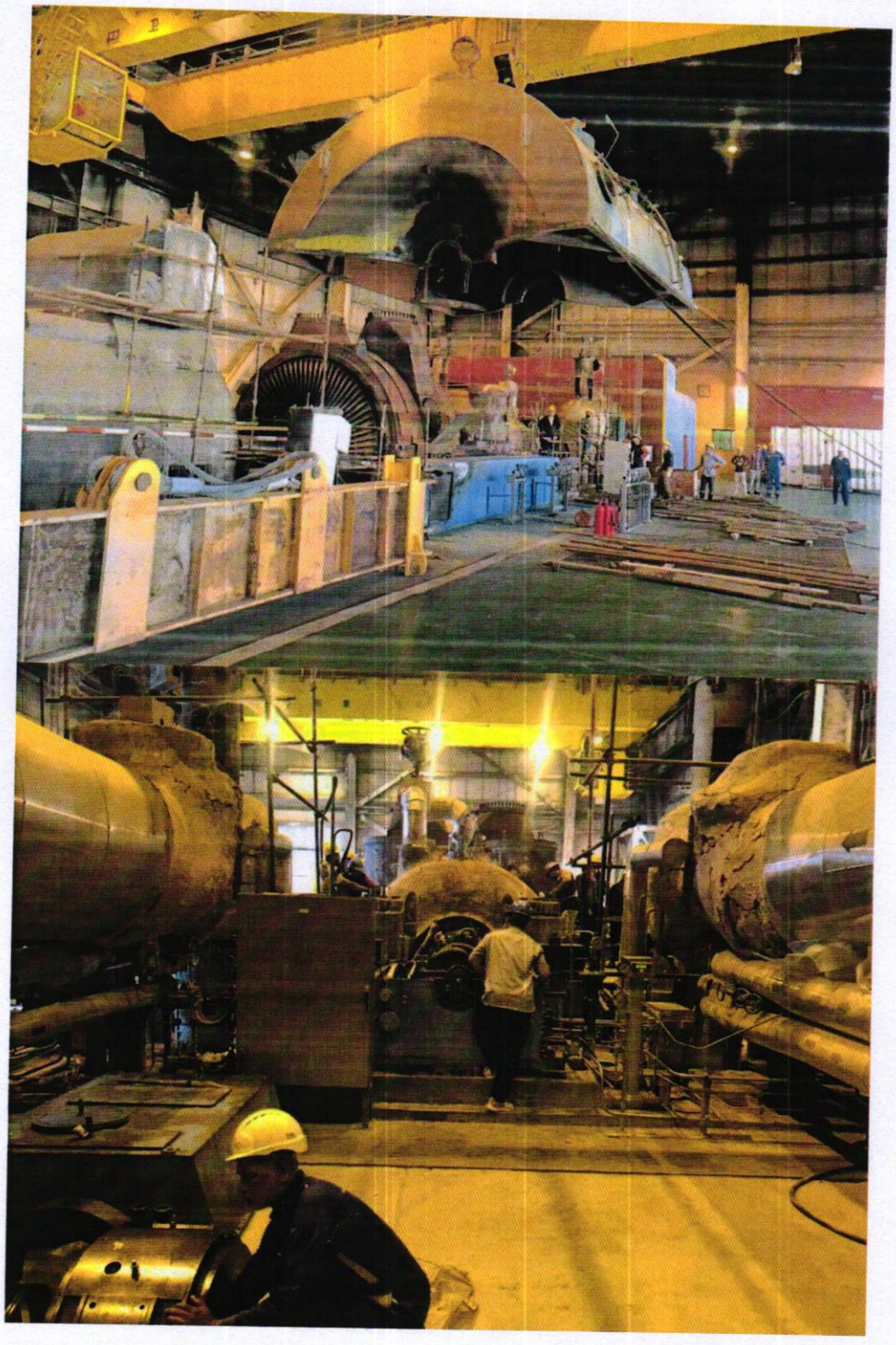
4.18 Clean all parts and check for defects; (Completed)

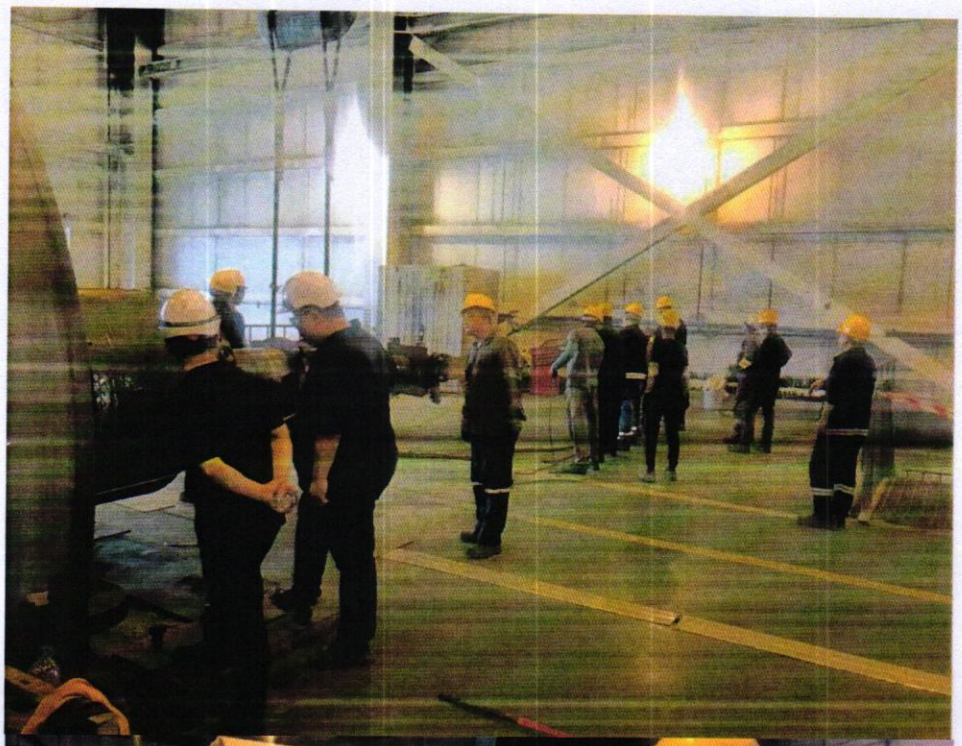
4.19 NDT(the method of NDT will be carried out according to the parts) ; (Completed)

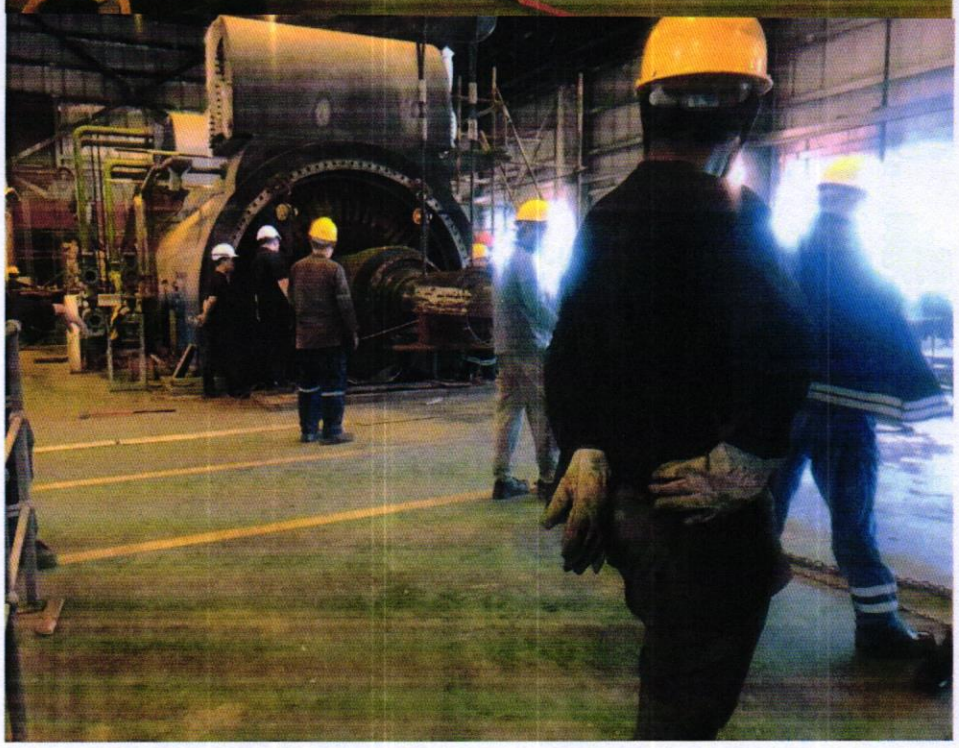
4.20 Inspection the cable, auxiliary equipment and other equipment with fire phenomenon; (Completed)

5. **Preparation of inspection report; (Completed)**
6. **Preparation of replacement parts list; (Completed)**
7. **Loss assessment; (Completed)**
8. **Preparation of repair plan; (Completed)**



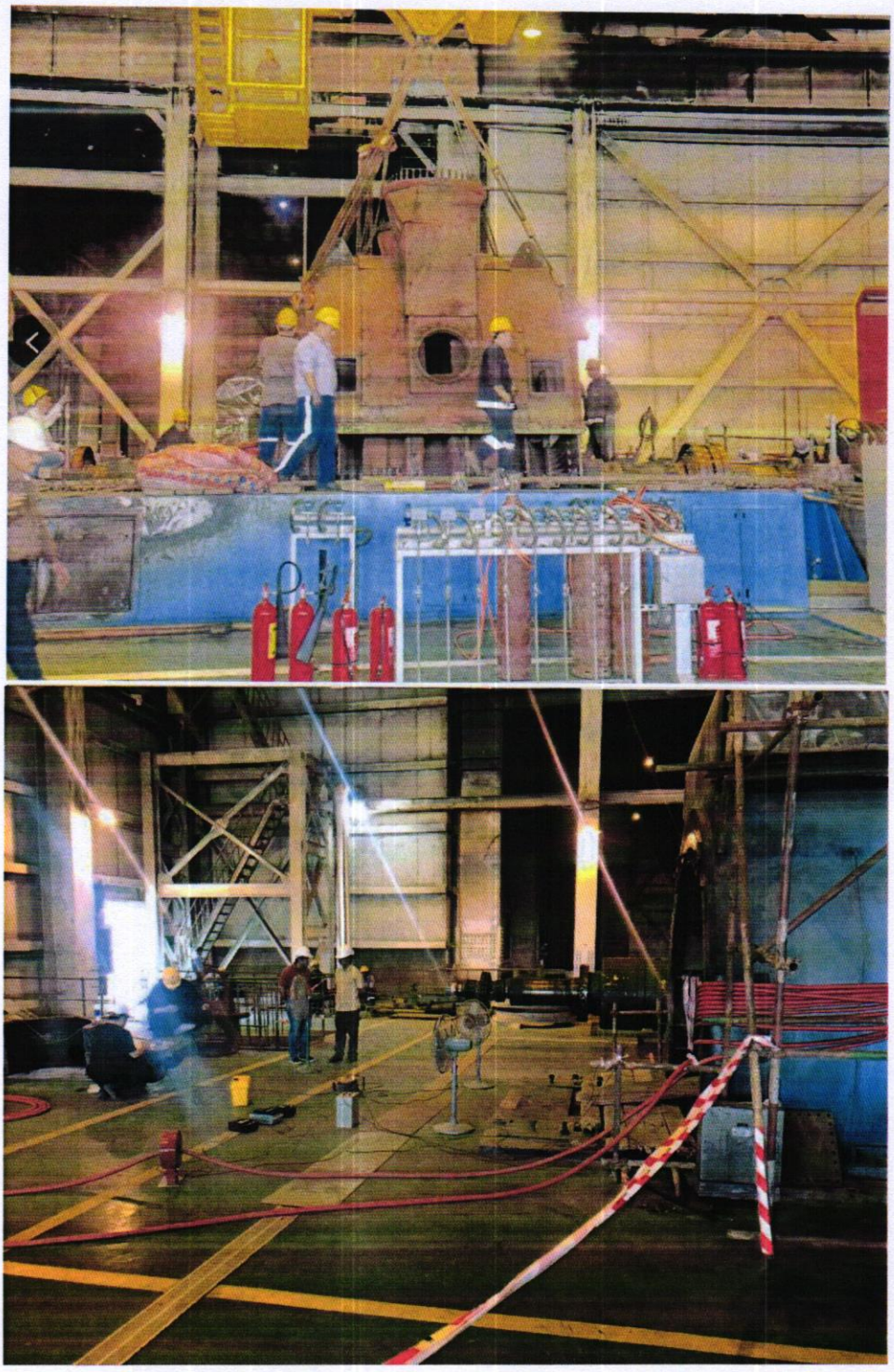








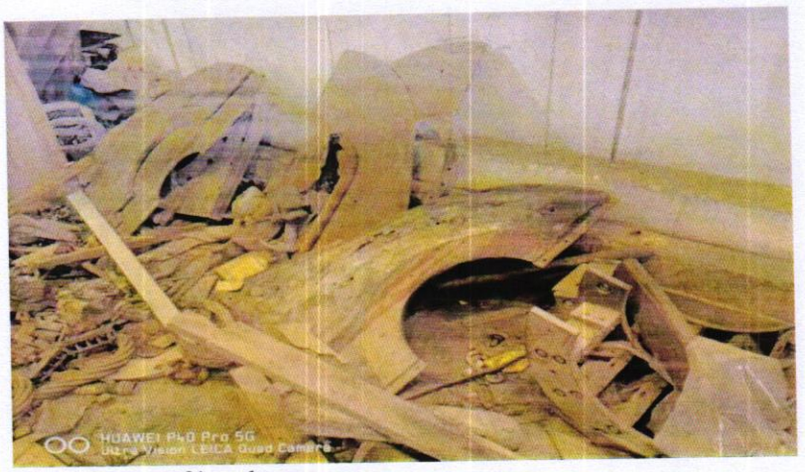




4 Defects found and Recommendation

4.1 Generator and auxiliary equipment:

1. Sound proof brush system were completely damaged by fire.



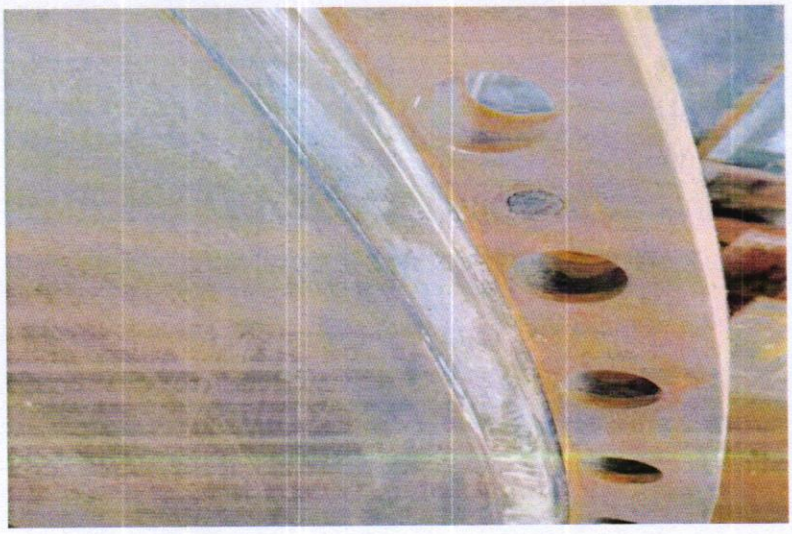
Recommendation: Replace sound proof brush system.

2. Obvious cracks were found on inner generator cover.



Recommendation:Replace inner generator cover.

3. Generator TE & EE end cover were both deformation by visual inspection.



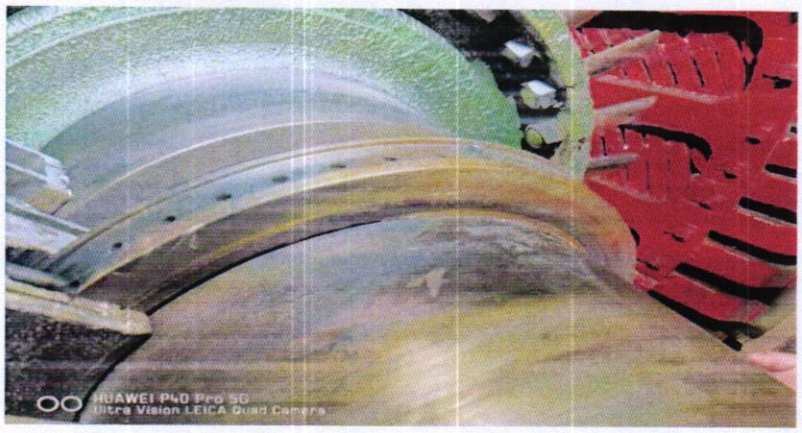
Recommendation:Replace TE&EE end cover.

4. TE & EE bearings were damaged.



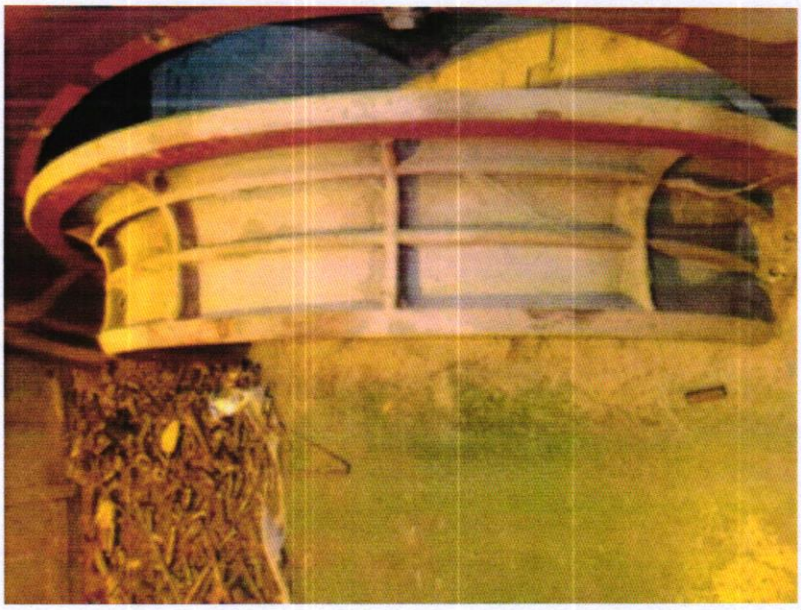
Recommendation:Replace TE&EE bearings.

5. Generator sealing rings were damaged by fire.



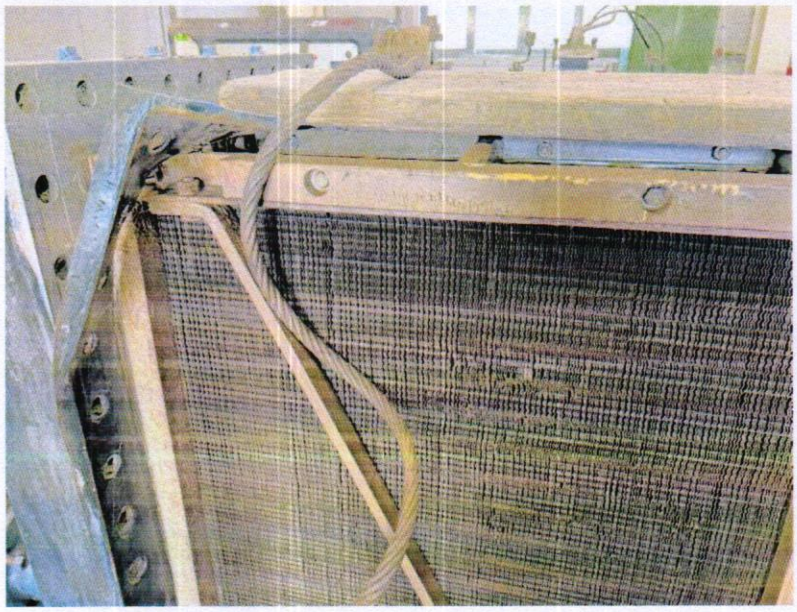
Recommendation:Replace generator sealing rings.

6. Ventilation guide ring deformation.



Recommendation:Replace ventilation guide rings.

7. Inner parts of hydrogen cooler were all damaged by fire, carbon powder is found on all heat exchange fins.



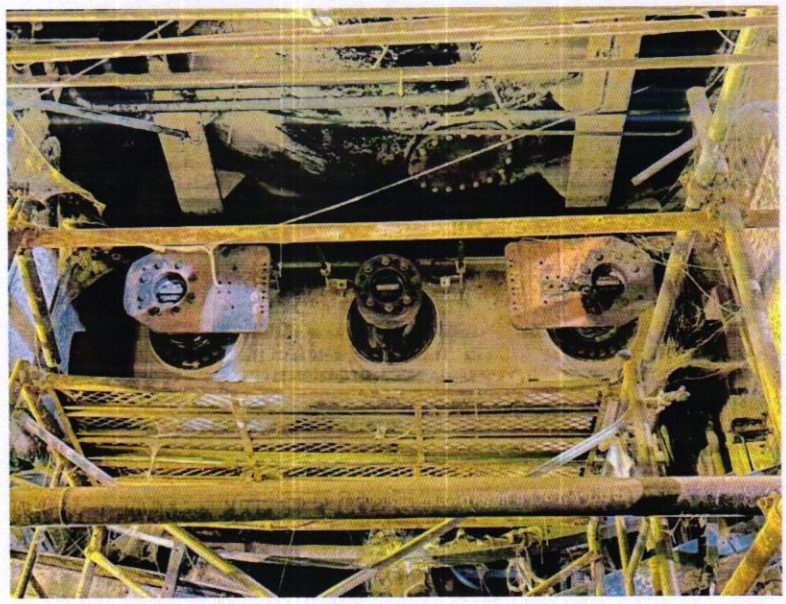
Recommendation:Replace all hydrogen coolers.

8. Generator stator winding main leads were damaged by fire.



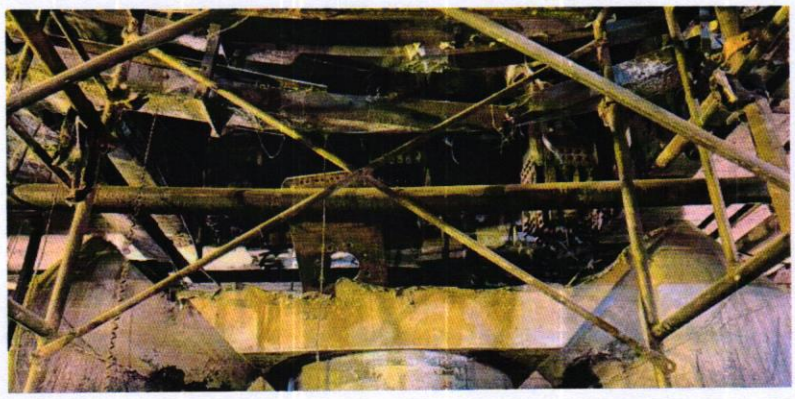
Recommendation:Replace main leads.

9. All CT and neutral points were damaged.



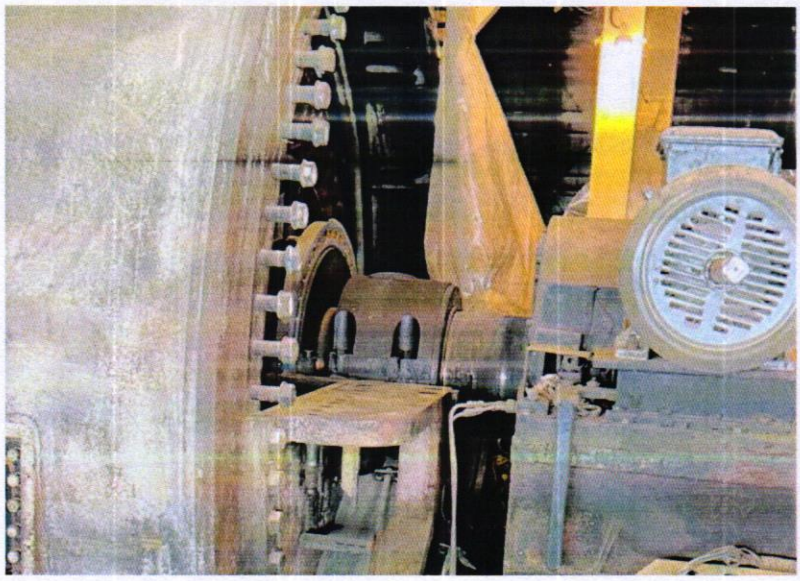
Recommendation:Replace All CT and neutral points.

10. Main lead bushings were damaged.



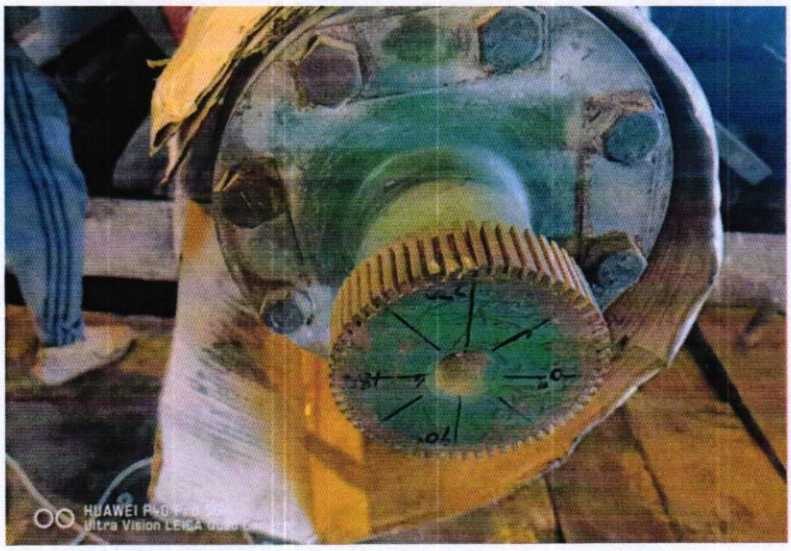
Recommendation:Replace all bushings.

11. Ground brush damaged.



Recommendation:Replace ground brush.

12. Speed measure gear is damaged.

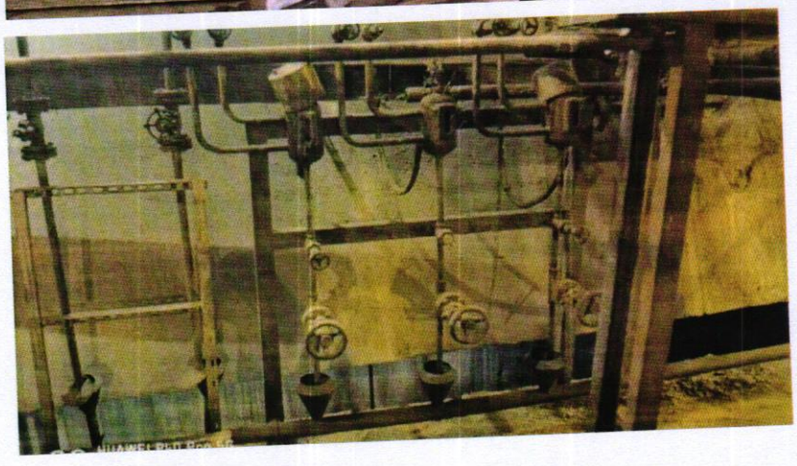


Recommendation:Replace Speed measure gear.

13. Hydrogen dryer, Hydrogen purity analyzer and Hydrogen pipelines were damaged.







Recommendation:Replace whole hydrogen system.

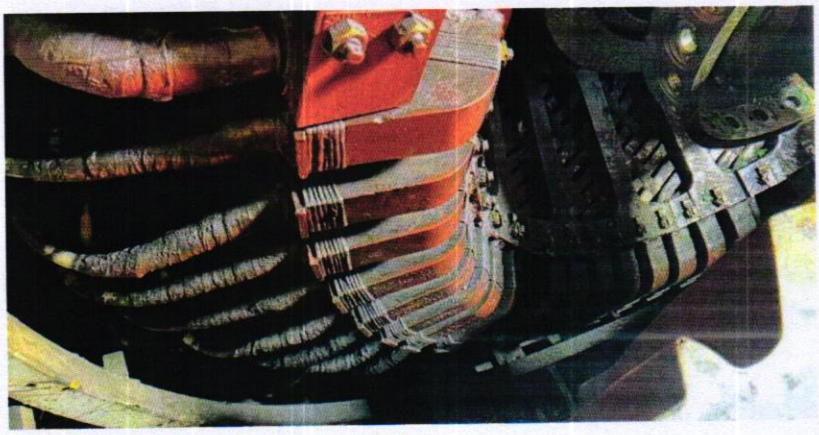
14. RSO test result shows that the rotor has inter-turn short, Serious plenty carbon powder and oil found in rotor ventilation holes, Rotor shaft deformation caused by long time no turning.

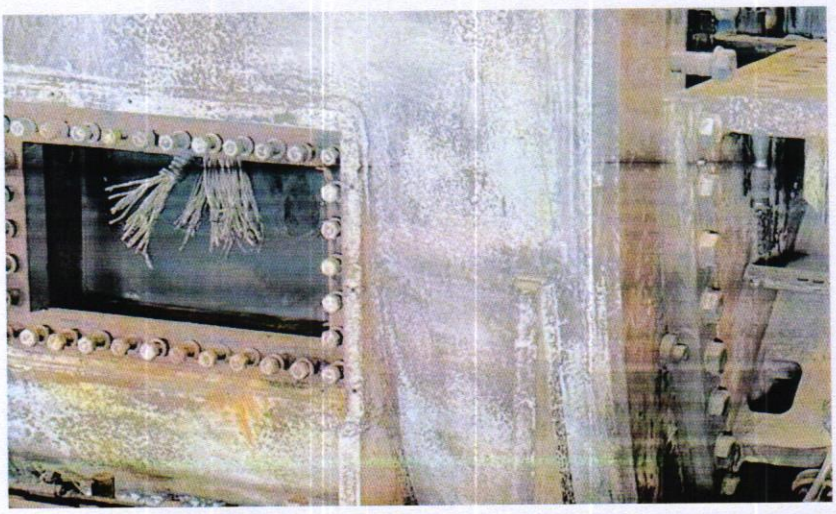


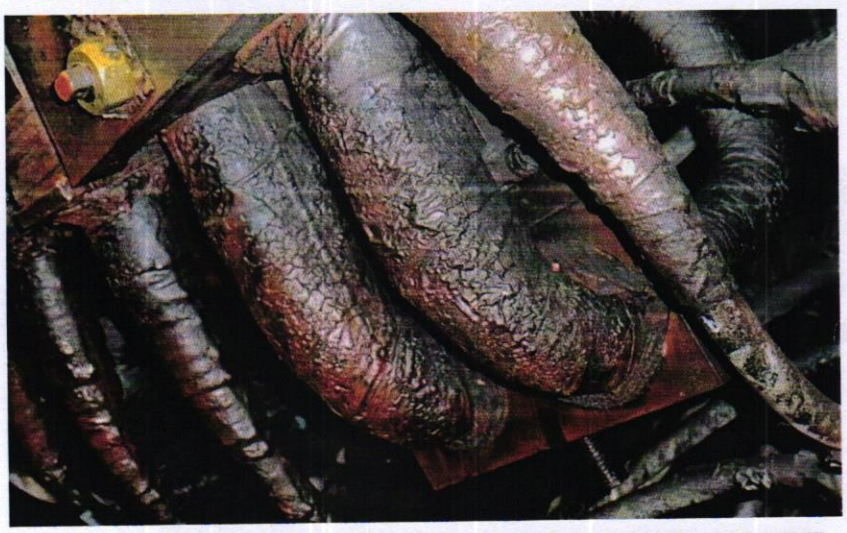


Recommendation:Replace the whole rotor.

15. Generator stator winding insulation were overheated; Plenty oil and carbon powder found on stator winding; IR test result shows the stator winding IR is nor qualified; Insulation pipes were found damaged and deformation; RTDs (with lines) of stator all damaged; Stator lamination displacement from original location; Stator iron loss test not qualified (TE end stator core bottom abnormal Temperature rise).



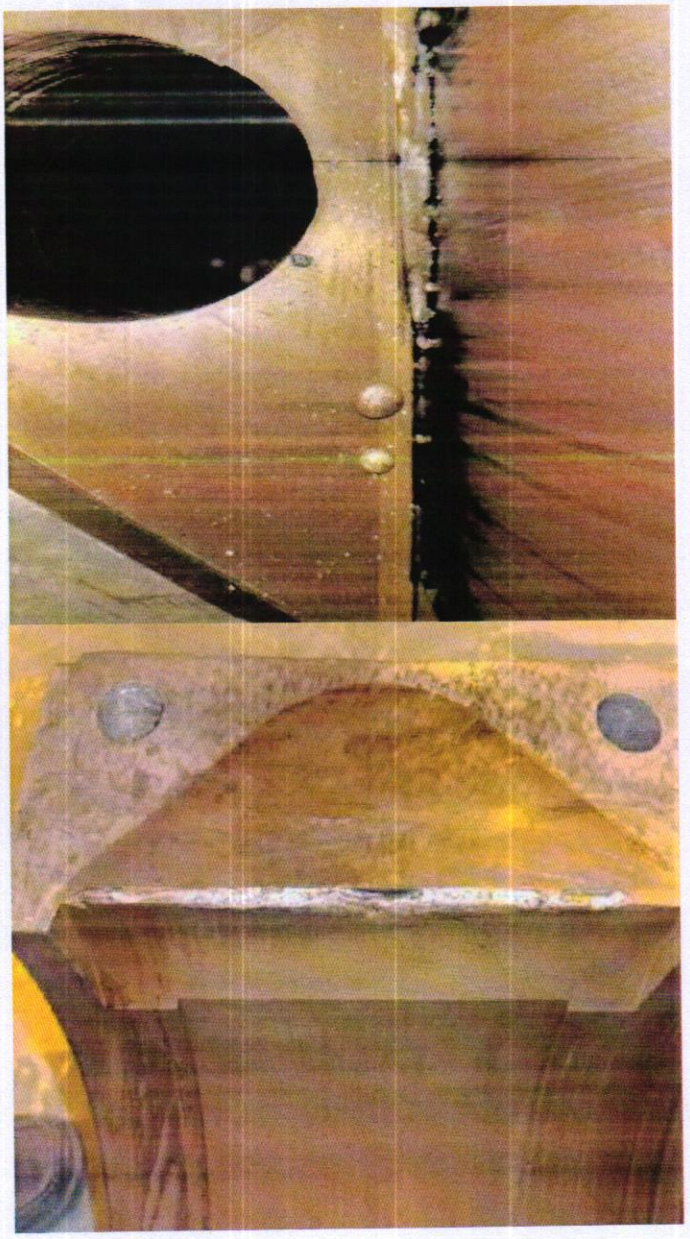






Recommendation:Replace the whole stator.

16. Generator bearing bush bearing surface/ babbit material melt





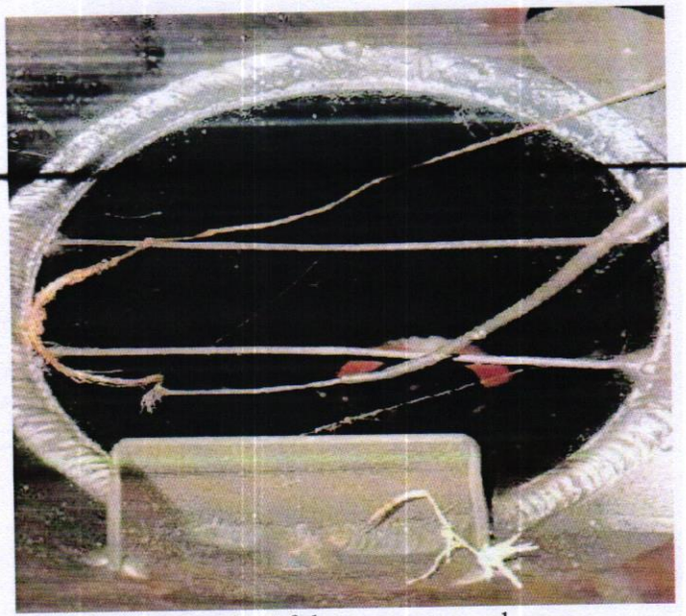
Recommendation:Replace the bearing bush.

17. The generator seal tile melts and deform.



Recommendation:Replace the seal tile.

18. Internal coking of the generator oil pipe over fire.



Recommendation:Replace the tubing on both sides of the generator end cover.

19. The turning control cabinet, turning device and cable are burned out.



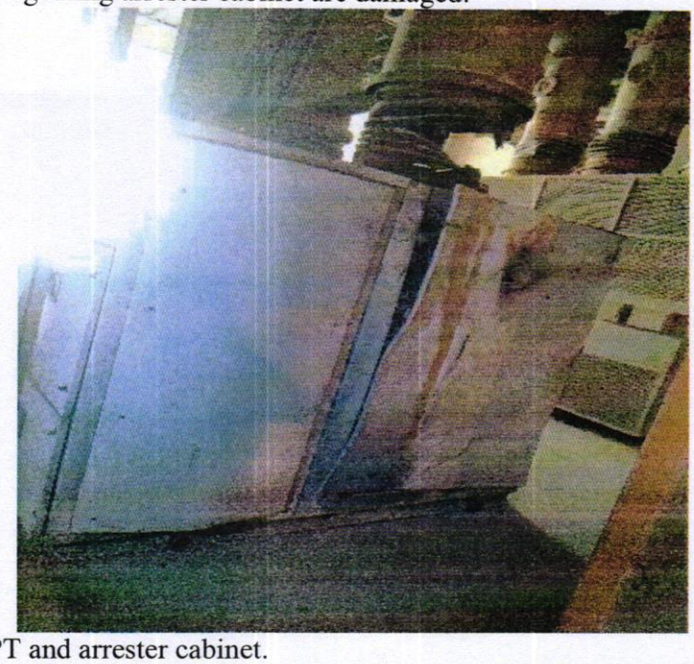
Recommendation:Replace the turning control cabinet, turning device and cable.

20. The connection mechanism of the generator PT and the lightning arrester cabinet is broken.



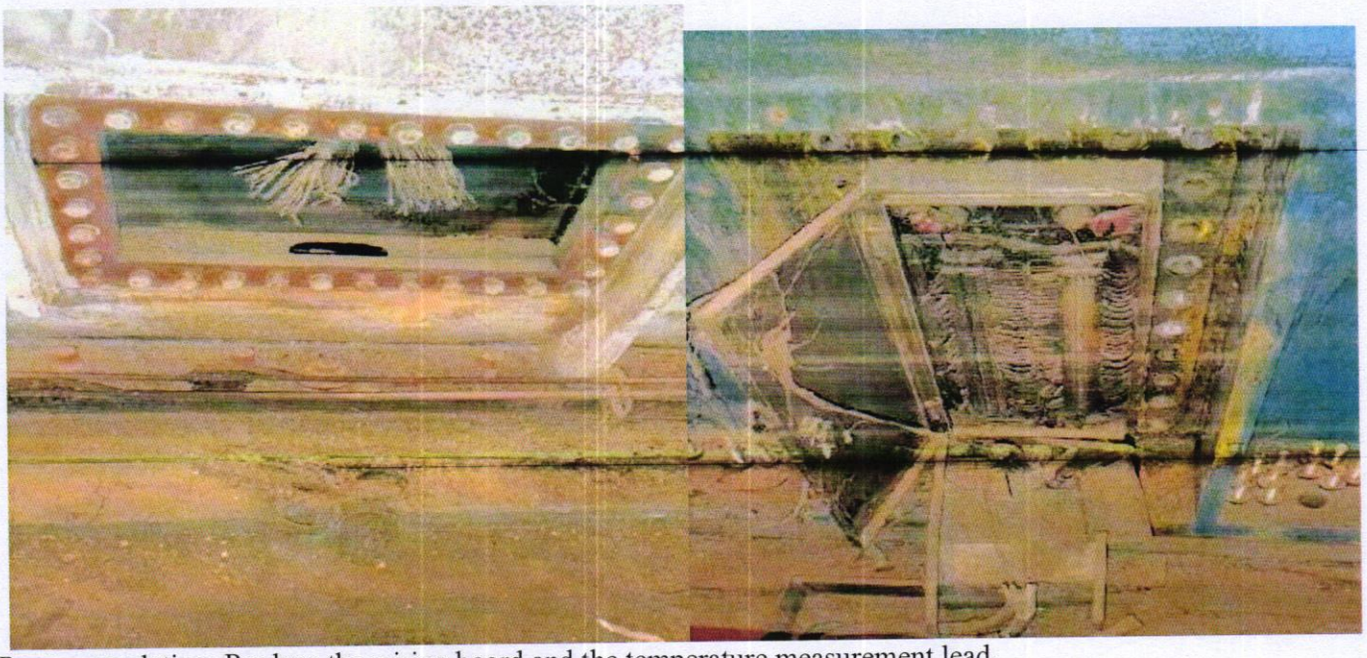
Recommendation:Replace the connection mechanism.

21. Generator outlet PT and lightning arrester cabinet are damaged.



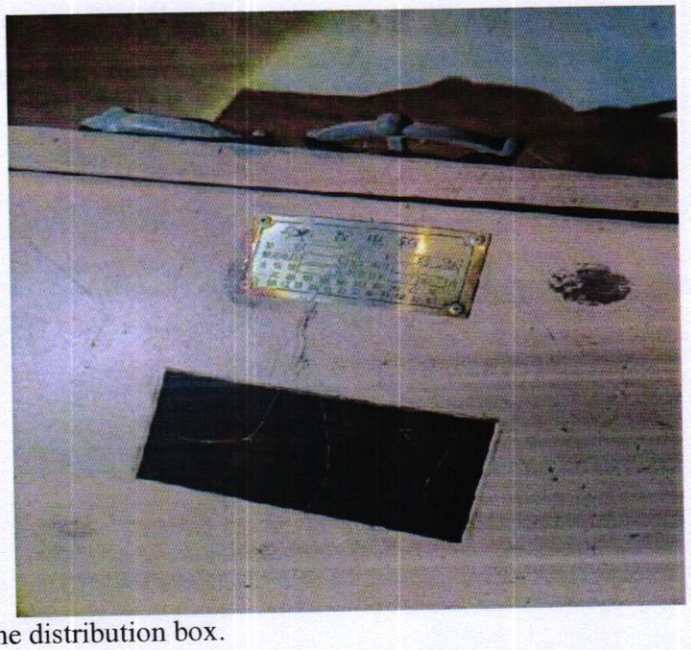
Recommendation:Replace PT and arrester cabinet.

22. Damage of generator body temperature lead, wiring board and DCS cable.



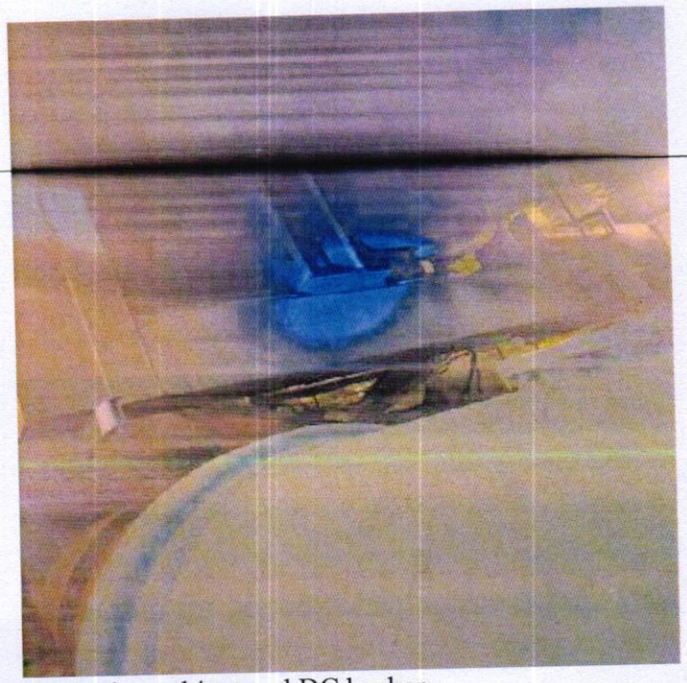
Recommendation: Replace the wiring board and the temperature measurement lead.

23. The distribution box of the temperature measuring point of the generator micro-positive voltage device was burned out.



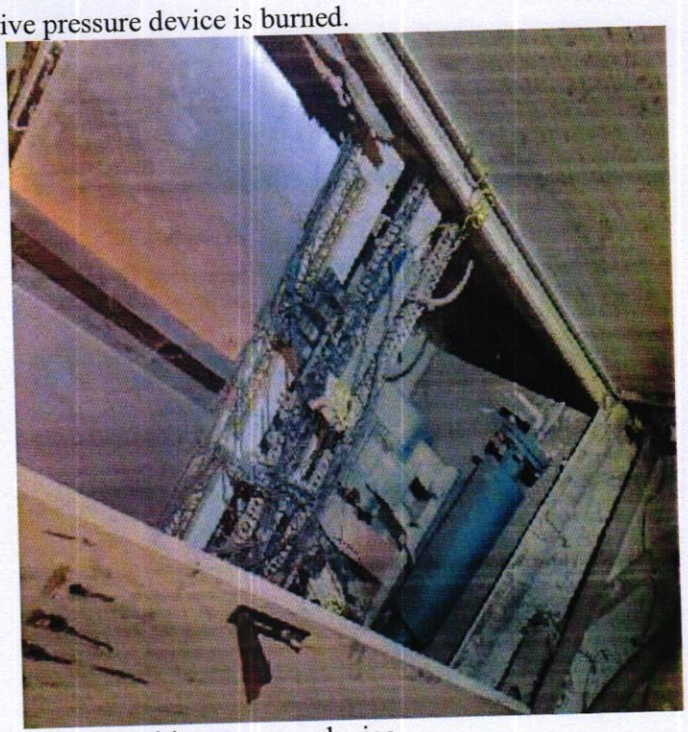
Recommendation:Replace the distribution box.

24. The generator excitation DC busbar is burned and smoked, and the excitation cabinet is overheating.



Recommendation:Replace the excitation cabinet and DC busbar.

25. Closed busbar micropositive pressure device is burned.



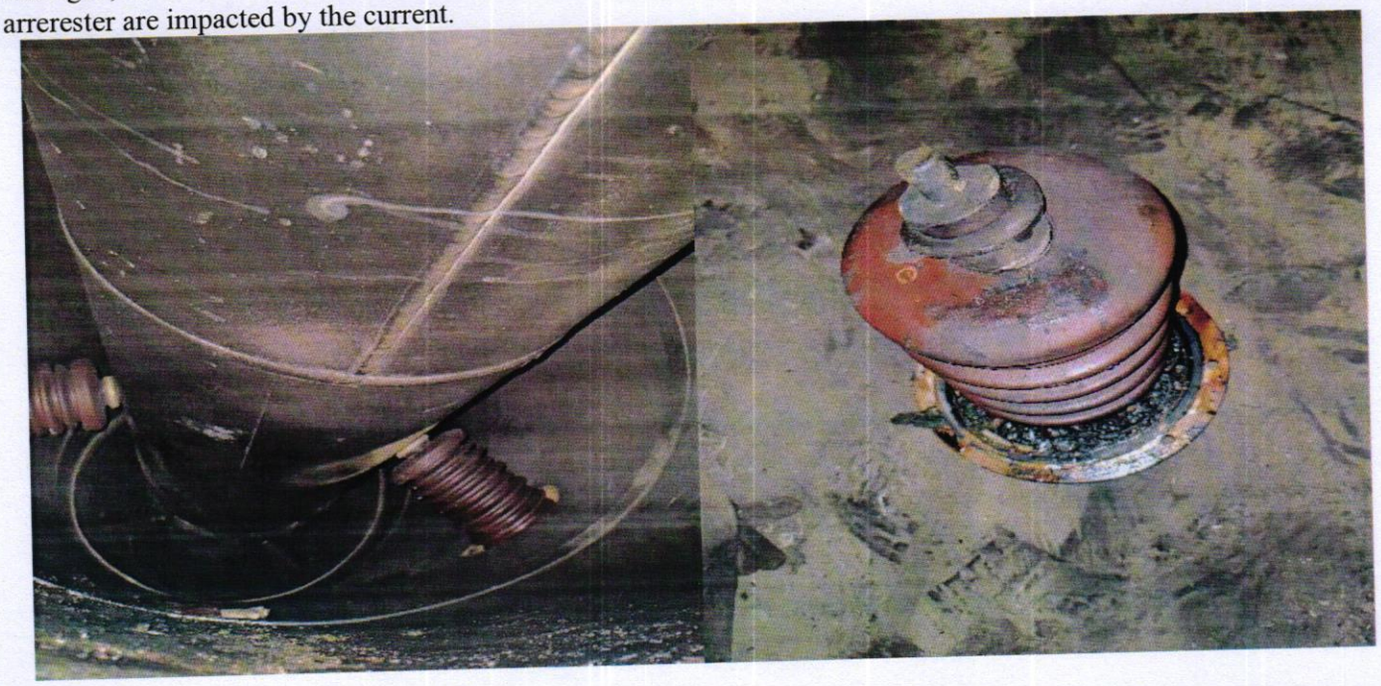
Recommendation:Replace the micro-positive pressure device.

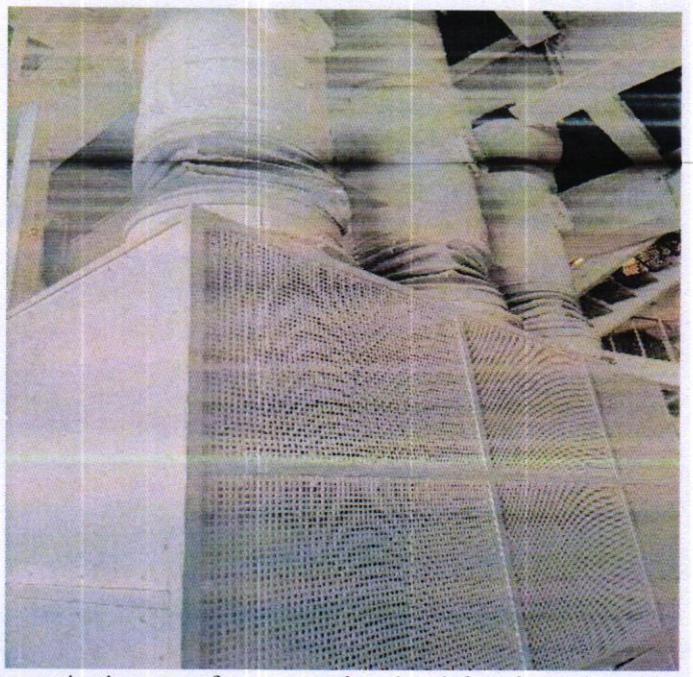
26. Generatot neutral point grounding transformaer overcurrent, grounding cable, insulator broken.



Recommendation: Replace the grounding transformer and grounding cabinet.

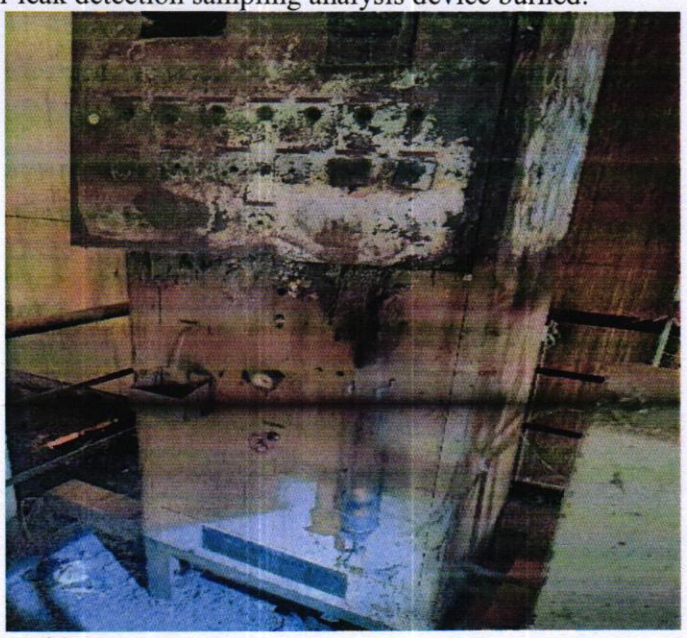
27. The generator closed bus is overheated and discoloration, there is smoke inside, the support insulator is damaged, a lot of water and oil are found inside, and the closed busbar, outlet circuit breaker and lightning arrerester are impacted by the current.





Recommendation: Replace the excitation transformer, outlet circuit breaker, closed busbar.

28. JL03 00Z Type condenser leak detection sampling analysis device burned.



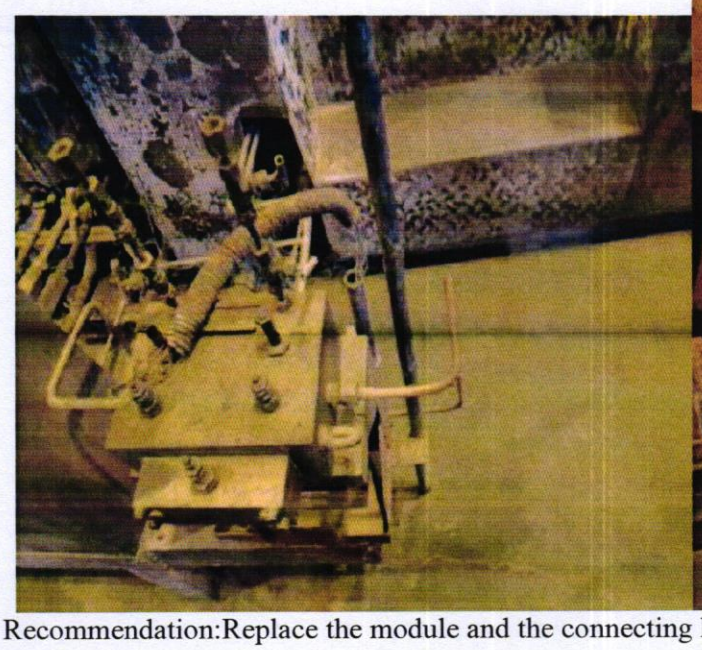
Recommendation:Replace the cabinet.

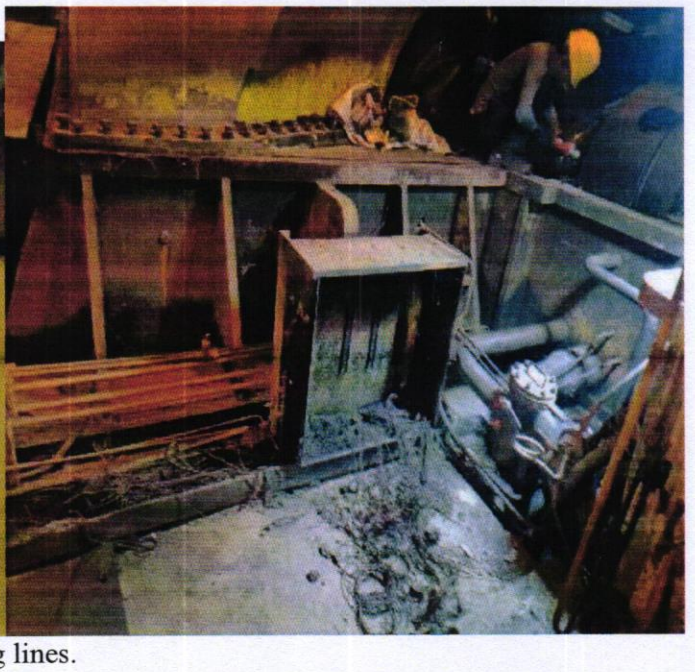
4.2 Steam Turbine and auxiliary equipment:

Bearings Result Summary

1. DC oil pump
AC oil pump
start oil pump
test module
overfire.

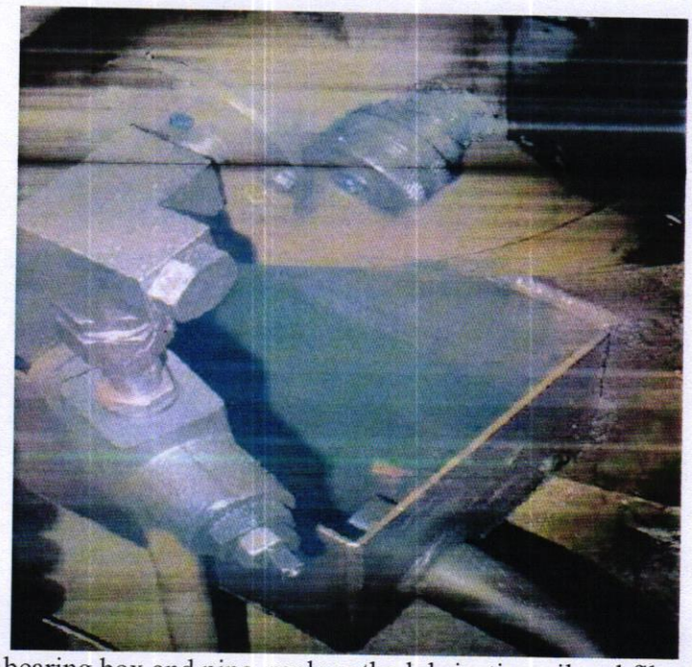
Bearing Number	Location	Visual Result	NDT result	Recommendation
1j	HP(T)	NOT OK	NOT OK	Replace with new
1t	HP	OK	OK	Thrust bearing condition is fine, however clearance gap is increased. Rotor needed to replace so bearing will also be required to replace
2j	HP(G)	NOT OK	NOT OK	Replace with new
3j	LP(T)	NOT OK	NOT OK	Replace with new
4j	LP(G)	NOT OK	NOT OK	Replace with new
5j	GE(T)	NOT OK	NOT OK	Replace with new
6j	GE(G)	NOT OK	NOT OK	Replace with new





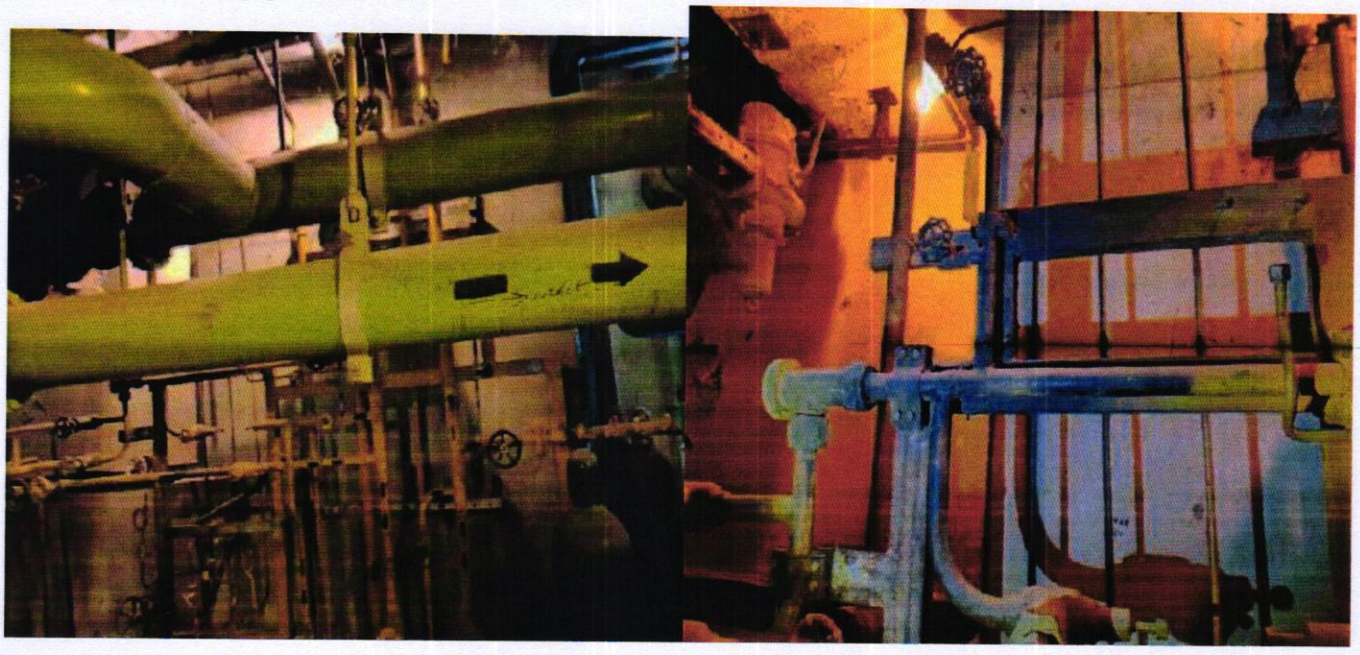
Recommendation:Replace the module and the connecting lines.

2. The lubricating oil of the main engine in the low-wheel bearing box becomes blue.



Recommendation: Clean the bearing box and pipe, replace the lubricating oil and filter the oil.

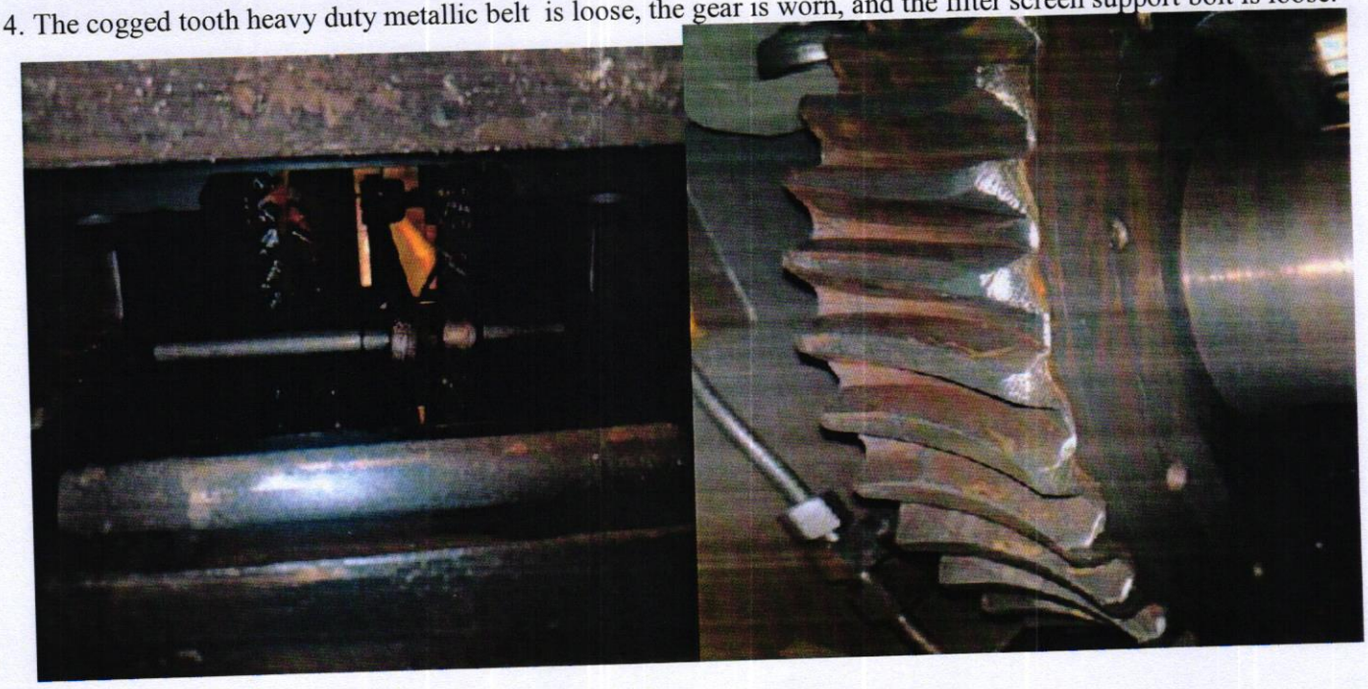
3. Hydrogen system pipeline fire





Recommendation:Replace the hydrogen system line and valve which were exposed to fire

4. The cogged tooth heavy duty metallic belt is loose, the gear is worn, and the filter screen support bolt is loose.





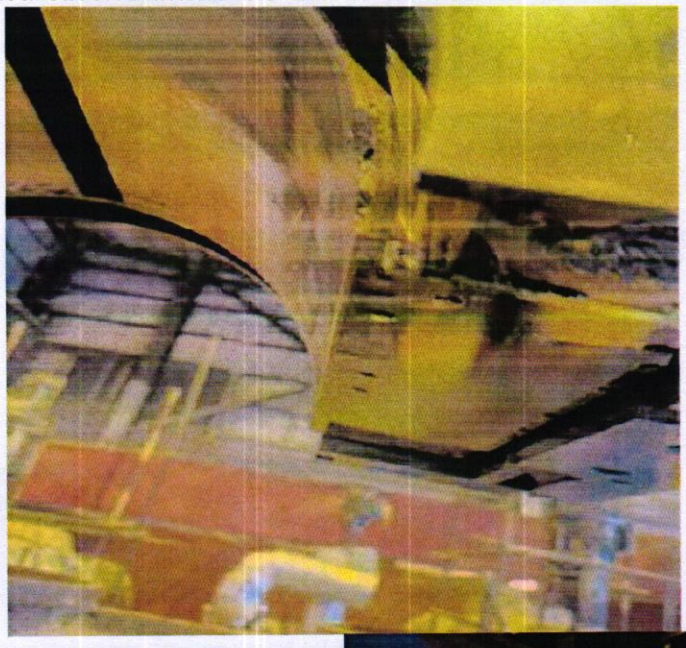
Recommendation:Replace the tray device.

5. #2 The upper half of the bush has rolling marks, The lower bearing surface/ babbit material falls off.



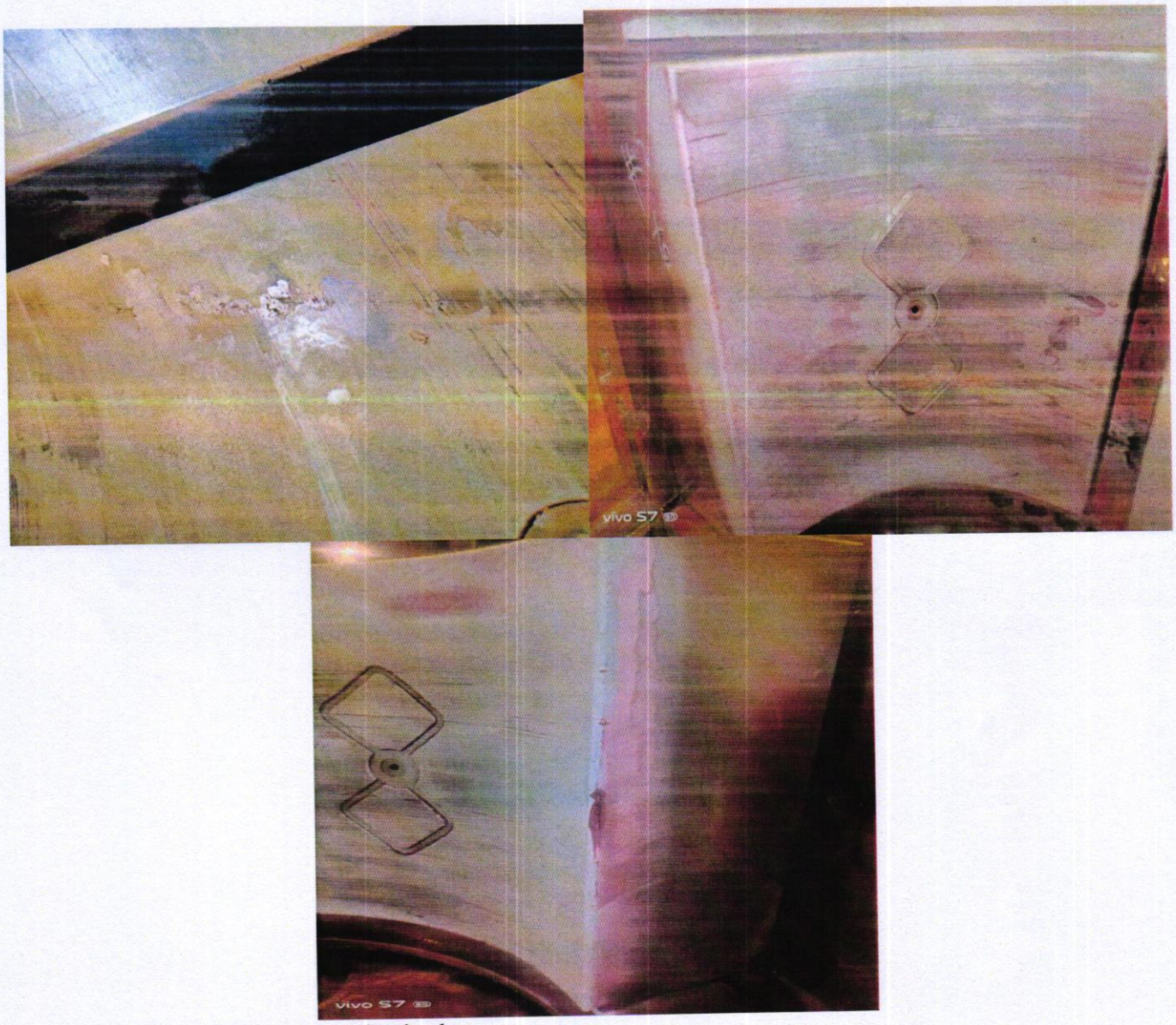
Recommendation:Replace the whole bearing bush and the floating ring.

6. #3 The upper bearing surface/ babbit material and half of the shaft tile falls off.



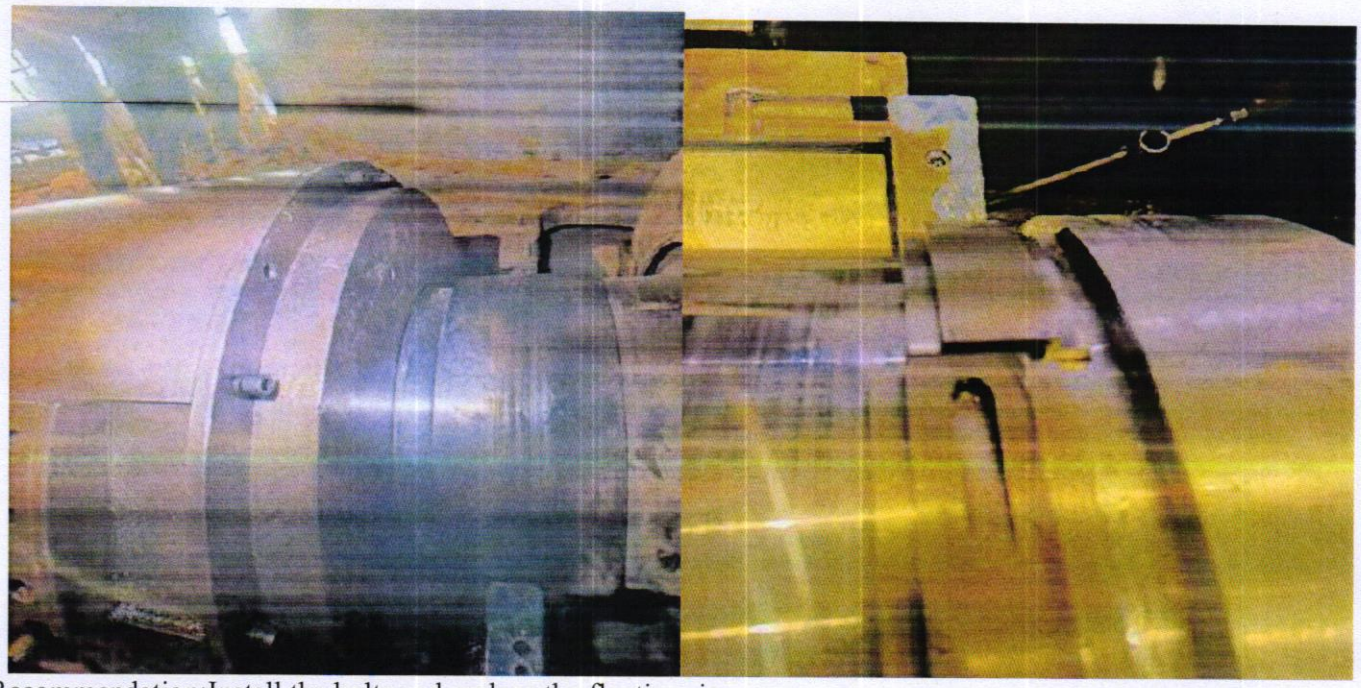






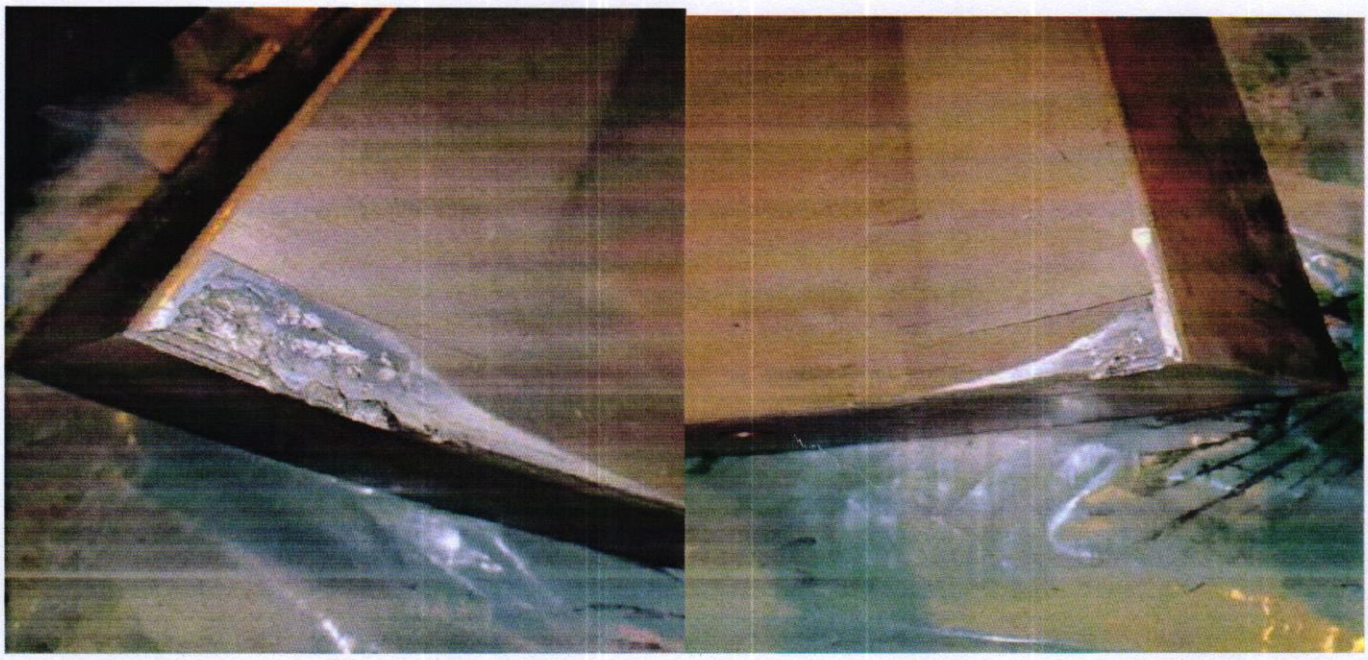
Recommendation:Replace the bearing bush.

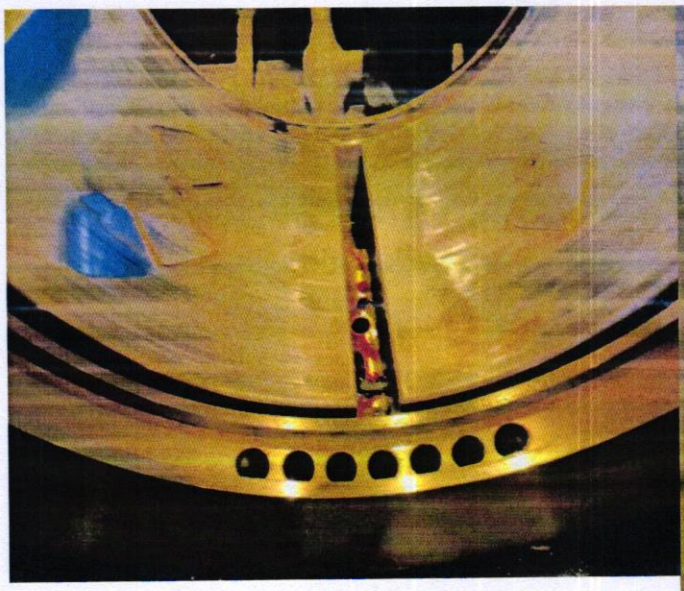
7. # 3 The shaft tile oil block plate bolt falls off, and the oil block ring bolt falls off.

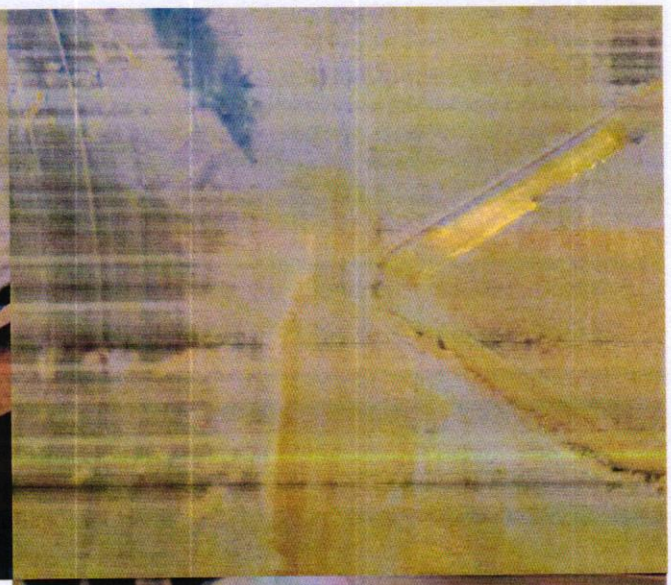


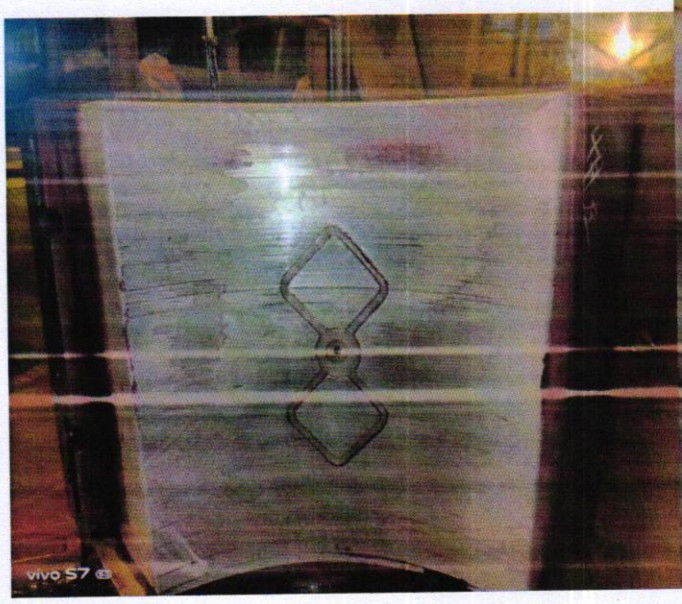
Recommendation:Install the bolts and replace the floating ring.

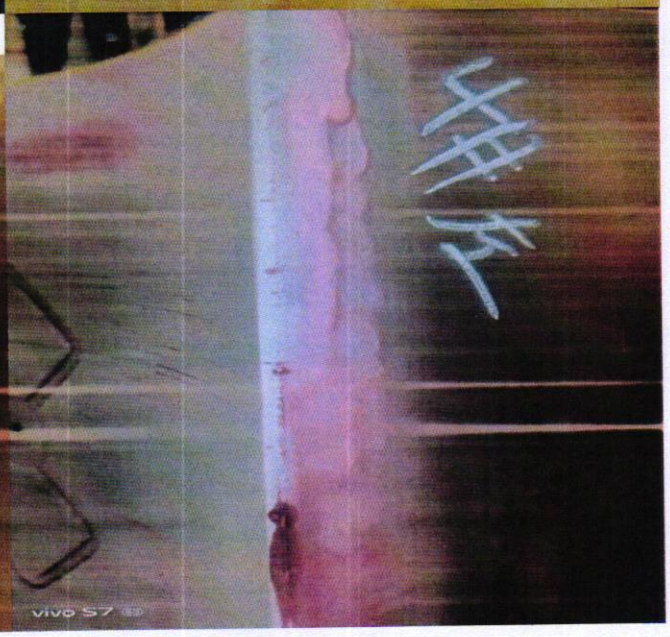
8. # 4 The upper half of the bush falls off, and the oil sealing ring is melt

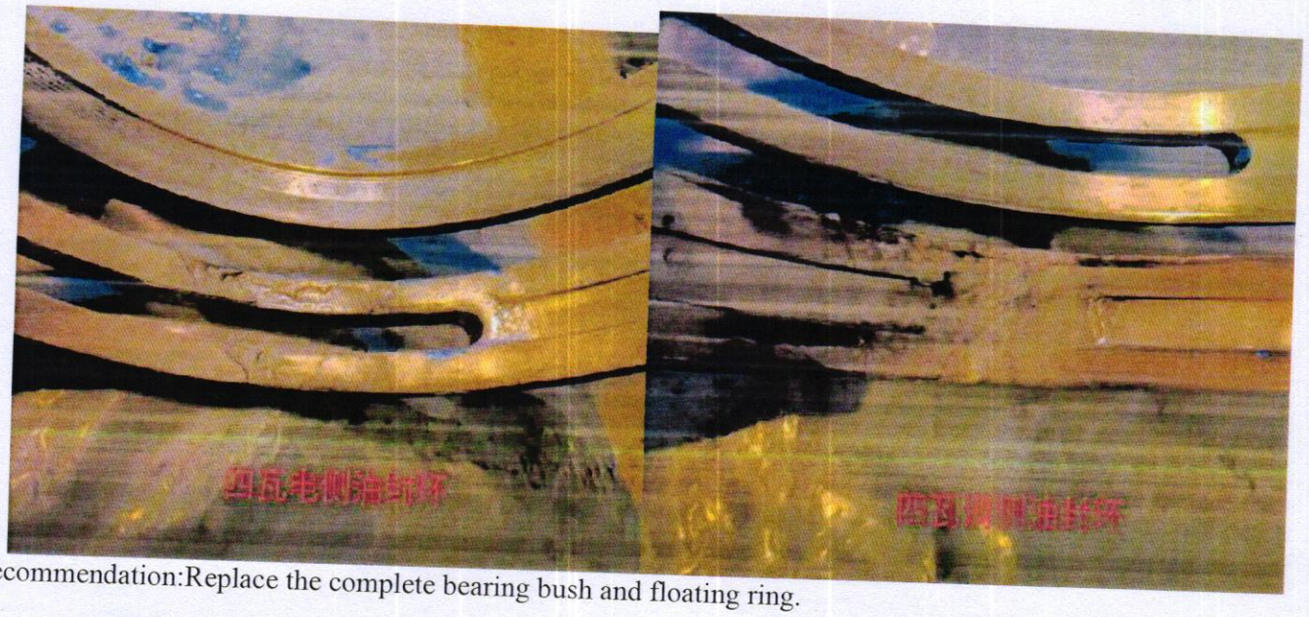







vivo S7


vivo S7



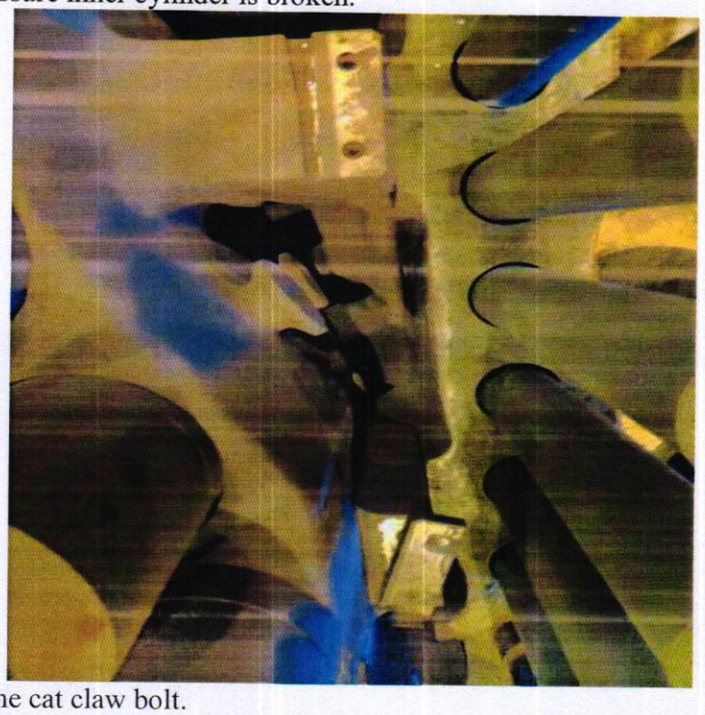
Recommendation:Replace the complete bearing bush and floating ring.

9. The low-pressure inner cylinder heat shield falls off.




Recommendation:Replace the heat shield and refix it when reinstalled.

10. The bolt of the high pressure inner cylinder is broken.

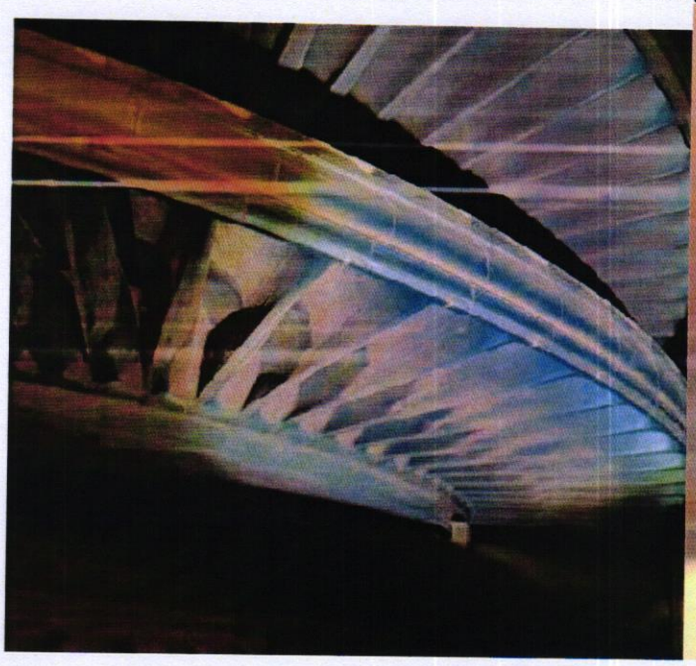


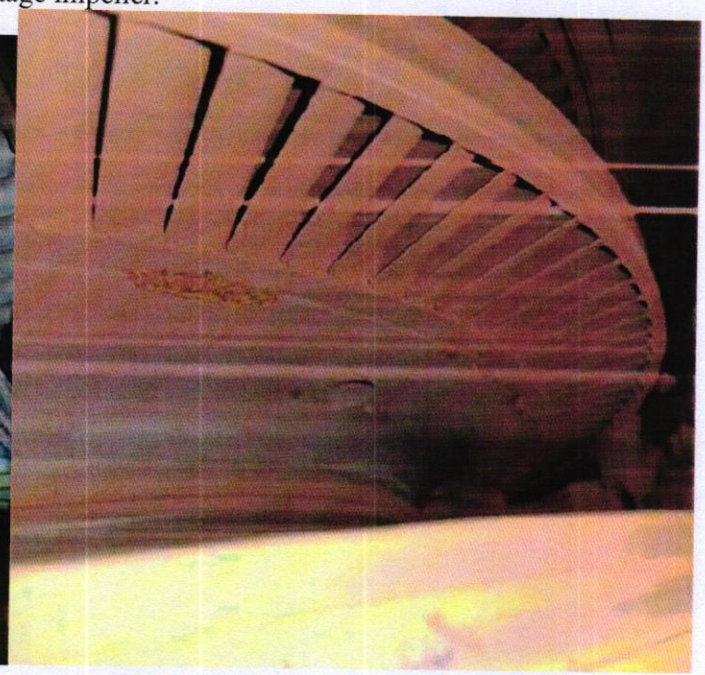
Recommendation:Replace the cat claw bolt.

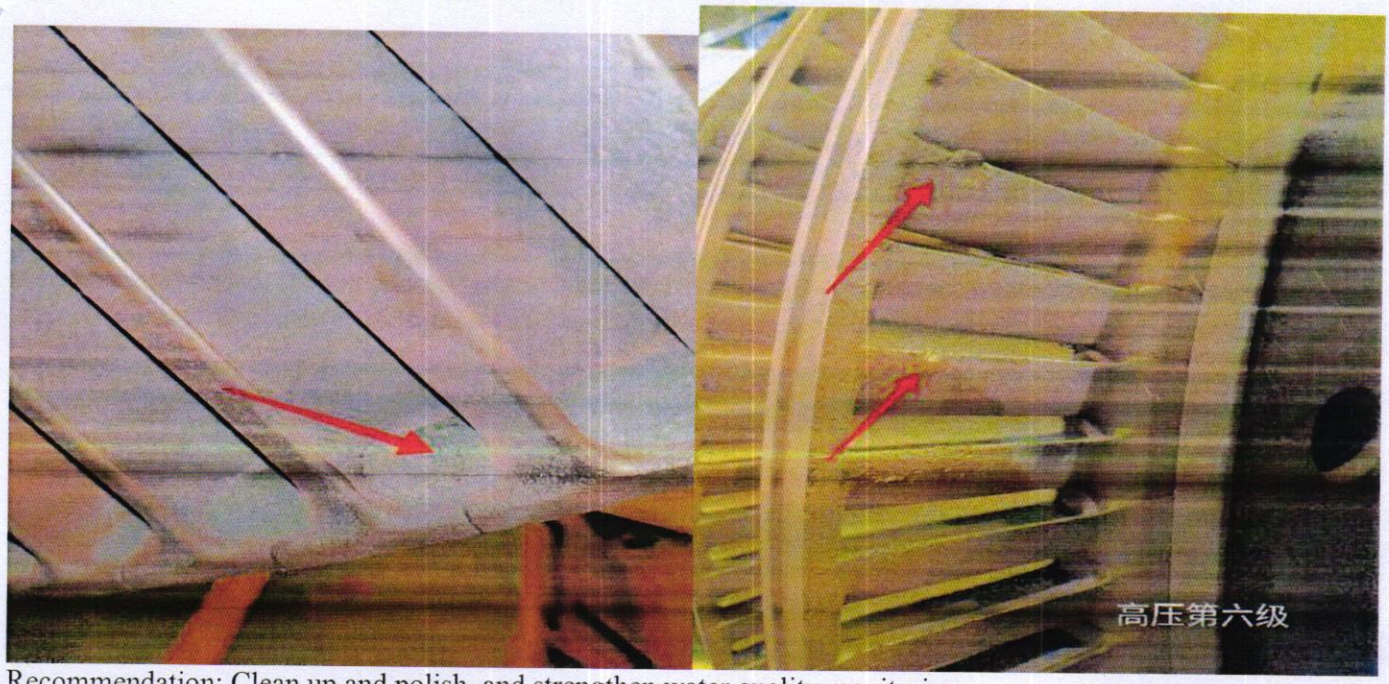


Recommendation:Replace the blade.

12. The high pressure rotor is heavily corroded and scaled, and the foreign body accumulates at the top of the grade IP 1st blade, and the foreign body strikes in the HP 6th stage impeller.

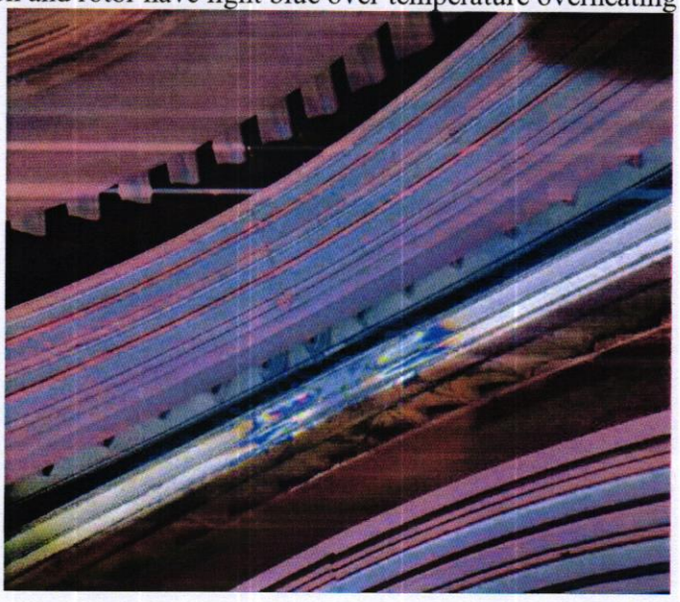


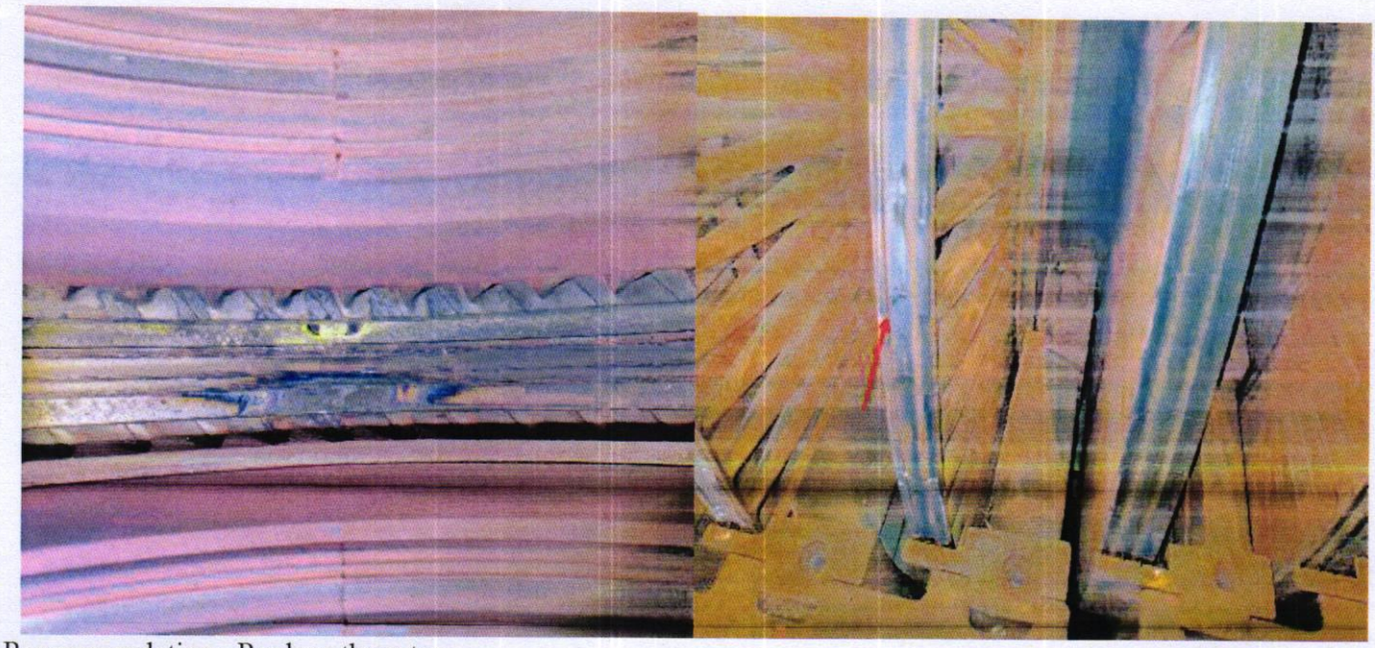




Recommendation: Clean up and polish, and strengthen water quality monitoring.

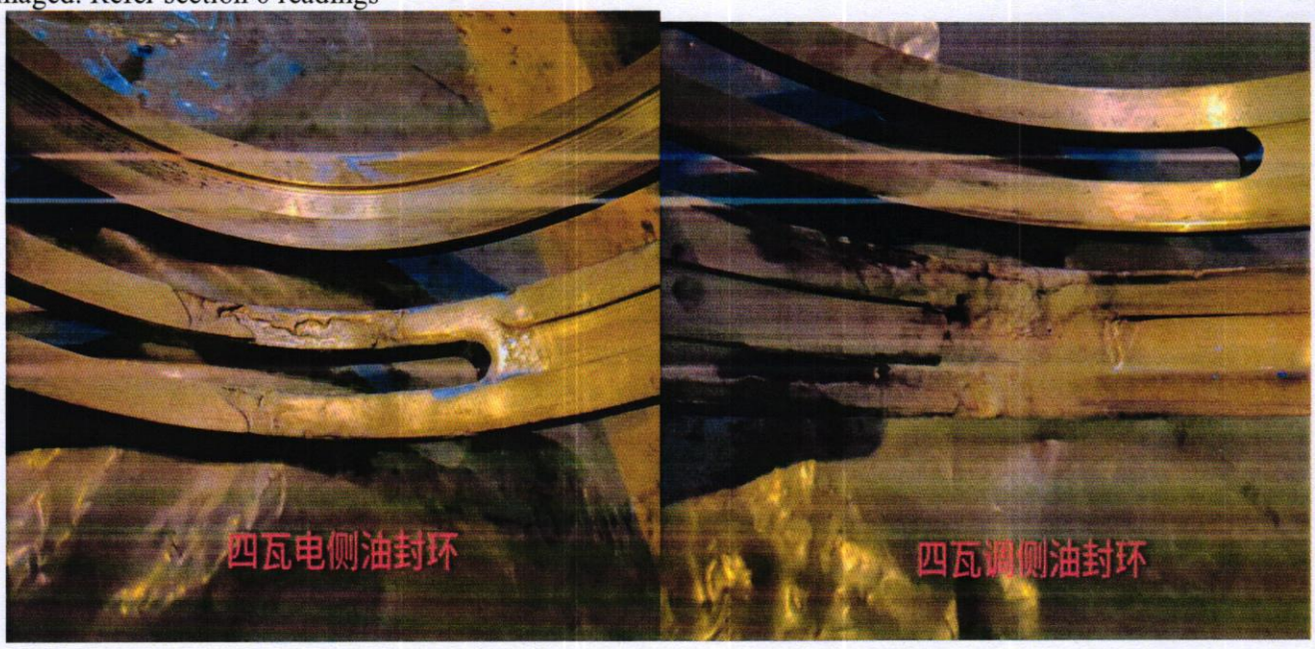
13. The maximum bending of the HP-IP rotor axis is 0.10mm, and the bending of the IP side rotor is large. The medium pressure side partition and rotor have light blue over temperature overheating traces.

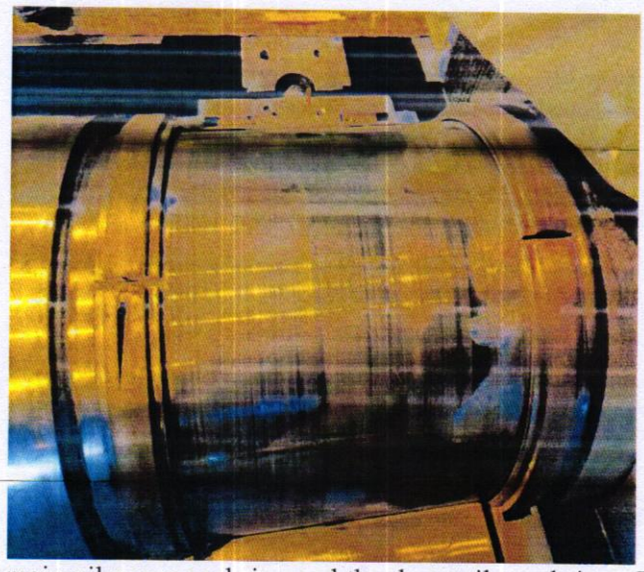




Recommendation: Replace the rotor.

14. The clearance of the sealing ring and the thrust tile sealing ring exceeds the standard, and the thrust clearance is 0.42 (standard 0.28-0.38). The clearance of # 1 and # 2 exceeds the standard, # 3 and # 4 bearing oil seal ring is damaged. Refer section 6 readings

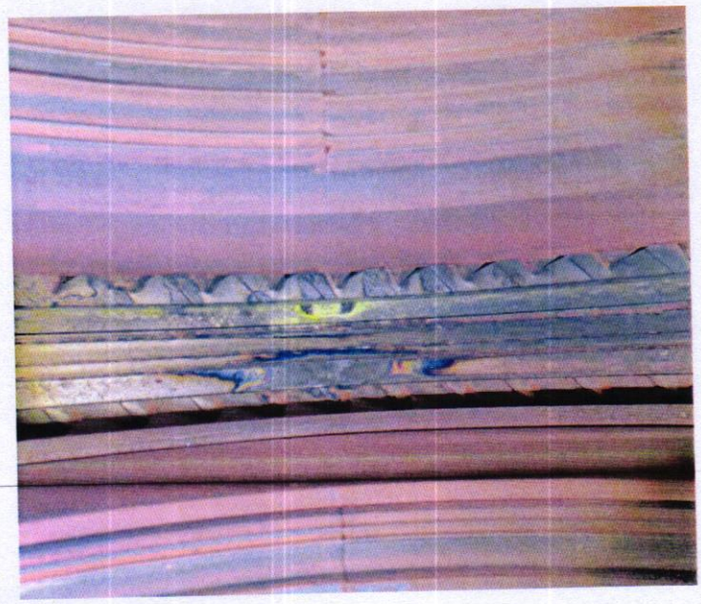




Recommendation: Replace the main oil pump seal ring and the thrust tile seal ring, Replace # 1- # 4 oil seal ring.

15. HP : The top steam sealing clearance, partition steam seal, middle balance ring steam seal, and end steam seal wear, and the steam seal clearance exceeds the standard, The spring blade loses its elasticity for a long running time. Readings are mentioned in section 6.

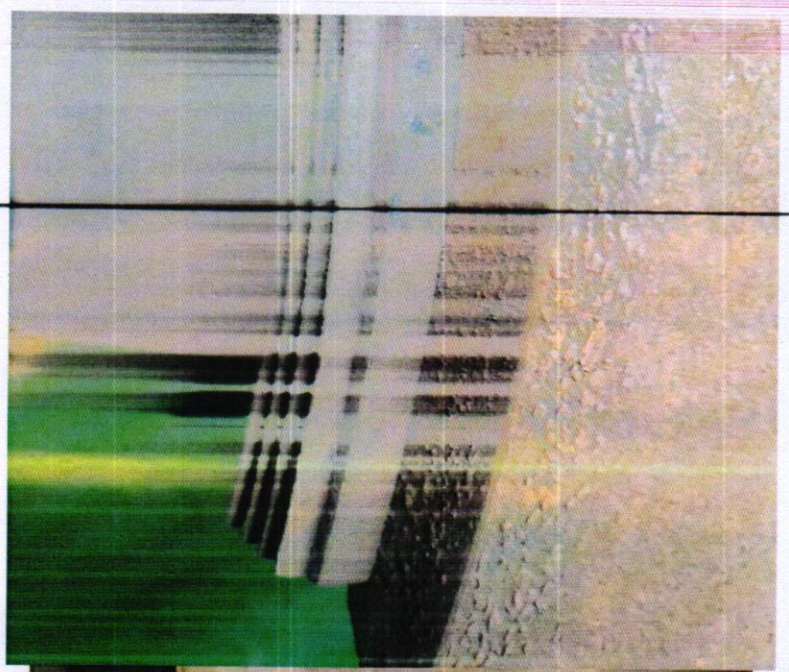


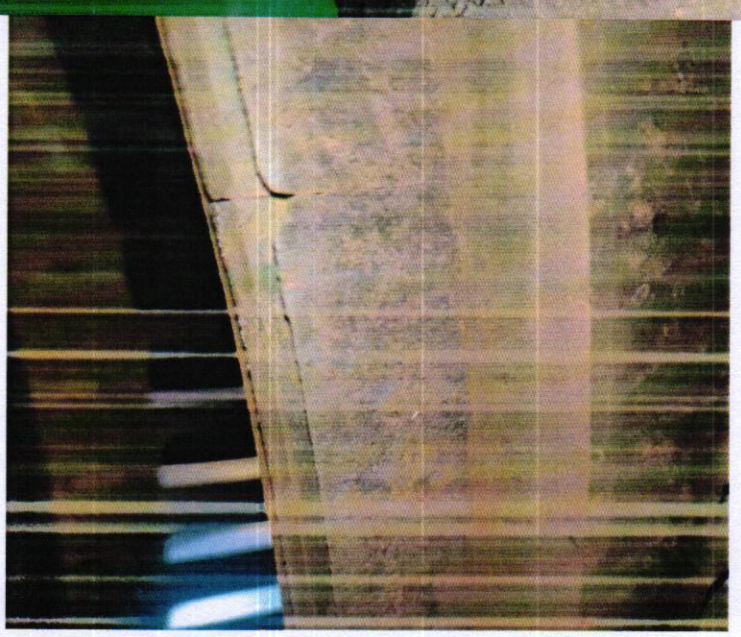


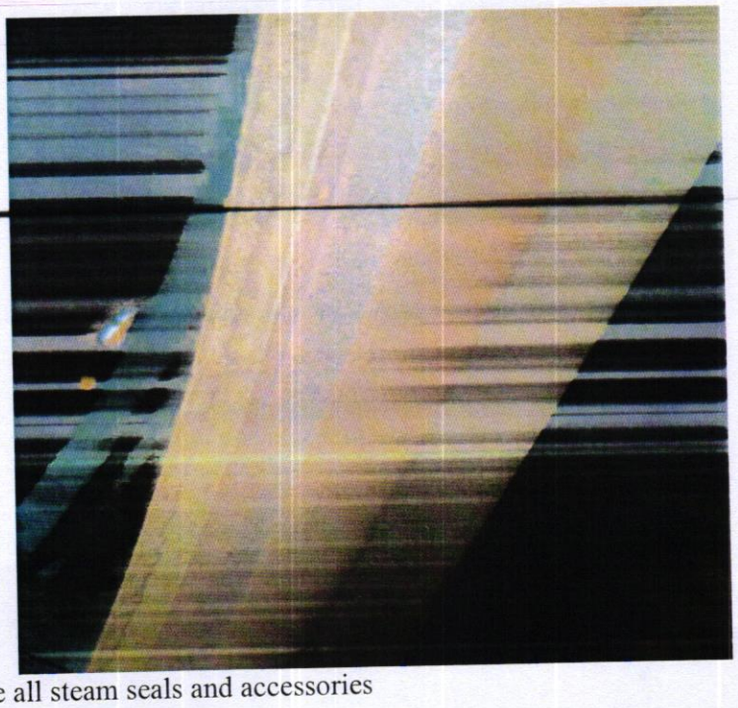
Recommendation: Replace all the steam sealing blocks and accessories, and reinsert the leaf top steam sealing teeth.

16. LP:The steam seal and end steam seal of the low pressure rotor partition plate are seriously corroded, the spring sheet loses its elasticity for a long time, and the leaf top steam seal clearance exceeds the standard. Readings are mentioned in section 6.



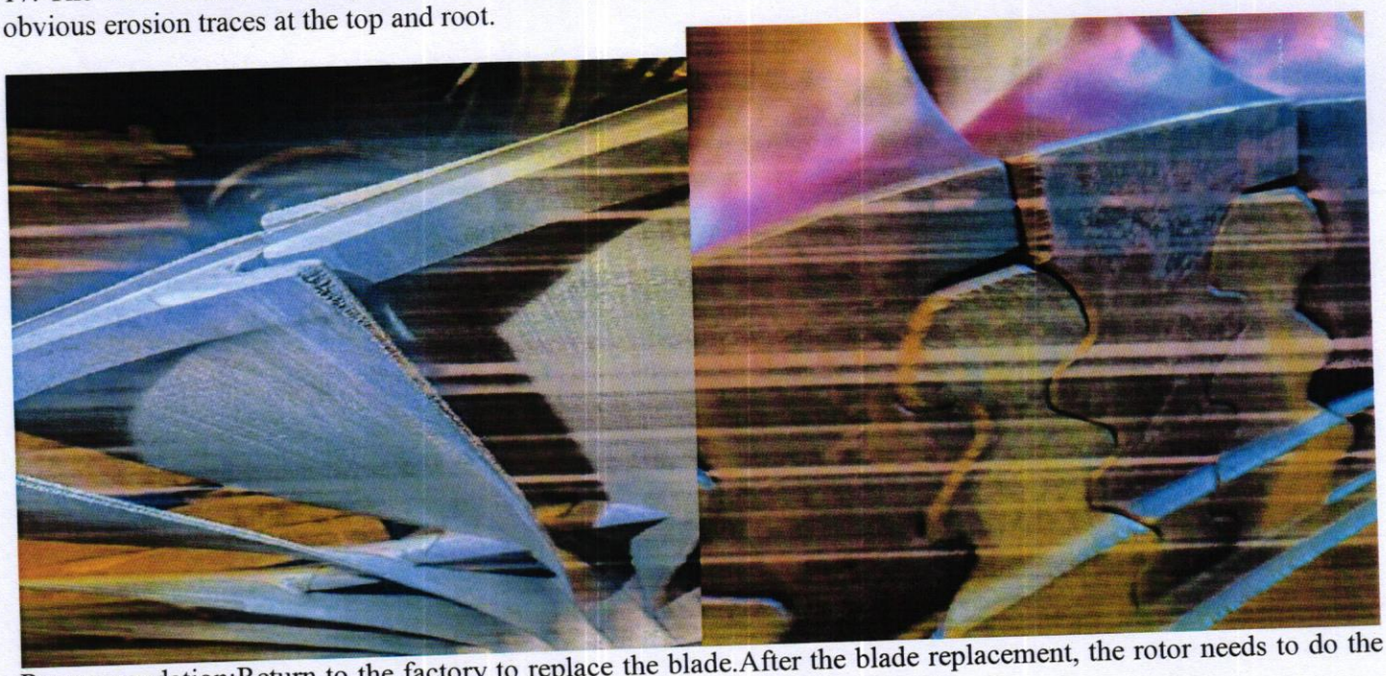






Recommendation:Replace all steam seals and accessories

17. The water erosion of the generator and turbine side final blade of the low pressure rotor is serious, and there are obvious erosion traces at the top and root.



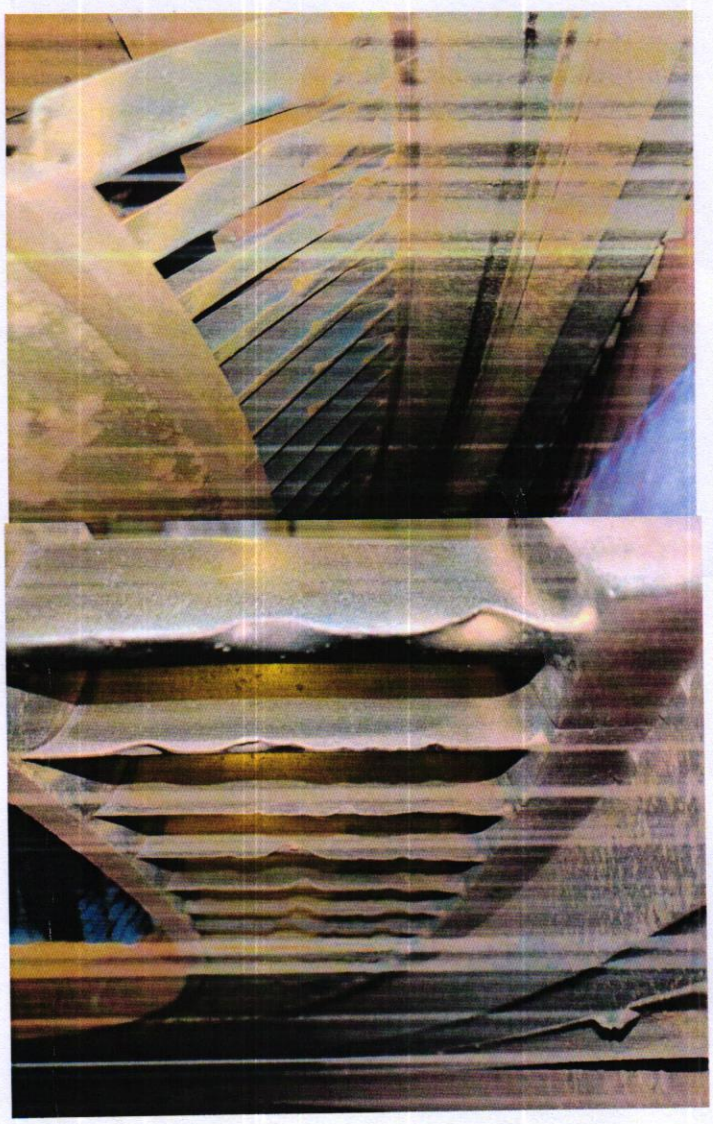
Recommendation:Return to the factory to replace the blade.After the blade replacement, the rotor needs to do the dynamic balance test separately, and the conditions are not available on the site

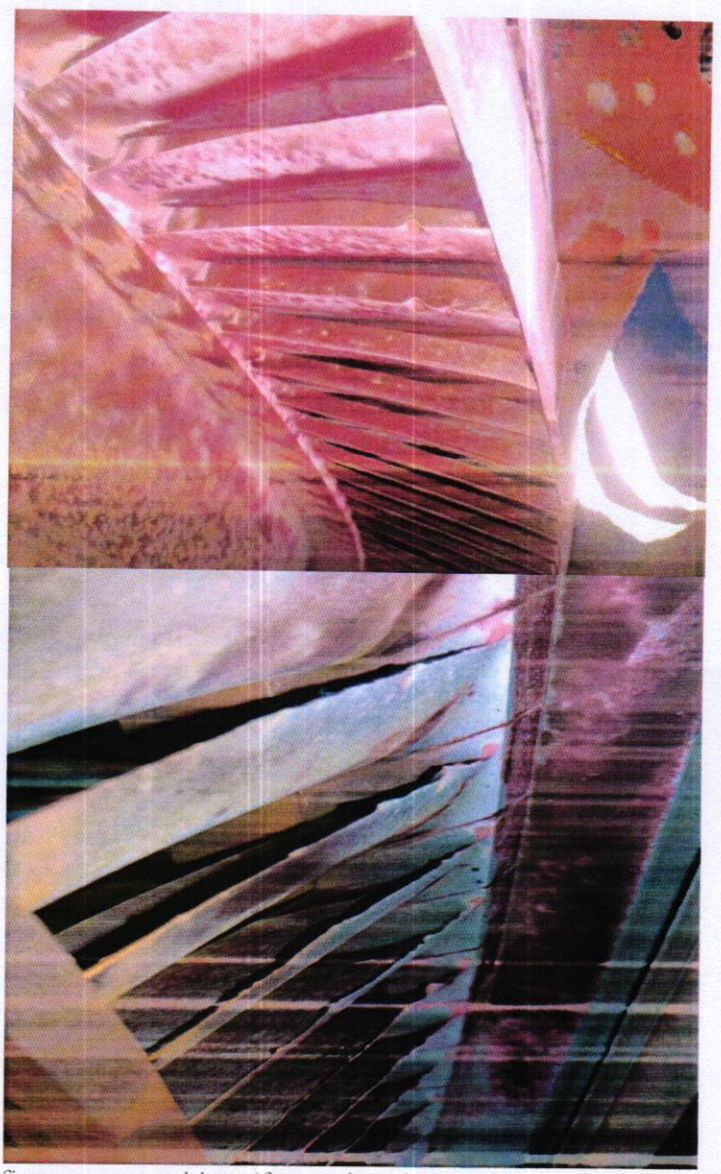
18. The low pressure inner cylinder has large deformation, the clearance of the without bolts inner cylinder is 1.2mm, and the maximum clearance after tightening 1 / 3 bolts is 0.90mm (required <0.10)。 Readings are mentioned in section 6.

Recommendation:Return to the factory processing on the upper casing, the lower casing site grinding combined surface.Under normal circumstances, both the upper and lower cylinders need to return to the factory, but the lower

cylinder can be manually polished and leveled according to the plane of the upper cylinder.The binding surface of the upper cylinder requires mechanical leveling, and the accuracy requirement are high. According to the plane of

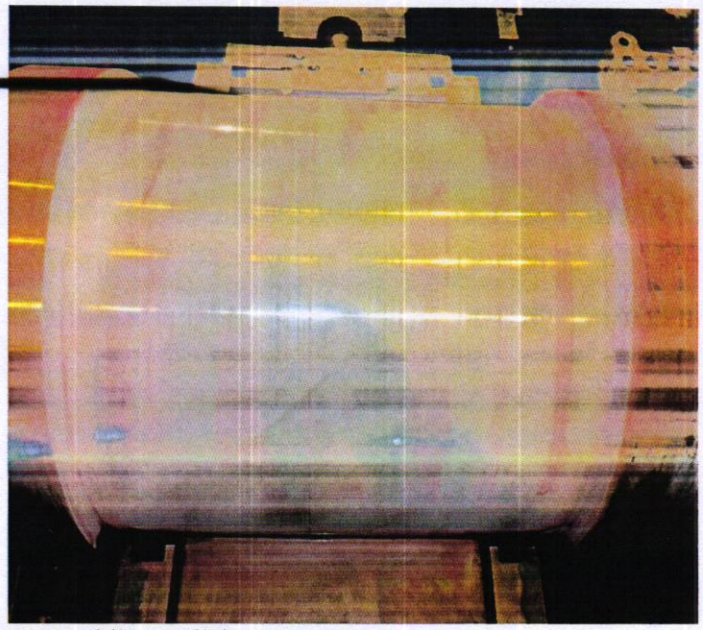
the partition plate, low pressure steam intake to the first stage, reverse level 4, high pressure level 6, etc., the





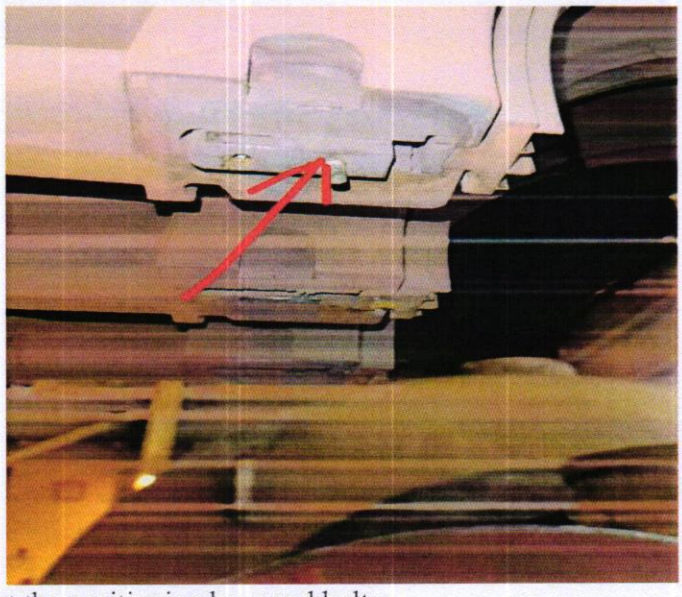
Recommendation: LP The first stage partition (forward and reverse) needs to be replaced, and the remaining partitions need to be repaired on site。 .

20. Low pressure rotor shaft diameter wear has scratches, and wear has dents.



Recommendation:shaft diameter welding polishing treatment.

21. In the process of lifting the upper high pressure diaphragm, the bolt is broken due to the positioning key, and the positioning key falls off.

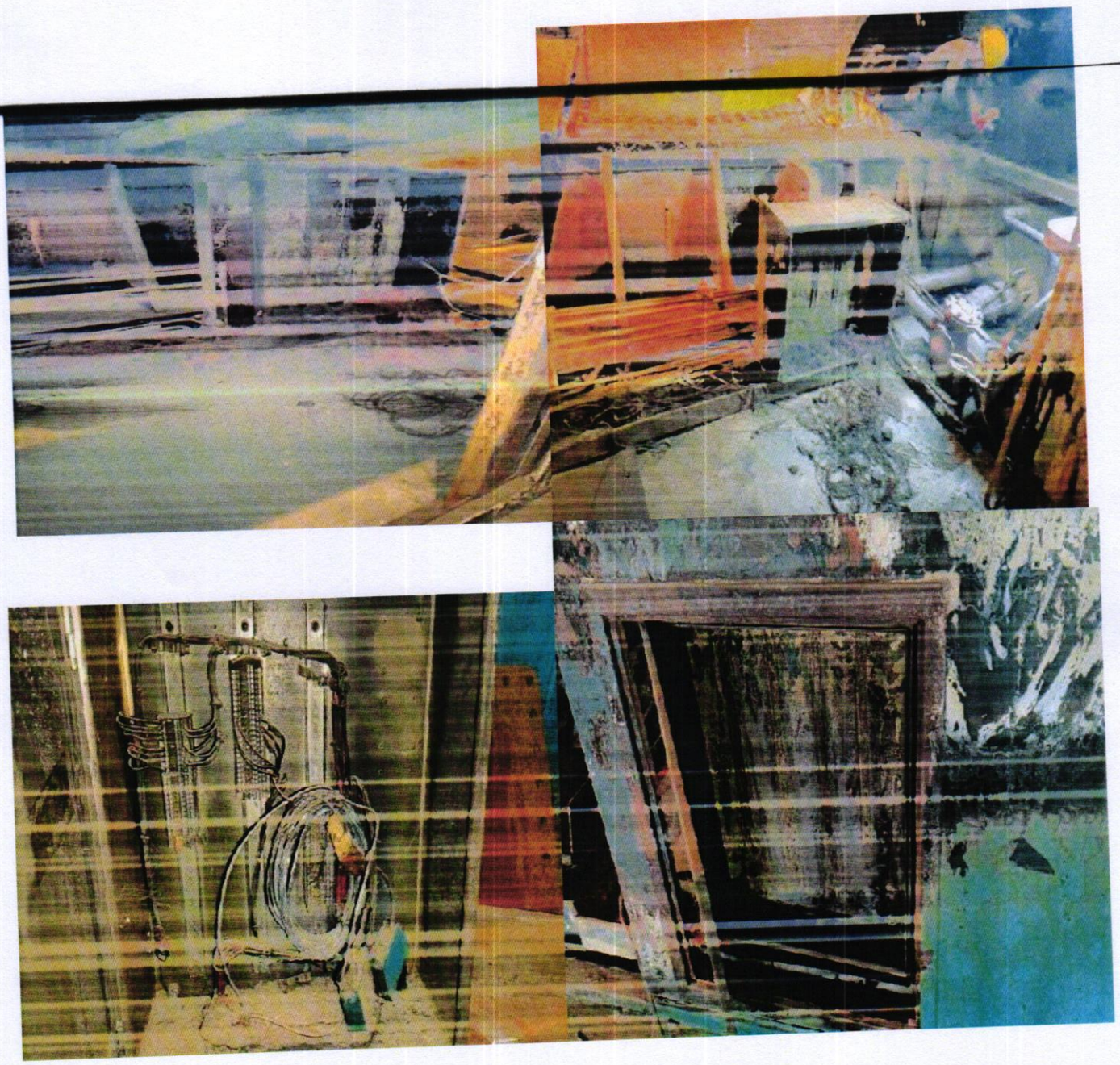


Recommendation: supplement the positioning keys and bolts.

22. 5 bolts of low pressure inner cylinder, 62 unqualified bolts accounted for 47% of the total bolts, and 14 unqualified bolts of high pressure.
Recommendations: Low-pressure inner cylinder and partition plate sleeve bolts shall be replaced with damaged bolts and other damaged parts during disassembly, and spare parts shall be prepared according to 20% of the total bolts. (见金属试验报告NDT report attached)

4.3 I&C System:

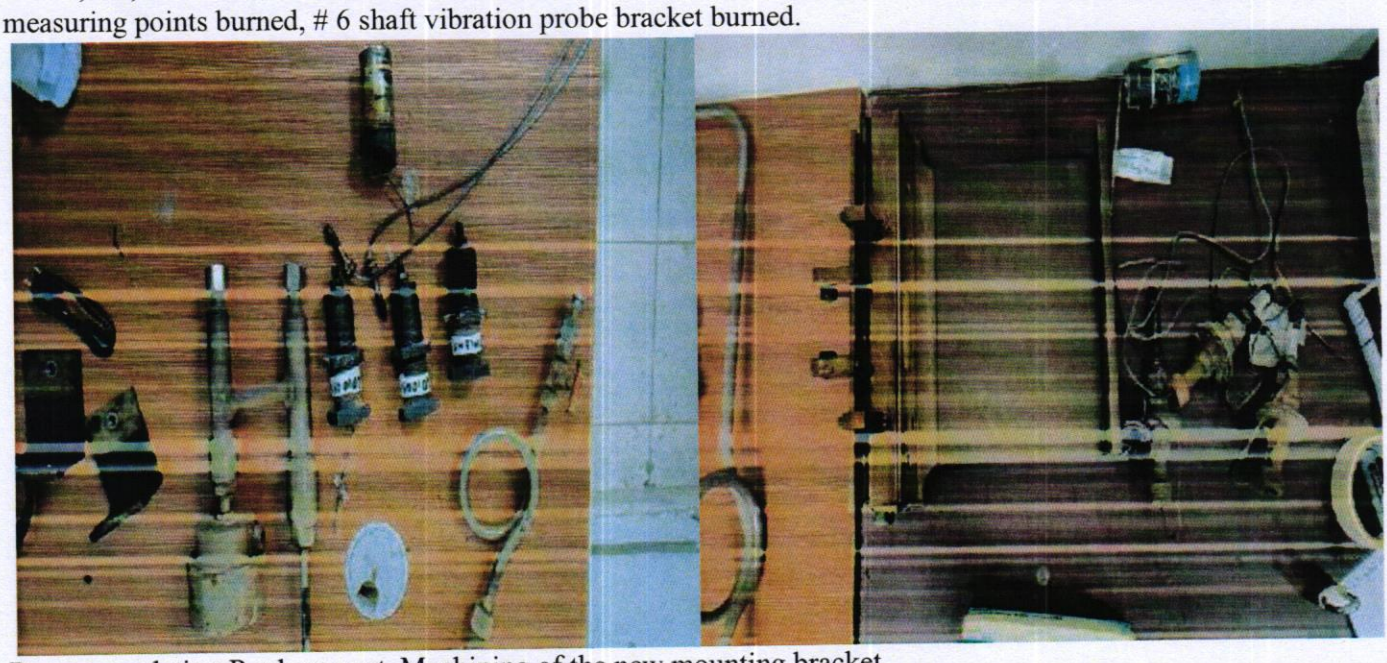
1. Steam engine body connecting box (TSI measuring point) over fire.





Recommendation:Replace the measuring point.

2. # 4, # 5, # 6 Shaft vibration, tile vibration, low pressure cylinder expansion difference, overspeed and other TSI measuring points burned, # 6 shaft vibration probe bracket burned.



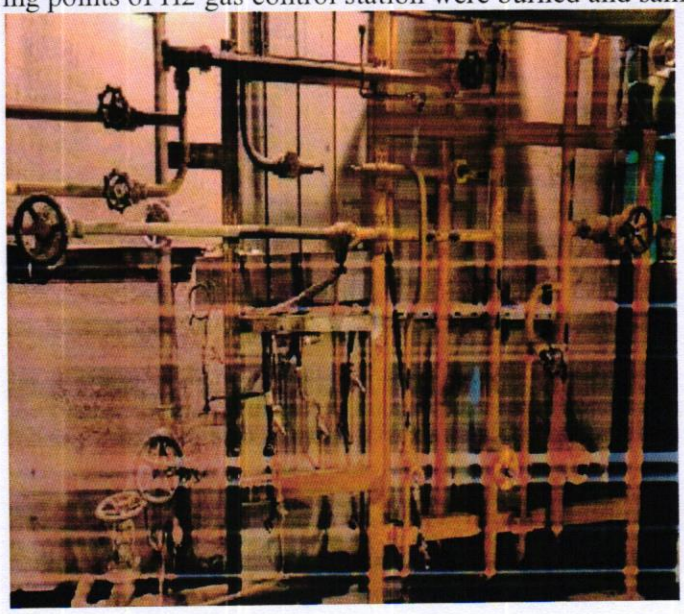
Recommendation:Replacement. Machining of the new mounting bracket.

3. # 1, # 2, # 3 Axial vibration and tile vibration, the equipment of axial displacement measuring point is aging, and some extension cables are damaged. The front box speed probe was found to be struck by the speed.



Recommendation:Replacement.

4. All thermal control measuring points of H2 gas control station were burned and sampling valves were burned.





Recommendation:Replace the relevant measuring points and sampling valve.

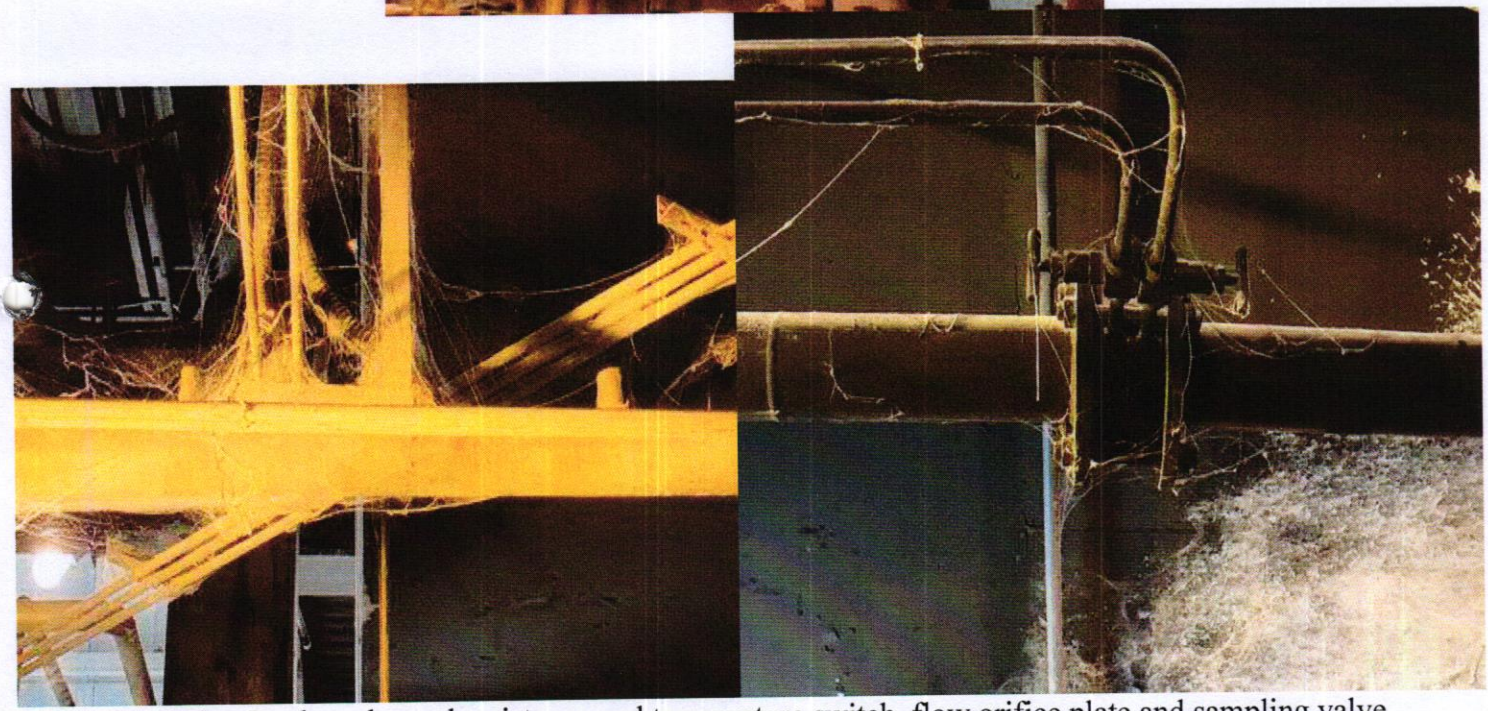
5. The generator hydrogen cooler inlet control valve burned, the hydrogen cooler outlet cooling water temperature measurement point burned.



Recommendation:Replace the new electric actuator and the temperature resistance.

6. The temperature measuring points of inlet and outlet pipes of stator cooling water were burned, and the inlet and outlet flow orifice plates were fired.

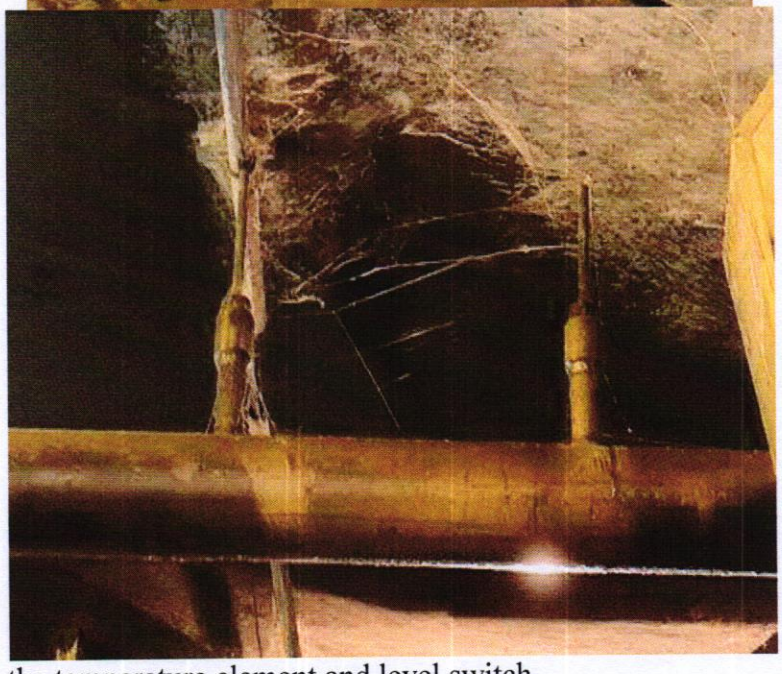




Recommendation:Replace thermal resistance and temperature switch, flow orifice plate and sampling valve.

7. The temperature measuring point of the sealed oil return pipeline and the liquid level switch of the defoamer are burnt out.





Recommendation: Replace the temperature element and level switch.

The metal temperature of #4,#5,#6 bearing and the oil return temperature measuring point are burned down, and the exhaust temperature measuring point of low pressure cylinder is burned down.







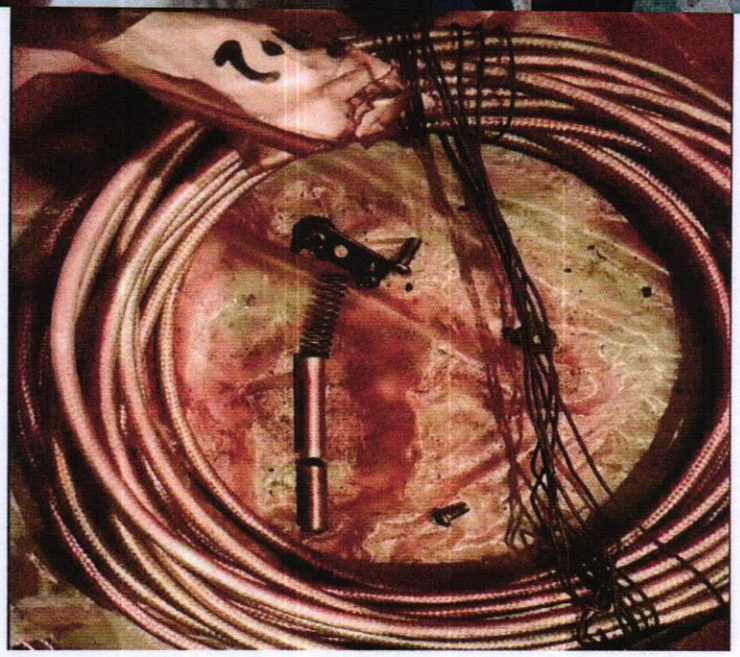


Recommendation:Replace the temperature measuring element.

9. # 1, # 2, # 3 Bearing metal temperature, oil return temperature, thrust tile temperature measuring point elements are aged and partially damaged.



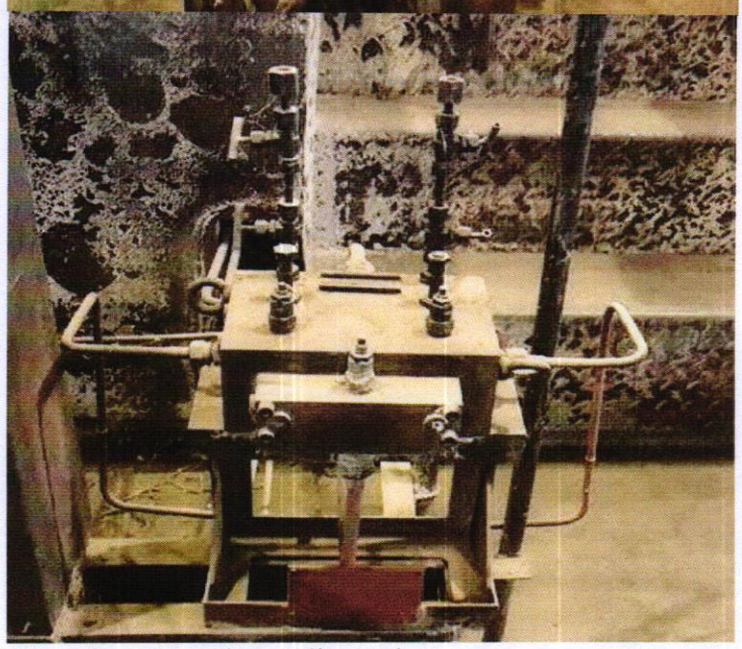




Recommendation:Replacement.

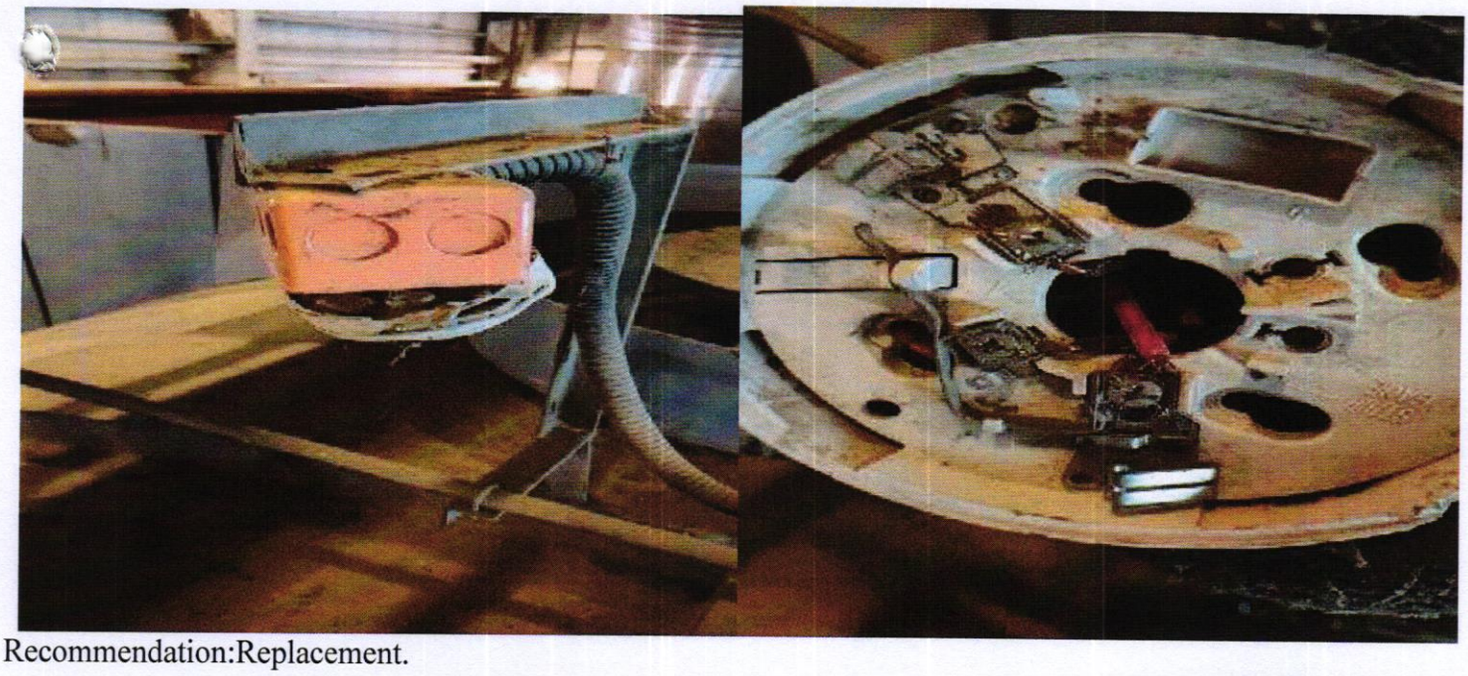
10. #2 Lubricating oil test block solenoid valve coil, jacking oil pressure switch and pressure gauge, lubricating oil pressure switch and pressure gauge burned, sampling valve were fired.





Recommendation:Replace I&C equipment and sampling valves.

11. Fire alarm detector is burned down



Recommendation:Replacement.

12. Junction box K, L, V, cable bridge damage.



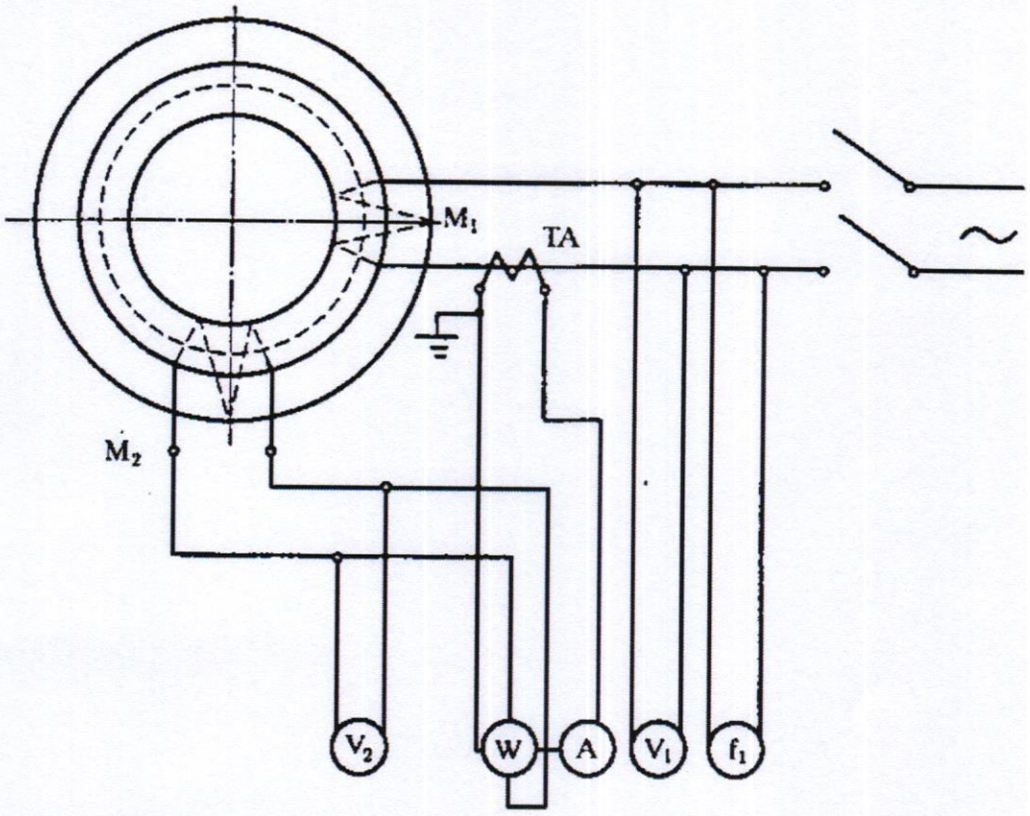
Recommendation:Replacement

5.Procedure Of Site Electrical Tests

1. Stator core magnetism test
Devices needed:

1) Ampere meter
2) Volt meter
3) Walt meter
4) CT
5) VT
6) Power Cable
7) Bolts and nuts for connecting the power cables

Connection:



Specifications:

B=1.4T

Test time(T)=45min

Requirement: $\Delta t_{max} \leq 25K$

Same part(tooth or slot) temperature differences $\delta t \leq 15K$

U1 from power supply=6.6kV

D1=2.537m Di=1.25m L=5.2m hs=0.1635m nv=63 bv=0.008m ρ=7650kg/m^3

Lu=4.414m hys=0.48m Q=2.1188 m^2 m=104694.1835kg W1=11 I=246.7A S=1791kVA

IW1=2714

Procedure:

(1)arrangement of power cable and M2 cable

(2)IR test of power cable

(3)connection of devices

(4)ground CT, VT and power cable, ground stator winding with 1 point.

(5)connection recheck

(6)Check whether the stator and tension bolts are loosen

(7)record ①stator core and ②room temperature before test

(8)provide AC power

(9)record following values:

U1:excitation voltage

U2:M2 voltage

I: excitation current

P: power

t_1:stator temperature

t_2:room temperature

(10) monitor temperature during test, stop test if find abnormal temperature increase, vibration and noise

2. Winding DC resistance

Stator winding DC resistance test:

Device needed:

1) DC resistance tester

Procedure:

(1)Disconnect stator winding with other system

(2)measure DC resistance of each phase

(3)record value

(4)compare with history data or or fabrication data

Rotor winding DC resistance test:

Device needed:

1) DC resistance tester

procedure:

(1)measure DC resistance of rotor winding

(2)record value

(3)compare with history data or fabrication data

3. Winding IR test

Stator winding IR test:

Device needed:

1) Internal water cooling generator stator winding IR tester or Mega meter

Procedure:

(1)Disconnect stator winding with other system

(2)Measure IR of each phase, each phase 60s

(3)record value

Rotor winding IR test:

Device needed:

1) Mega meter

Procedure:

(1)Measure IR of each phase, each phase 60s

(2)record value

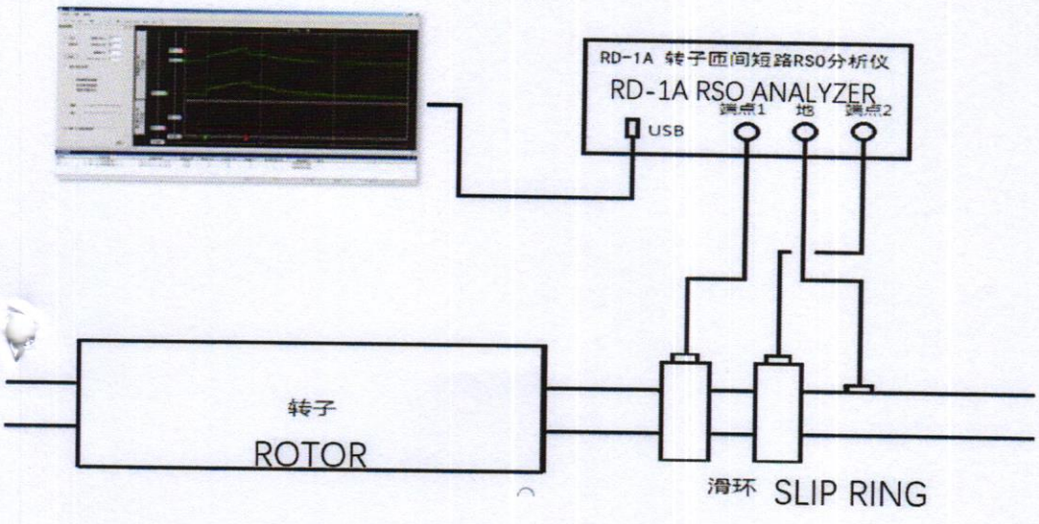
4. Rotor RSO test

Device needed:

1) Rotor RSO tester

Procedure:

(1)Connection rotor with RSO tester as follow:

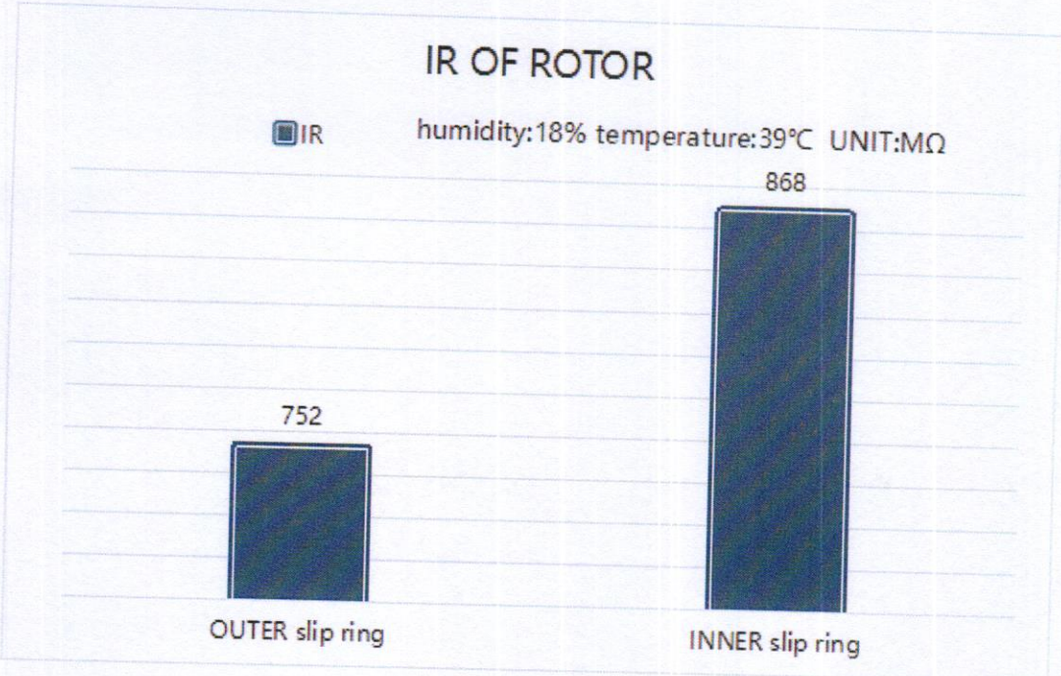


(2)Start analyze the rotor winding

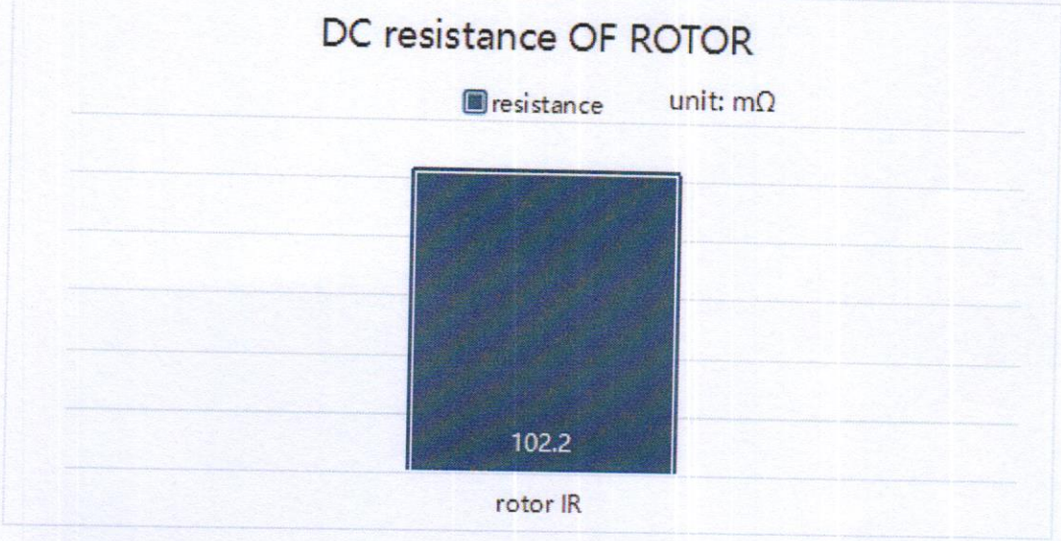
(3)Record test result

(4)Analysis of result

Rotor test report
1. Rotor IR test
Test date:2023.04.13

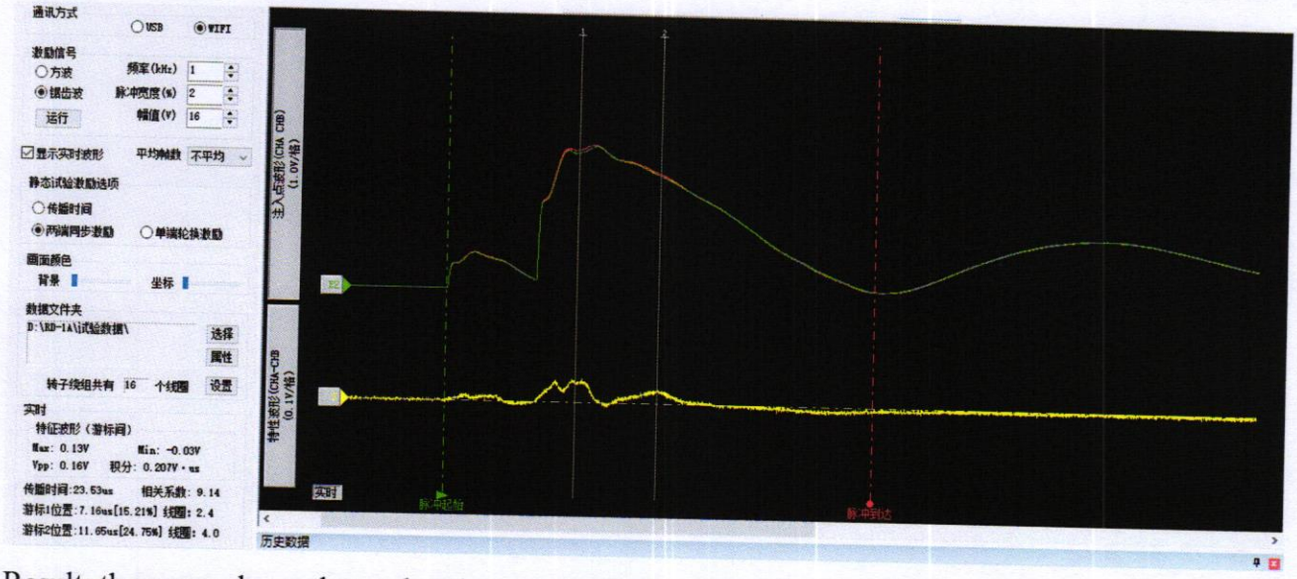


2. Rotor DC resistance
Test date:2023.04.13



3. Rotor RSO test

Test date:2023.04.13



Result: the curve above shows that there are inter-turn short circuits at:

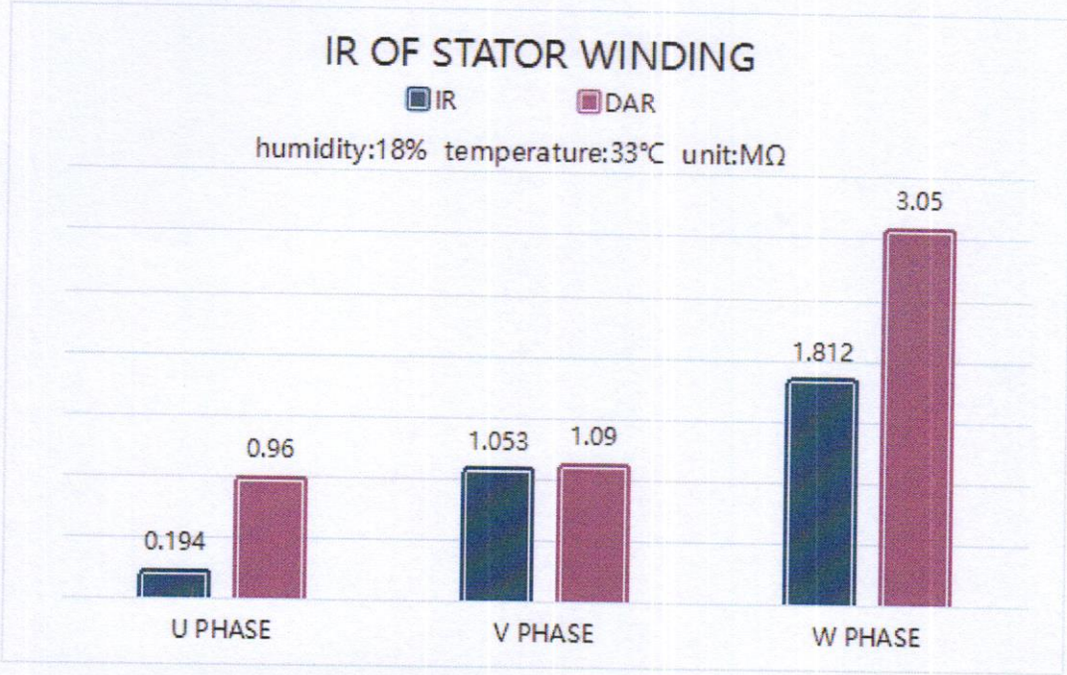
① No.3 coil

② and coil between No.4 No.5

Stator test report

1. Stator IR test

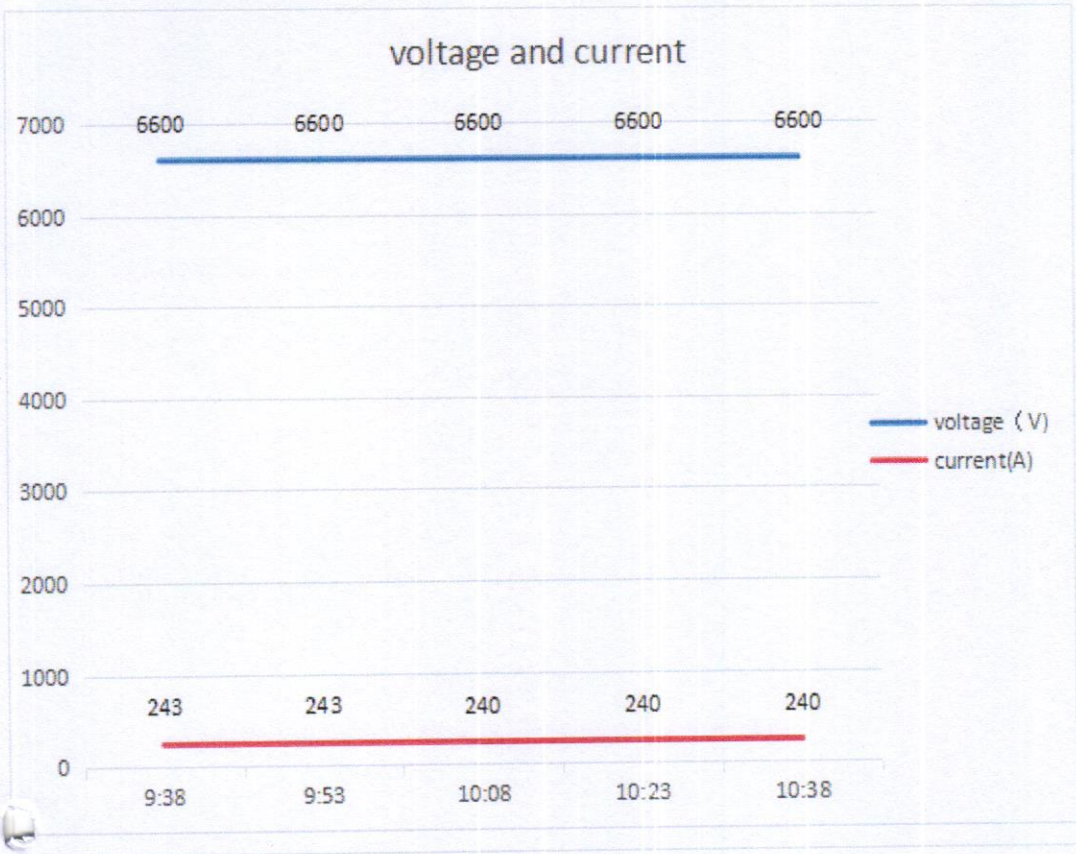
Test date: 2023.04.15

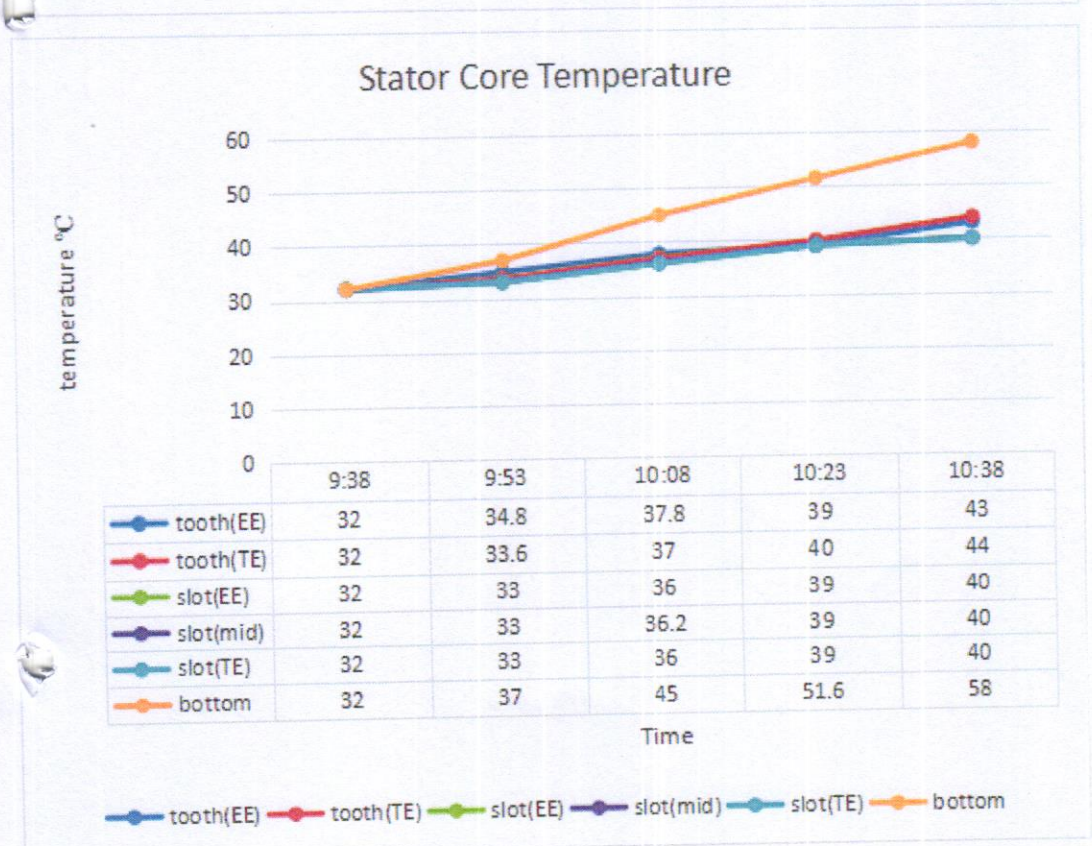


2. Stator Iron loss

Test date: 2023.04.15

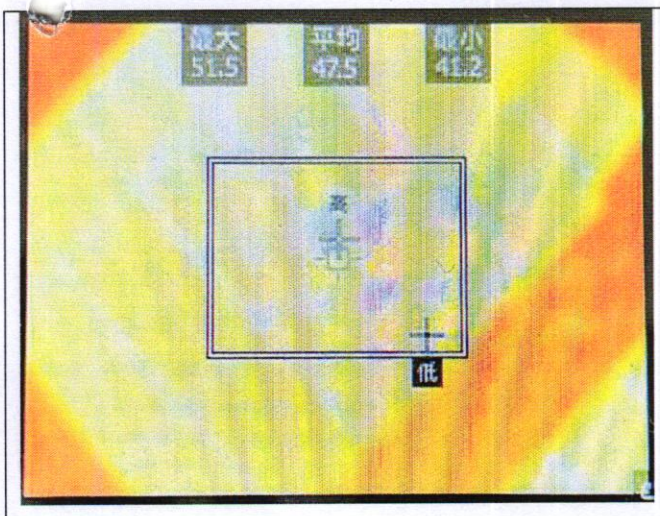
Room temperature: 32℃



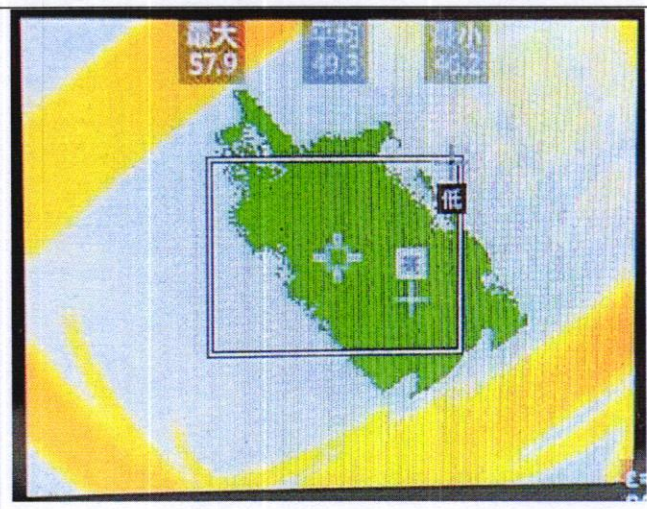


	9:38	9:53	10:08	10:23	10:38
tooth(EE)	32	34.8	37.8	39	43
tooth(TE)	32	33.6	37	40	44
slot(EE)	32	33	36	39	40
slot(mid)	32	33	36.2	39	40
slot(TE)	32	33	36	39	40
bottom	32	37	45	51.6	58

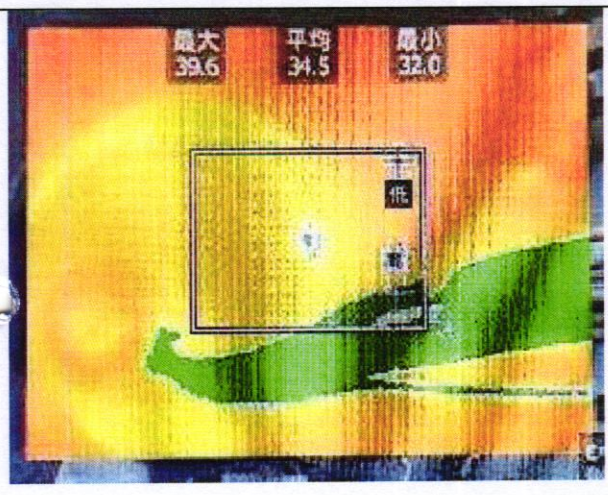
The temperature detection picture:



Temperature at stator bottom(EE)



Temperature at stator bottom(TE)



Stator core

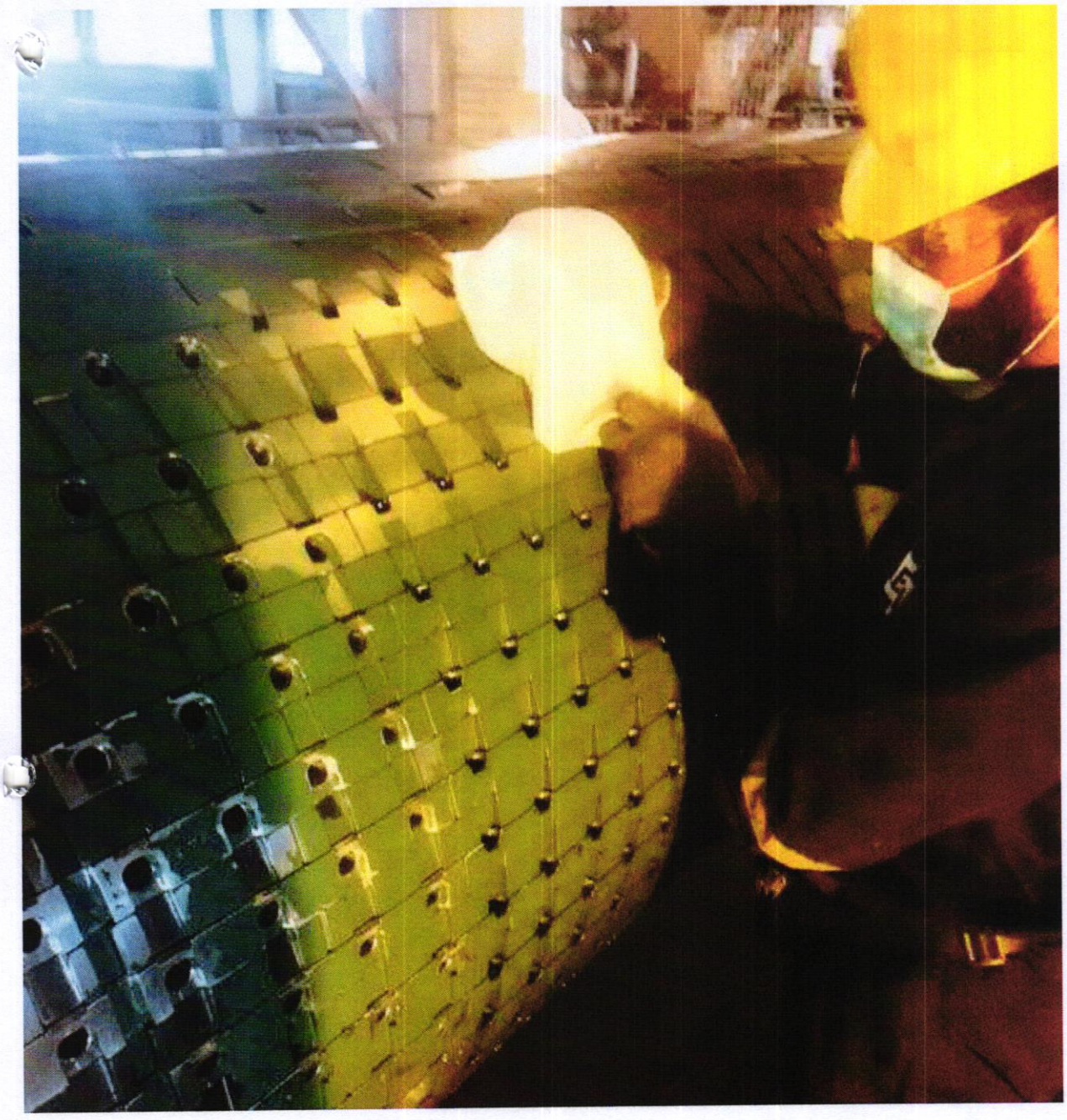
According to the requirement, the temperature rise at stator bottom is bigger than 25k, the result shows that the lamination at the stator core bottom(TE) is not qualified.

Generator Rotor

Generator rotor was cleaned using compressed air for cooling holes and interturn. Acetone was used as cleaning agent after compressed air in the presence of consultant and client team.

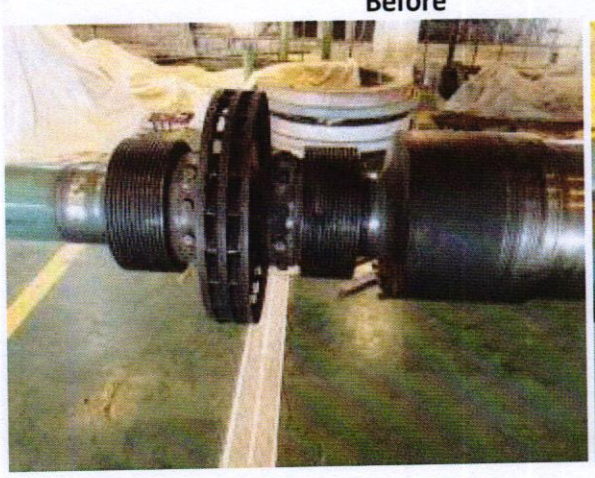




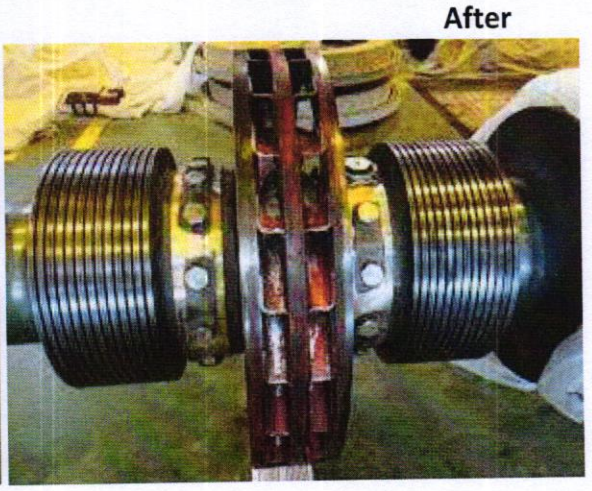




Before



After



Stator Cleaning

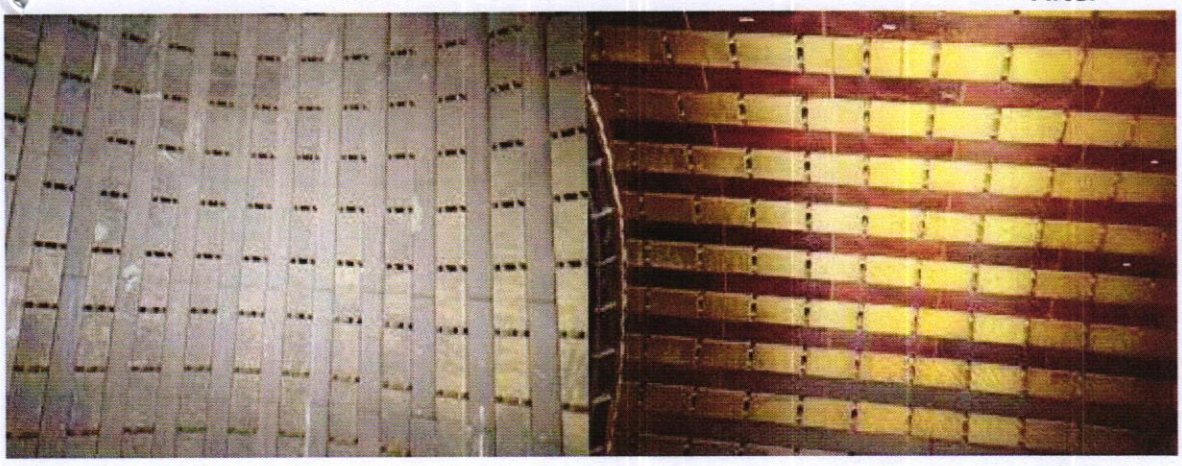
Stator cleaning was performed using compressed air and acetone in the presence of consult and client team.





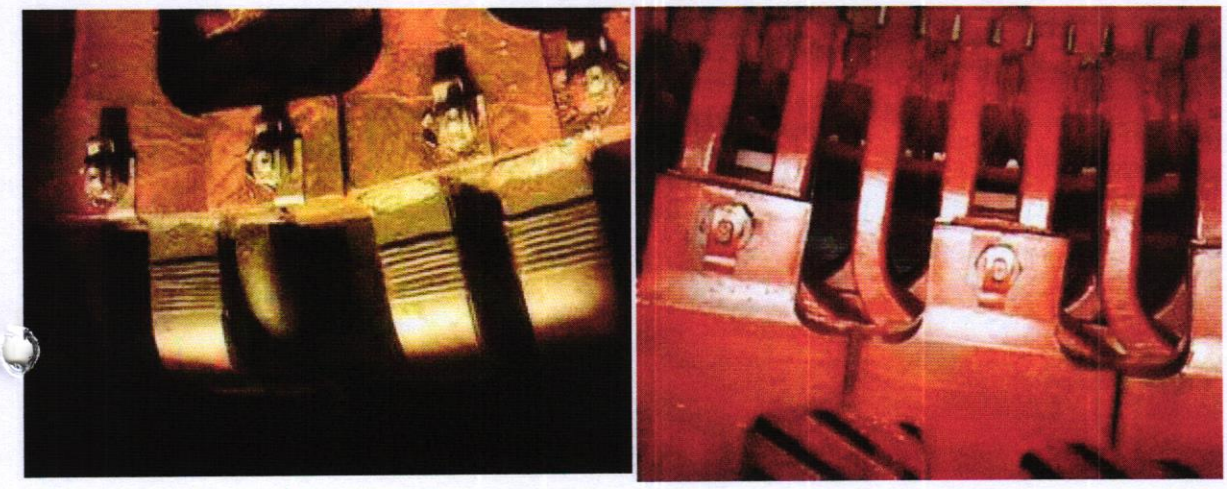
Before

After

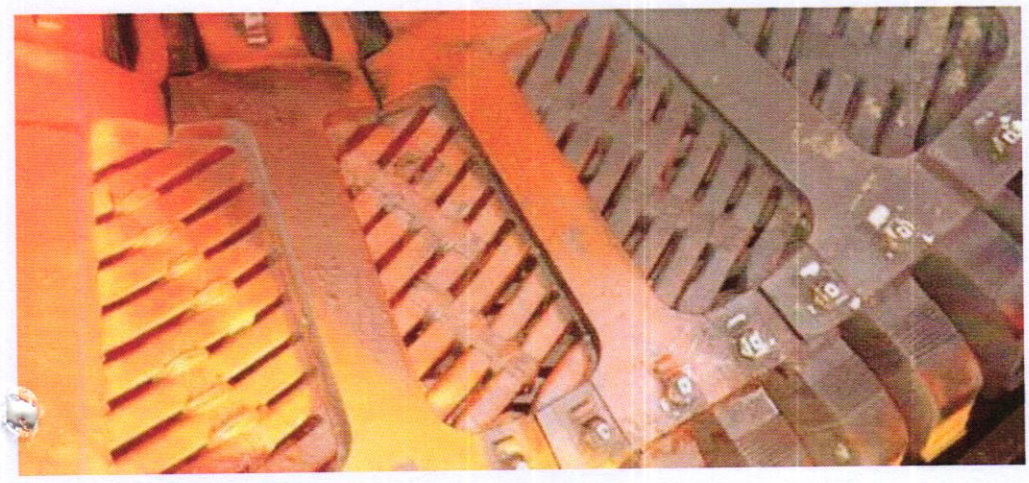


Before

After



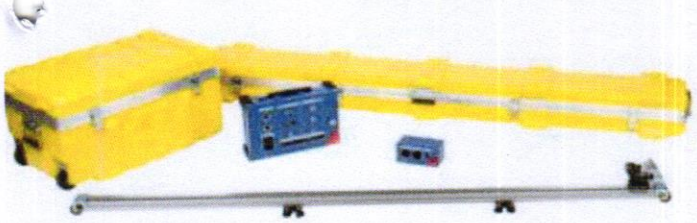
Comparison of cleaned and uncleaned Surface



sting Equipment

1. Omicron CPC 100
2. TD1 AC High Voltage Tester
3. SCMUO EL-CID
4. RSO SAMATRON
5. Megger MIT 1025



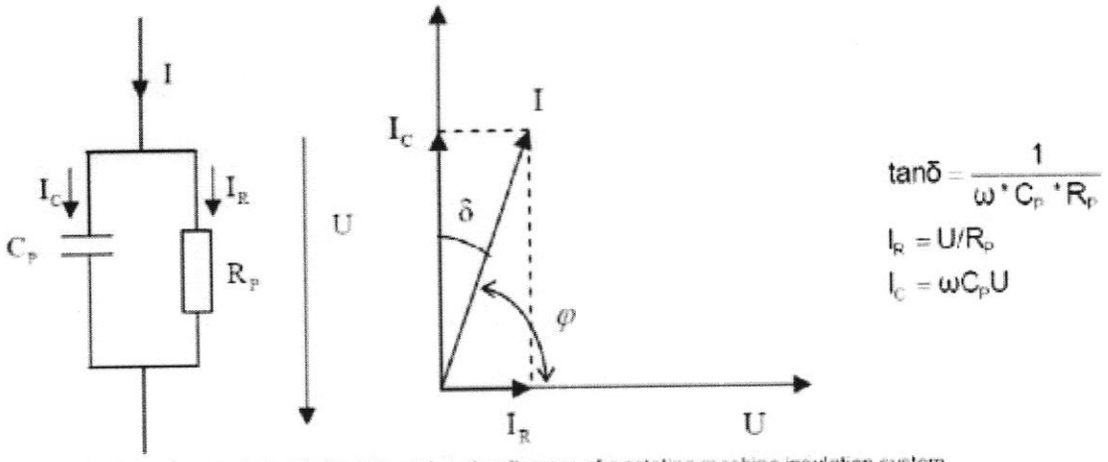




Dissipation Factor Theory and Procedure

In an ideal capacitor without any dielectric losses, the insulation current is exactly 90° leading according to the applied voltage. For a real insulation with dielectric losses, this angle is less than 90° . The insulation of a rotating electrical machine can be modelled by a loss-free capacitance with a parallel ohmic resistance representing the losses in the insulation system (Figure 1). The latter ones are caused by:

- **Surface currents**
- **Leakage currents**
- **Partial discharges**
- **Polarization losses**



Parallel equivalent circuit diagram and vector diagram of a rotating machine insulation system

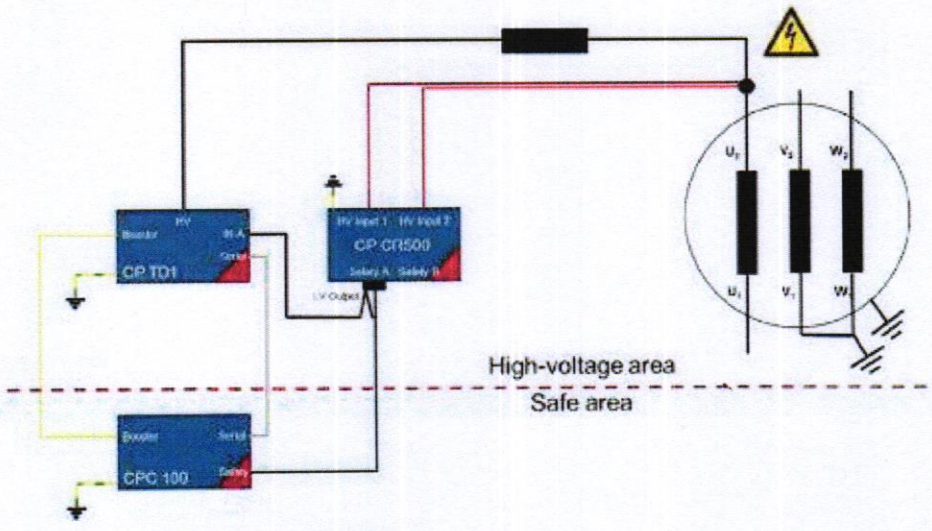
Applying a voltage to the parallel components causes a current IC to flow through the capacitance as well as through the resistivity IR. The overall current I therefore has a resistive and a capacitive component. A causal relation between losses and the resistive part can be assumed, as the higher the losses are, the higher the resistive current will be. The angle δ = 90 ° - φ is caused by the resistive part of the overall current and is proportional to the losses, which leads to the definition of the tan(δ) expressed in above figure as an indication of the overall condition of the insulation system of an electrical machine.

Procedure

For Tan Delta Testing, there are two methods, when neutral point is open and second is when Neutral point is not open due to accessibility,
for first method when neutral point of motor is open to isolate each phase. HV Source was connected with the line terminals of the motor with other two phases grounded; test voltage was raised in steps up of 20% to the maximum voltage of 3.46 kV. Tan Delta and Capacitance measured on each phase in steps.
For second method when neutral point is not open, short all windings and connect HV source and measure Tan Delta and Capacitance.

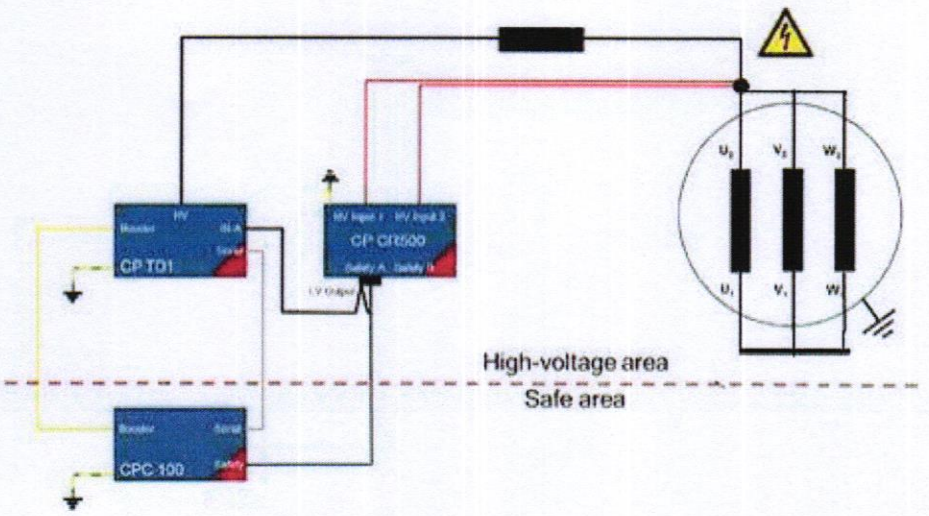
Testing Setup

When star point is accessible and open from both ends, take reading on each phase with respect to ground.



Setup of the test circuit with numbered items.

When star point is not accessible and one ends open then take reading as a single winding.



Setup of the test circuit with numbered items

REPETITIVE SURGE OSCILLOSCOPE (RSO) TEST

RSO test is performed to detect faults in rotor windings. The electrical faults in generator rotors fall into two main categories:

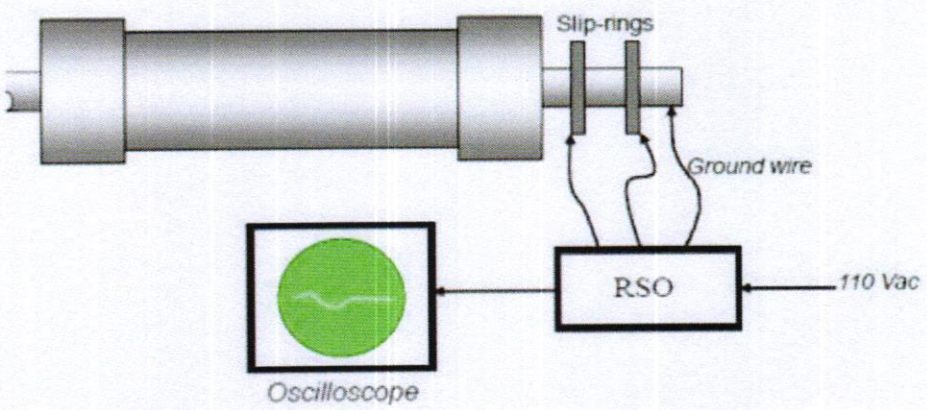
- Faults from the winding to the rotor body (earth faults)
- Faults between parts of the winding (inter-turn winding faults).

The existence of the faults will frequently display excessive mechanical vibration and cause serious concern. An RSO test identifies the type of fault and pinpoints the position of the fault.

Principle:

A fast fronted step voltage impulse is repeatedly applied using a Repetitive Surge Oscillography (RSO) to the rotor winding at one of the slip- rings SR1 and the reflected waveform at the other end SR2 is recorded and this process is reversed by applying voltage impulse at SR2 and the reflected waveform is recorded at SR1 and the two waveforms are then superimposed to check for rotor winding abnormalities like inter-turn shorts, earth faults and high resistance joints.

A healthy rotor winding will have two identical traces, which are superimposed and a rotor with a fault will have non-identical traces, which are not superimposed. If both the traces are superimposed, it can be safely assumed that the rotor winding is free from inter-turn faults, earth faults and high resistance joints.



EL-CID ELECTROMAGNETIC CORE IMPERFECTION DETECTOR

Purpose and Theory

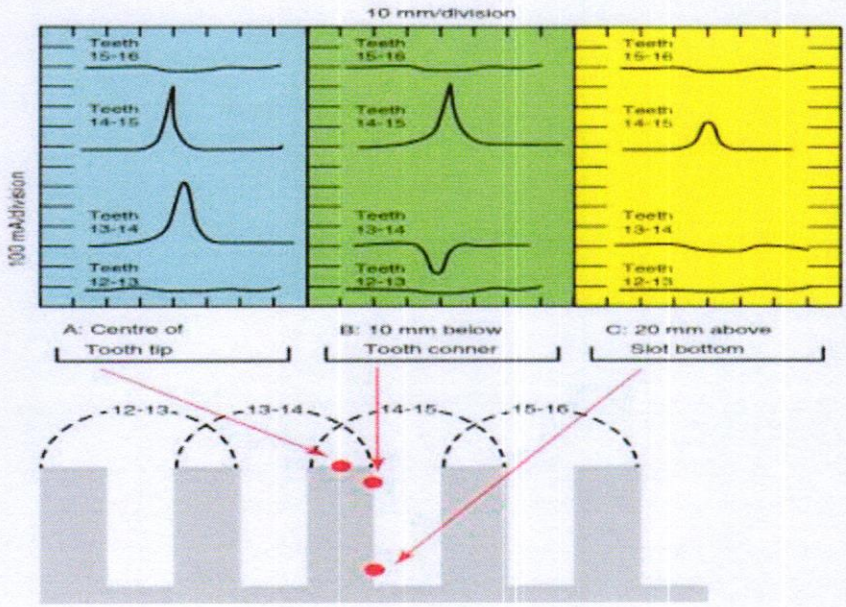
The electromagnetic core imperfection detector (EL- CID) identifies the presence of faulty core insulation by an electromagnetic technique. It operates on the basis that axial currents will flow through failed or significantly aged core insulation even when a flux equivalent to a few percentages of rated voltage is induced in it. In the low flux test, these axial currents are directly detected by the magnetic field they create, rather than from the heat they create or from the power loss.

The EL- CID system uses a special pickup known as a Chattock coil (or Maxwell' s " worm") to obtain a voltage signal that is proportional to the axial current flowing between laminations. This solenoid coil is wound with a double layer of fine wire on a U-shaped form. When this coil is placed in a position bridging two core teeth, the voltage induced in it by an axial fault current between the laminations is approximately proportional to the line integral of the alternating magnetic field along its length.

Applying Ampere' s law for any closed loop of integration, the line integral of the magnetic field is equal to the enclosed current, in this case, the fault current. Hence, if the effects of the field in the core are ignored, the Chattock coil will give a voltage output proportional to the current (I) flowing in the area encompassed by it, the two teeth it spans, and the core behind these teeth.

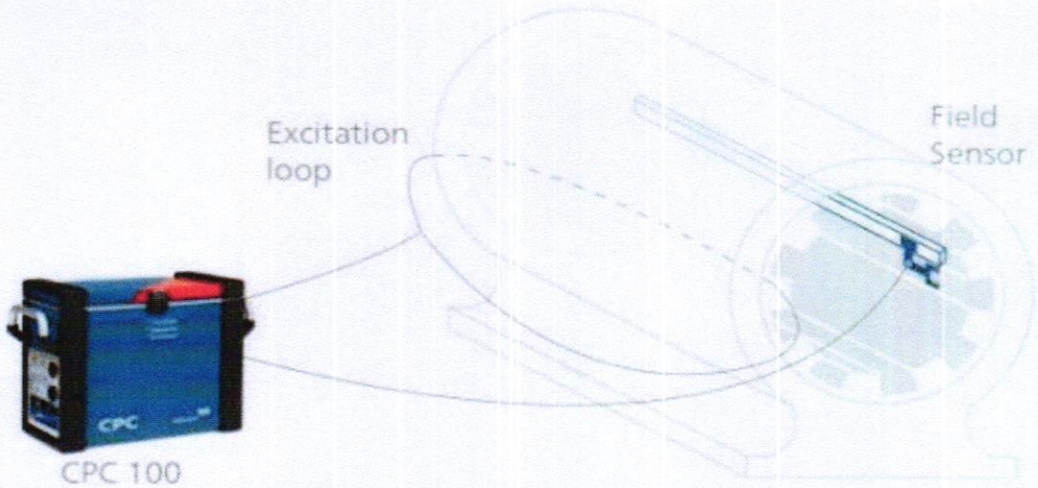
The output from the Chattock coil cannot be used directly to give an indication of core insulation quality. This is because there is another component of voltage induced in it by the circumferential magnetic field generated by the excitation winding that produces the test flux in the core. Consequently, the voltage induced in the Chattock coil is the mean potential difference between teeth due to both currents (IF) flowing between laminations and those induced circumferentially in the laminations by the excitation winding field (I_w). Fortunately, there is a phase shift between the excitation winding flux and that produced by axial fault currents as these currents are at 90 ∘ to one another. Thus, if the voltage output from the Chattock coil is fed to a signal processor, the portion generated by the excitation winding can be eliminated to produce a voltage that is proportional to the axial component of current. The separation is done by feeding another signal from a reference coil in the excitation cable into the signal processor.

The signal- processing unit gives an output in milliamperes that is a function of the component of Chattock coil voltage generated by axial eddy currents. If there is faulty insulation in the core or there are interlamination shorts at the core surfaces, they will be indicated by relatively high milliampere readings. Industry experience indicates that with 4% of rated back-of-core flux, the measured limit for healthy core insulation is 100 mA, which equates to a 5– 10∘C hotspot temperature from a " rated flux test" . For other flux levels, this milliampere limit is adjusted in proportion to the actual flux density, for example, for 3% rated flux, the limit is 3/4 × 100 = 75 mA.


10 mm/division
100 mA/division
Teeth 15-16
Teeth 14-15
Teeth 13-14
Teeth 12-13
A: Centre of Tooth tip
B: 10 mm below Tooth conner
C: 20 mm above Slot bottom
12-13
13-14
14-15
15-16

Test setup and measurement

The test setup principle is shown in Figure, where the excitation of the stator performs the current in the excitation loop. V2 AC input offers the connection to the Rogowski coil, which is moved along the slots (blue area) to detect possible interlamination faults. The procedure is repeated for every slot around the stator.



As the measurement is a comparative method, every measurement on a certain stator requires similar excitation. To check the excitation, an optional reference loop (consisting of standard laboratory cables) measures the excitation of the core. The measurement is performed with the V1 AC input of the CPC 100 prior the electromagnetic imperfection test starts.

Condition Assessment Indicators

Condition	Symbol	Criteria
Acceptable		Test results are acceptable, and results do not suggest the presence of an active failure mode
Cautions		Results are outside the recommended guidelines but do not provide a firm indication of an active failure mode. If results are still within the recommended guidelines, but a variation has been observed when comparing with sister units or nameplate values, then these are noted under this category for future assessments.
Urgent		Test results suggest the presence of an active failure mode.

GENERATOR TEST RESULT

1-UNIT 16 ST GENERATOR

Generator Details	
Serial No.	UNIT 16 ST GENERATOR
Manufacturer	HERBIN ELECTRIC MACHINERY CO LTD
Type	QFSN-280-2
Power	280 MW
Rated voltage	20 kV
Rated Current	9.5093 kA
RPM	3000
Rated Field Voltage	317.3 V
Rated Field Current	2456 A
Rated frequency	50.00 Hz
Core length	5200 mm
Number of slots	54
Core factor	0.92
Number of phases	3
Manufacturing Year	2012

Winding Resistance Generator Stator

Phase U			Phase V			Phase W		
R_{meas}	R_{dev}	R_{corr}	R_{meas}	R_{dev}	R_{corr}	R_{meas}	R_{dev}	R_{corr}
2.122 mΩ	0.119 %	2.580 mΩ	2.122 mΩ	0.181 %	2.687 mΩ	2.038 mΩ	0.092 %	2.478 mΩ

Comments: The measured resistance values of all three phases are within 2% According to IEEE Standard.

Insulation Resistance Stator Winding

IR	U-PHASE (kΩ)	V-PHASE (kΩ)	W-PHASE (kΩ)
Applied Voltage 5 kV	Voltage Sustain 1863 V	Voltage Sustain 2508 V	Voltage Sustain 3227 V
IR Measured	621 k Ω	842 k Ω	1092 k Ω

DC Hi Pot Stator Winding

DC HI POT	U-PHASE	V-PHASE	W-PHASE
Applied Voltage 10 kV	Voltage Sustain < 2kV	Voltage Sustain < 2kV	Voltage Sustain < 2kV
Leakage Current µA	< 80 µA	< 80 µA	< 80 µA

AC Hi Pot Stator Winding

Applied Voltage	Frequency	U-PHASE Leakage Current mA	V-PHASE Leakage Current mA	W-PHASE Leakage Current mA
1 kV	50Hz	57.94 mA	57.92 mA	58.20 mA
2 kV	50Hz	116.00 mA	116.10 mA	117.00 mA
3 kV	50Hz	173.79 mA	173.21 mA	174.34 mA
3.5 kV	50Hz	Insulation Breakdown	201.89 mA	Insulation Breakdown
4 kV	50Hz	Insulation Breakdown	Insulation Breakdown	Insulation Breakdown

Insulation Resistance Generator Rotor

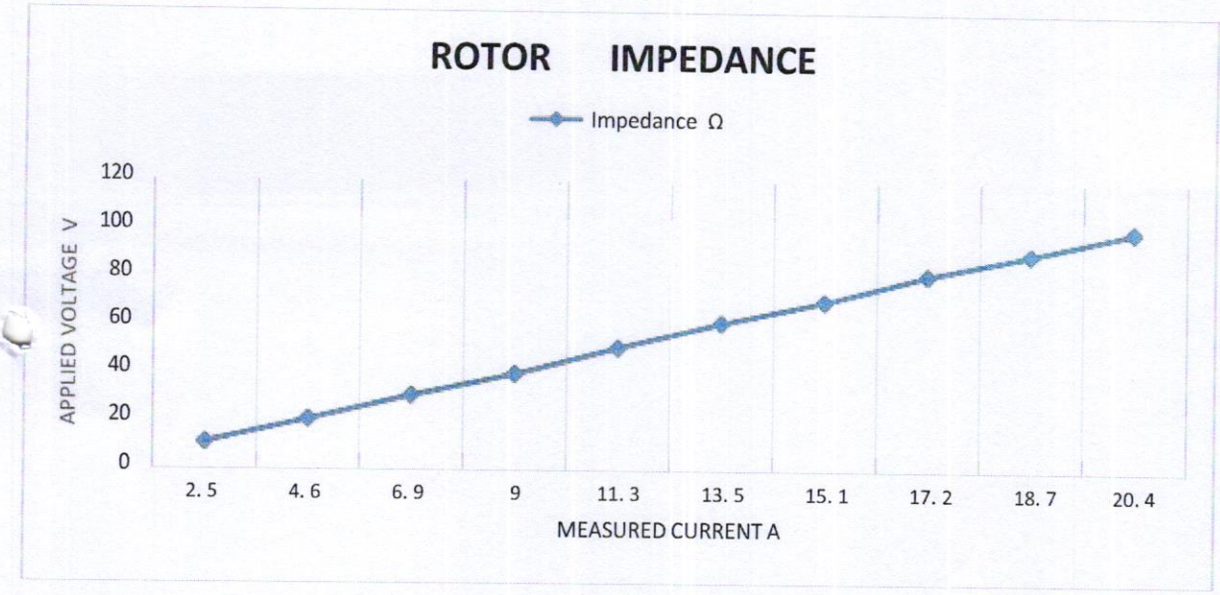
Rotor IR	
R_{meas} MΩ	DAR
353 MΩ ⚠	1.28

Winding Resistance Generator Rotor

Rotor WR		
R_{meas}	R_{dev}	R_{corr}
103.251 mΩ	0.086 %	120.803 mΩ

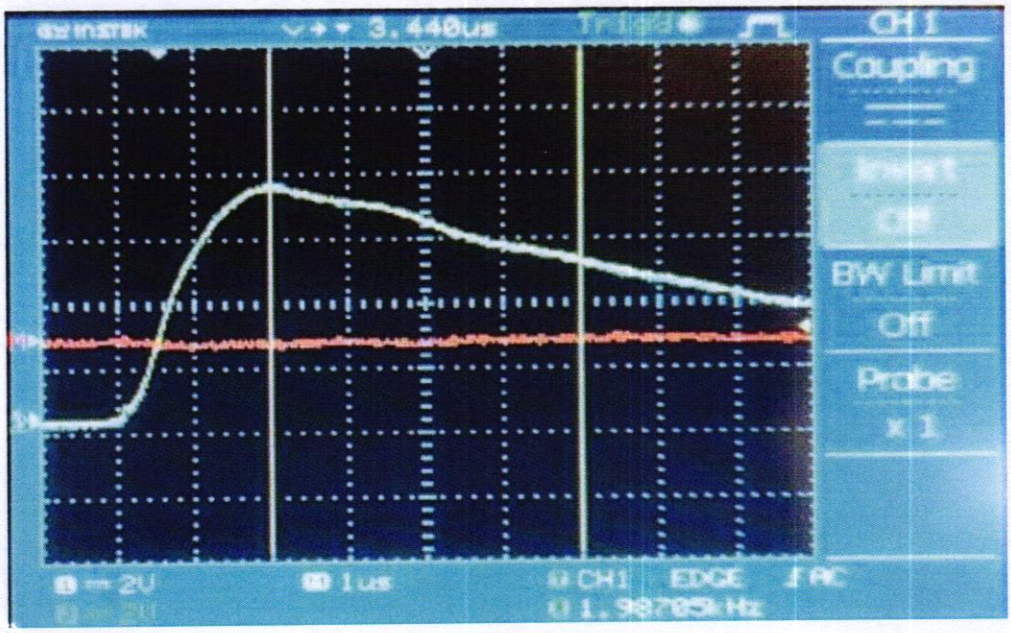
Generator Rotor Impedance

Voltage Applied V	Measured Current A	Impedance Ω	Δ Impedance Ω
10.52	2.5	4.208	Δ (4.208-4.90) = 0.692 Ω ⚠
20.28	4.6	4.4	
30.42	6.9	4.4	
39.40	9	4.37	
50.5	11.3	4.46	
61.0	13.5	4.51	
70.1	15.1	4.64	
81.3	17.2	4.72	
90.2	18.7	4.82	
100.0	20.4	4.90	



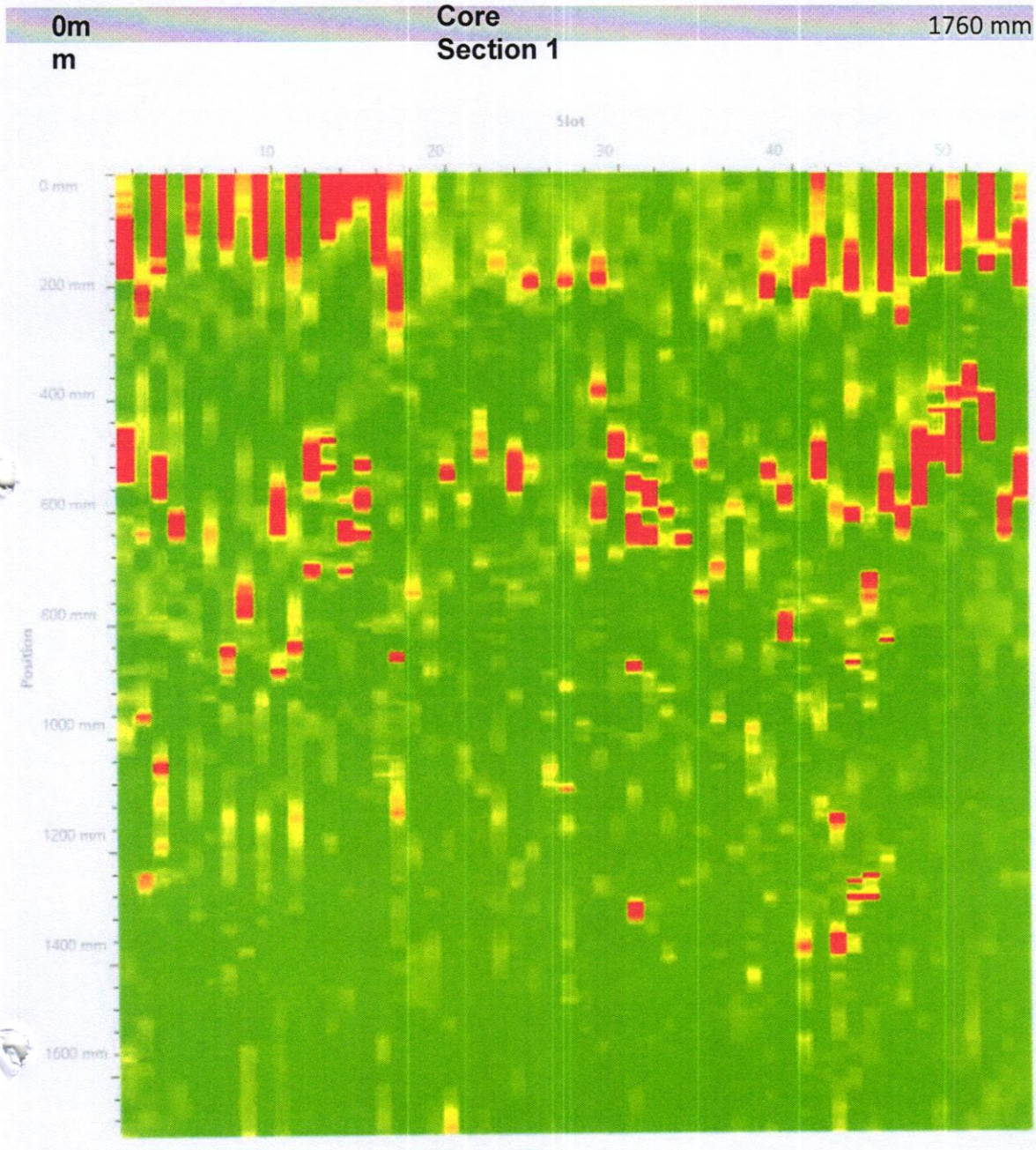
Repetitive Surge Oscilloscope graph (RSO)

Trace 1

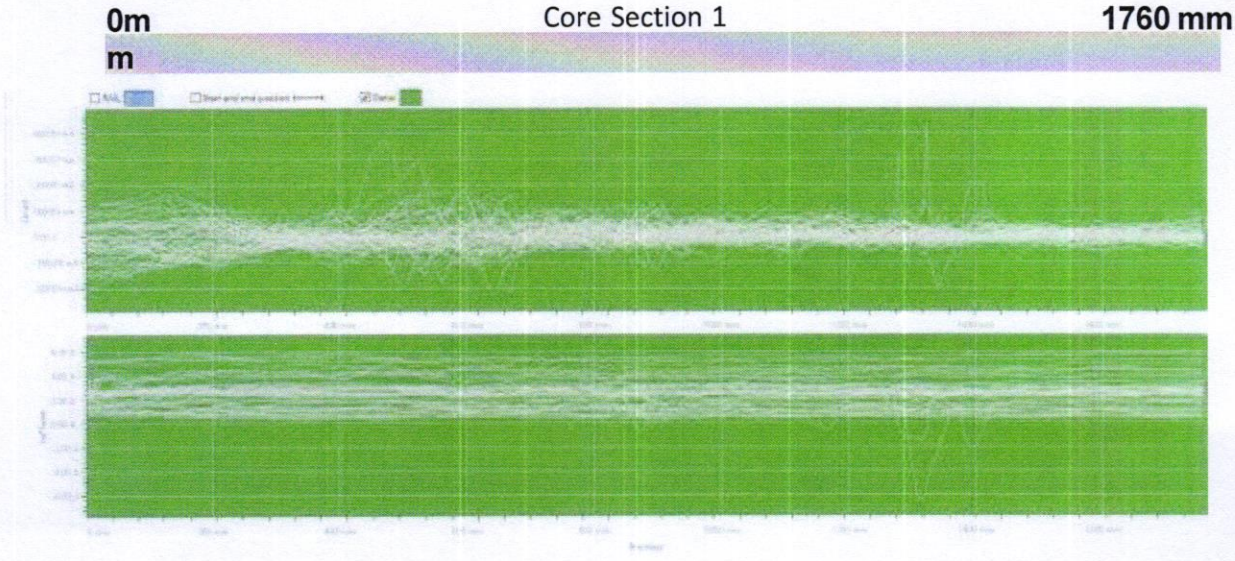


EL-CID ELECTROMAGNETIC CORE IMPERFECTION DETECTOR MEASUREMENTS

GENERATOR STATOR CORE HEAT MAP CORE SECTION 1

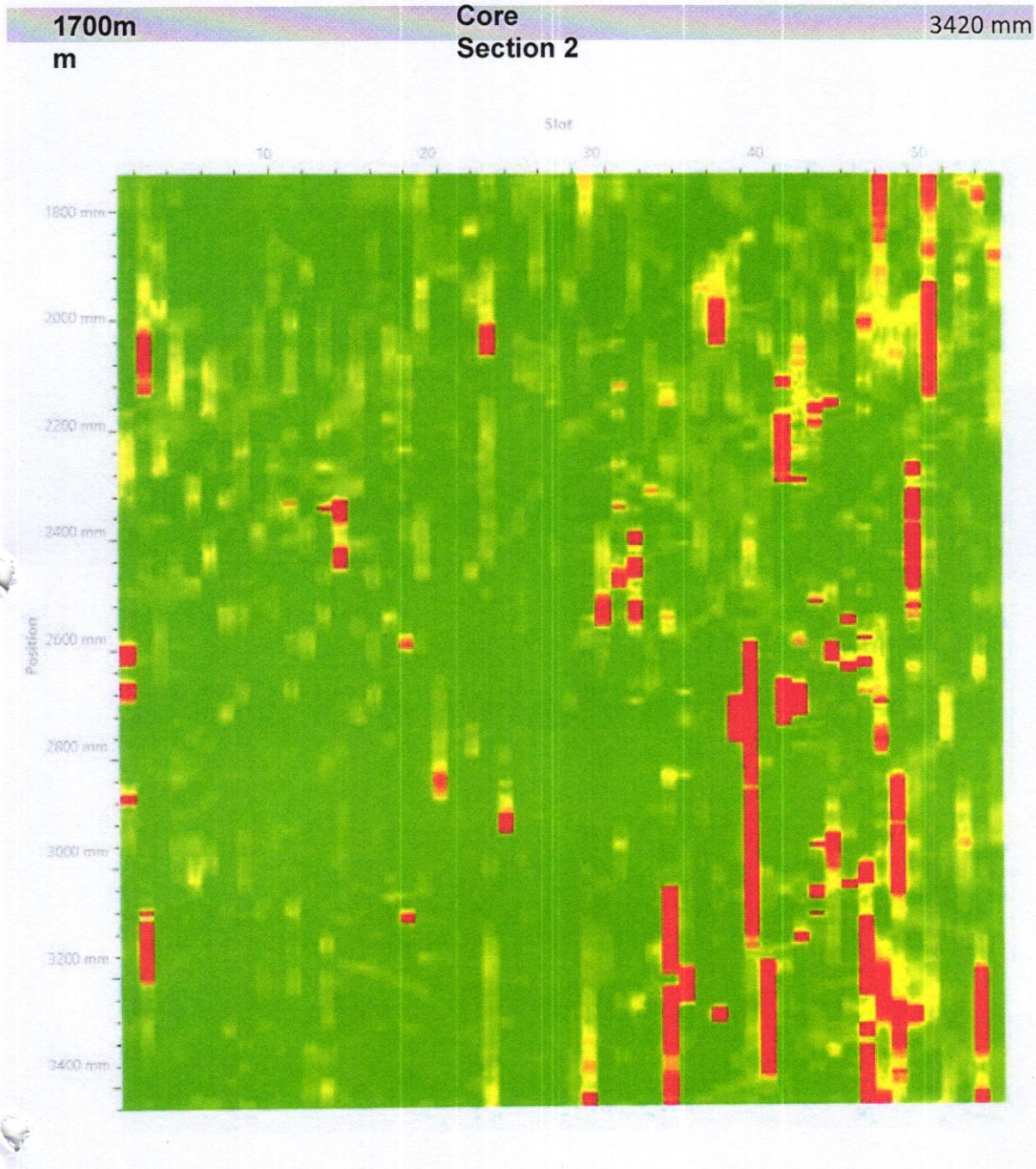


MEASURED CURRENT TRACES COMBINE CHART CORE SECTION 1

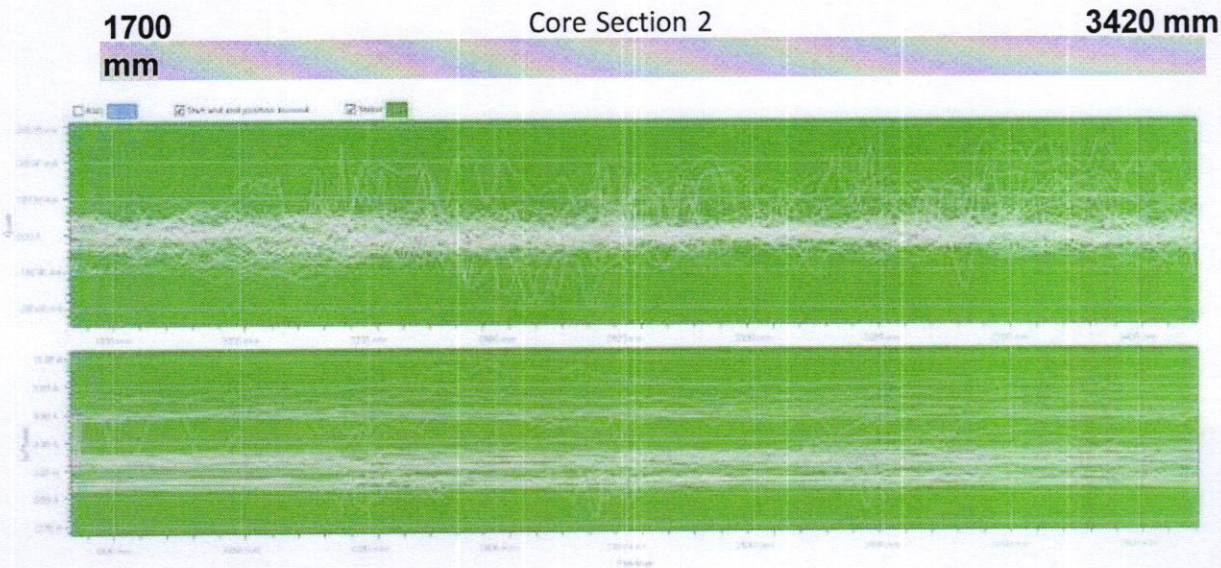


Heat map of the stray flux measurement including thermographic pictures of the comparison measurement with full flux. There are locations with higher temperature identified in the stray flux measurement, where spots had an amplitude of higher than 100 mA.

GENERATOR STATOR CORE HEAT MAP CORE SECTION 2

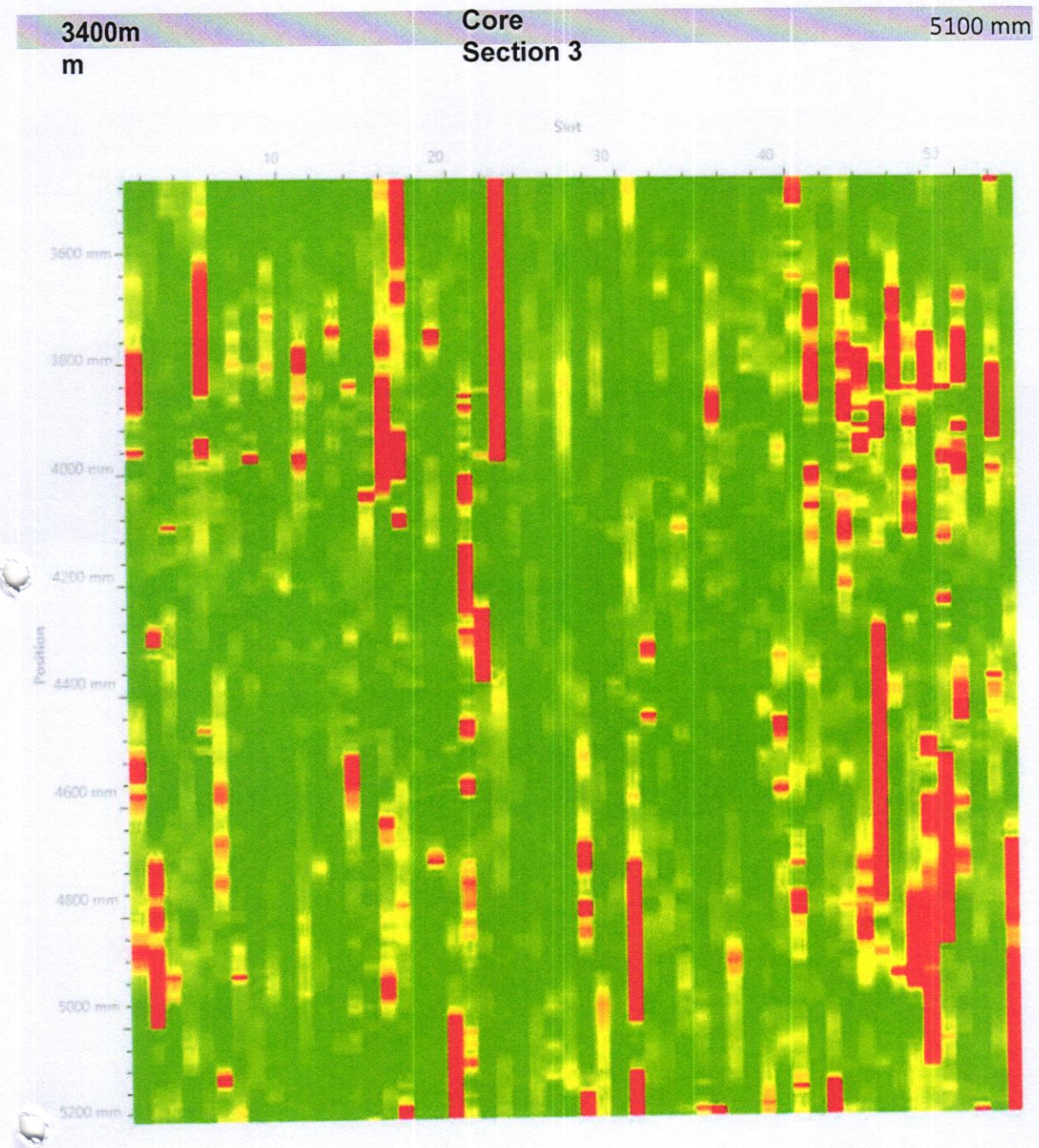


MEASURED CURRENT TRACES COMBINE CHART CORE SECTION 2

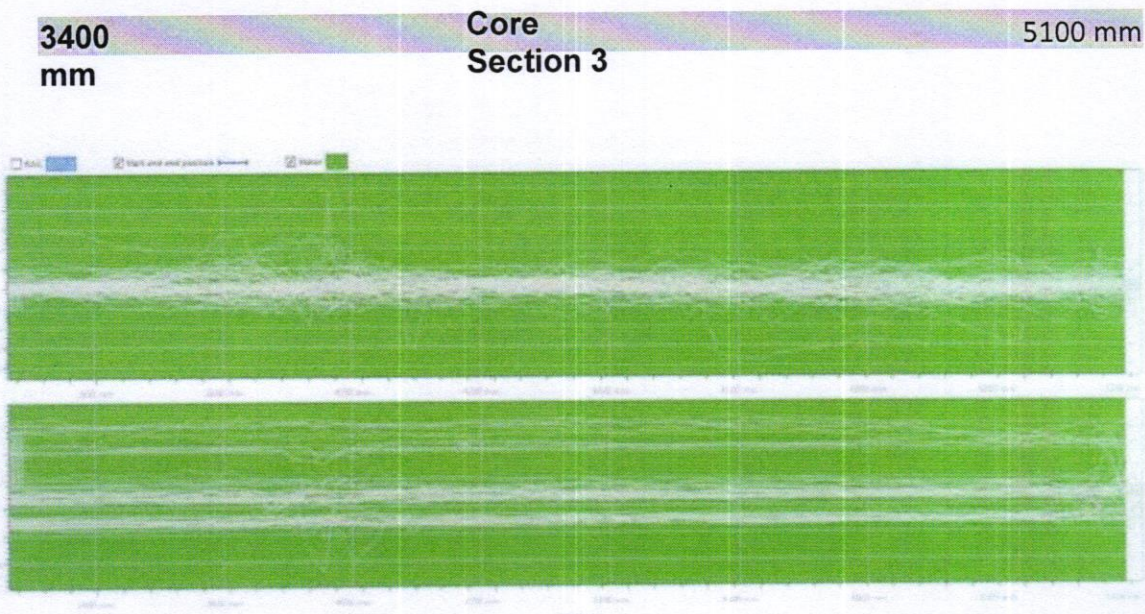


Heat map of the stray flux measurement including thermographic pictures of the comparison measurement with full flux. There are locations with higher temperature identified in the stray flux measurement, where spots had an amplitude of higher than 100 mA.

GENERATOR STATOR CORE HEAT MAP CORE SECTION 3

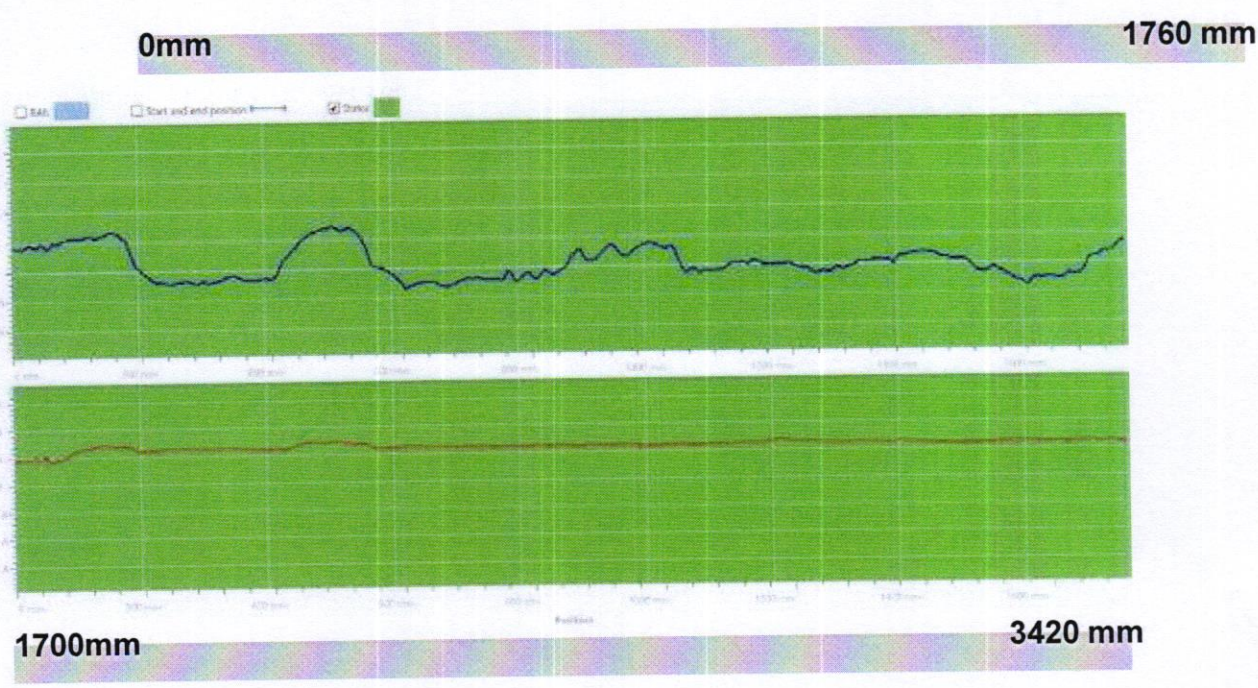


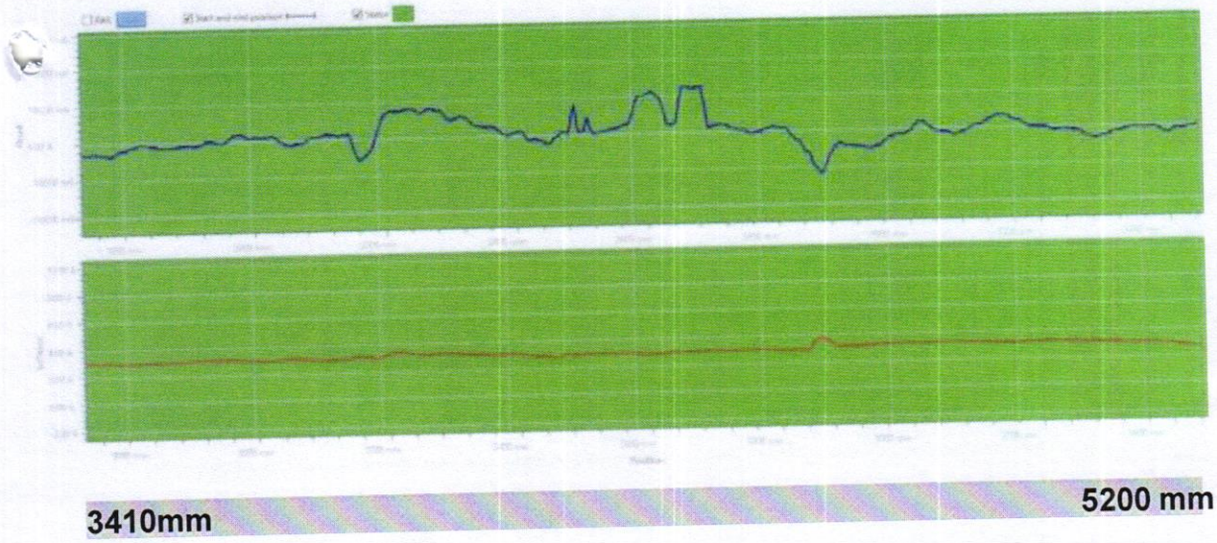
MEASURED CURRENT TRACES COMBINE CHART CORE SECTION 3

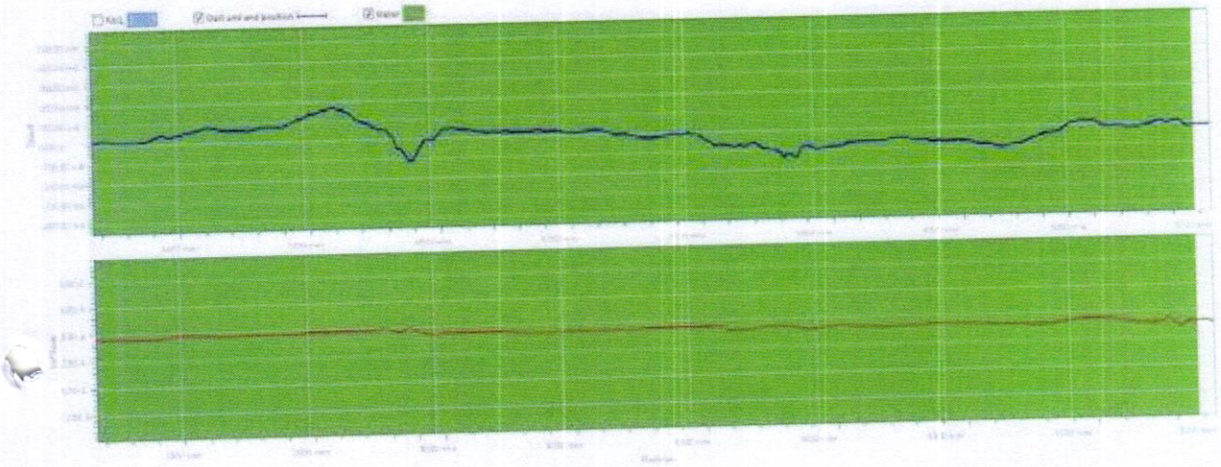


Heat map of the stray flux measurement including thermographic pictures of the comparison measurement with full flux. There are locations with higher temperature identified in the stray flux measurement, where spots had an amplitude of higher than 100 mA.

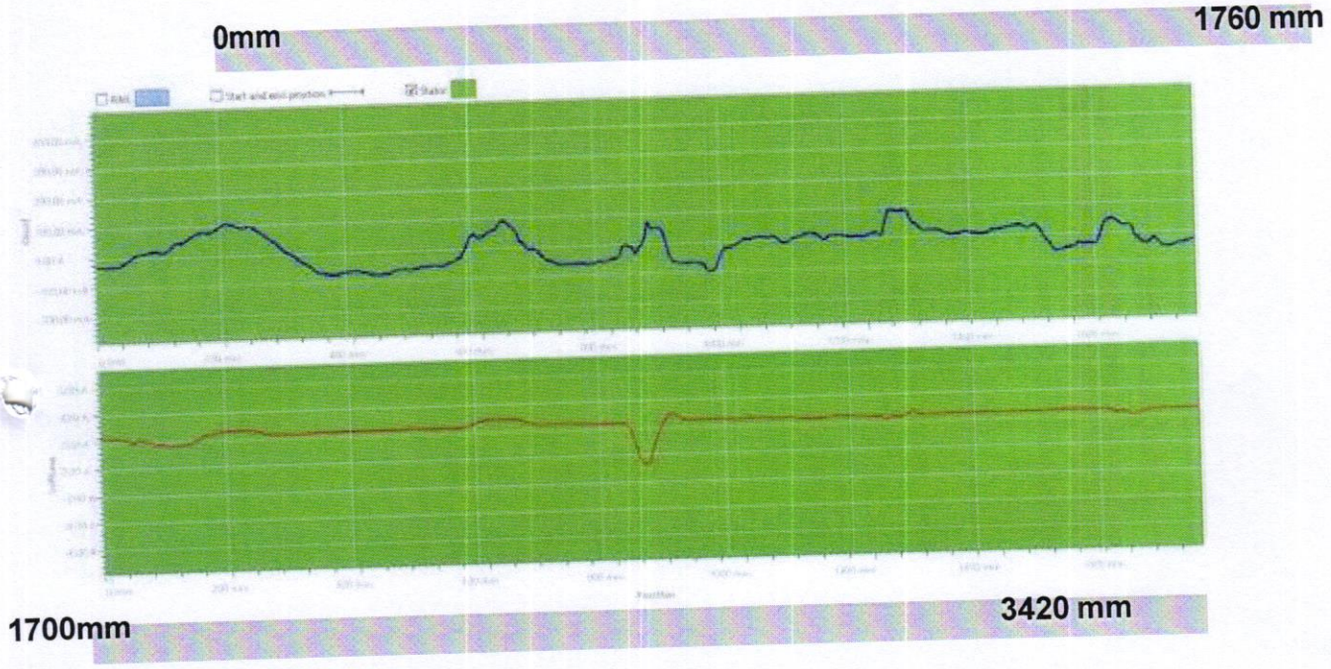
Slot 01

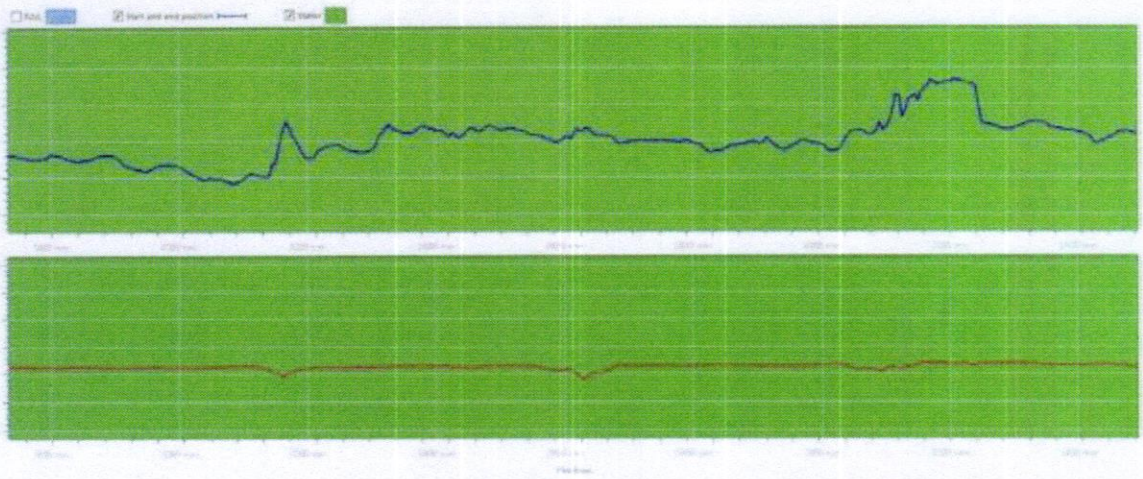




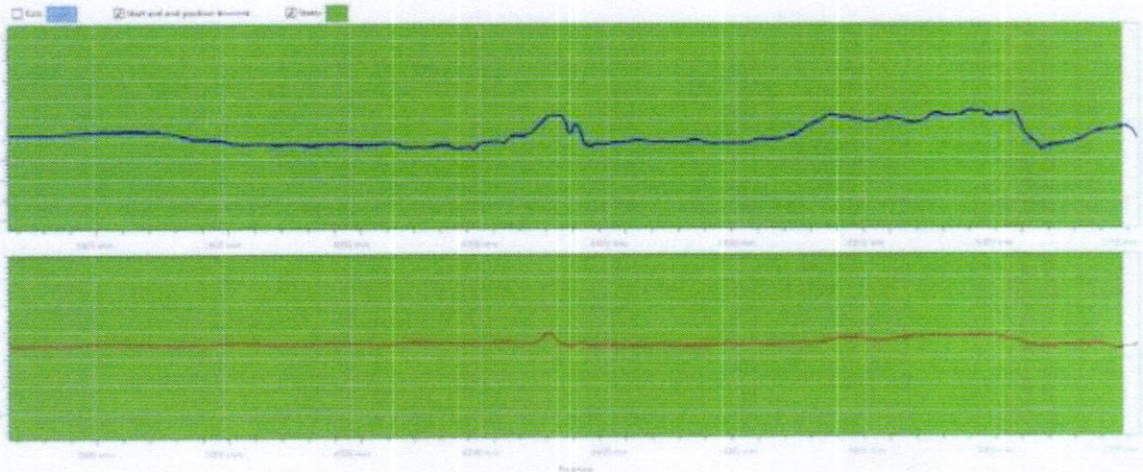


Slot 02



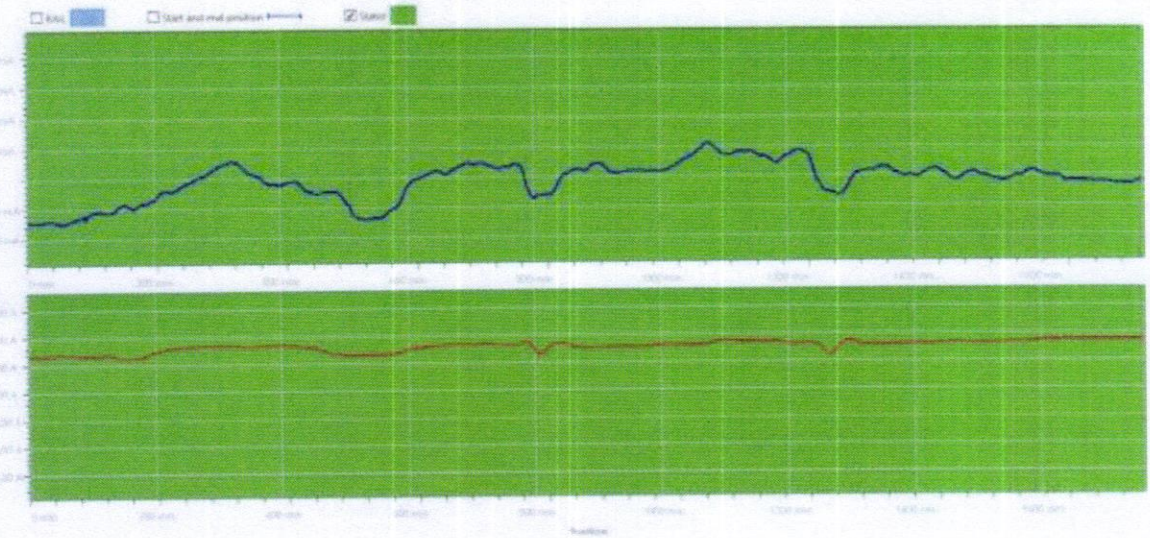


3410mm 5100 mm

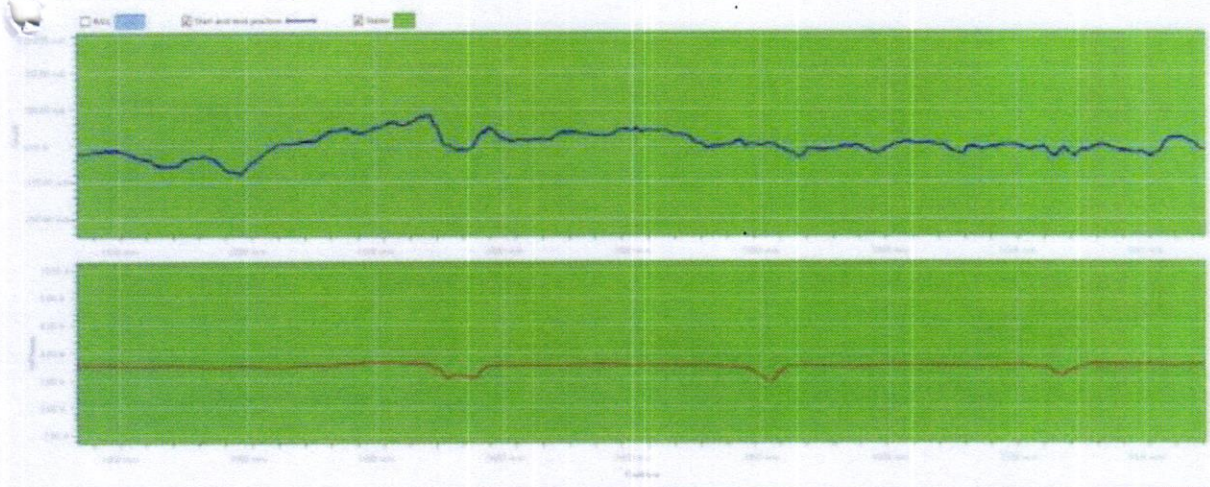


Slot 03

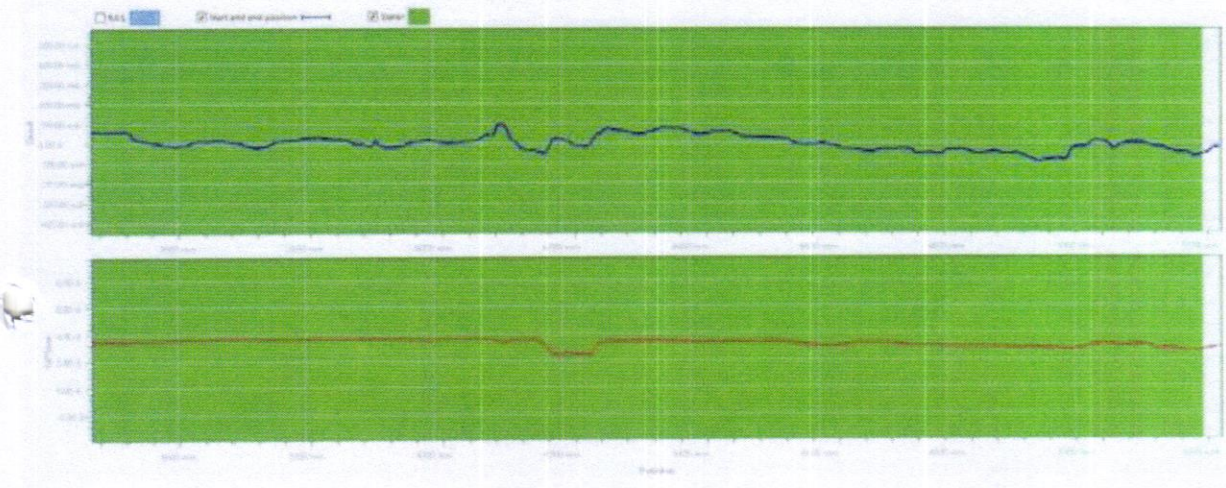
0mm 1760 mm



1700mm 3420 mm

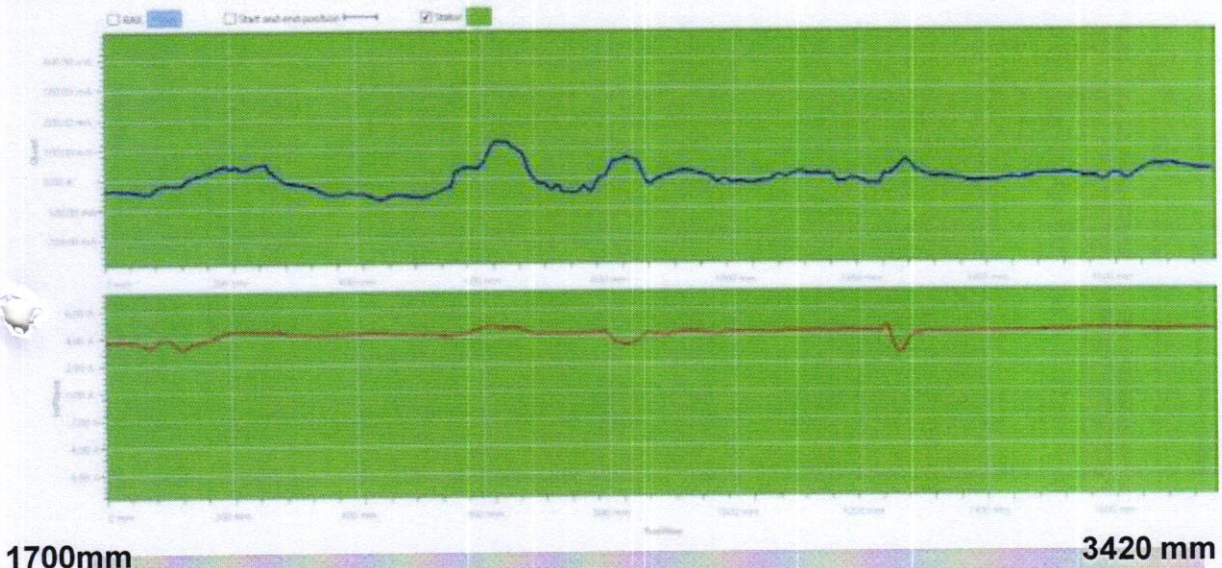


3410mm 5200 mm

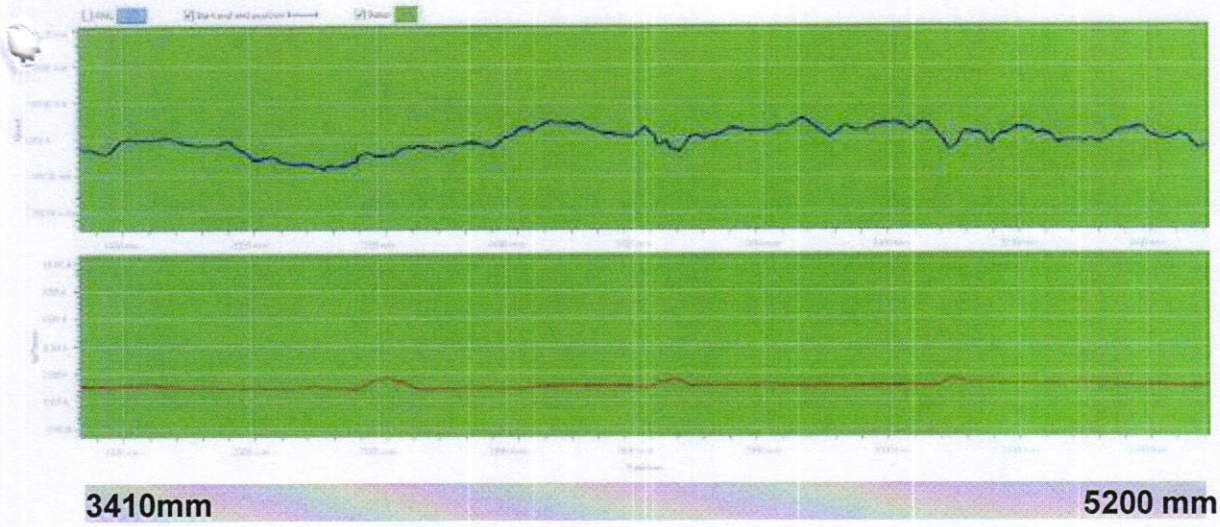


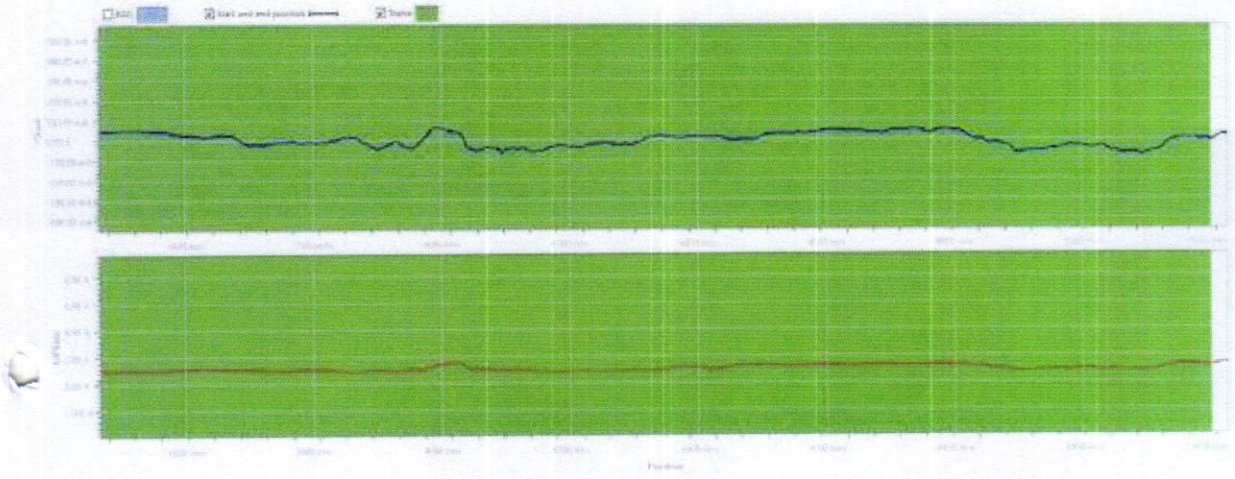
Slot 04

0mm 1760 mm



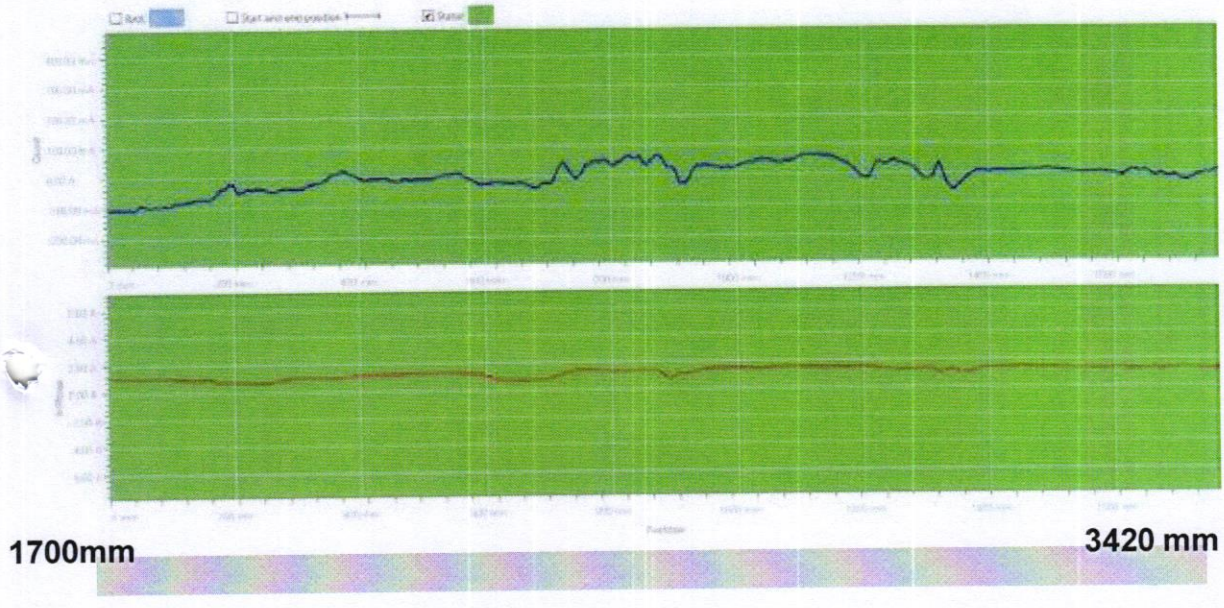
1700mm 3420 mm

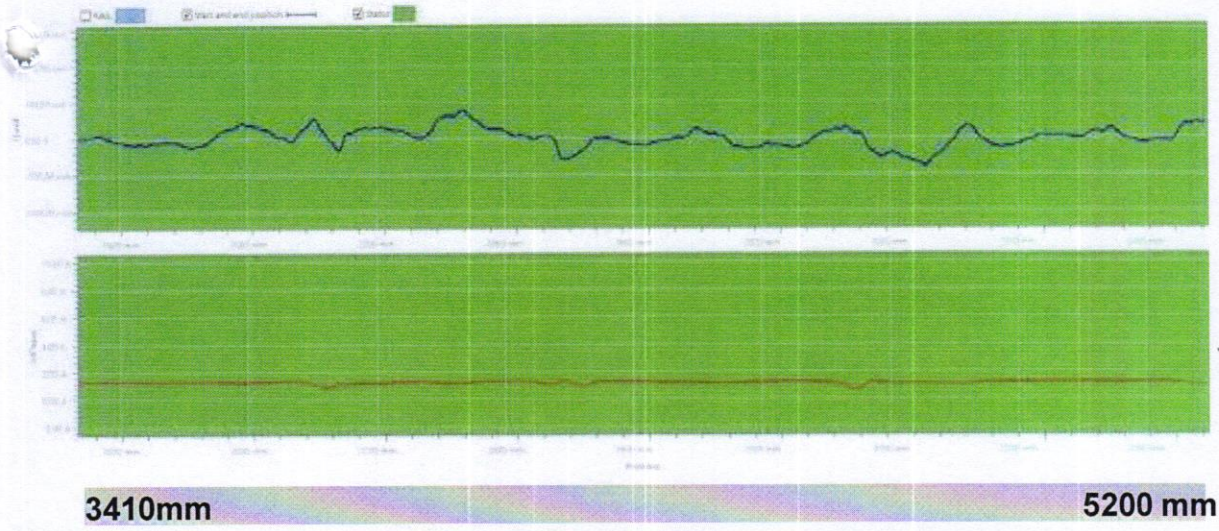


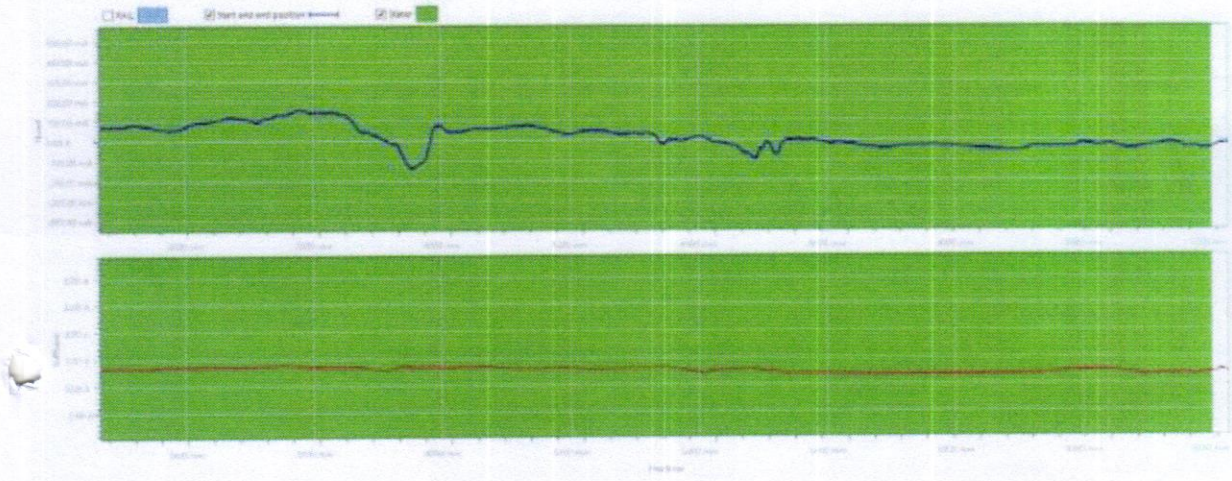


Slot 05

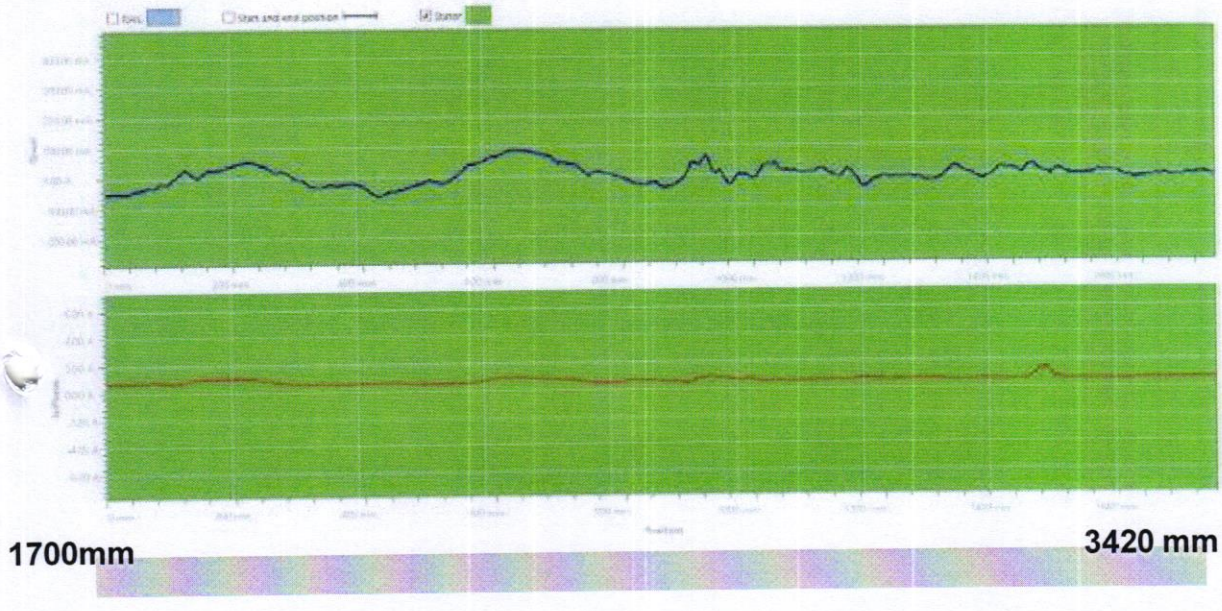


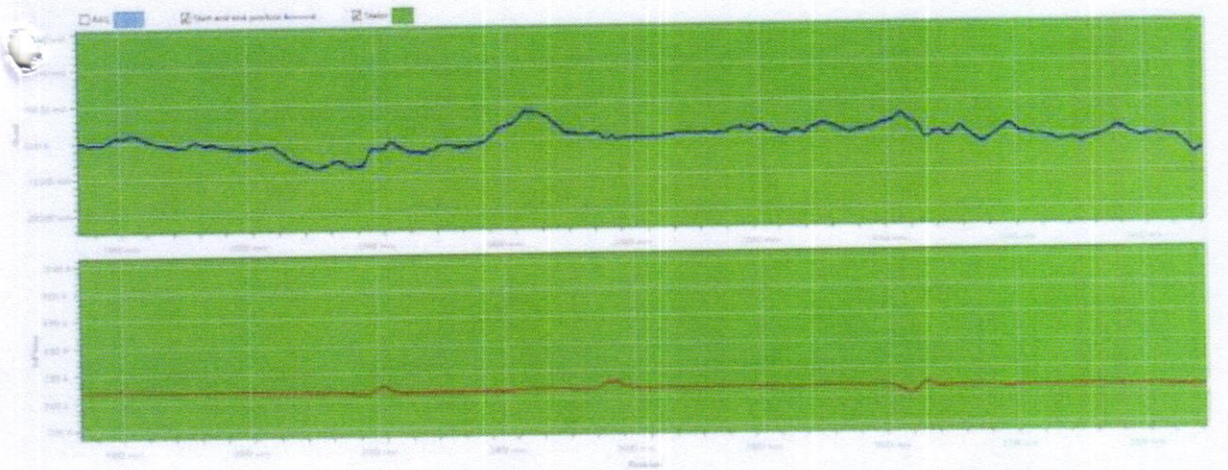




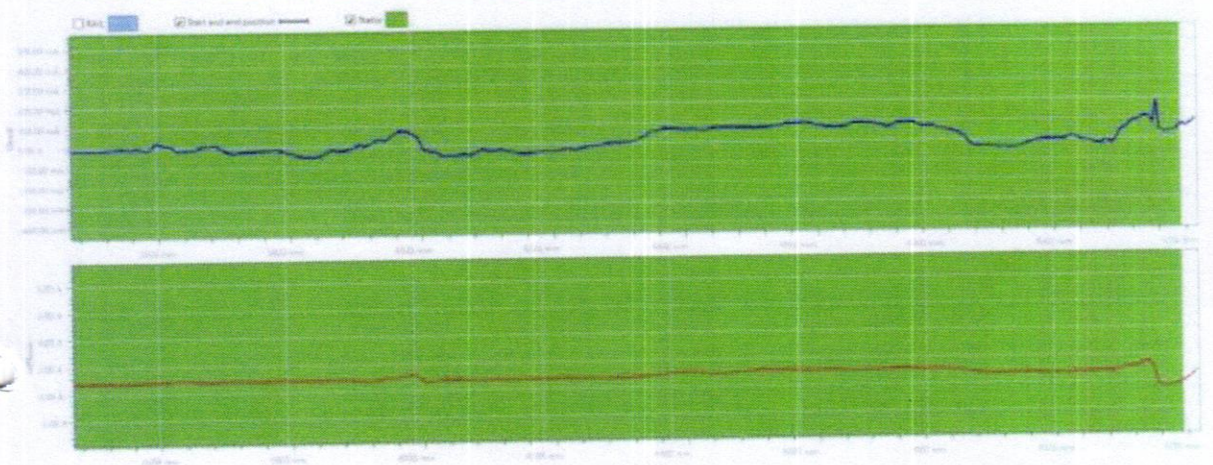


Slot 06



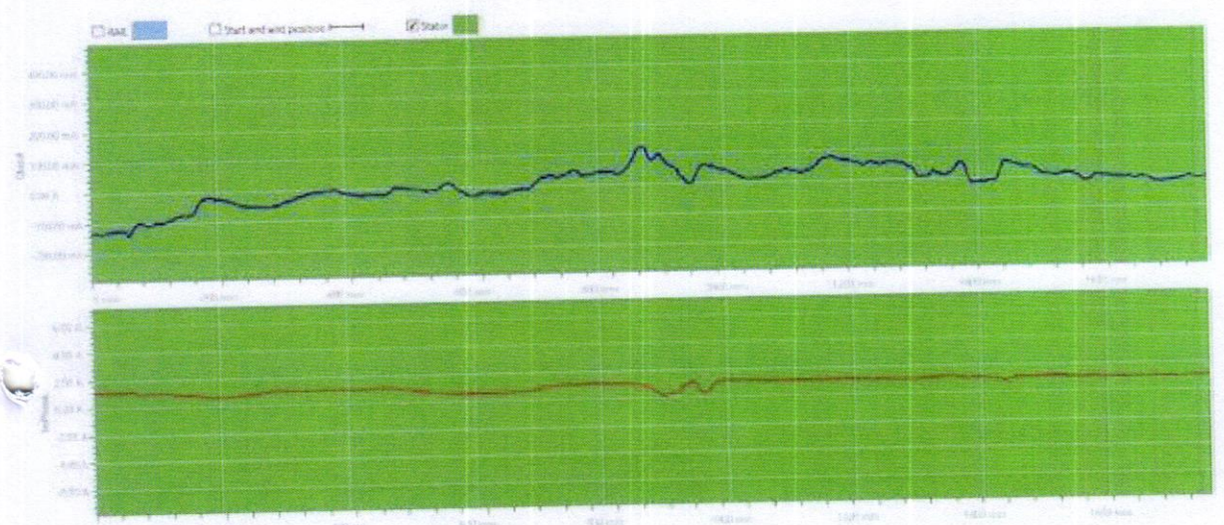


3410mm 5200 mm

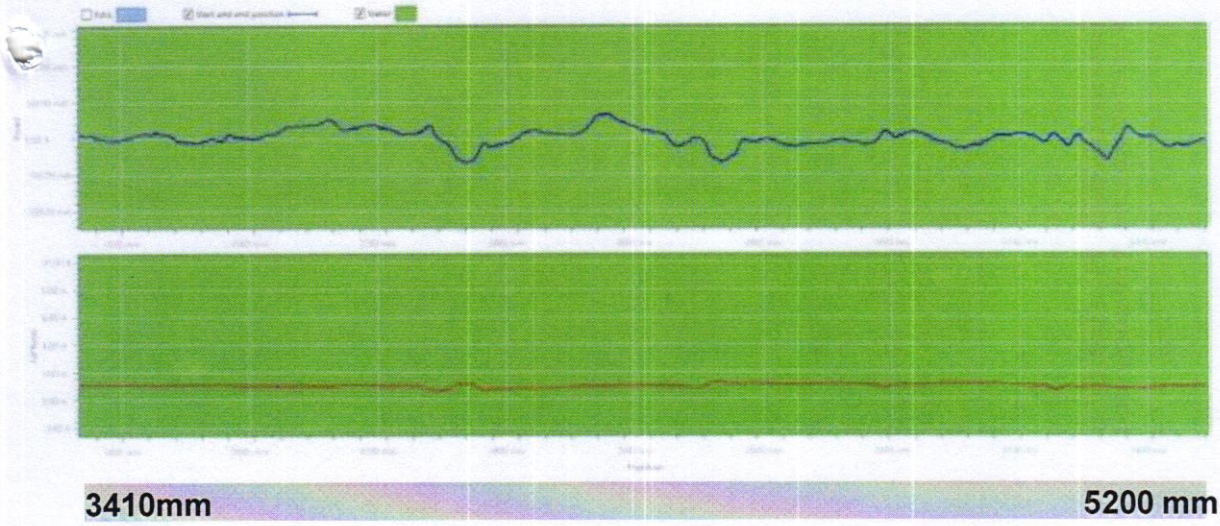


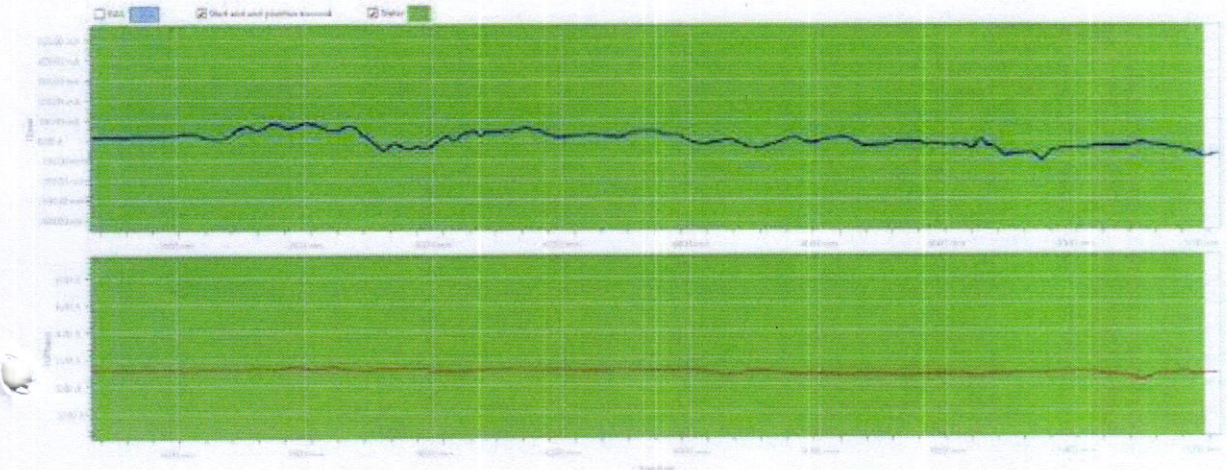
Slot 07

0mm 1760 mm

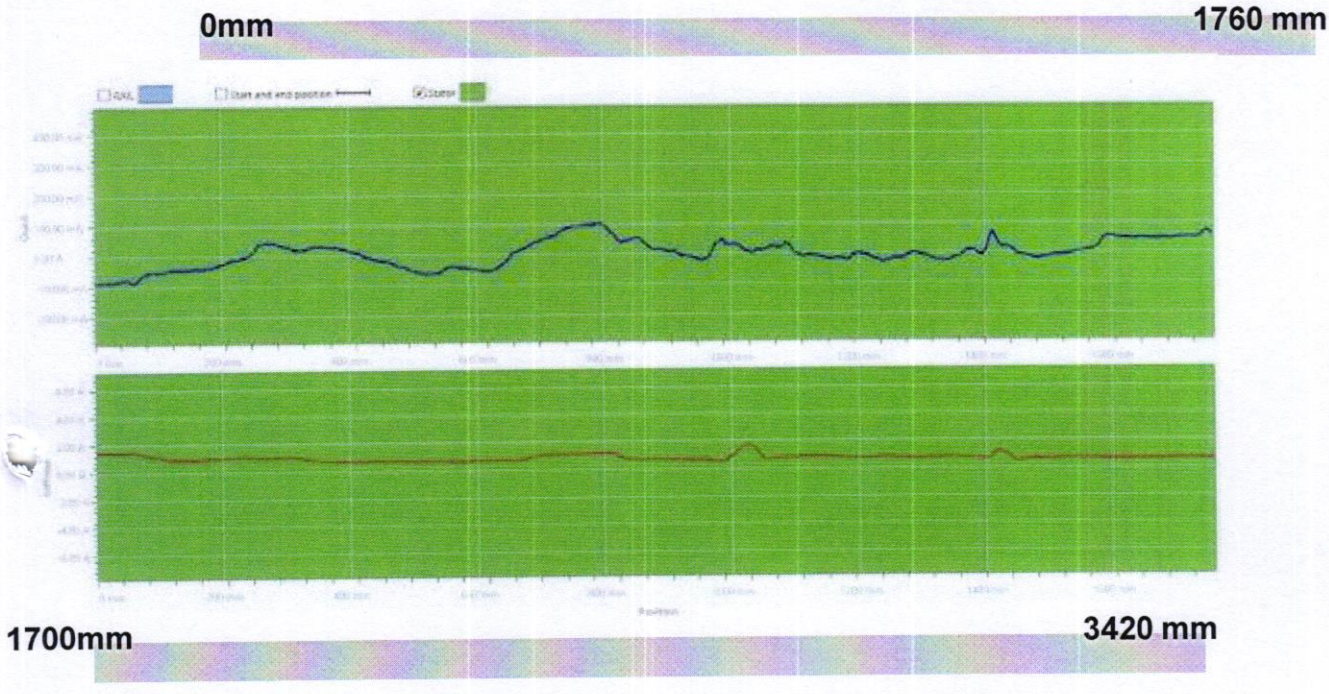


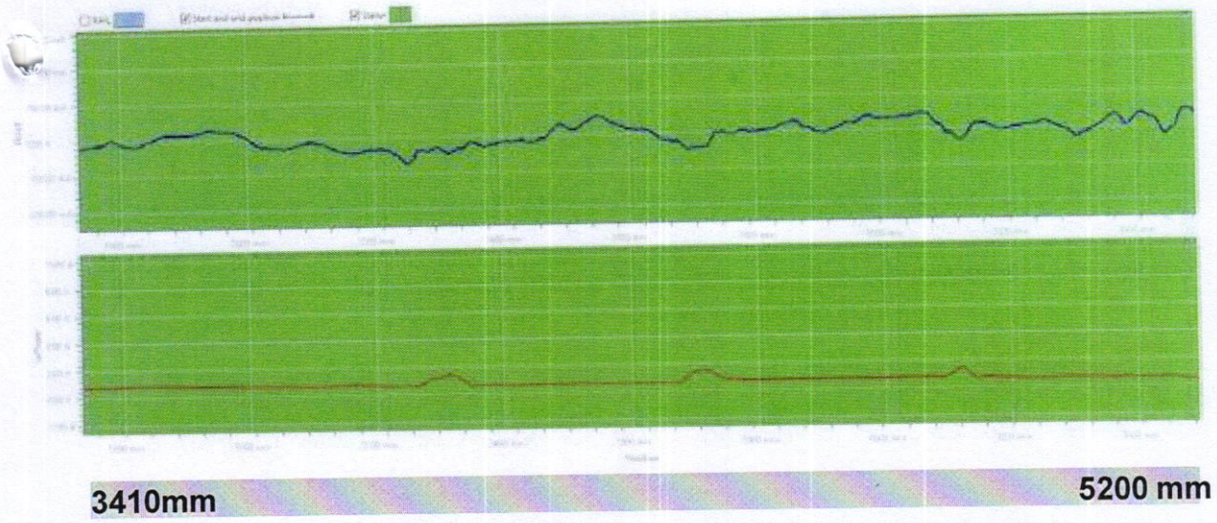
1700mm 3420 mm



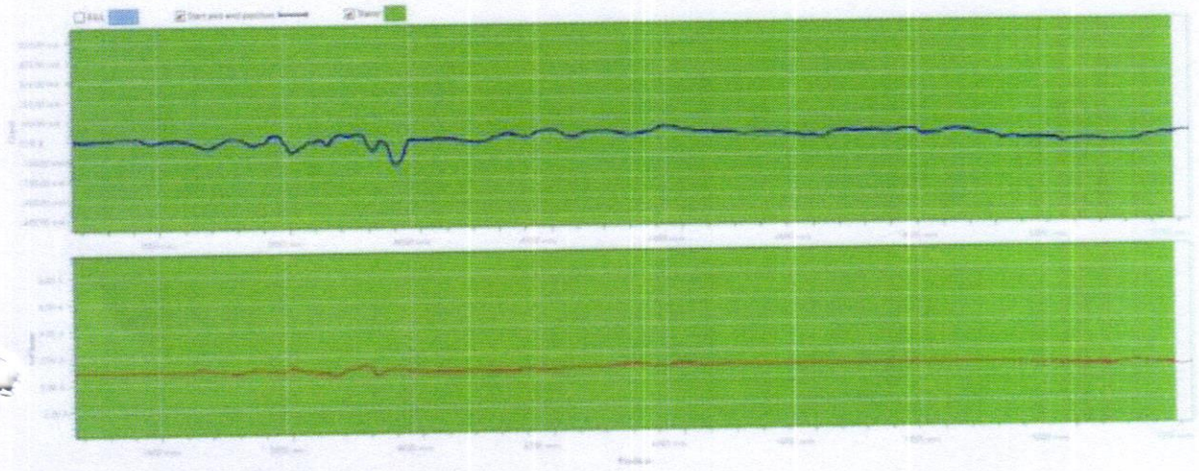


Slot 08



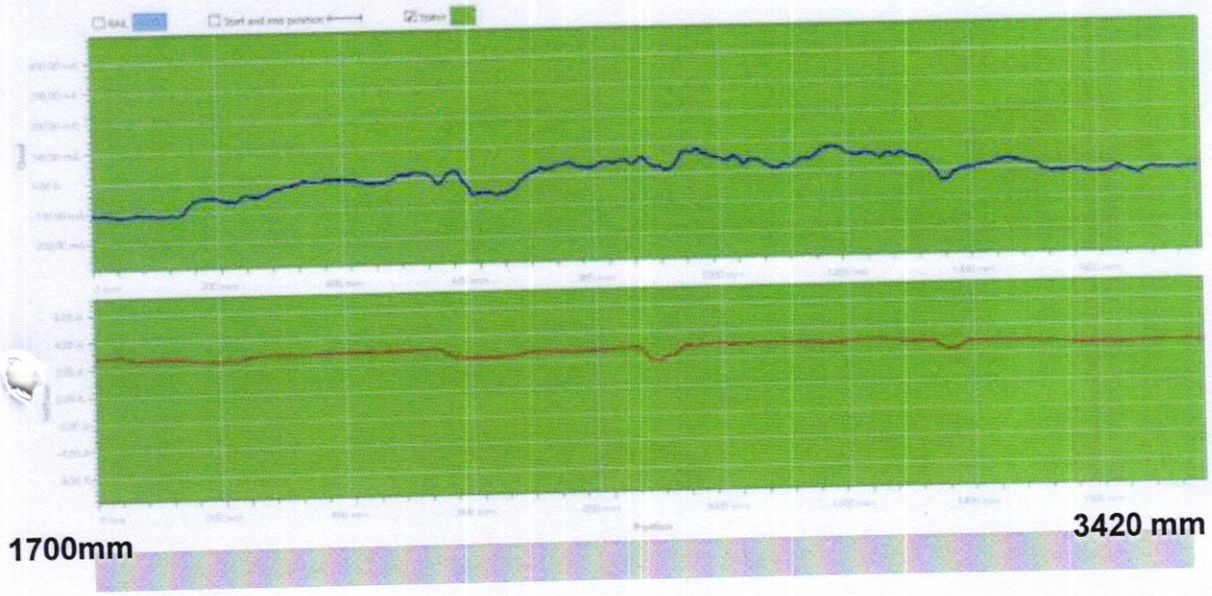


3410mm 5200 mm

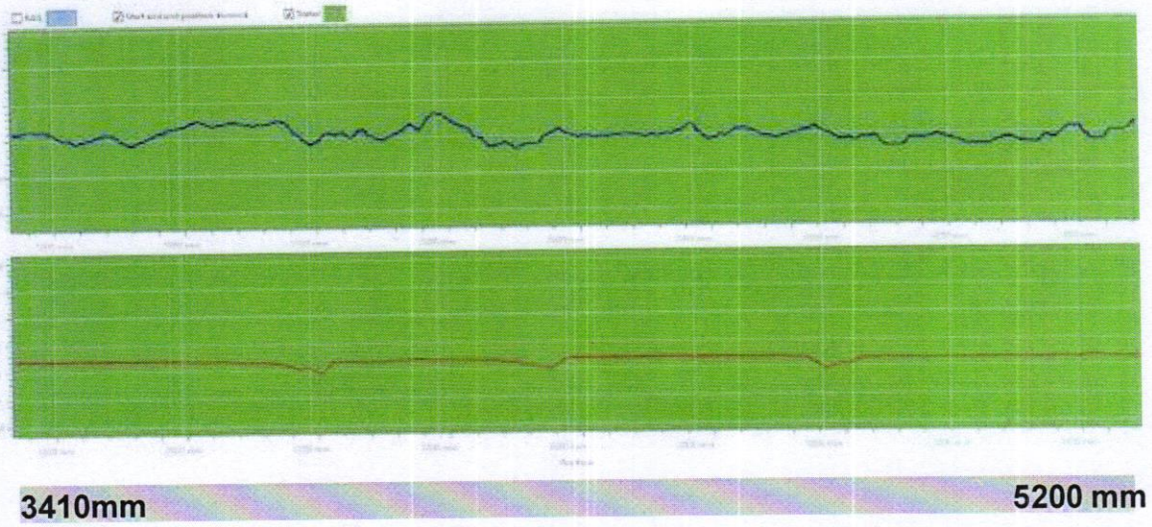


Slot 09

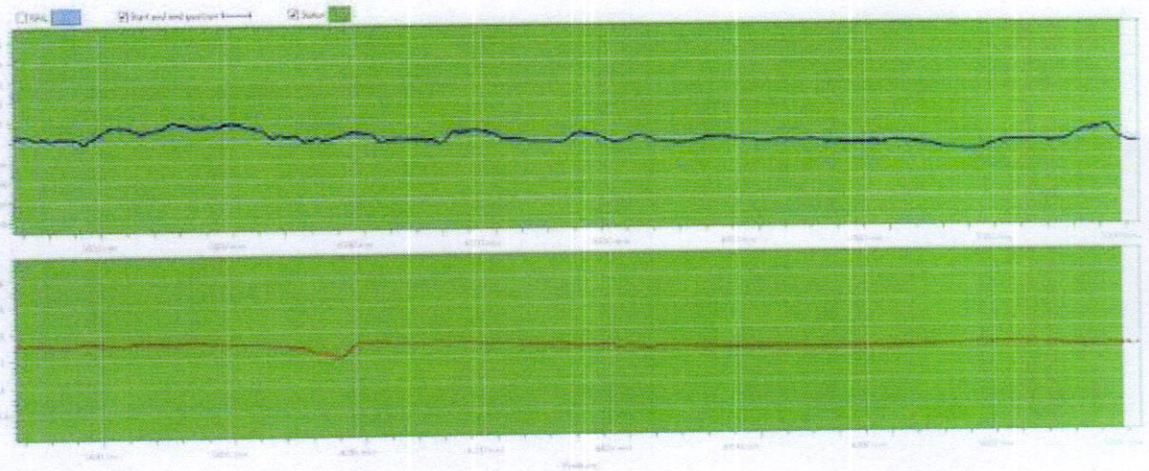
0mm 1760 mm



1700mm 3420 mm

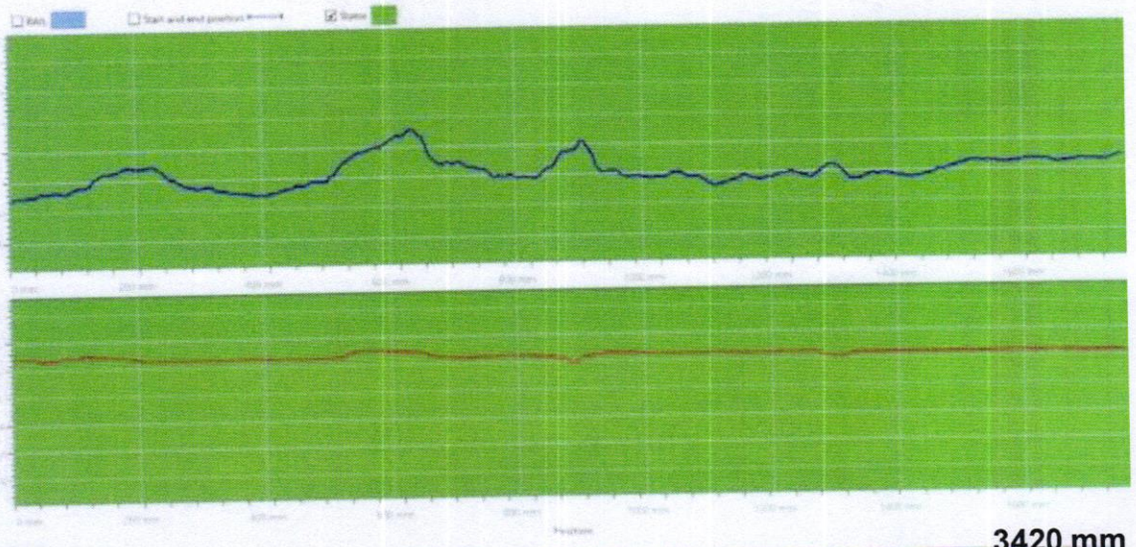


3410mm 5200 mm

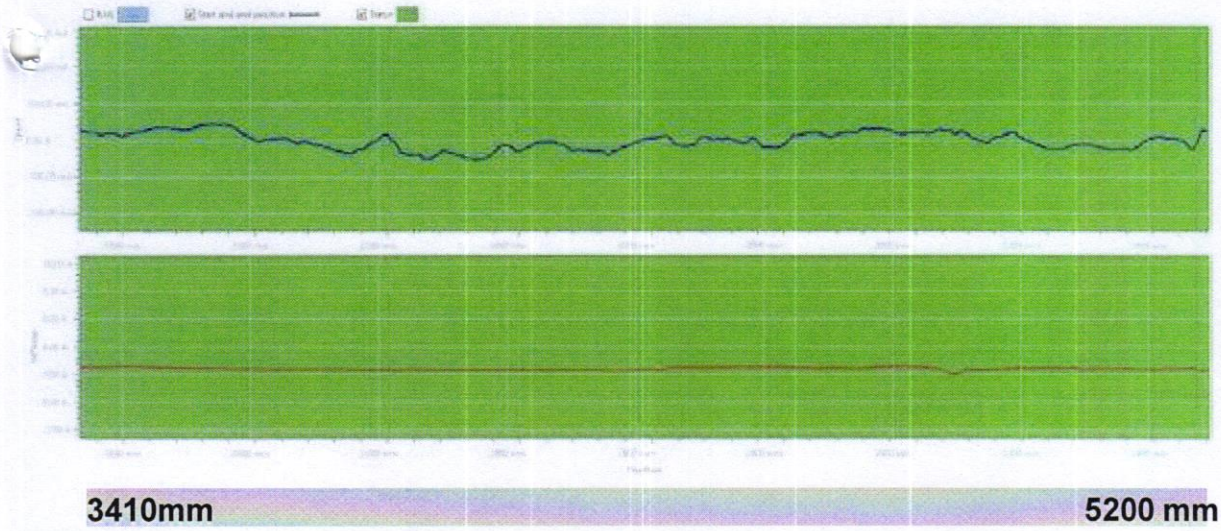


Slot 10

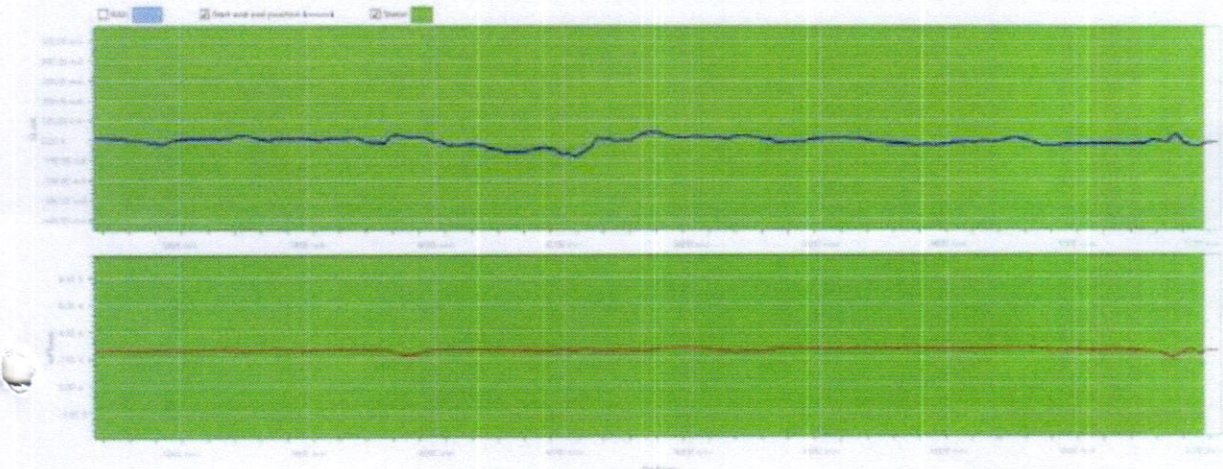
0mm 1760 mm



1700mm 3420 mm

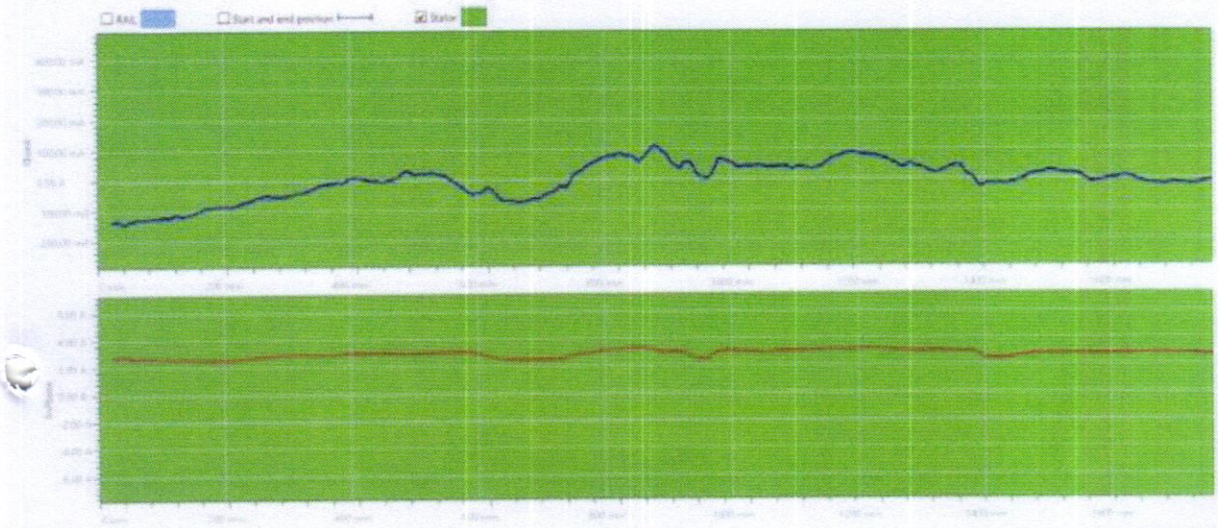


3410mm 5200 mm

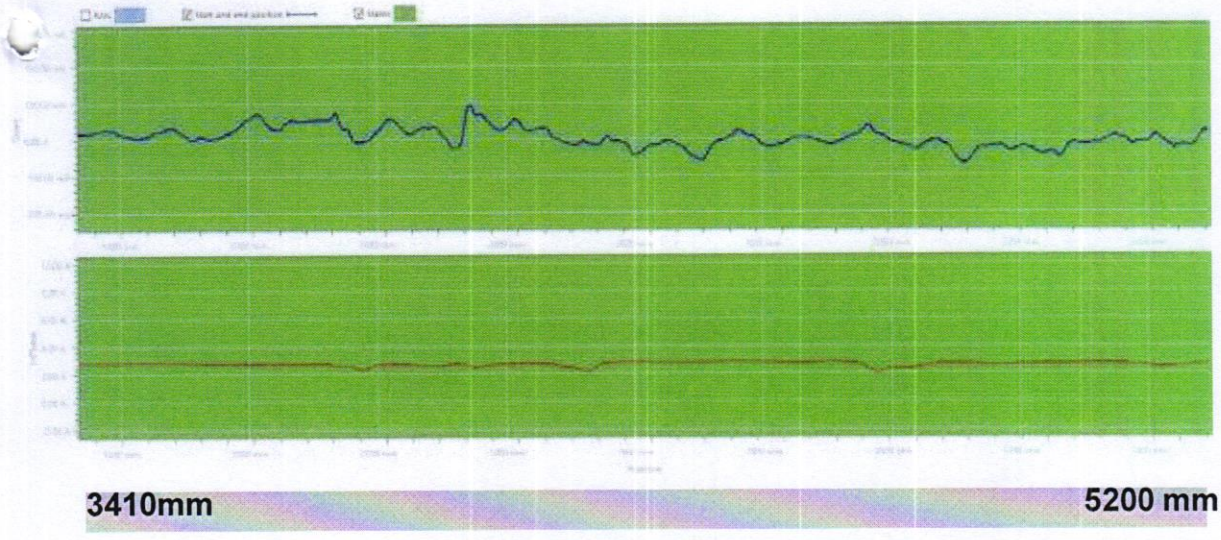


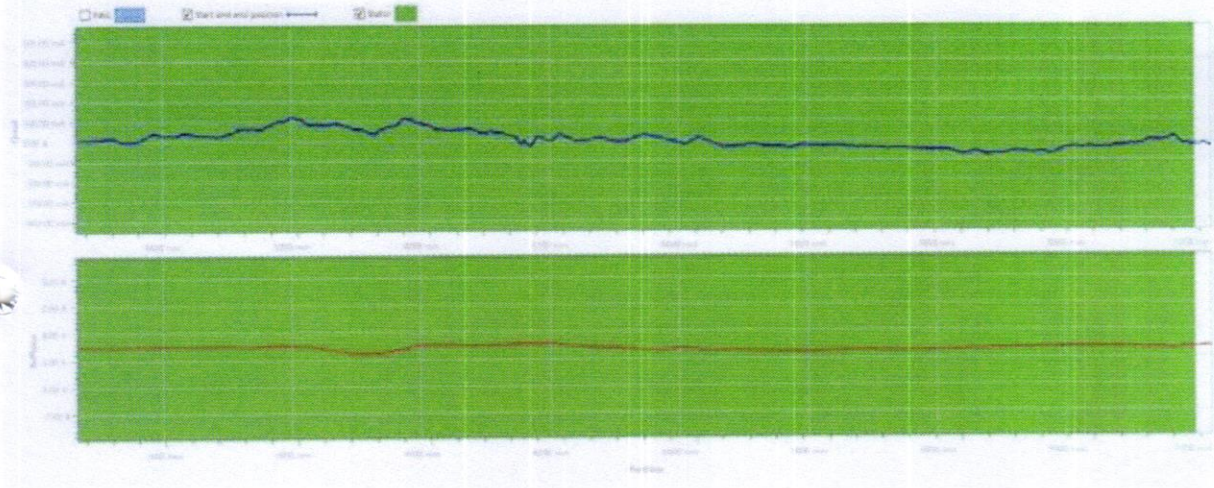
Slot 11

0mm 1760 mm



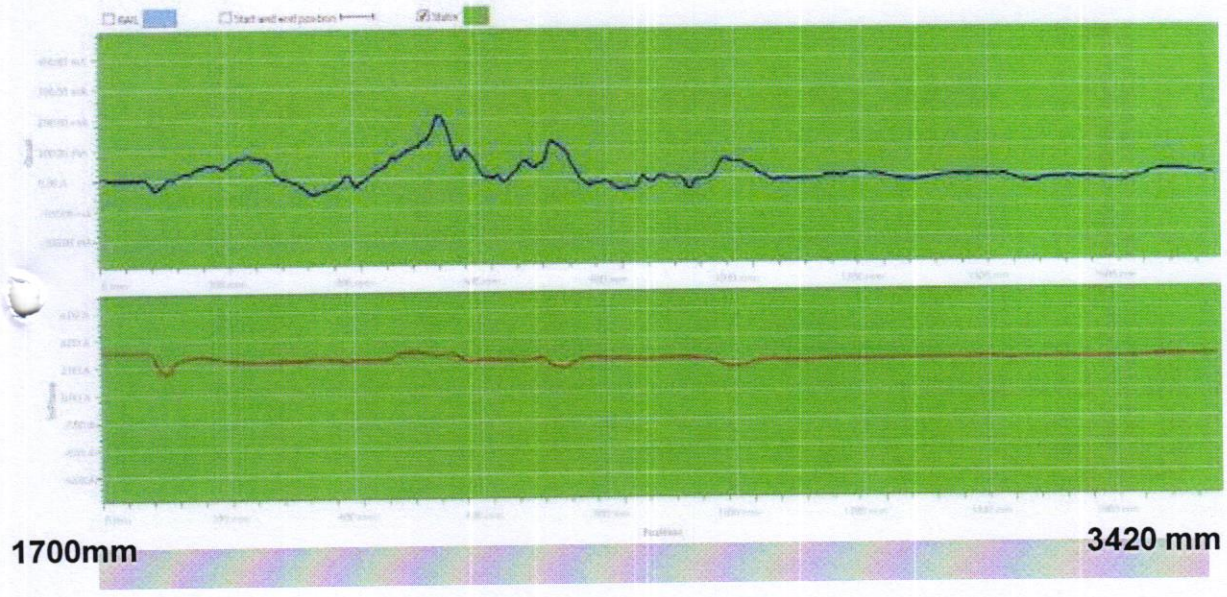
1700mm 3420 mm

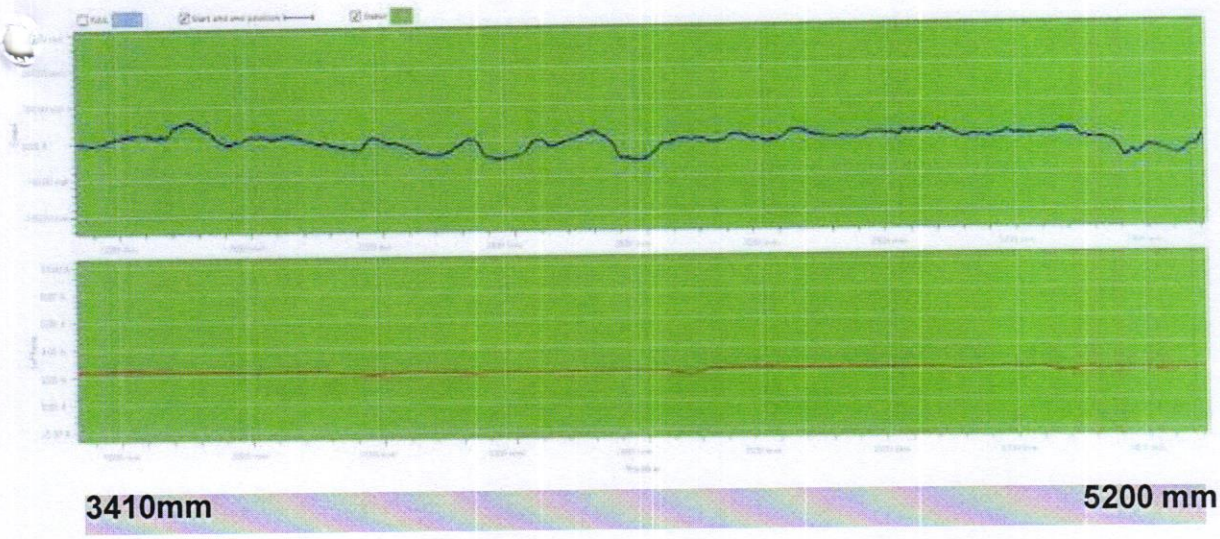


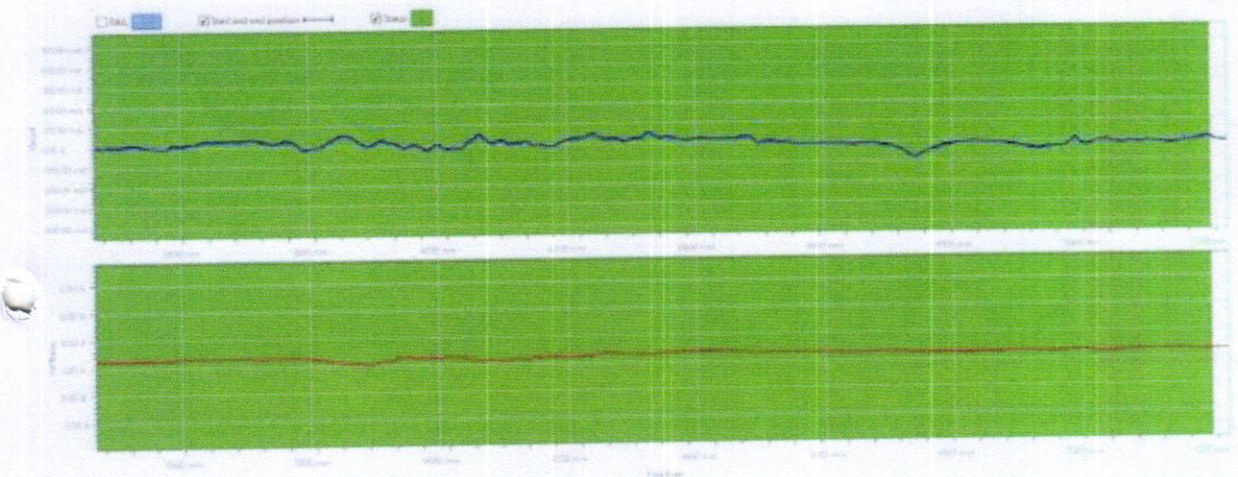


Slot 12

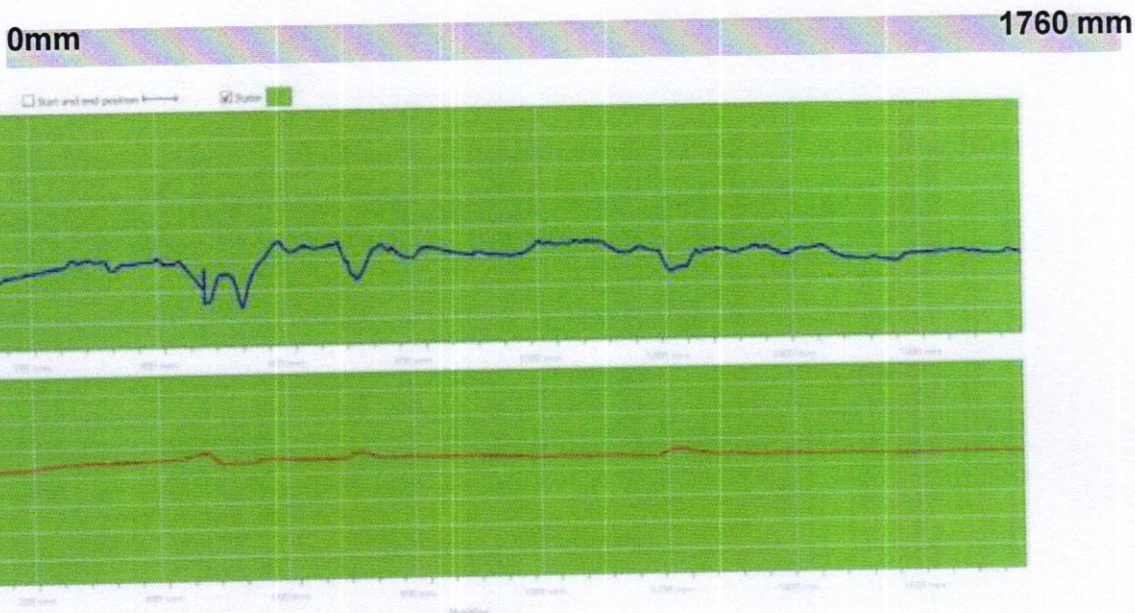


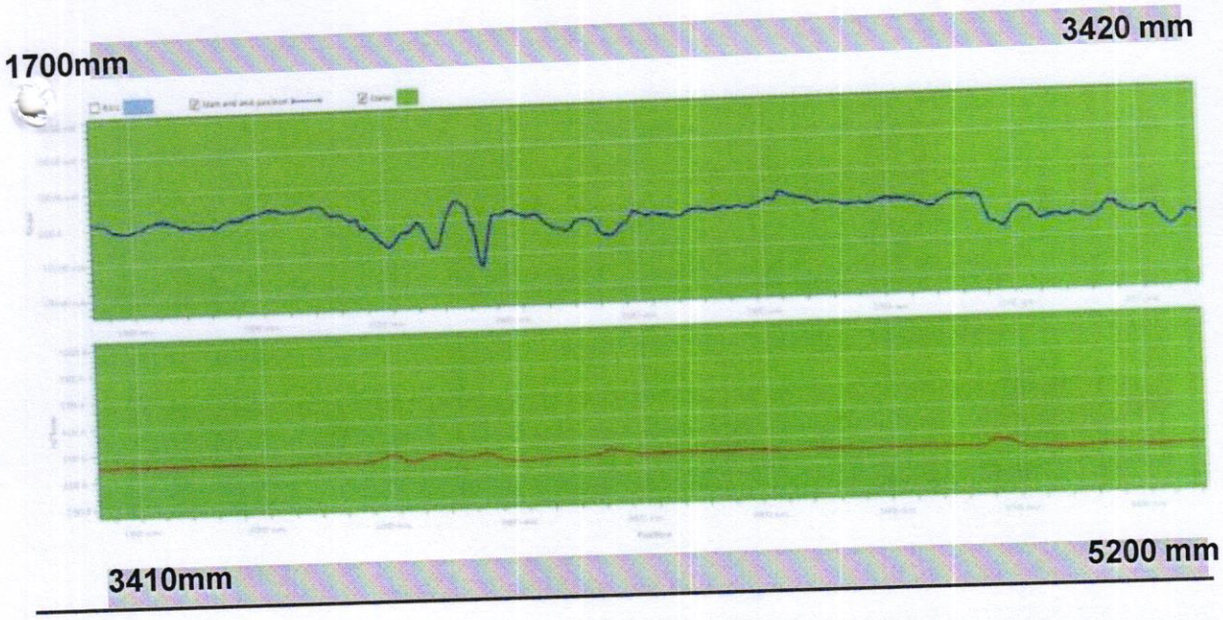


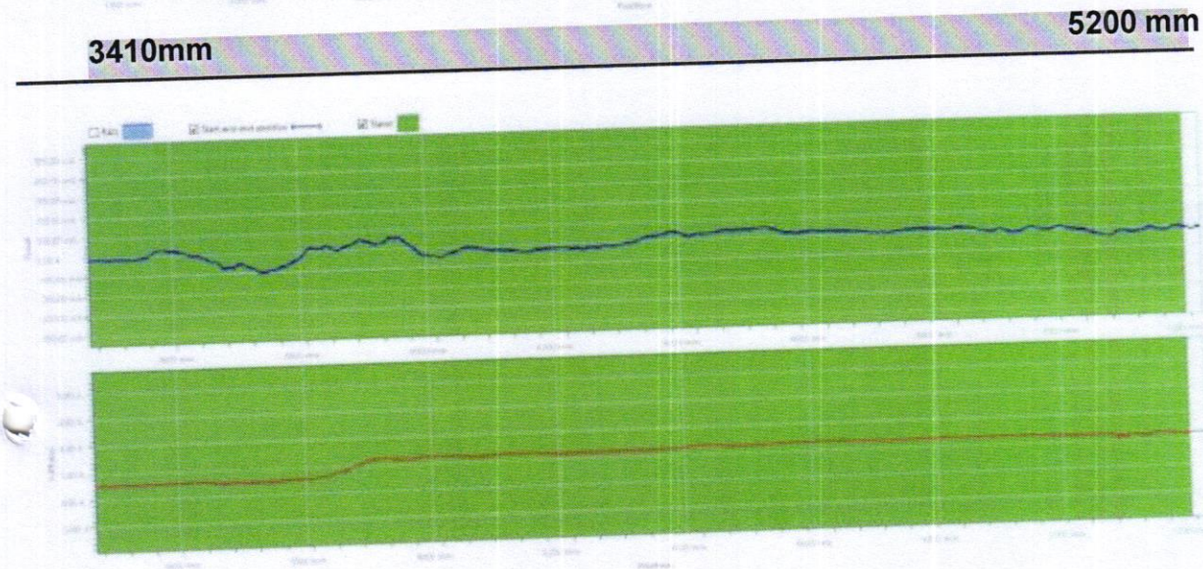




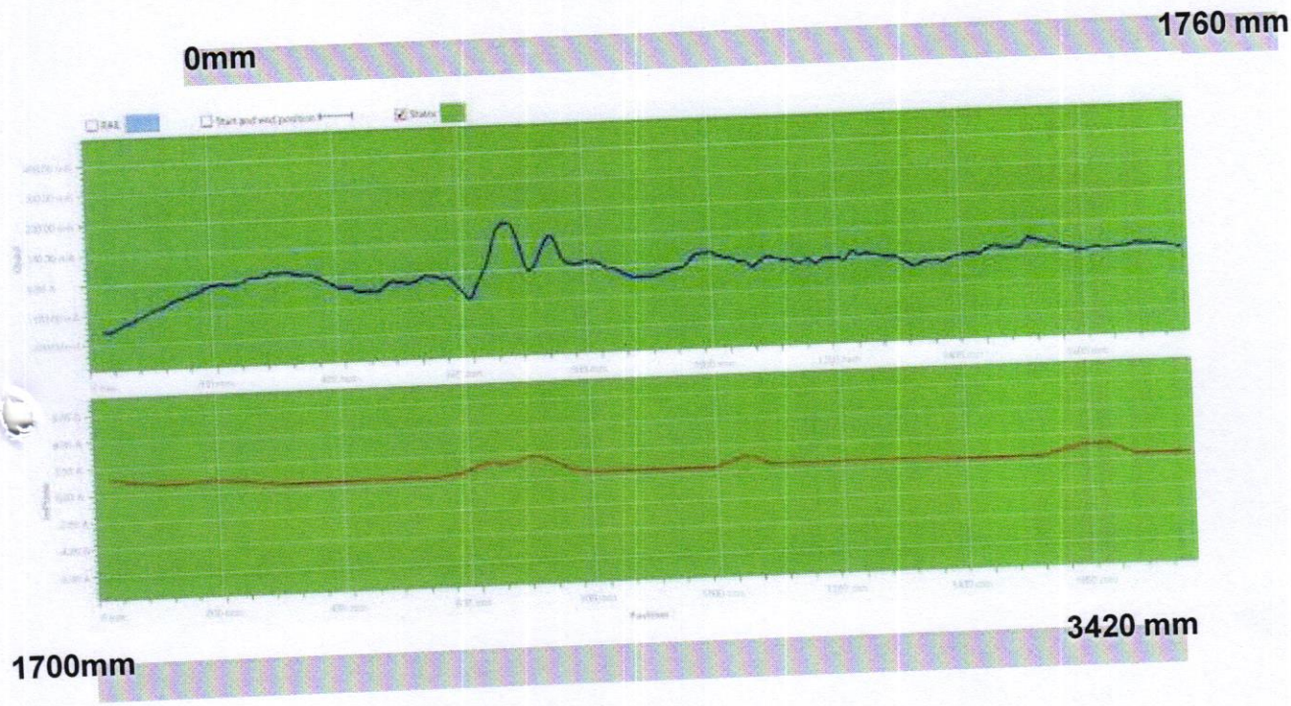
Slot 13

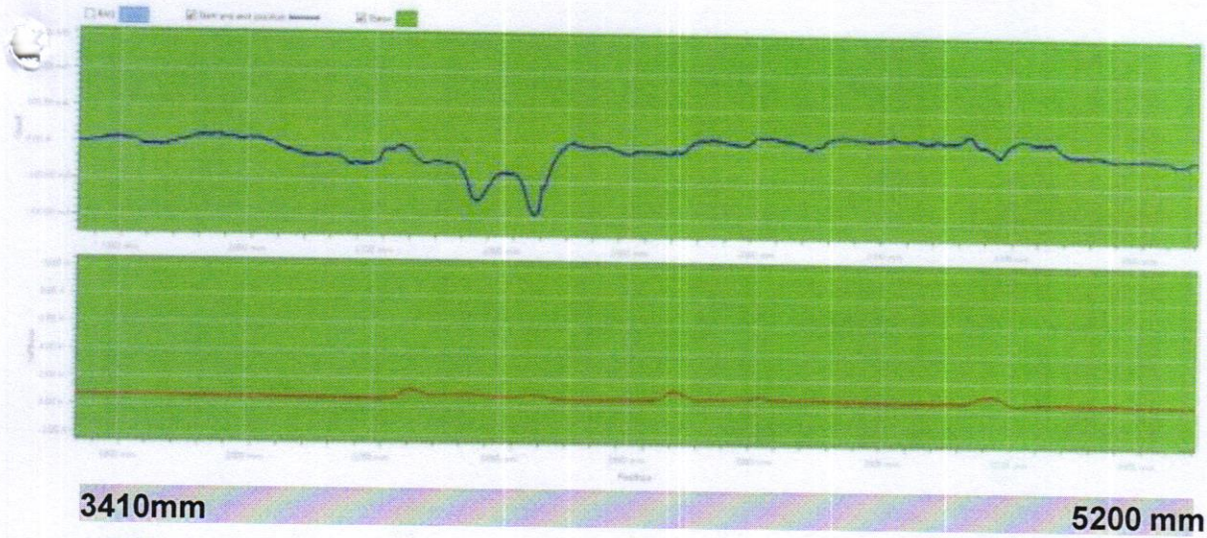


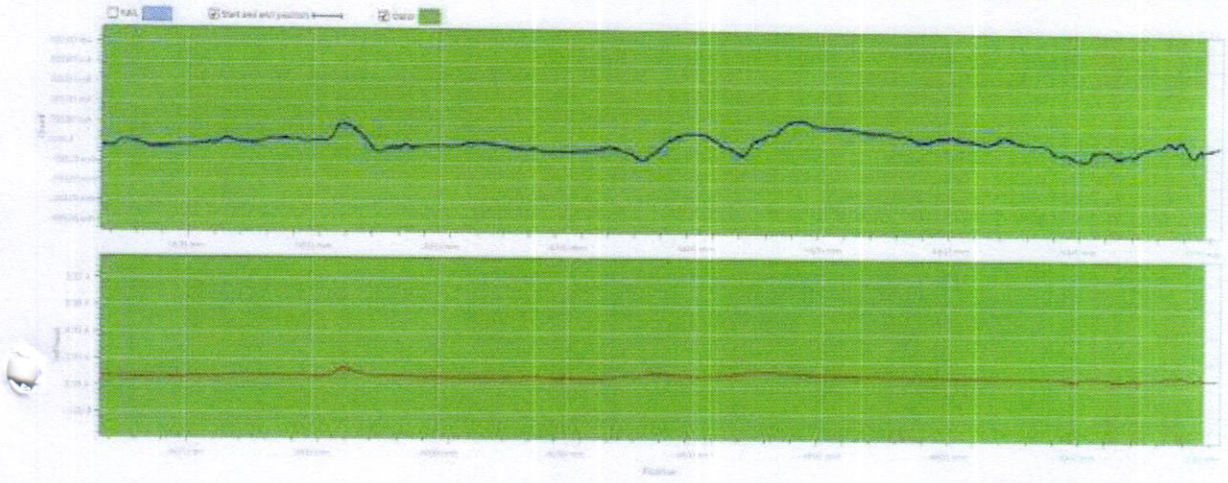




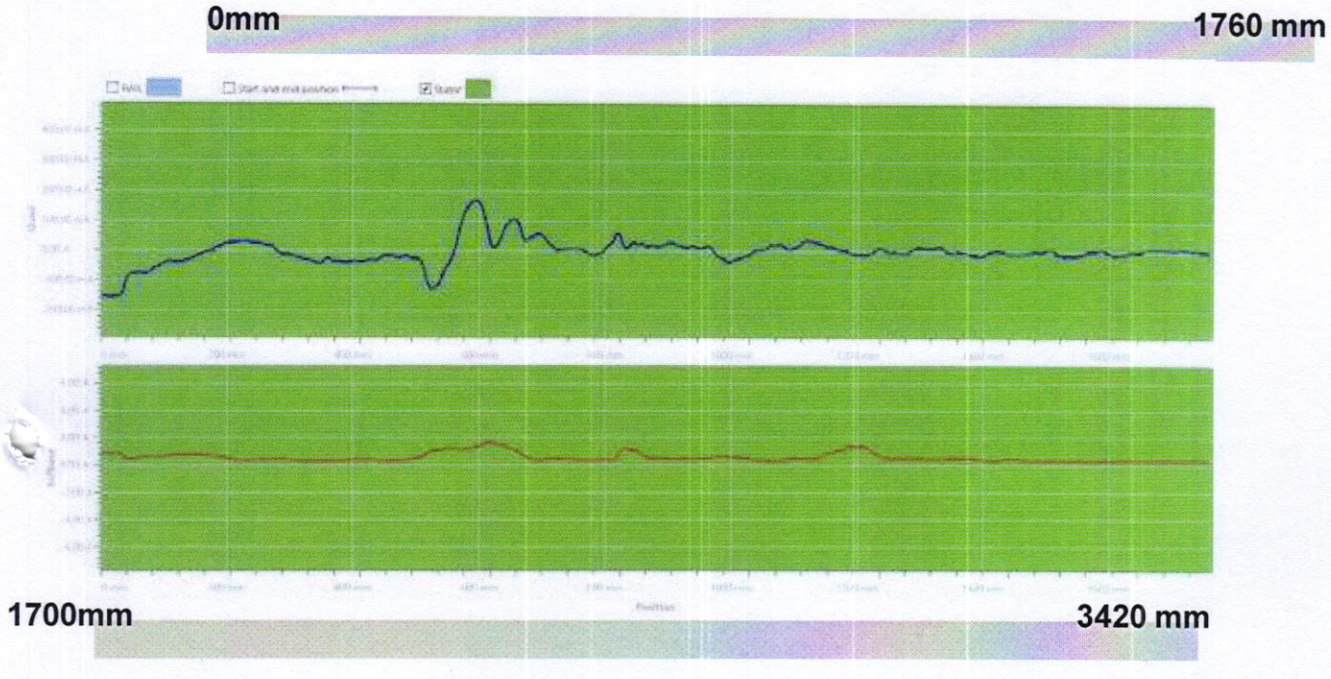
Slot 14

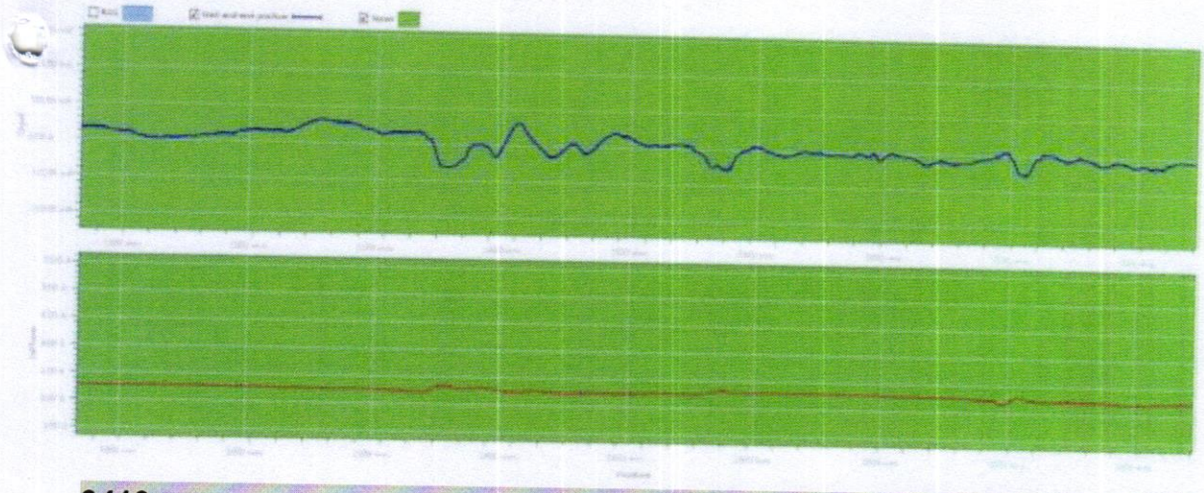




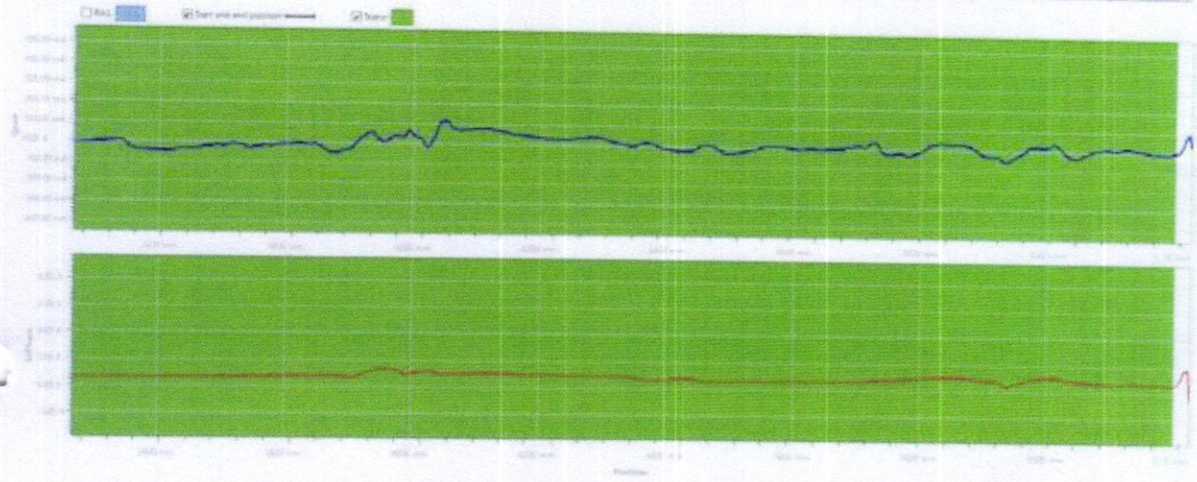


Slot 15



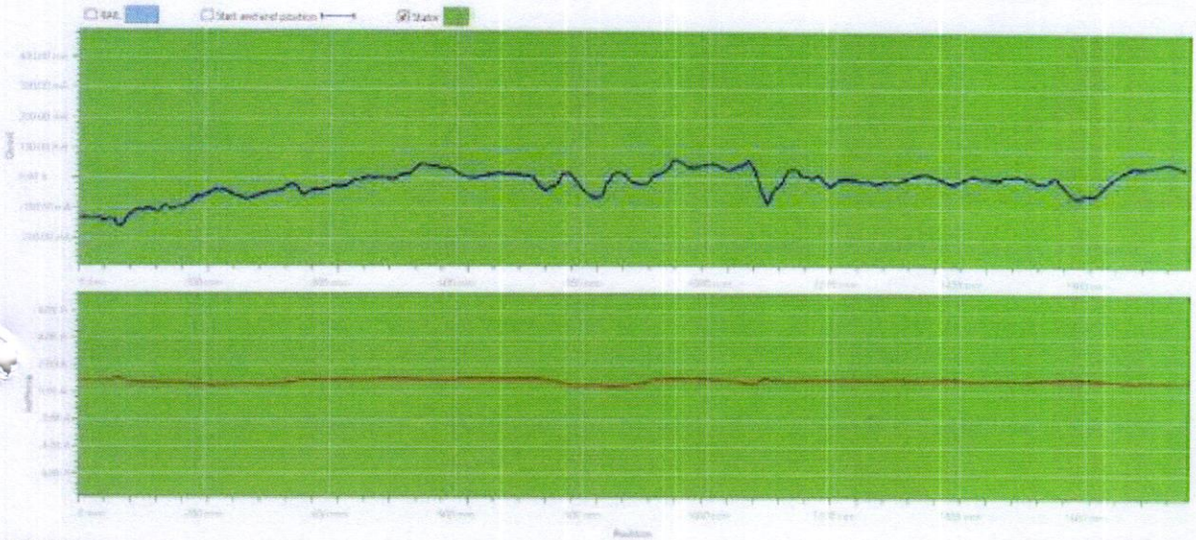


3410mm 5200 mm

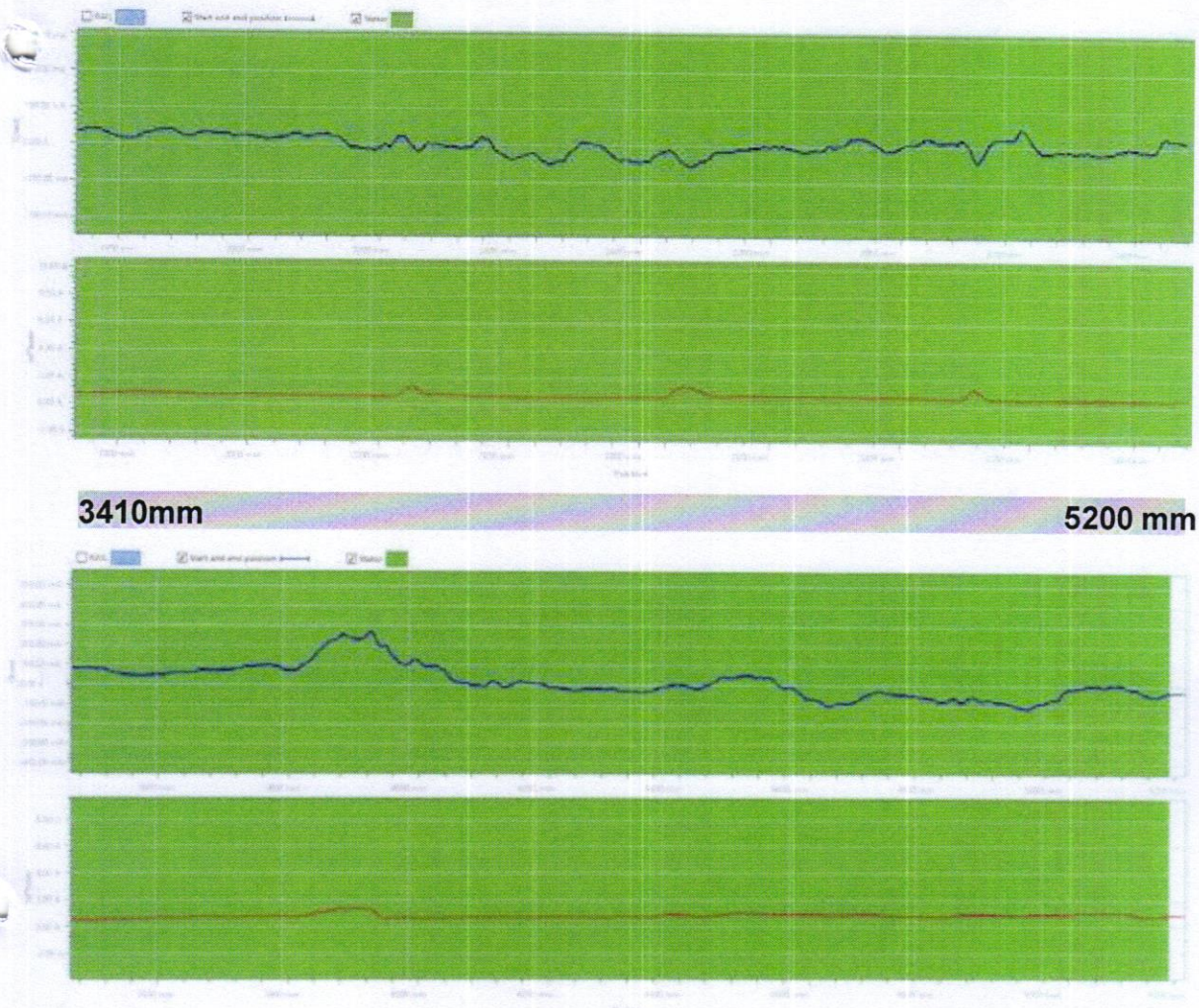


Slot 16

0mm 1760 mm

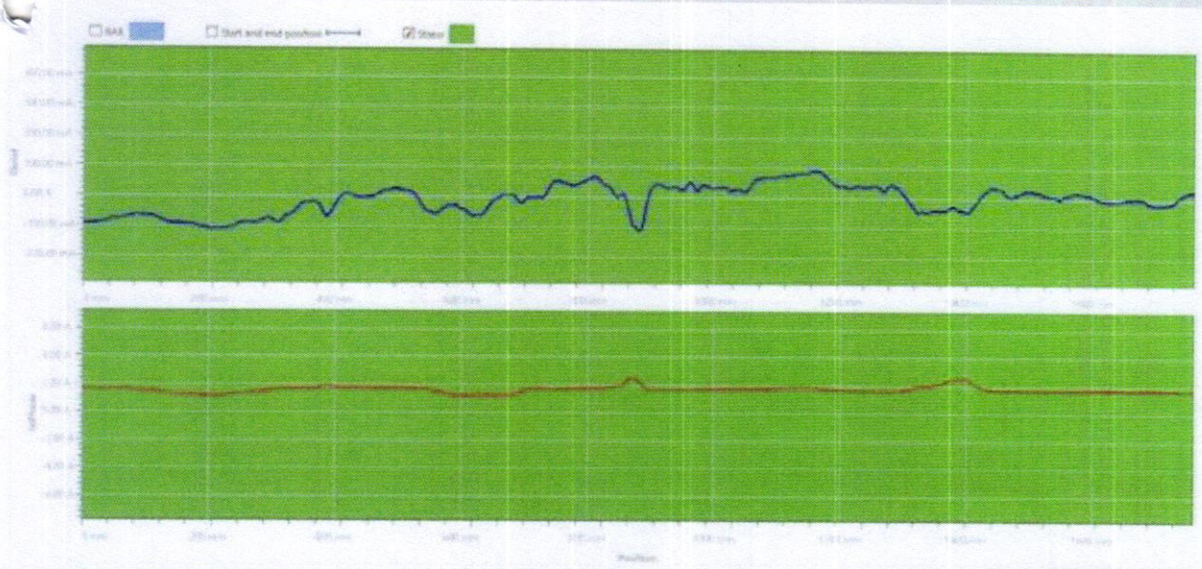


1700mm 3420 mm

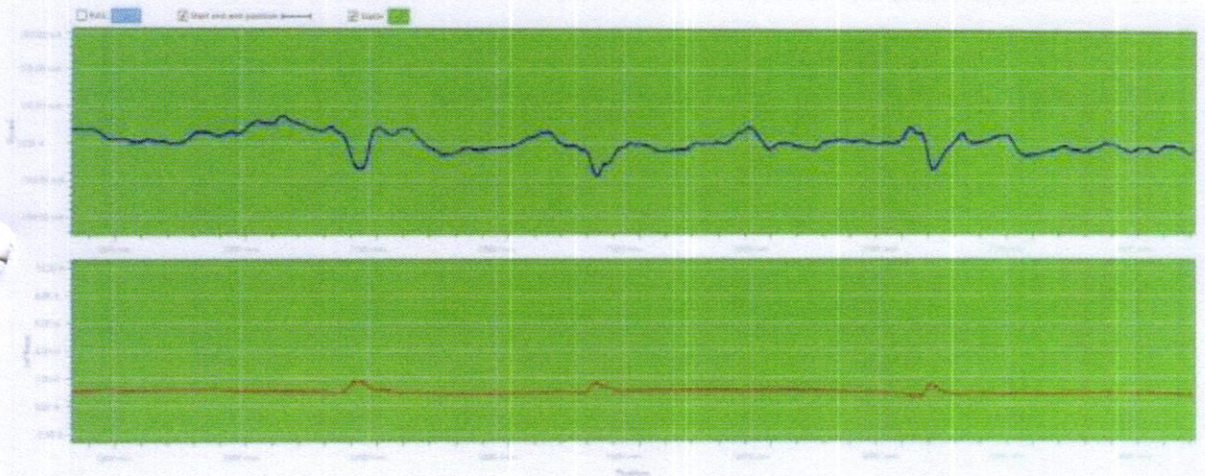


Slot 17

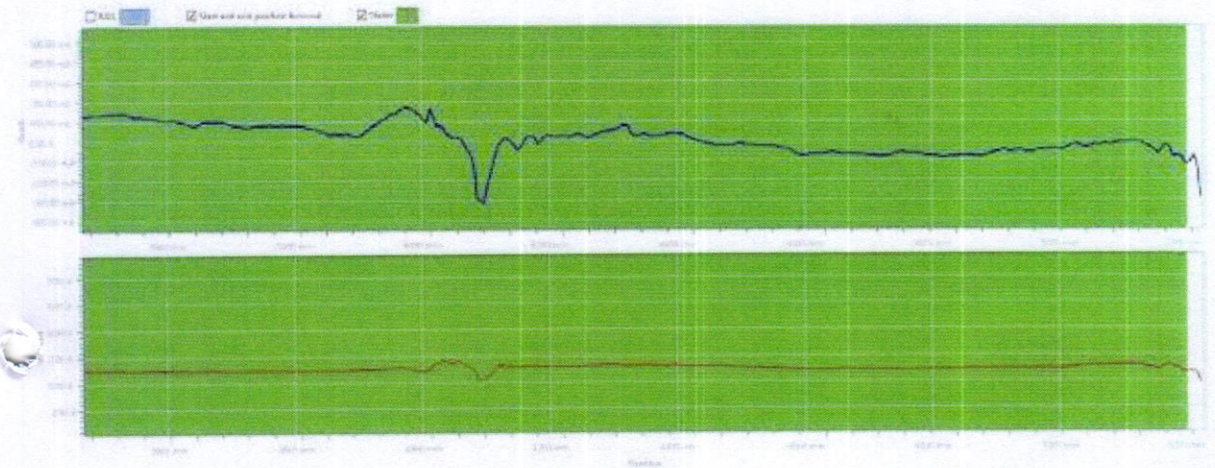
0mm 1760 mm



1700mm 3420 mm

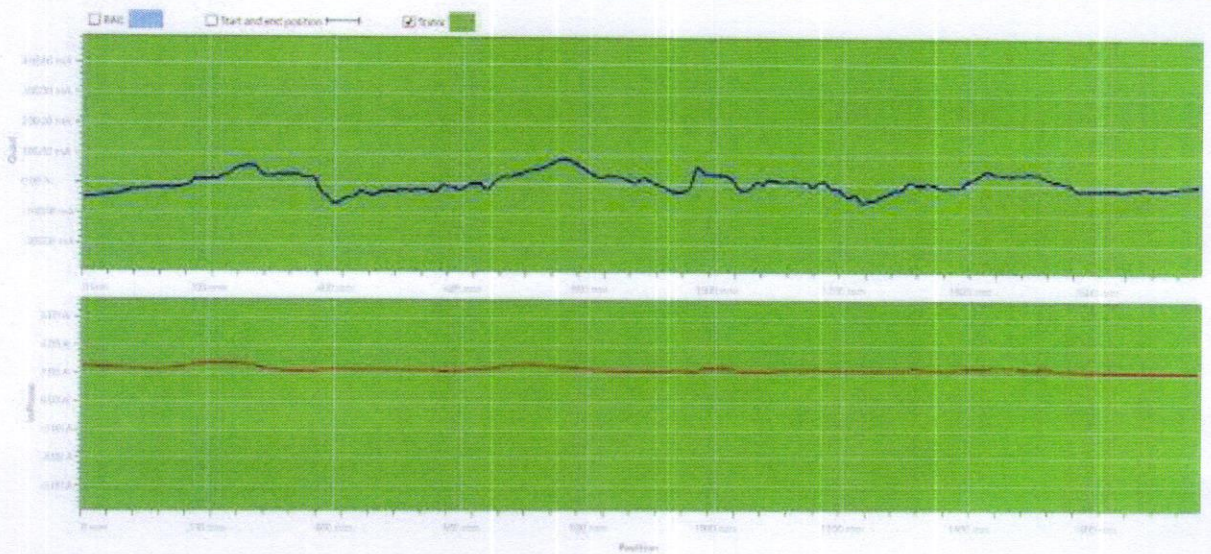


3410mm 5200 mm

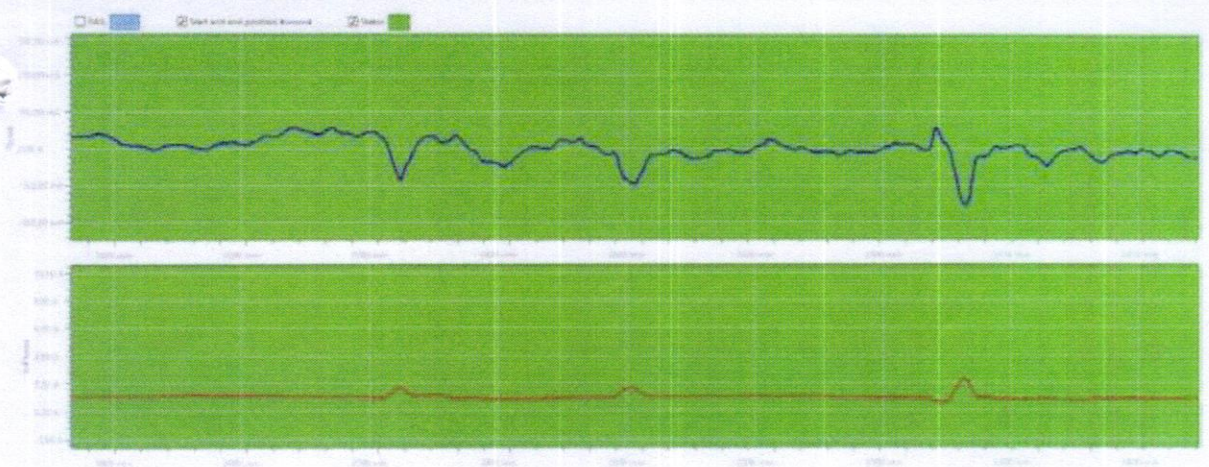


Slot 18

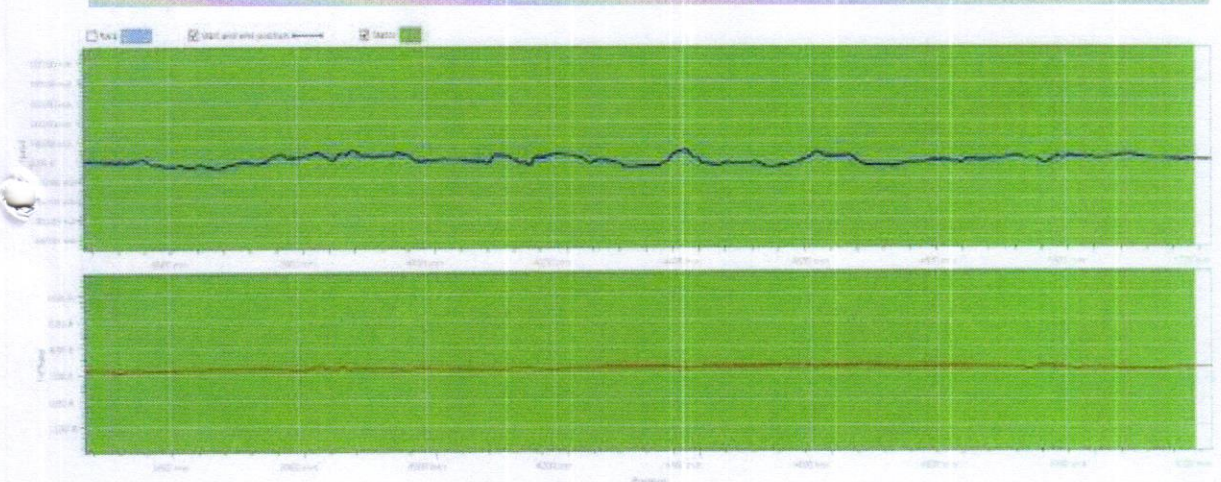
0mm 1760 mm



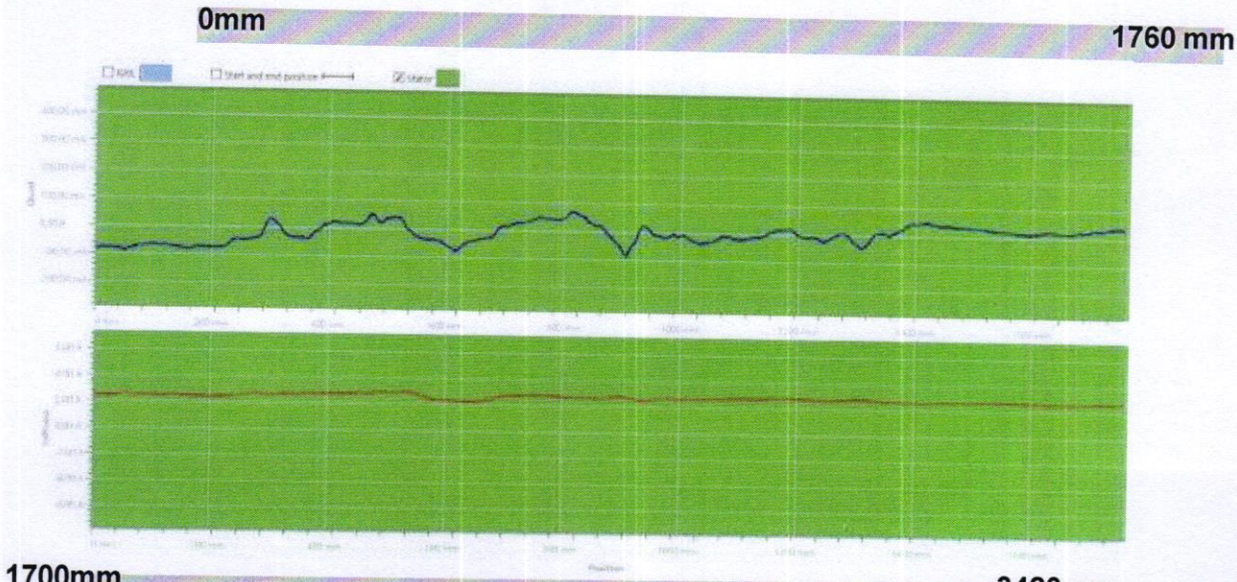
1700mm 3420 mm

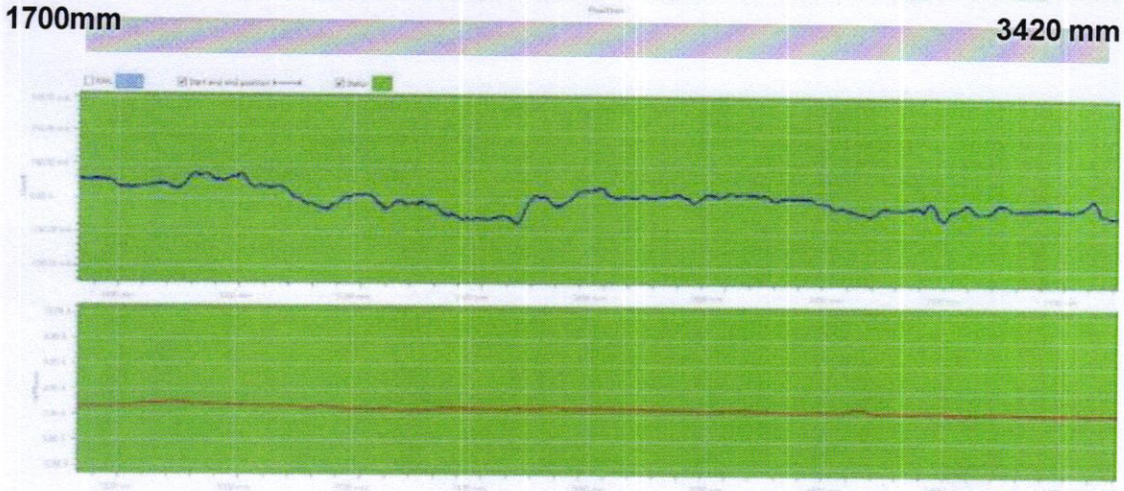


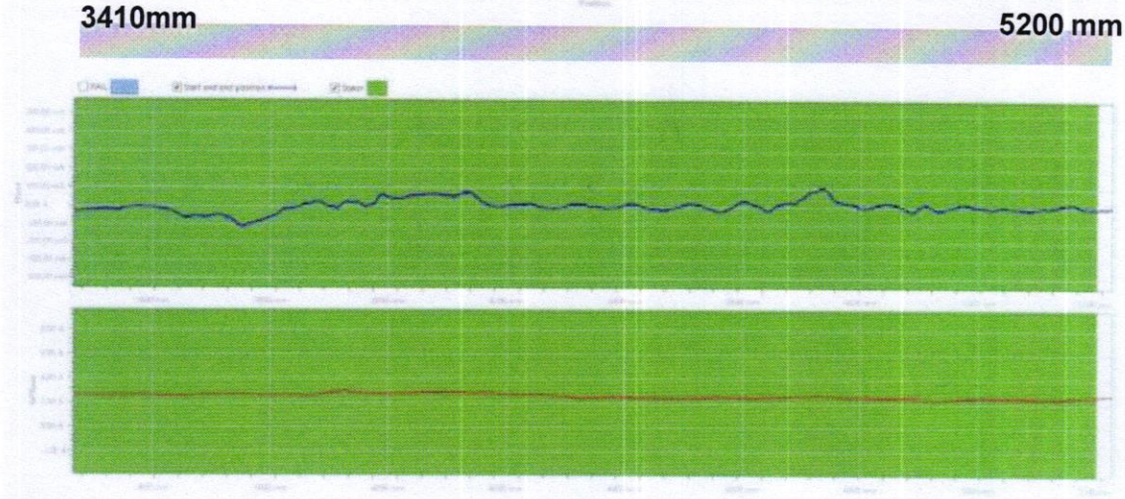
3410mm 5200 mm



Slot 19

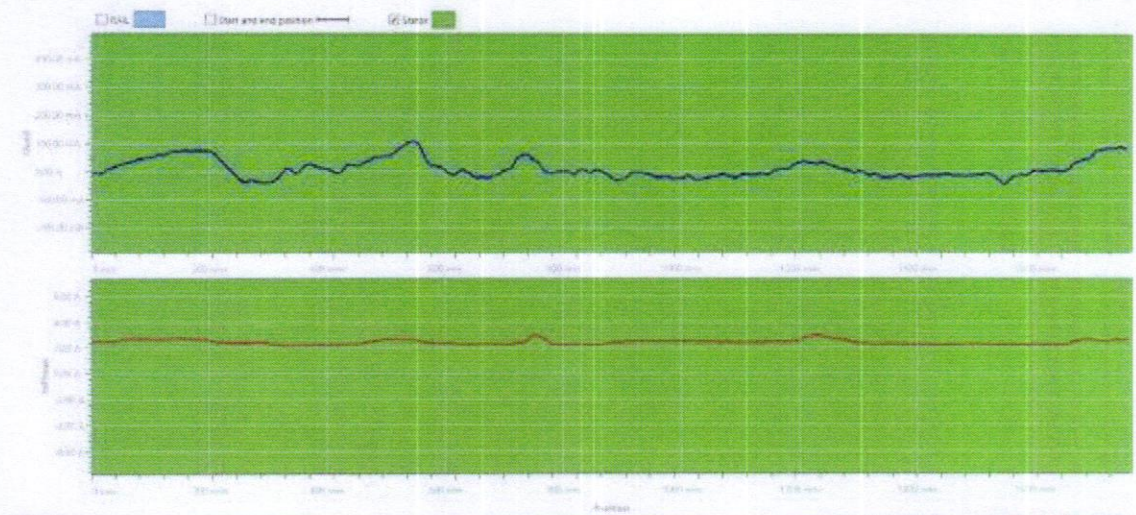




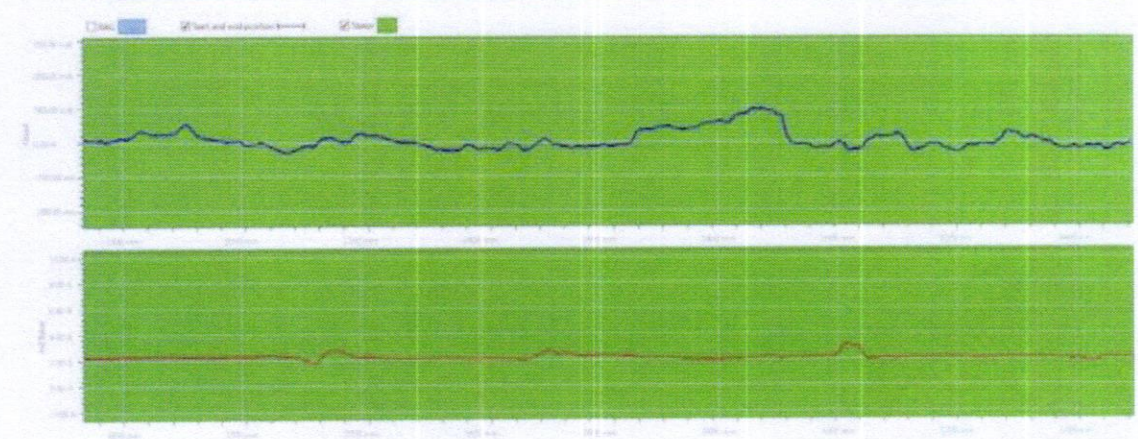


Slot 20

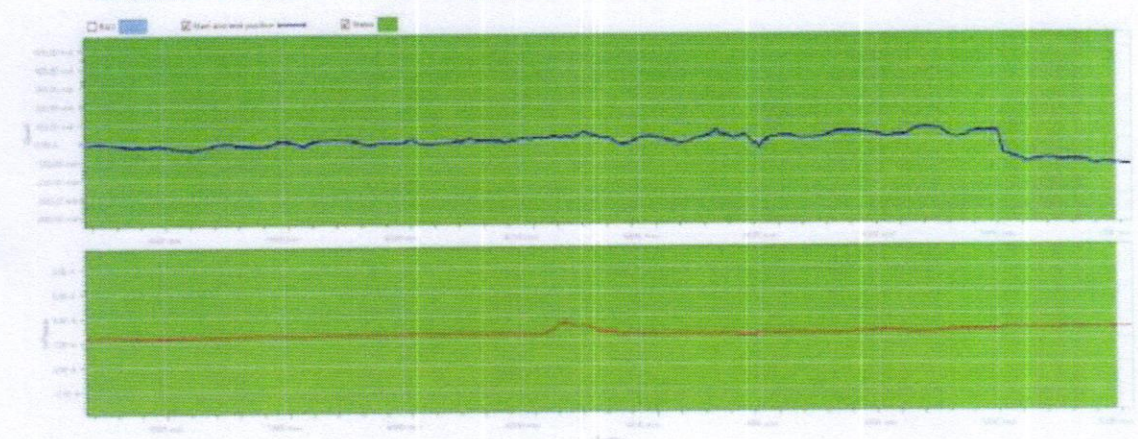
0mm 1760 mm



1700mm 3420 mm

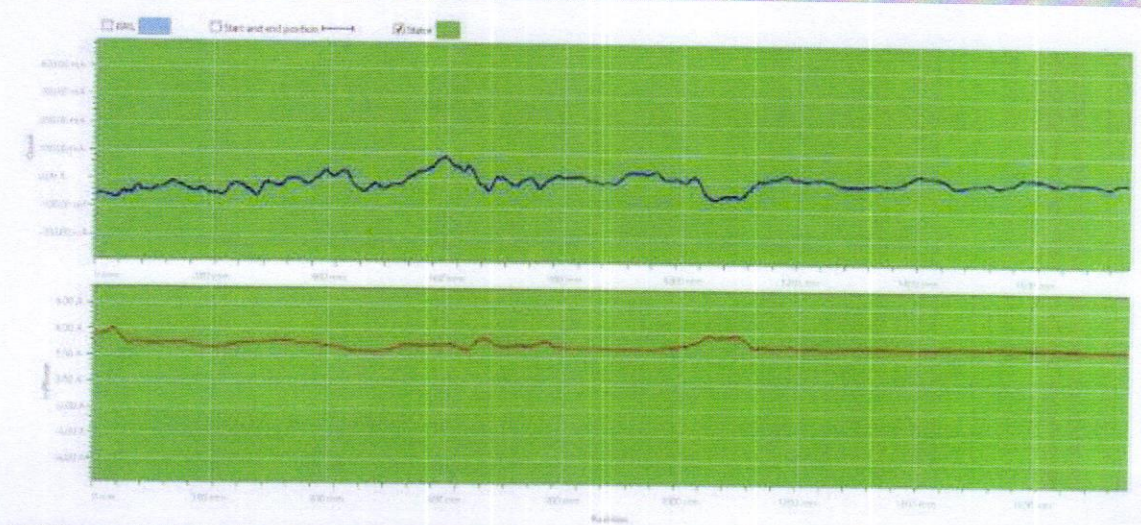


3410mm 5200 mm

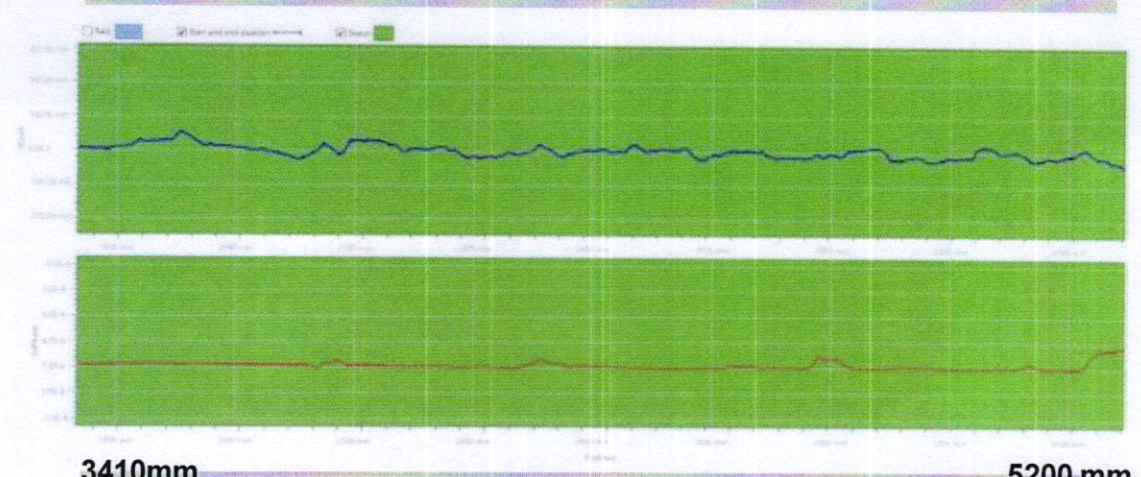


Slot 21

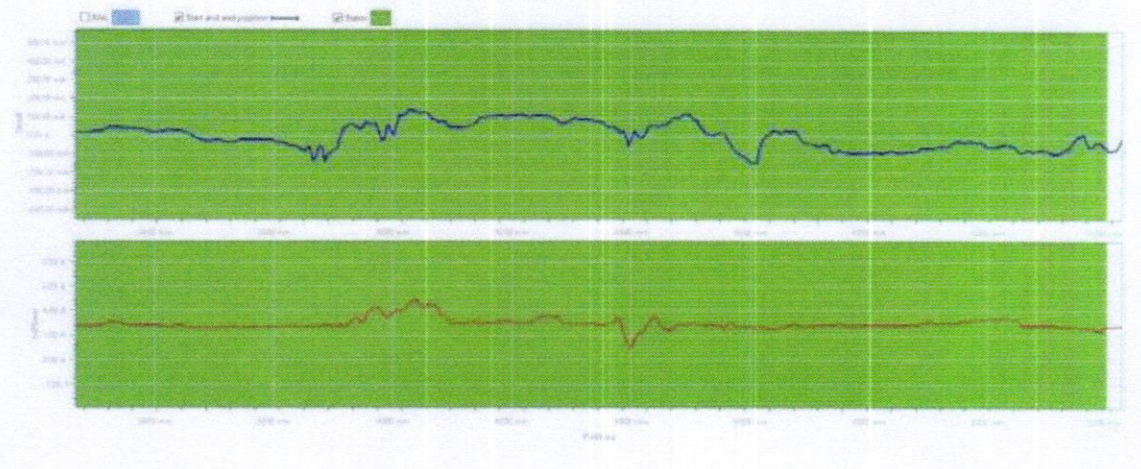
0mm 1760 mm



1700mm 3420 mm

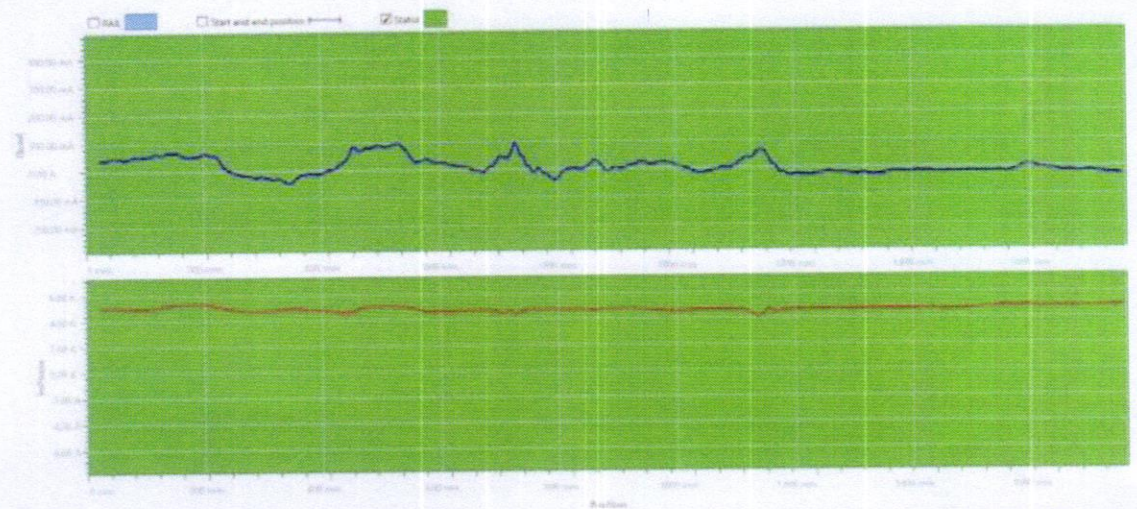


3410mm 5200 mm

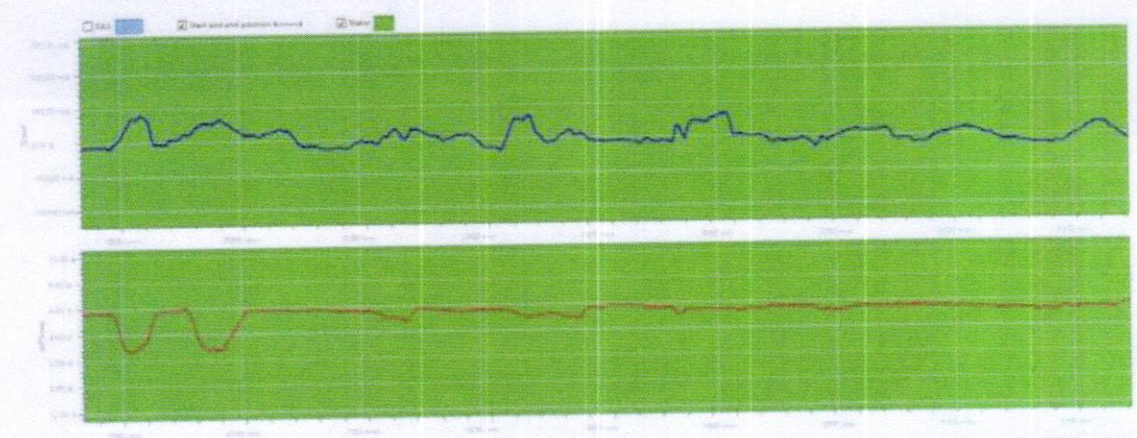


Slot 22

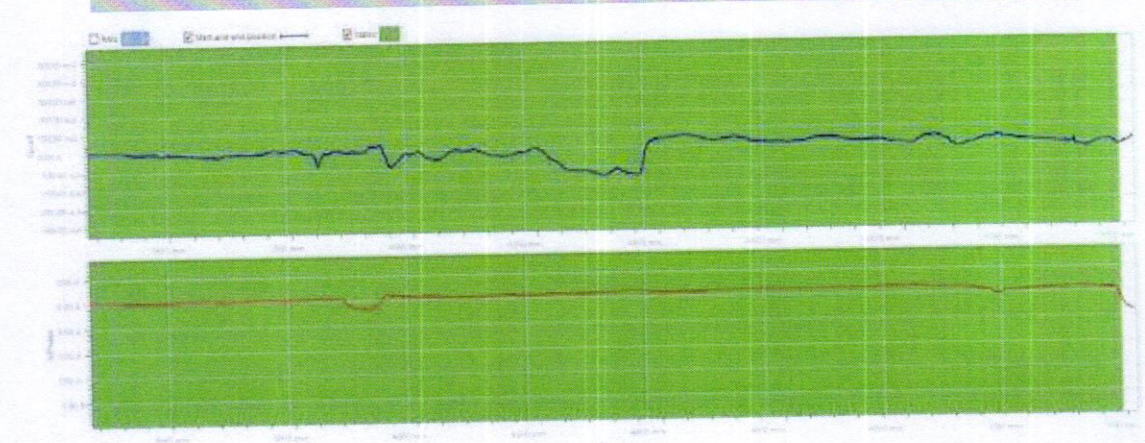
0mm 1760 mm



1700mm 3420 mm

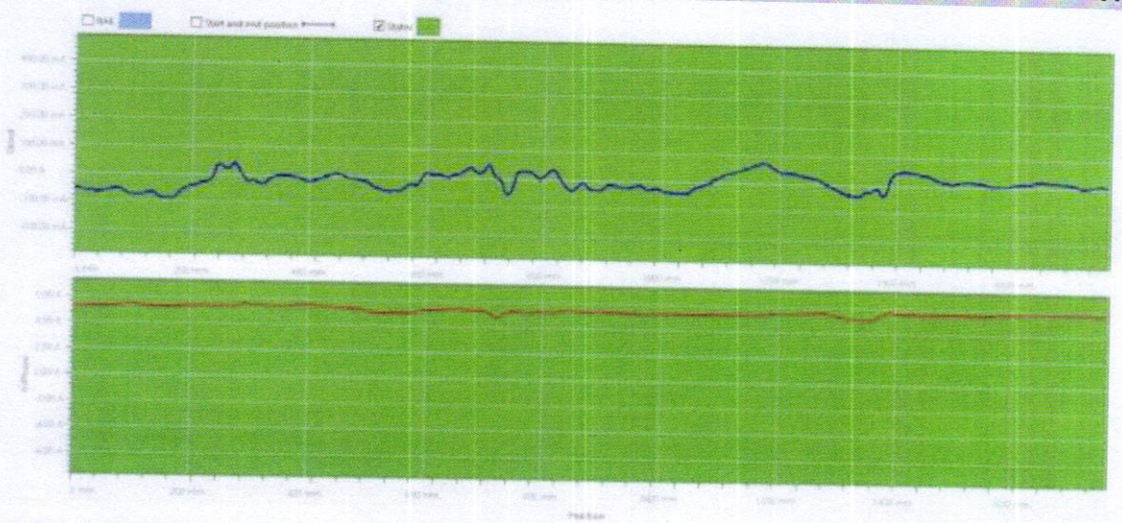


3410mm 5200 mm

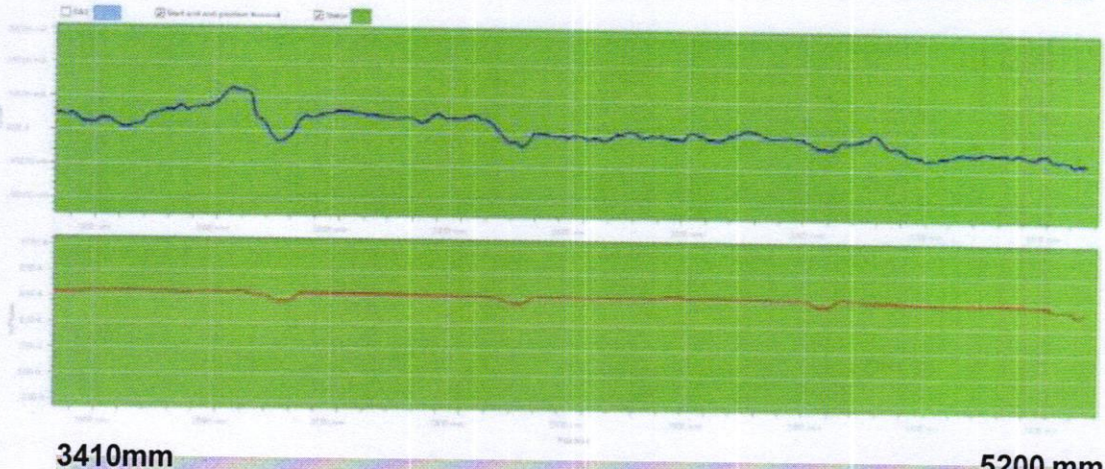


Slot 23

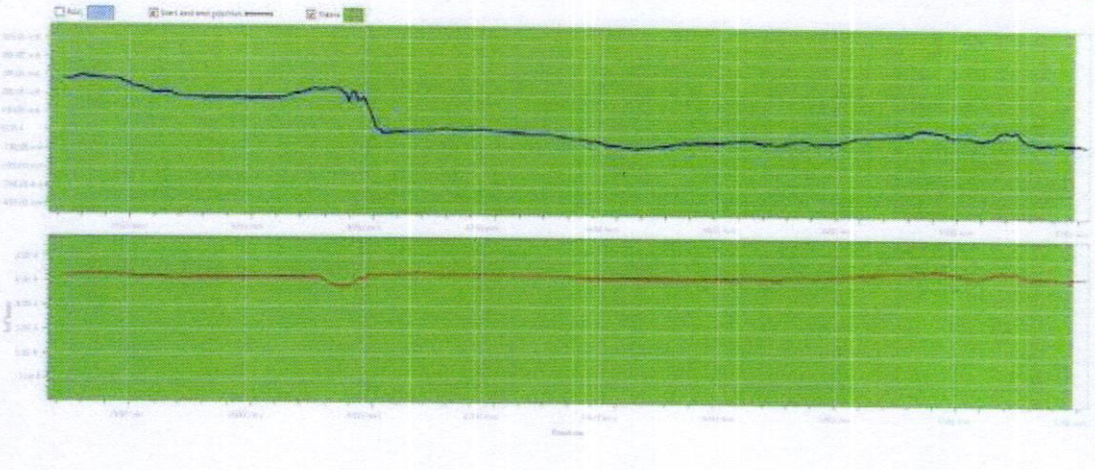
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1700mm 3420 mm

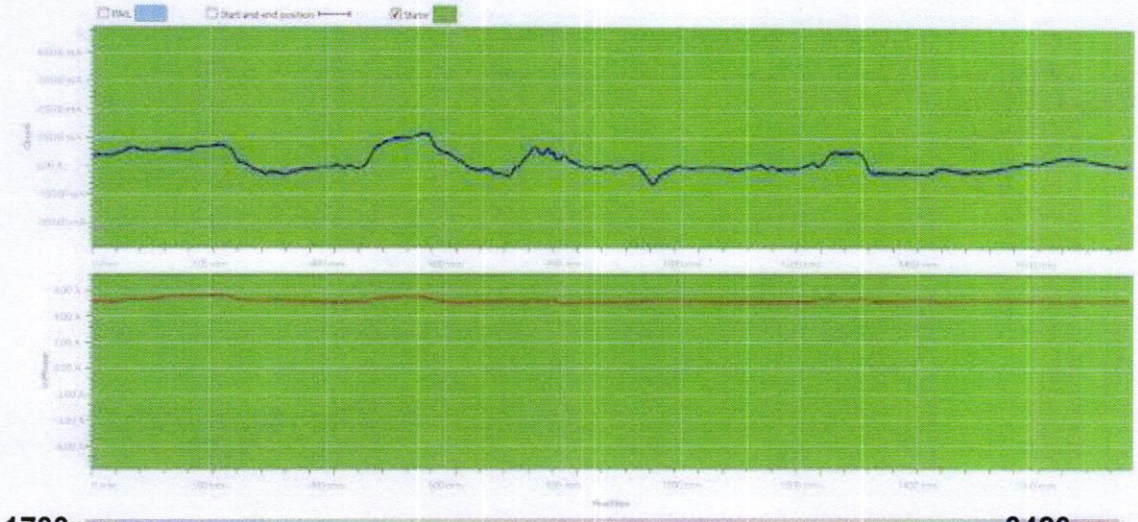


3410mm 5200 mm

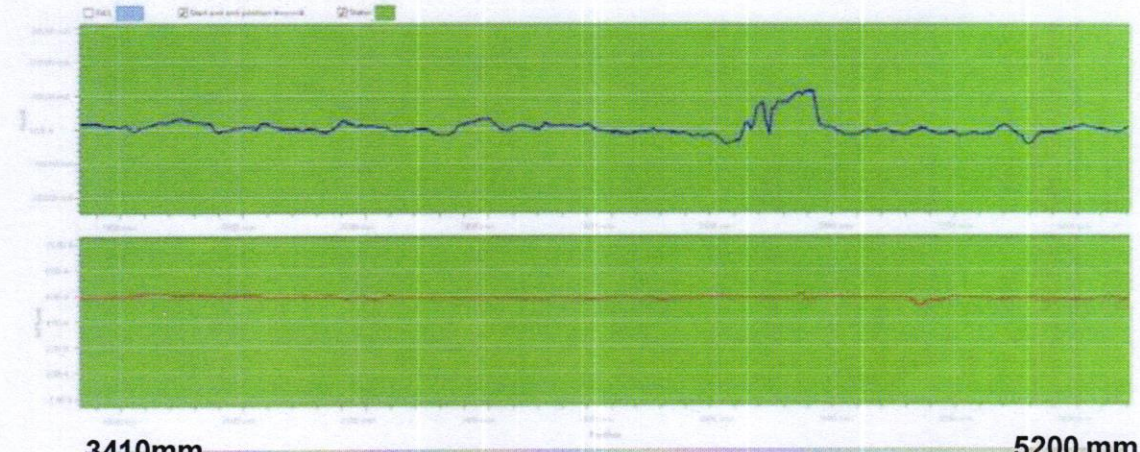


Slot 24

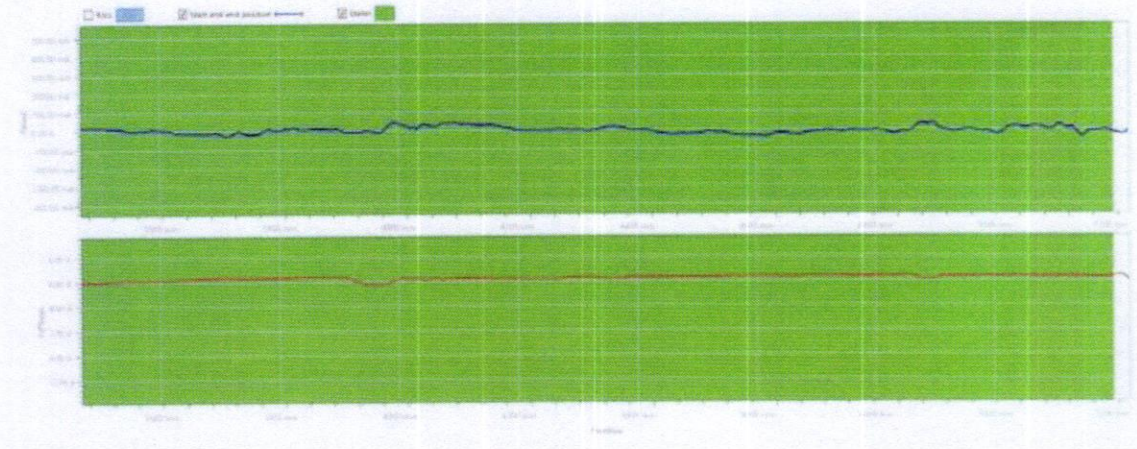
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1700mm 3420 mm

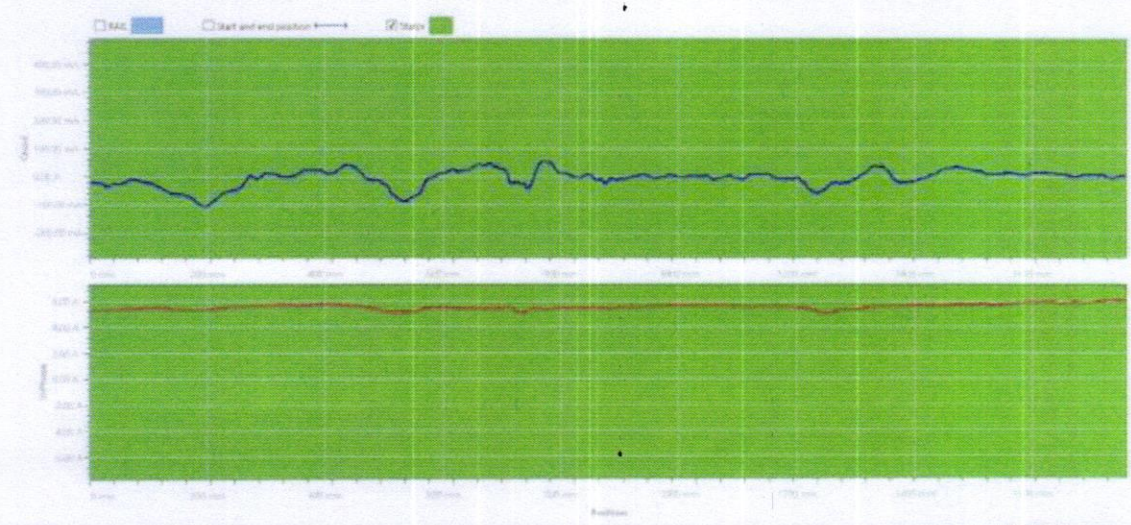


3410mm 5200 mm

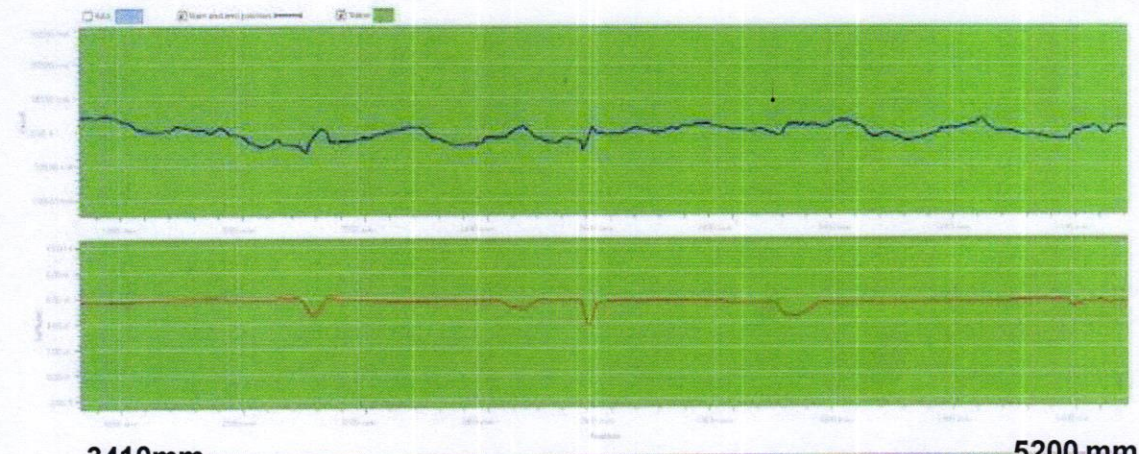


Slot 25

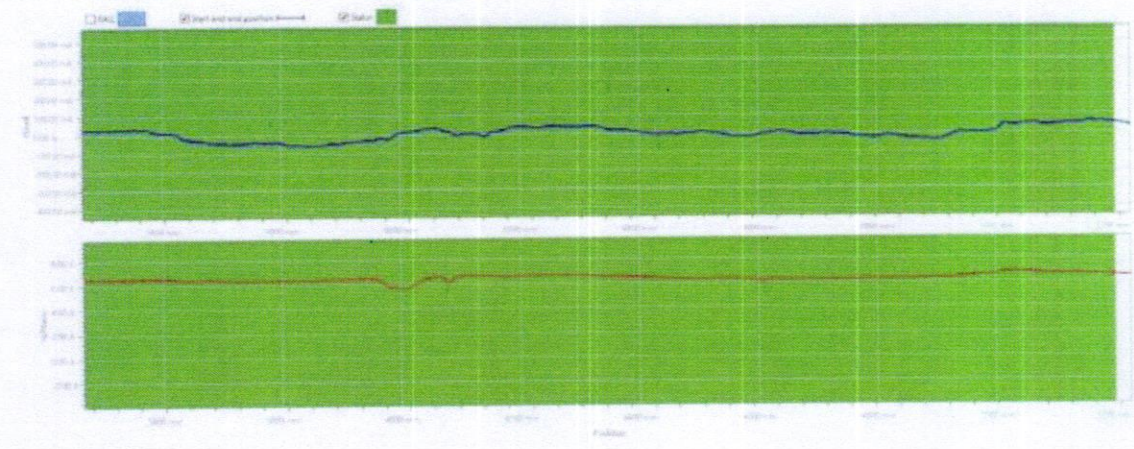
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1700mm 3420 mm

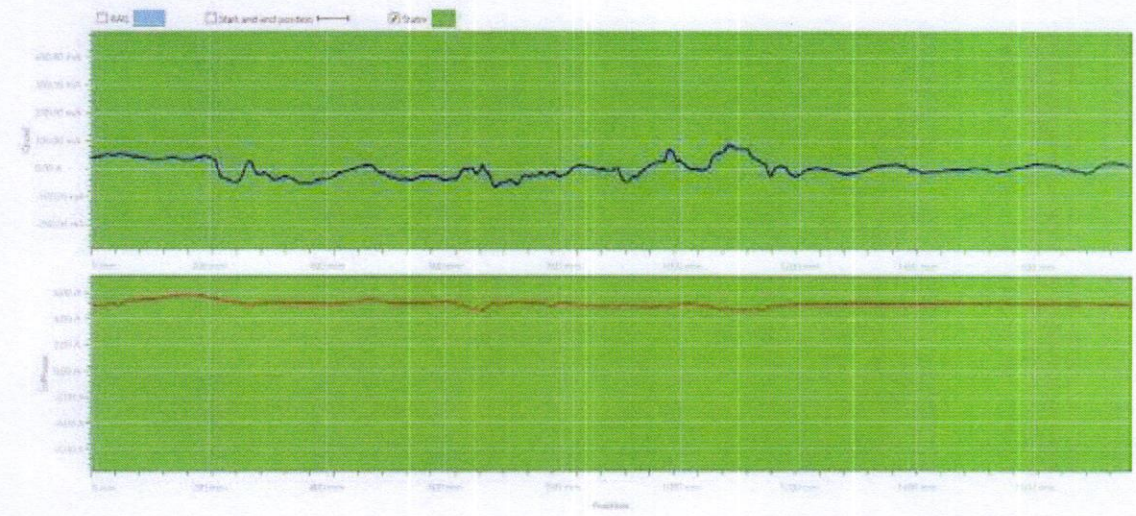


3410mm 5200 mm

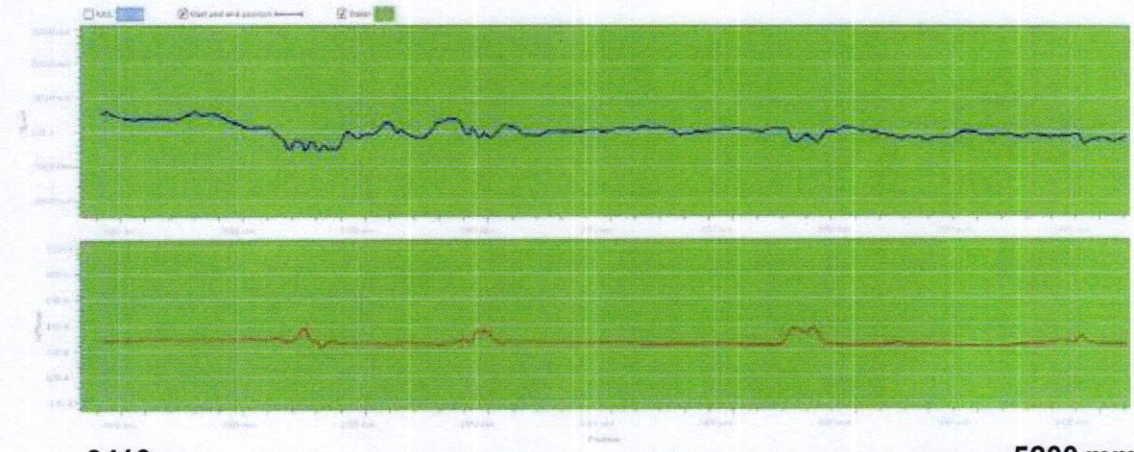


Slot 26

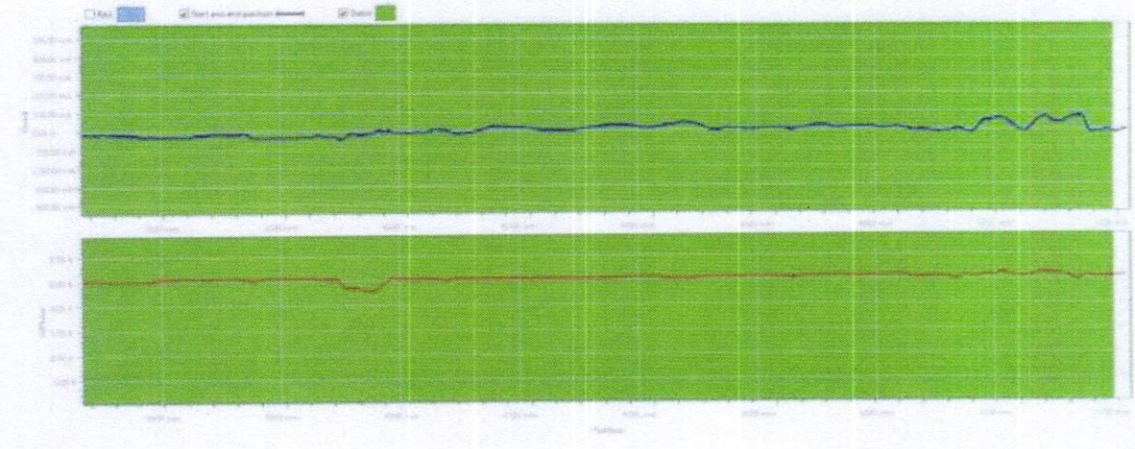
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1700mm 3420 mm

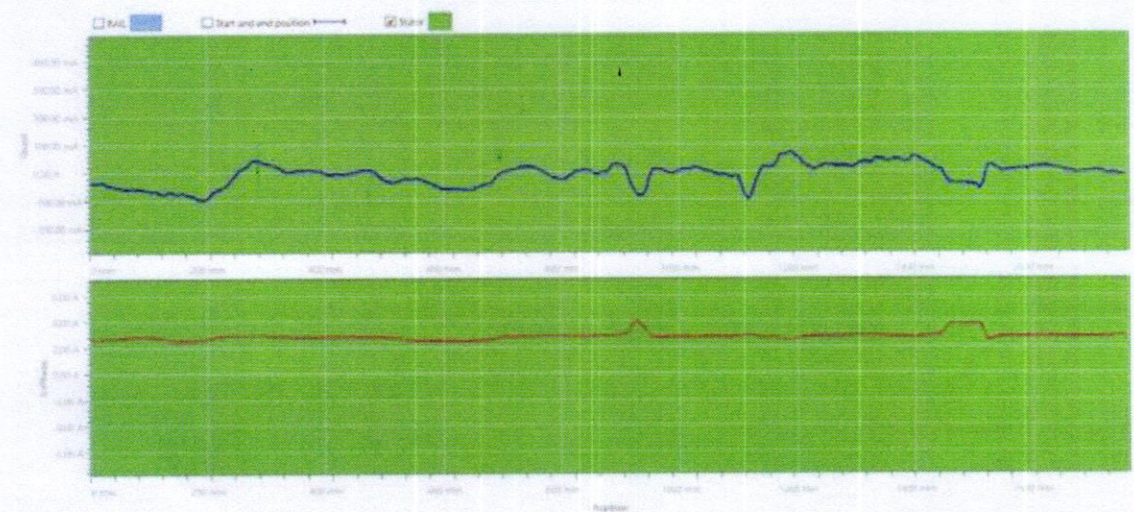


3410mm 5200 mm

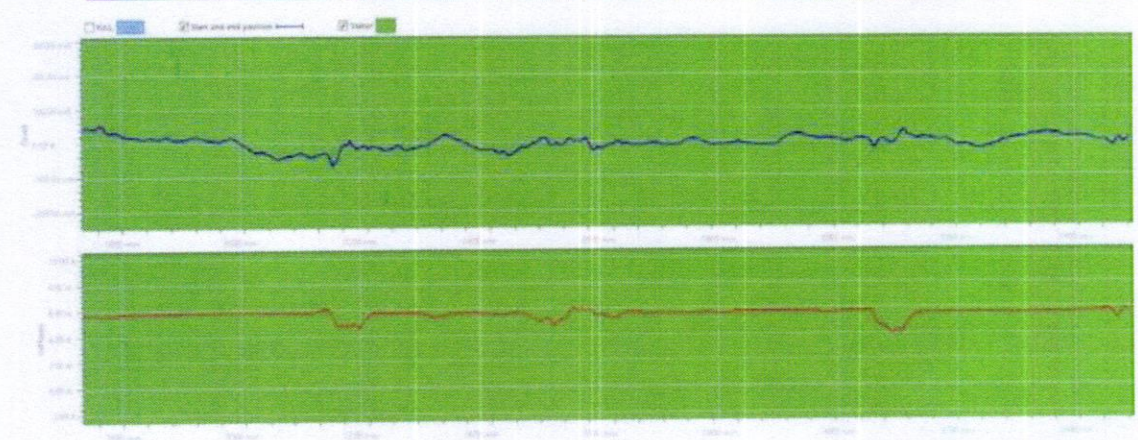


Slot 27

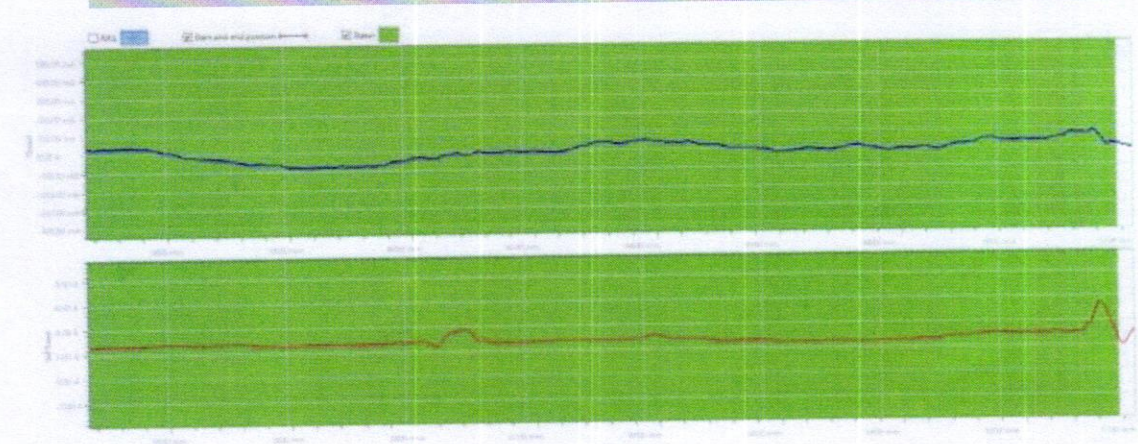
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1700mm 3420 mm

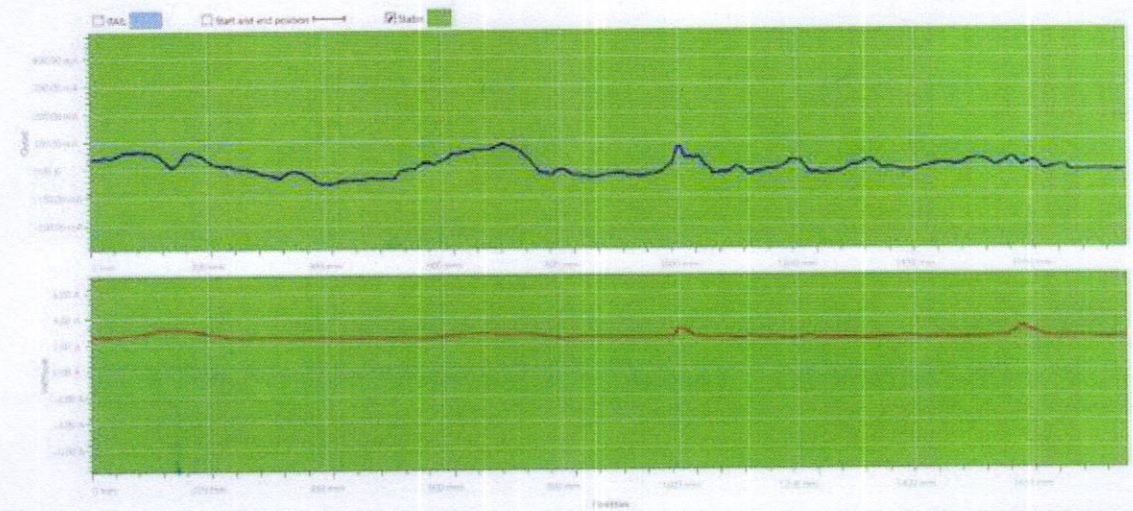


3410mm 5200 mm

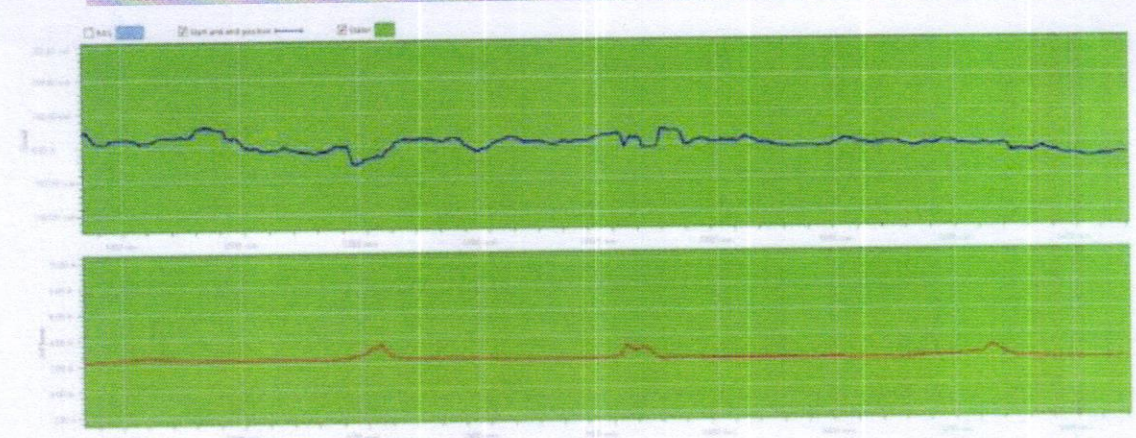


Slot 28

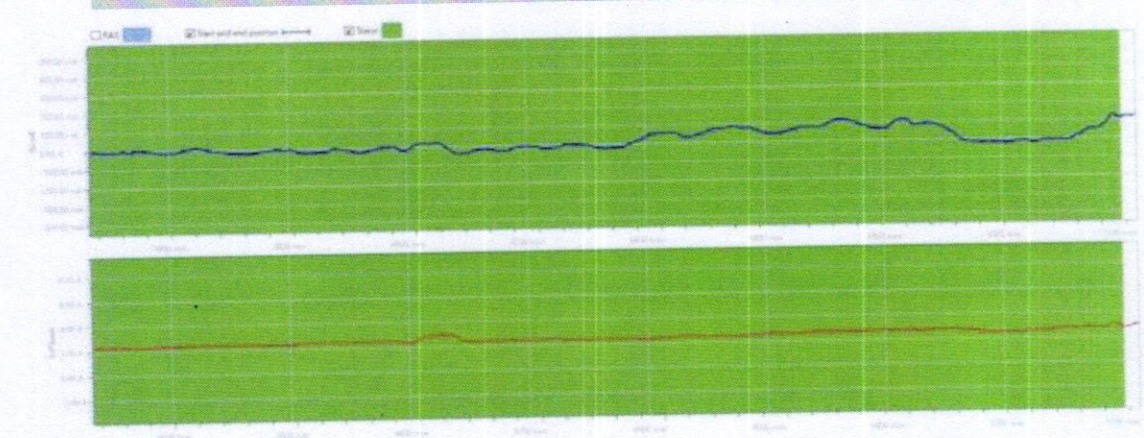
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1700mm 3420 mm

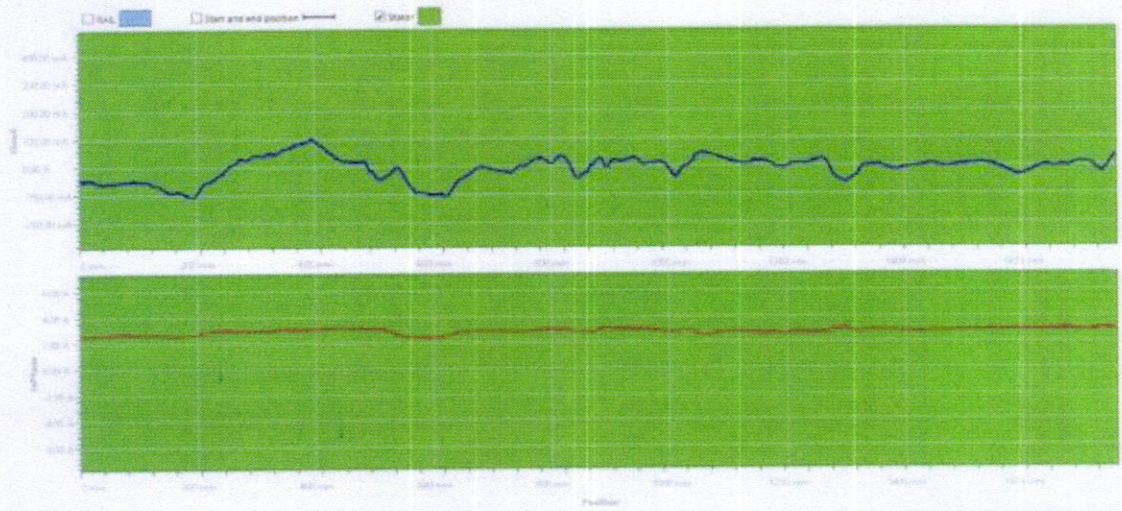


3410mm 5200 mm

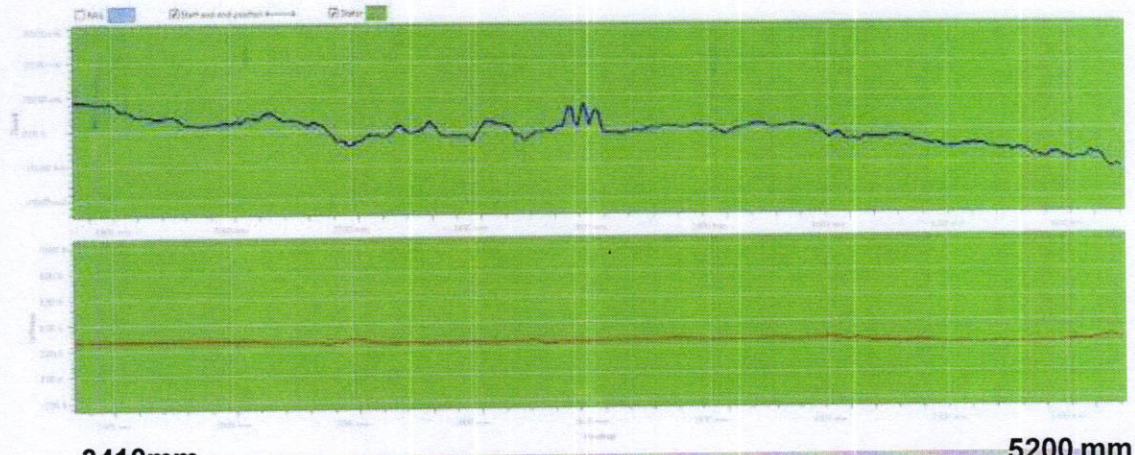


Slot 29

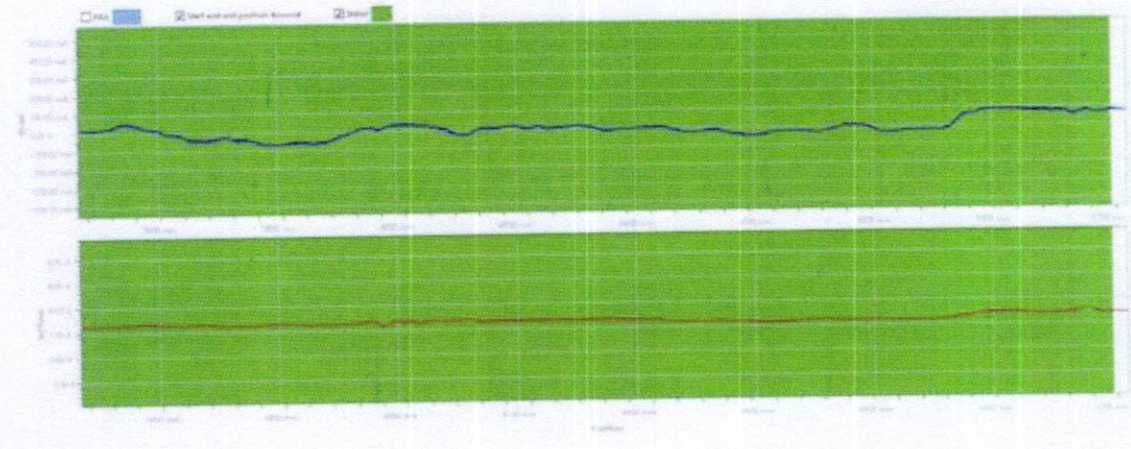
0mm 1760 mm



1700mm 3420 mm

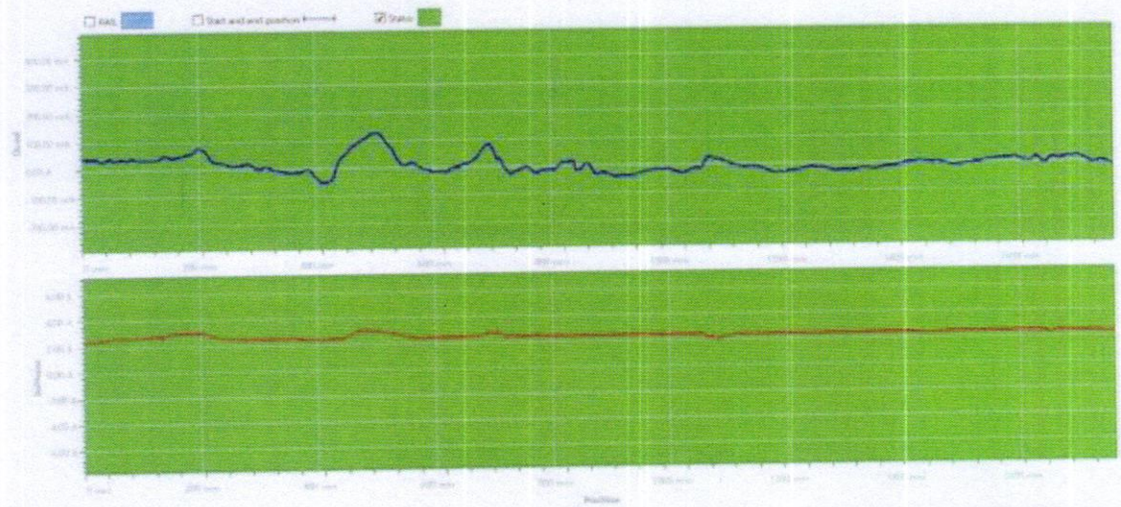


3410mm 5200 mm

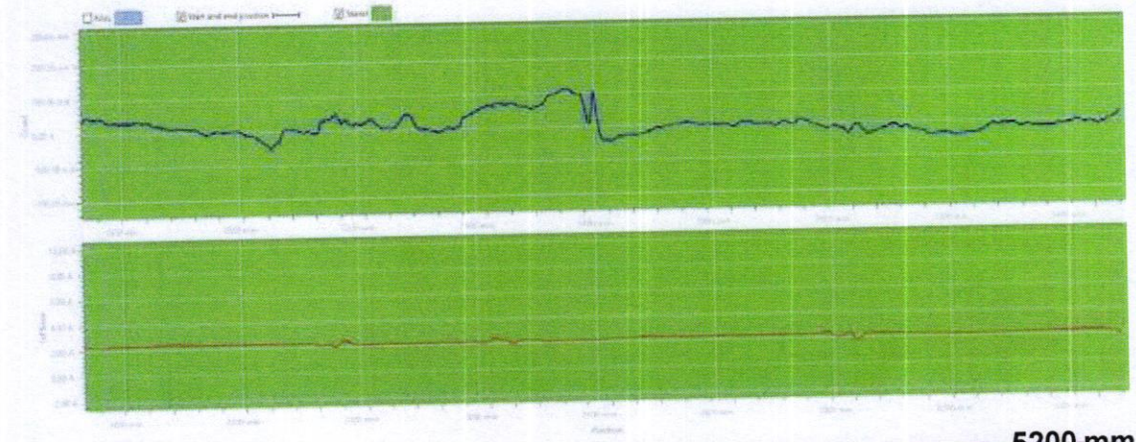


Slot 30

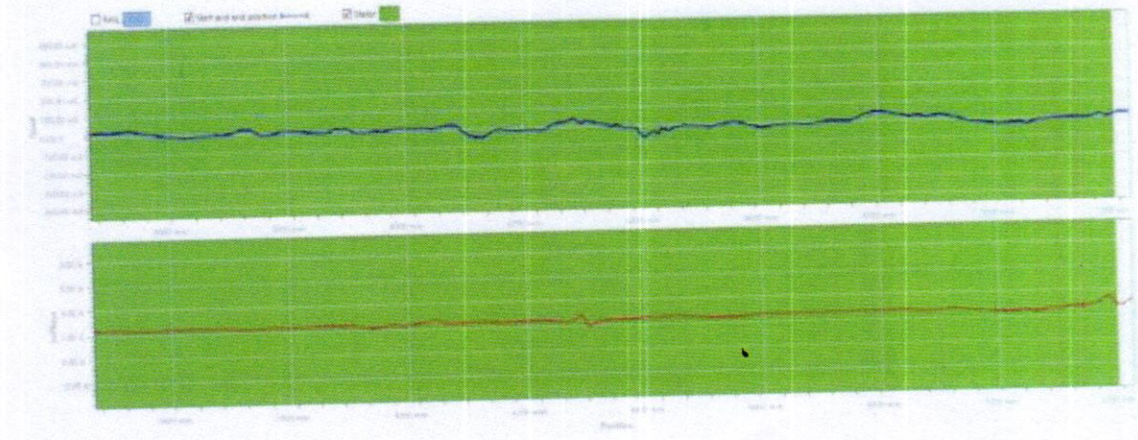
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1700mm 3420 mm

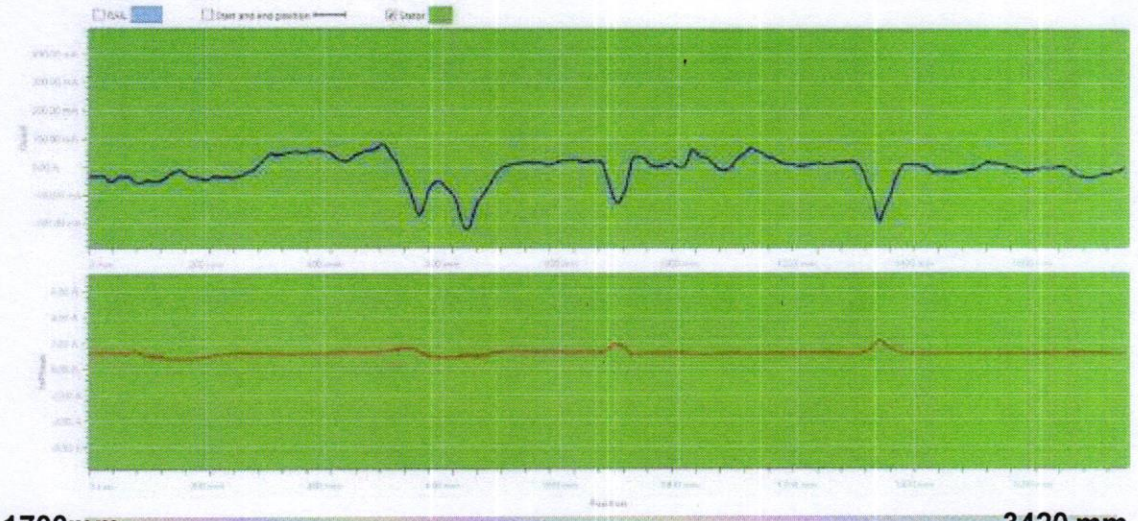


3410mm 5200 mm

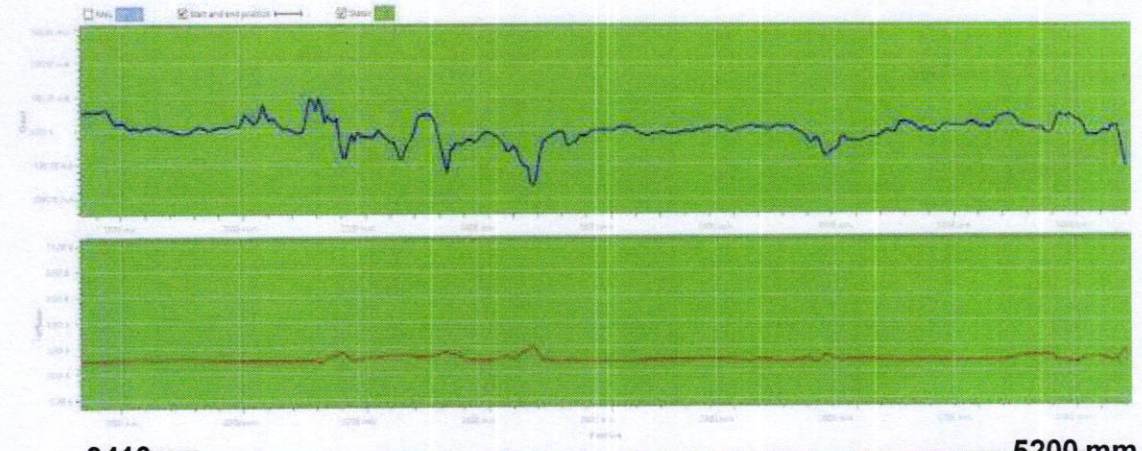


Slot 31

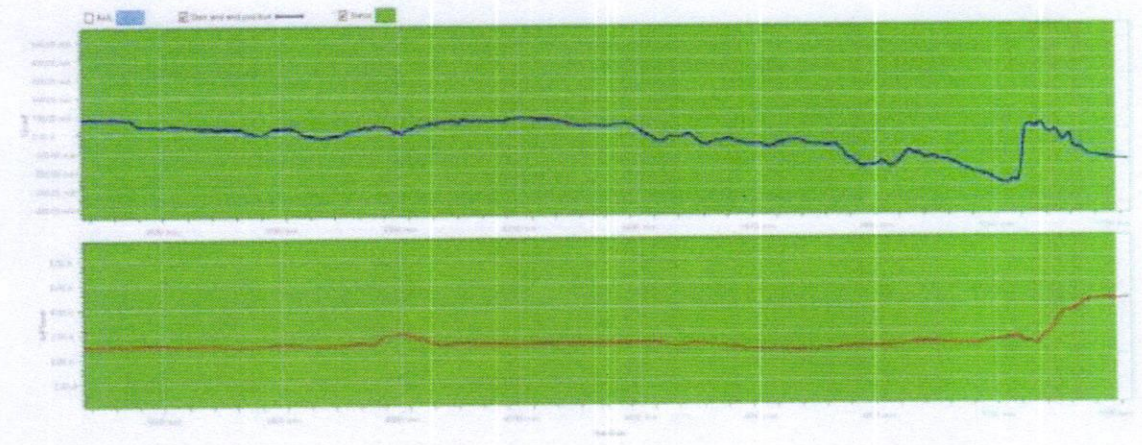
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1700mm 3420 mm



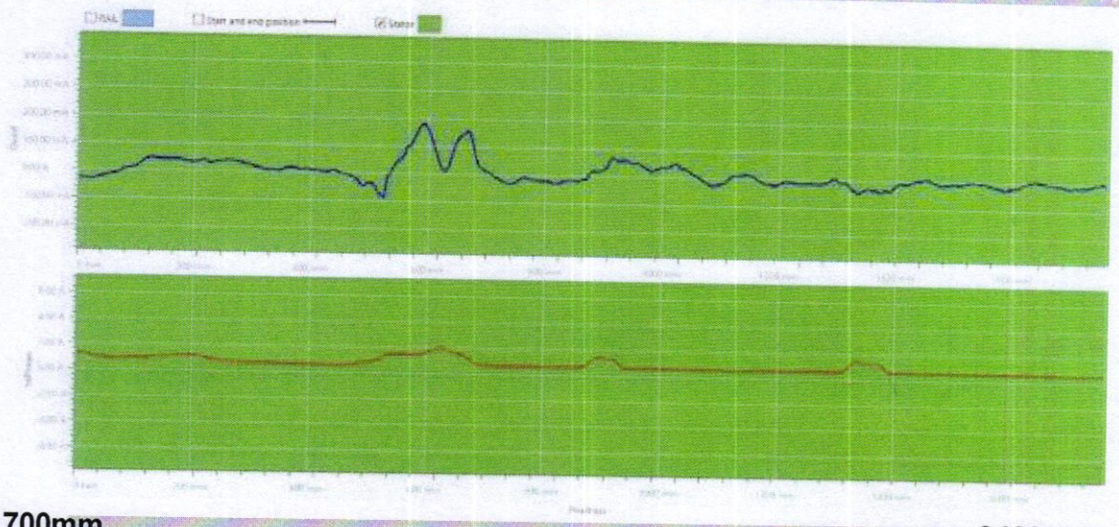
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Slot 32

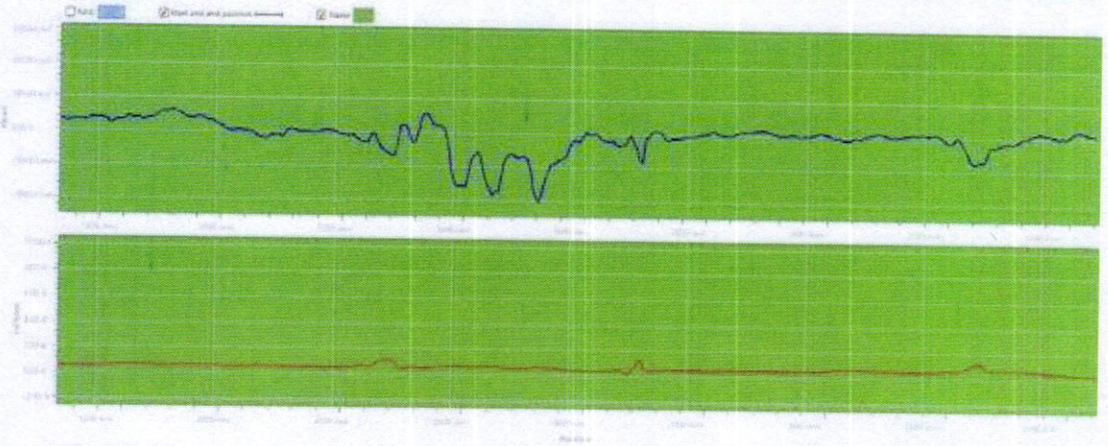
0mm

1760 mm



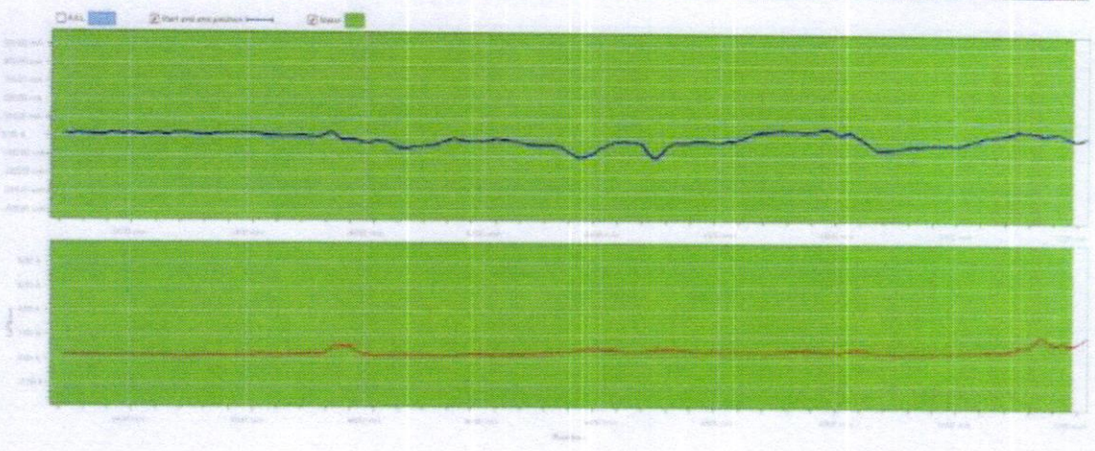
1700mm

3420 mm



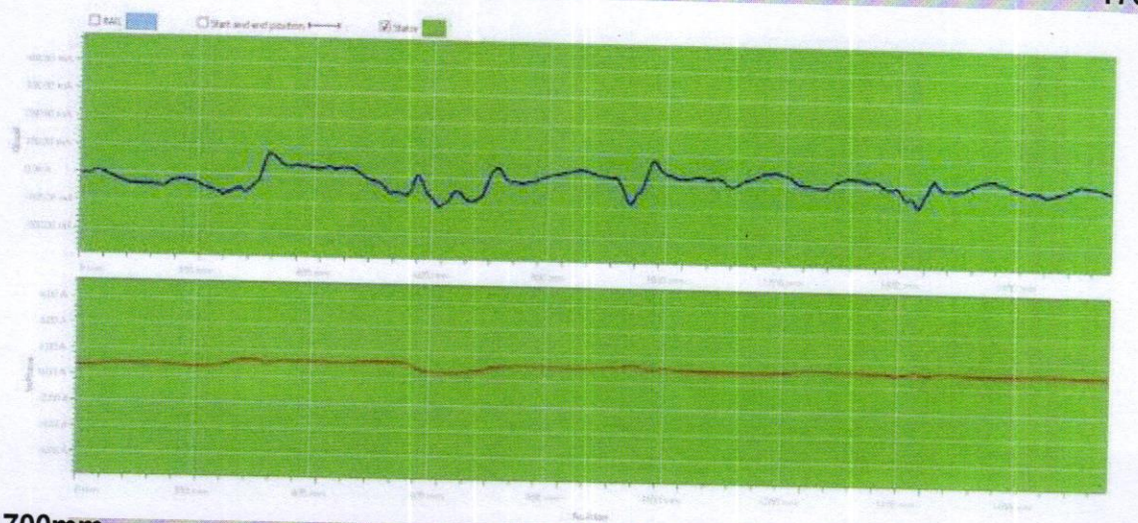
3410mm

5200 mm

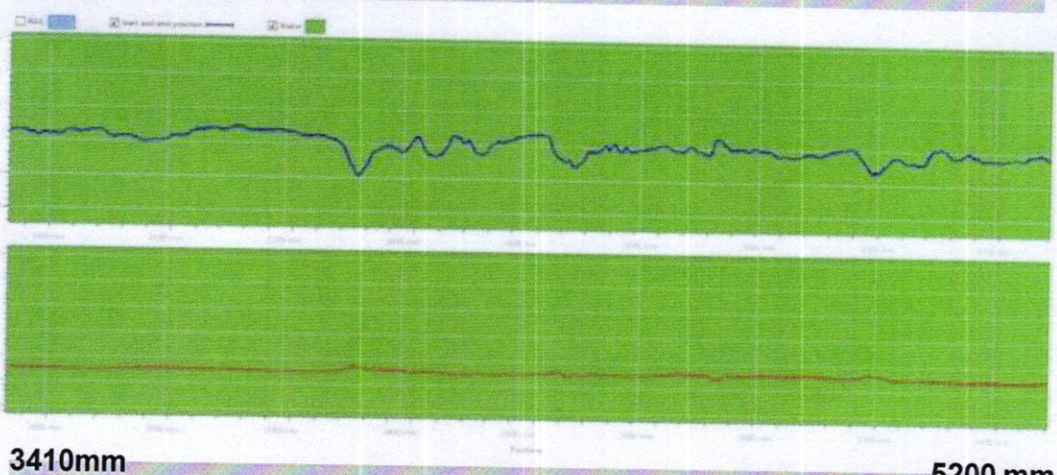


Slot 33

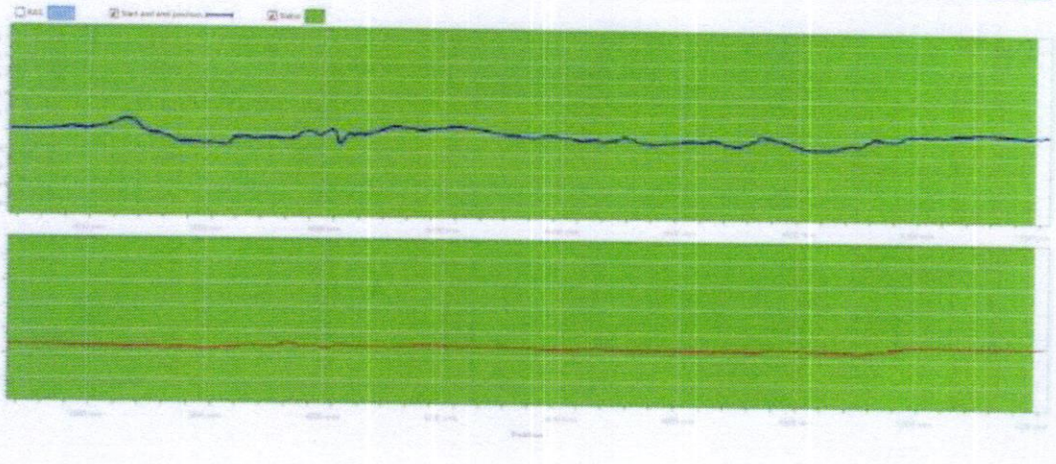
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1700mm 3420 mm



3410mm 5200 mm

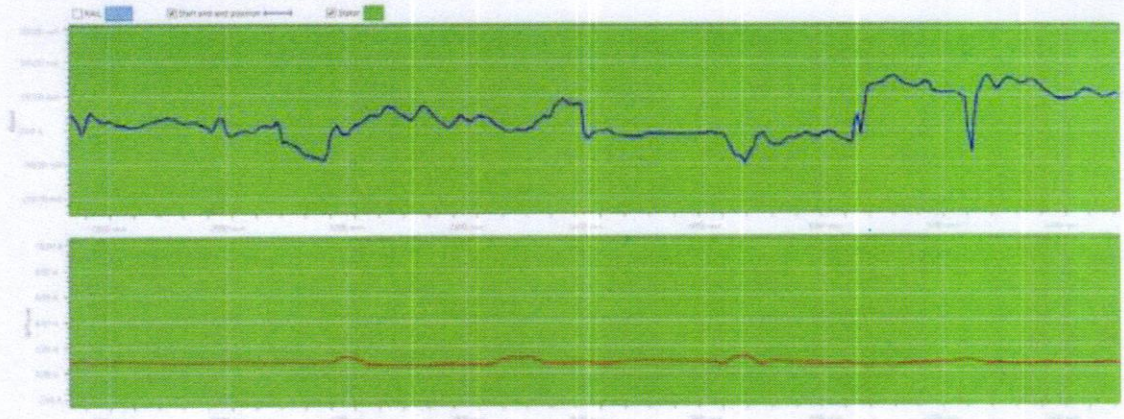


Slot 34

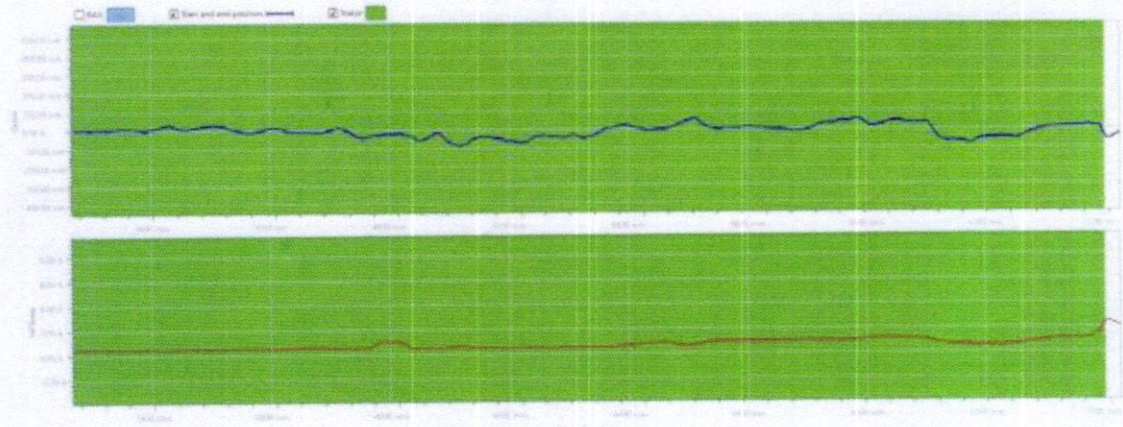
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1700mm 3420 mm

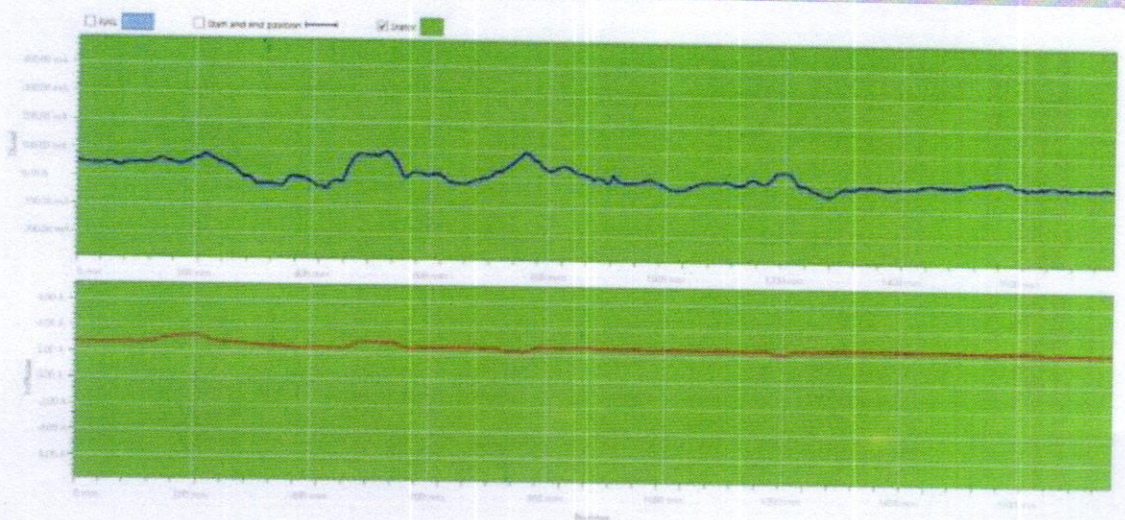


3410mm 5200 mm

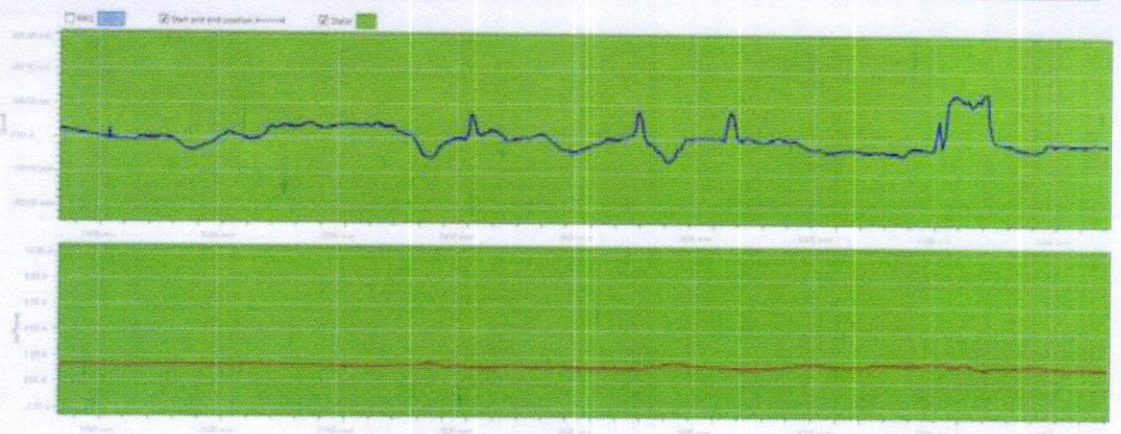


Slot 35

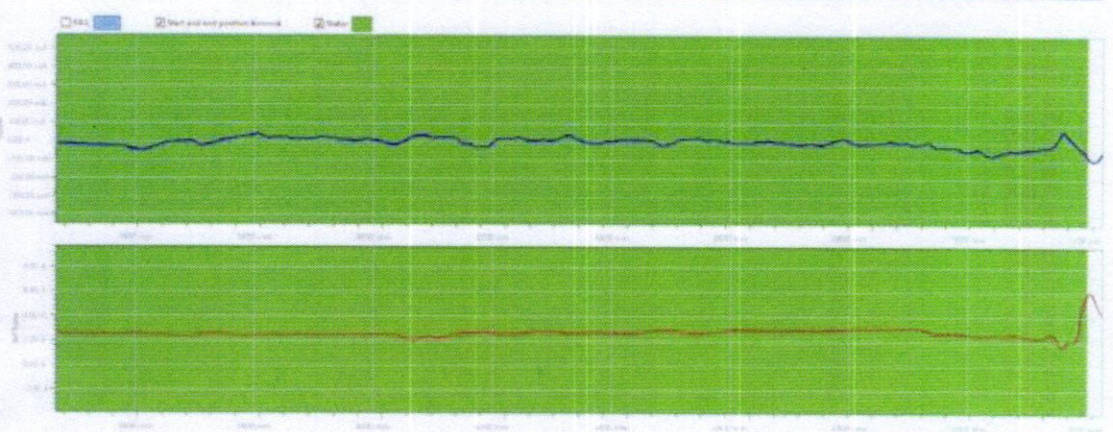
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1700mm 3420 mm



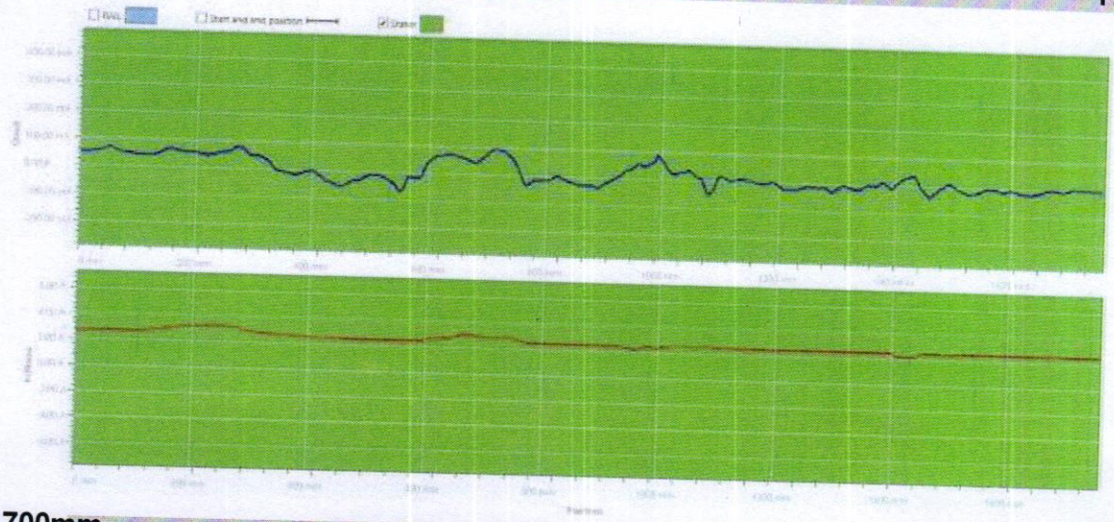
3410mm 5200 mm



Slot 36

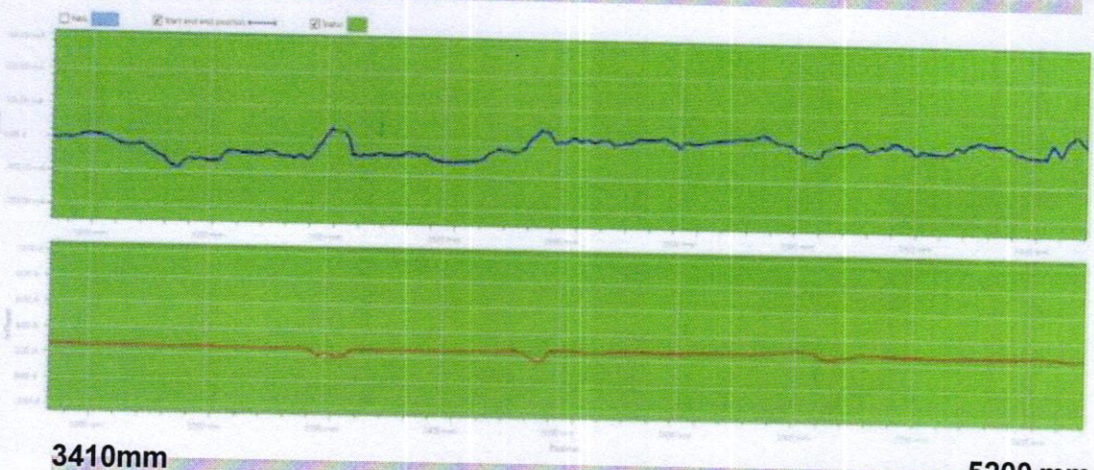
0mm

1760 mm



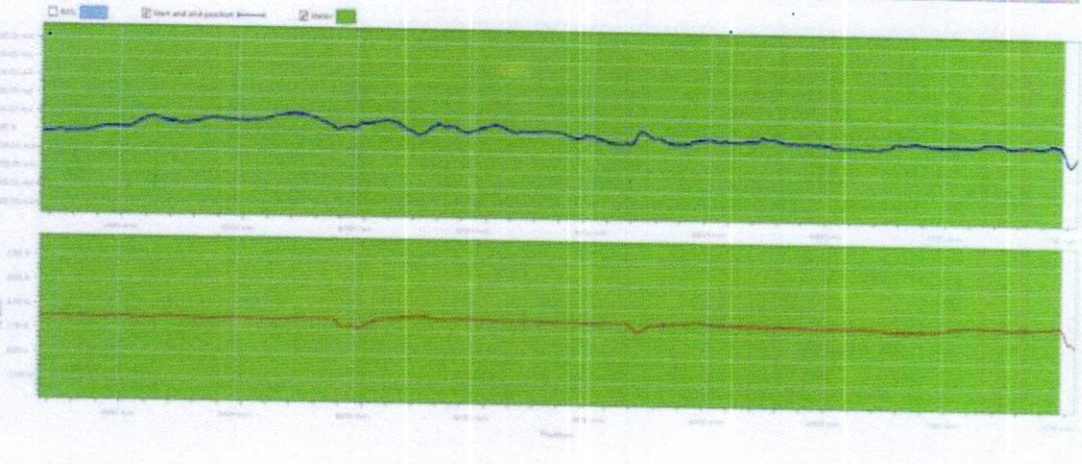
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3420 mm



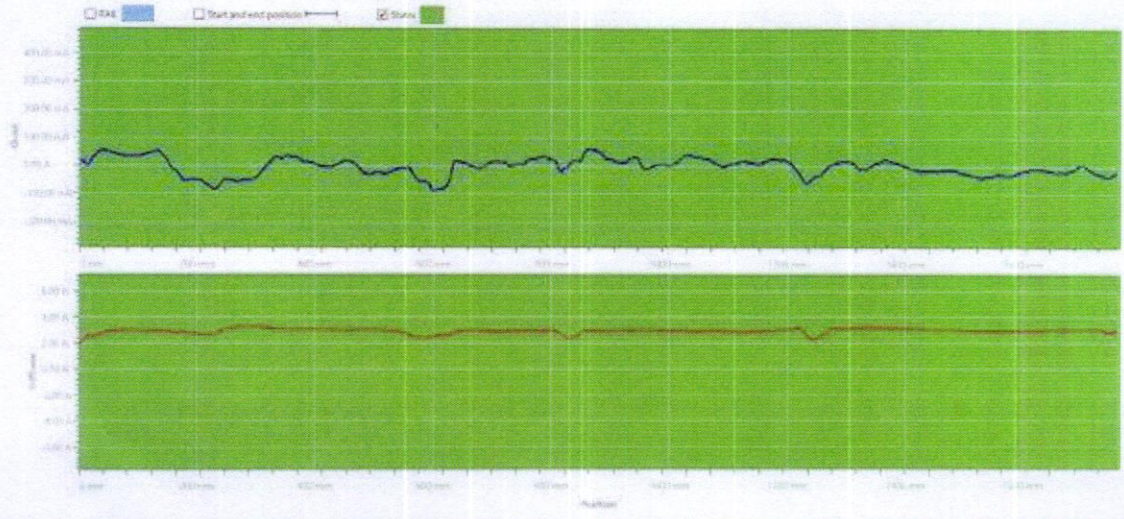
3410mm

5200 mm

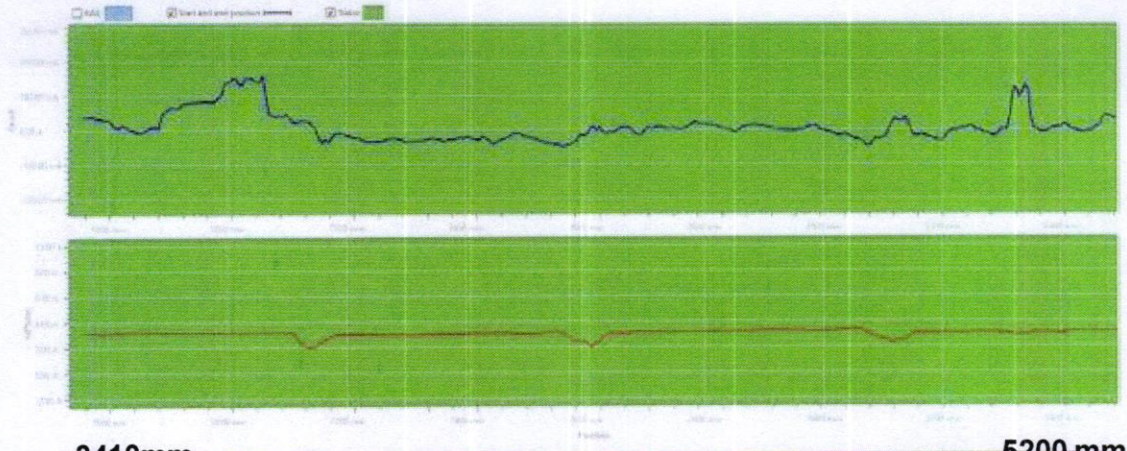


Slot 37

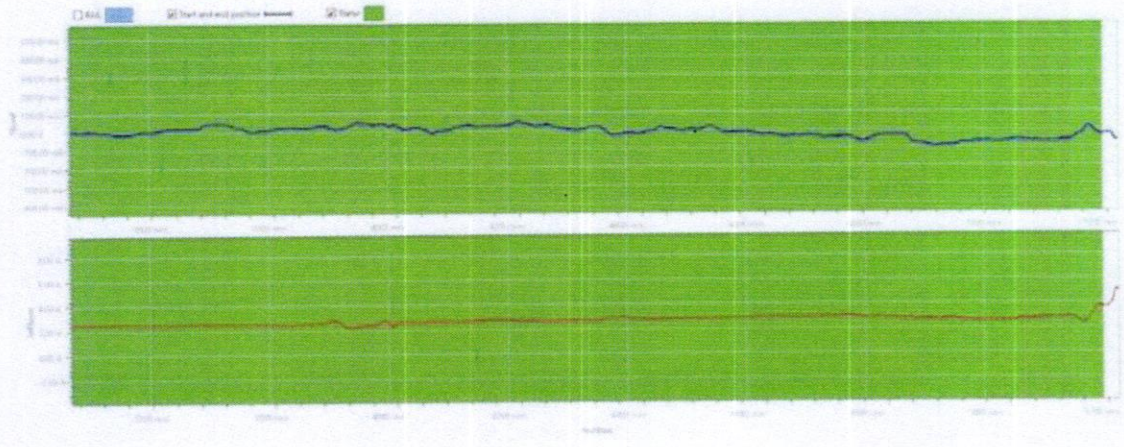
0mm 1760 mm



1700mm 3420 mm



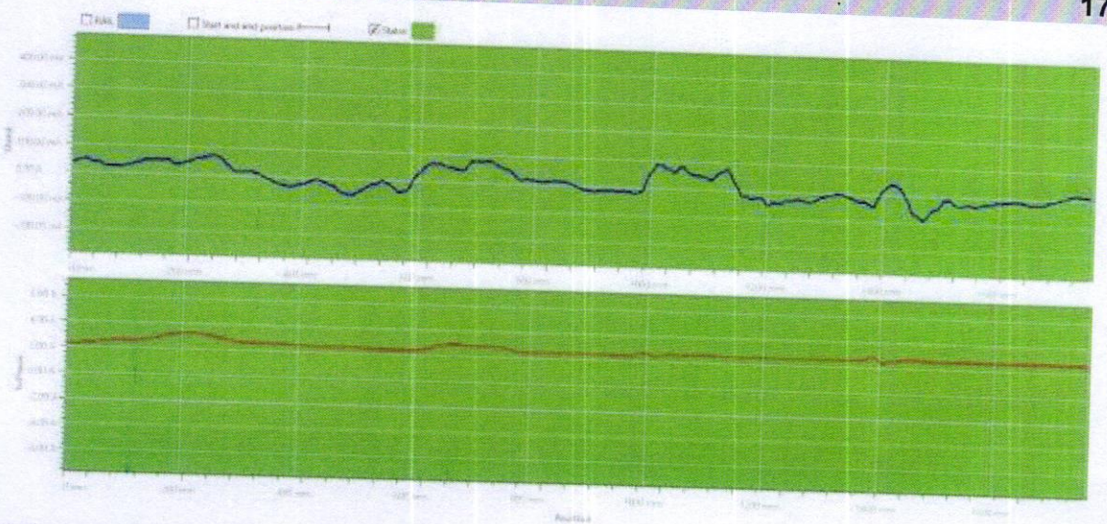
3410mm 5200 mm



Slot 38

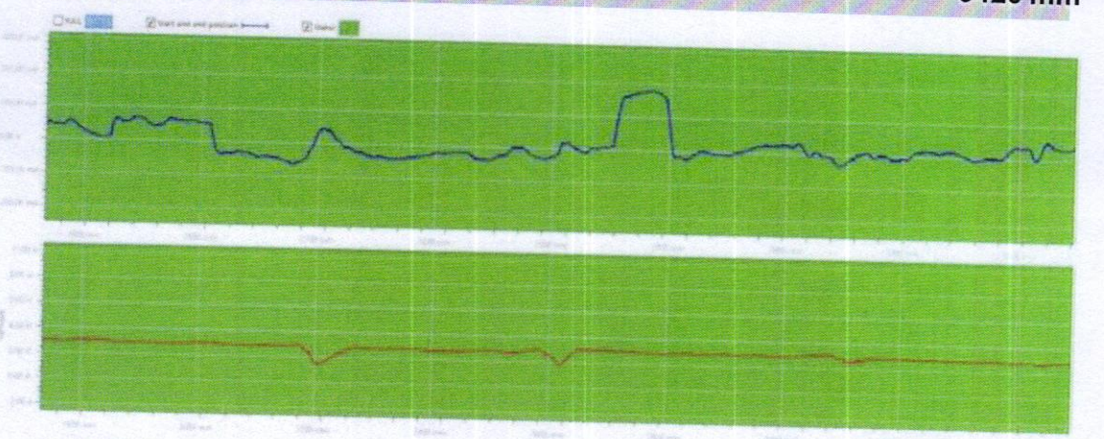
0mm

1760 mm



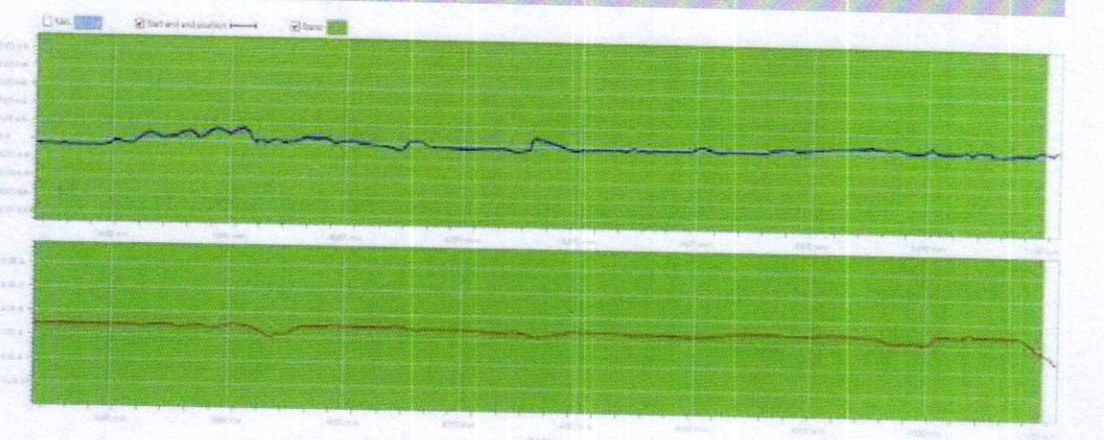
1700mm

3420 mm



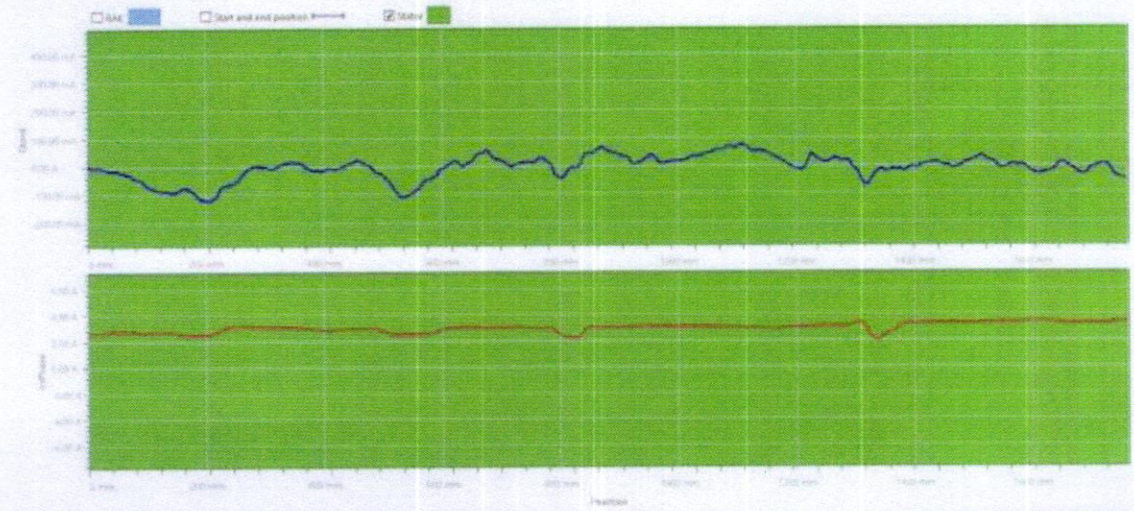
3410mm

5200 mm

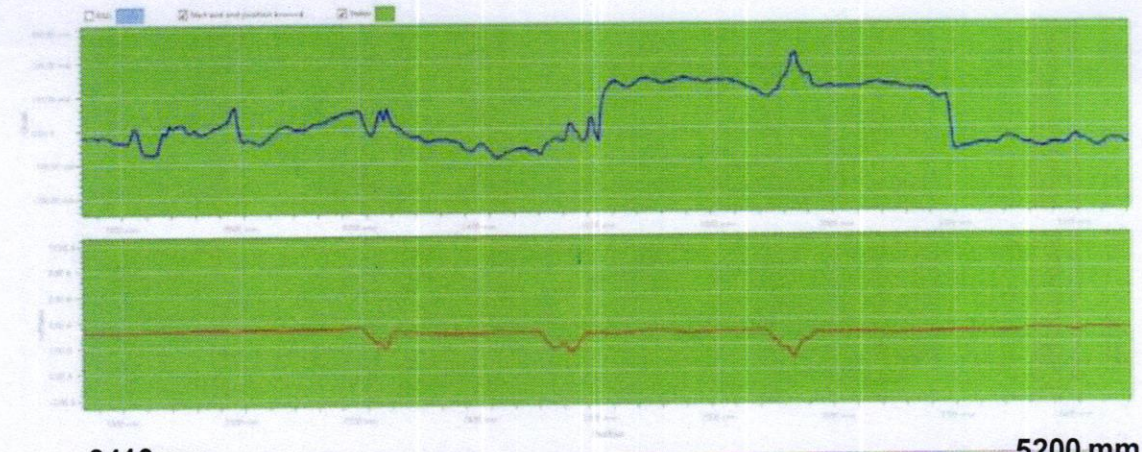


Slot 39

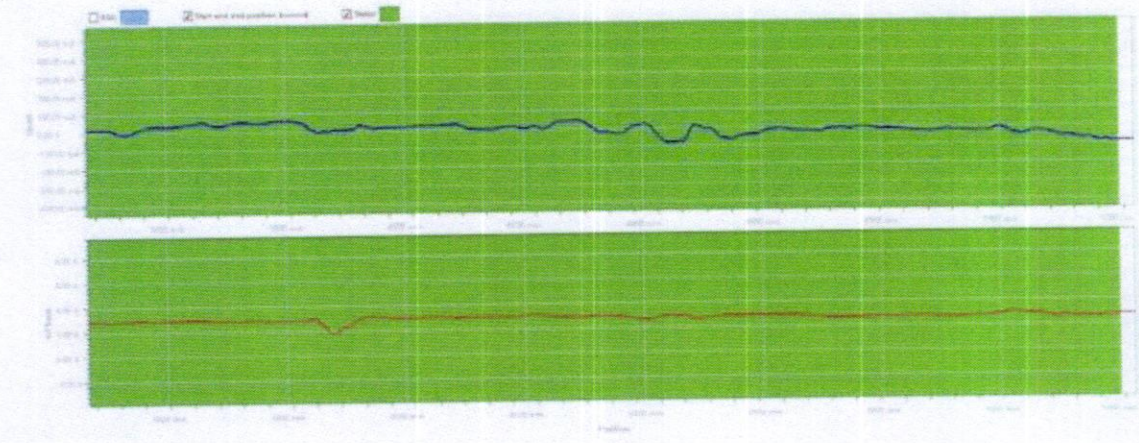
0mm 1760 mm



1700mm 3420 mm



3410mm 5200 mm

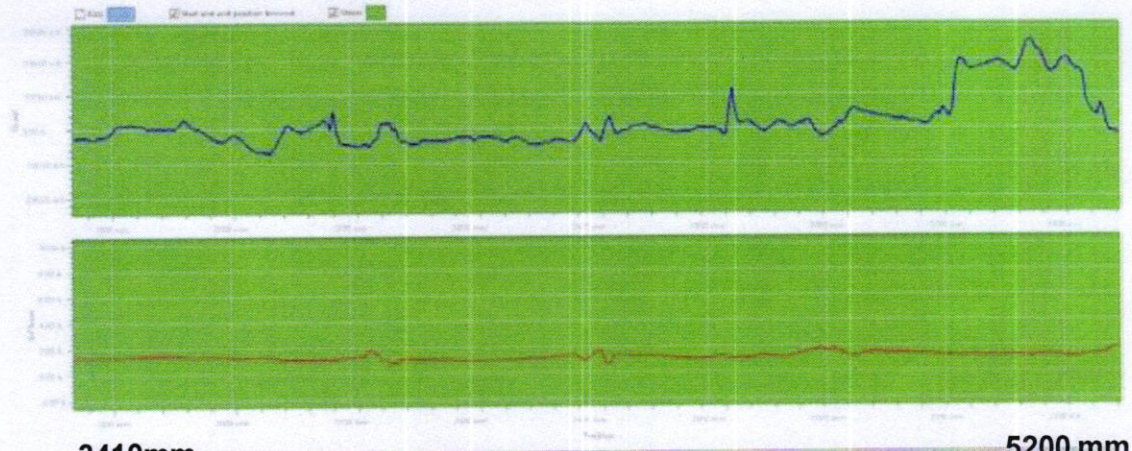


Slot 40

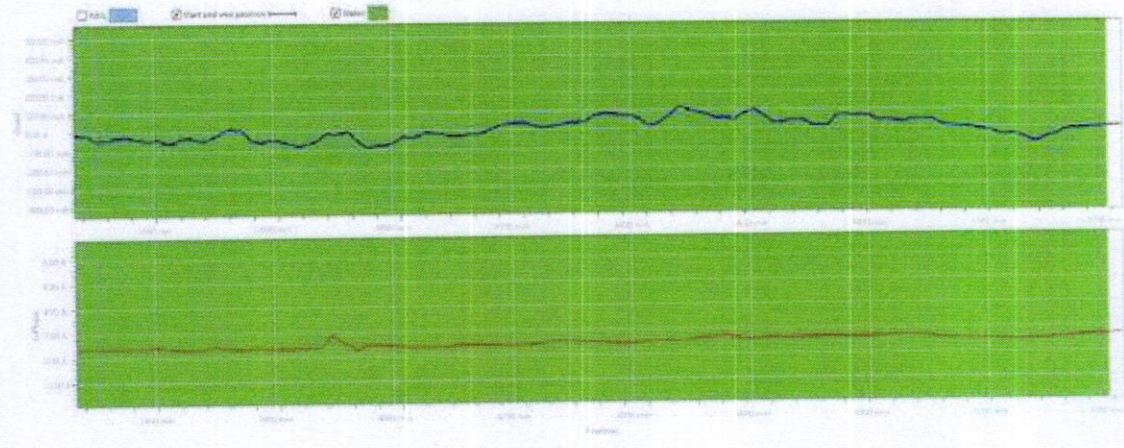
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1700mm 3420 mm

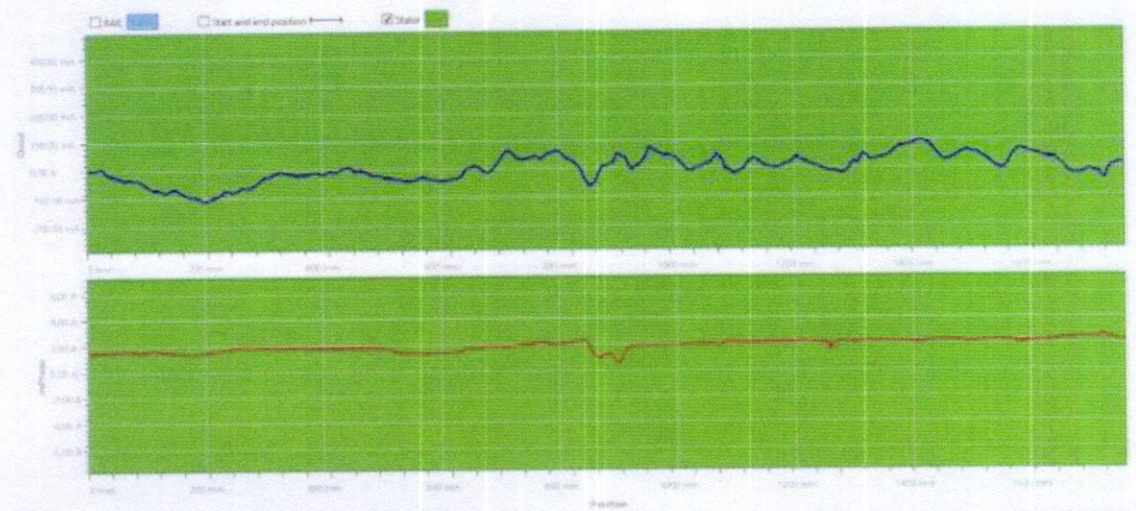


3410mm 5200 mm

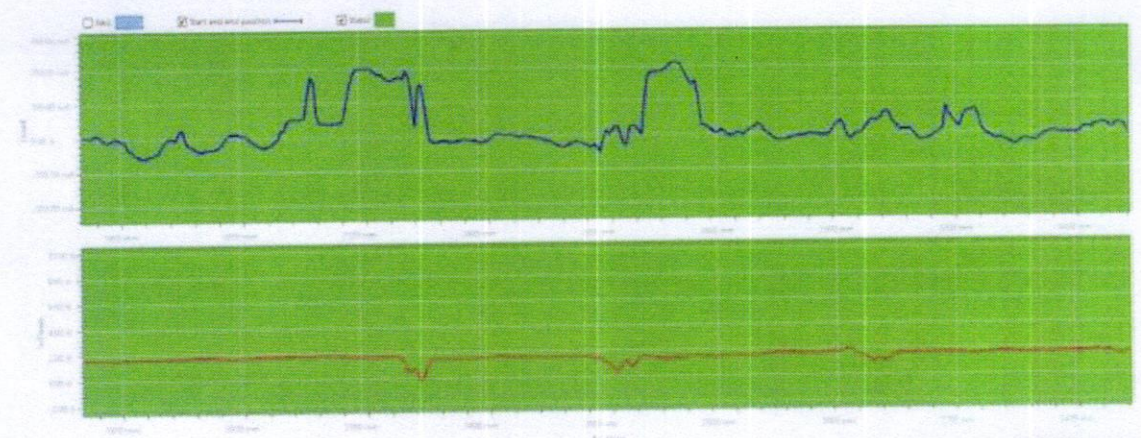


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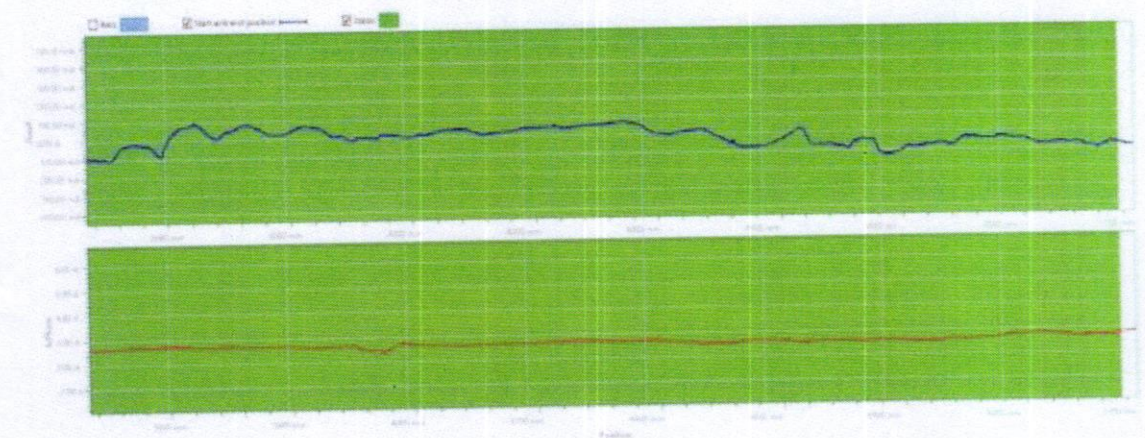
0mm 1760 mm



1700mm 3420 mm



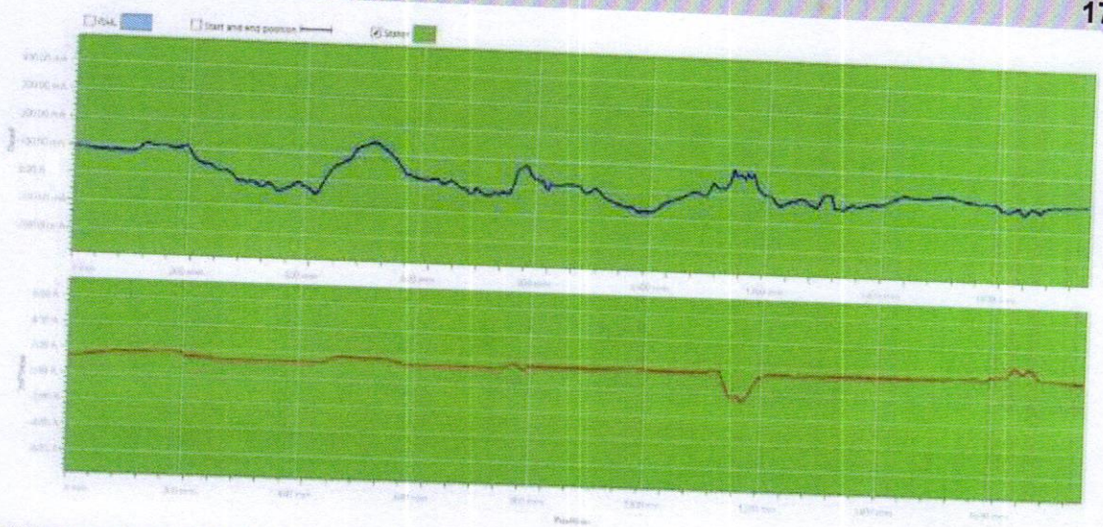
3410mm 5200 mm



Slot 42

0mm

1760 mm



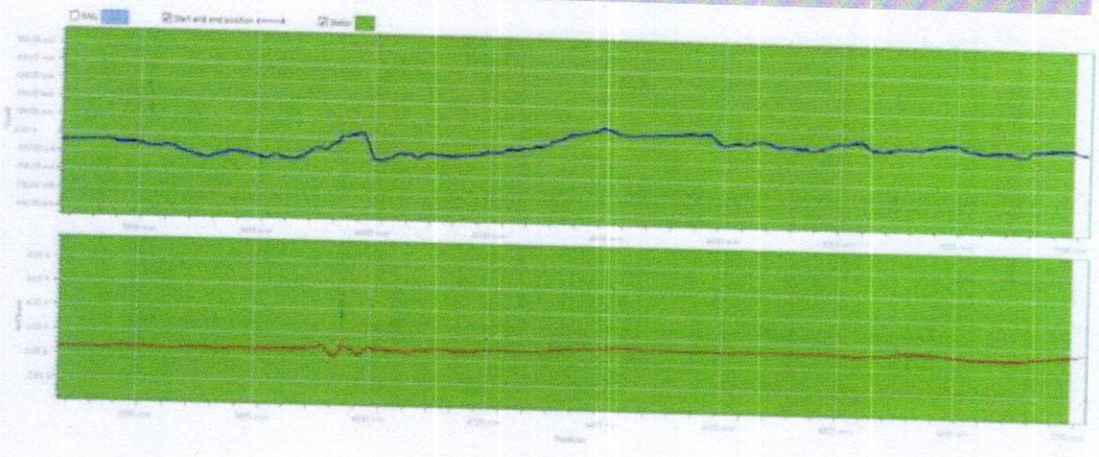
1700mm

3420 mm



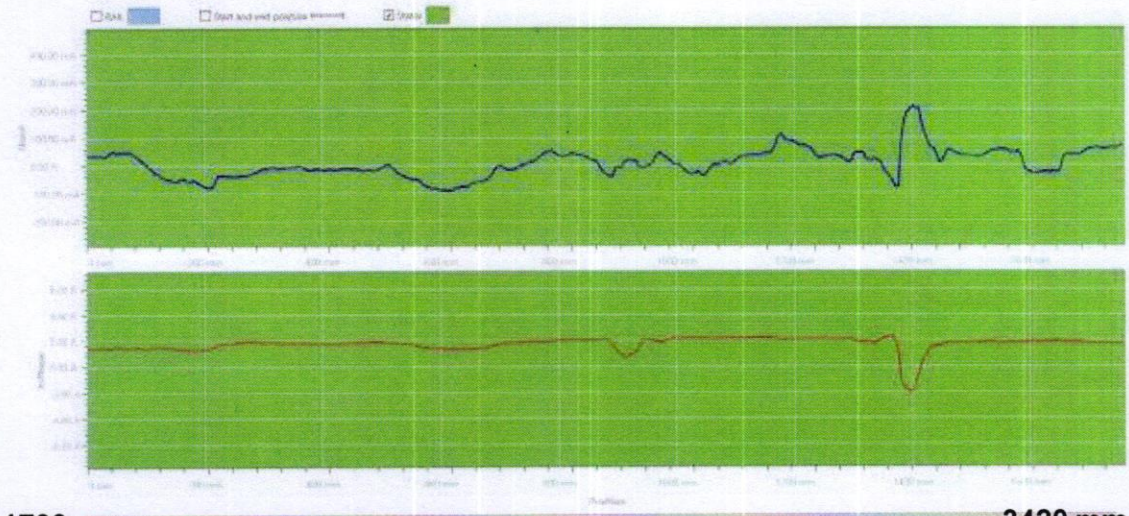
3410mm

5200 mm

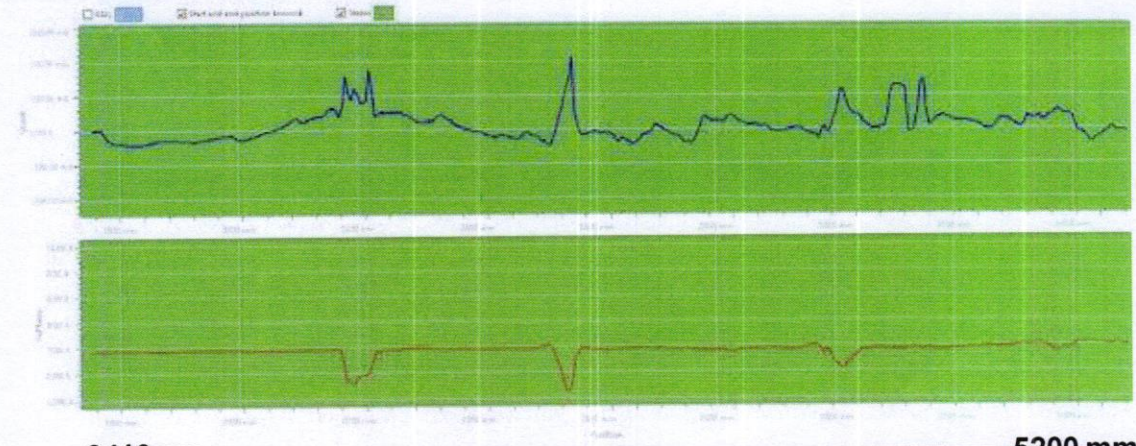


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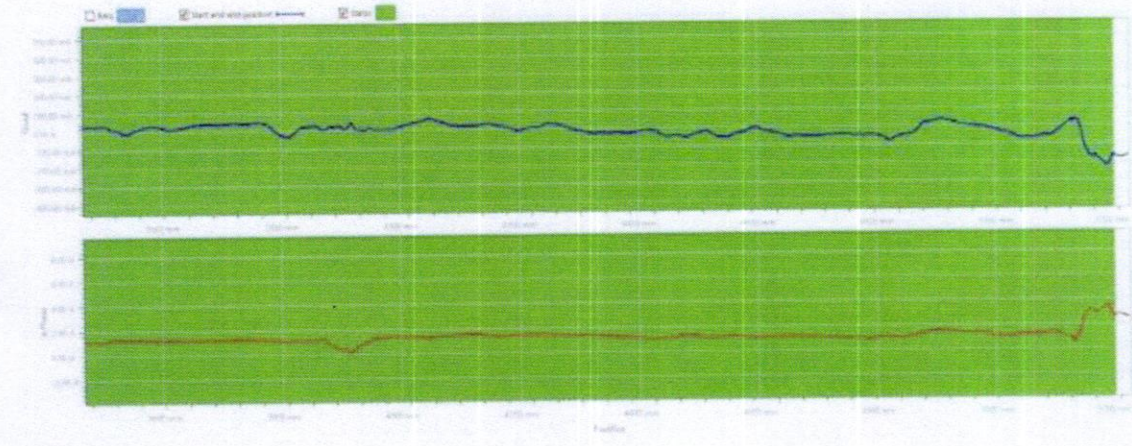
0mm 1760 mm



1700mm 3420 mm

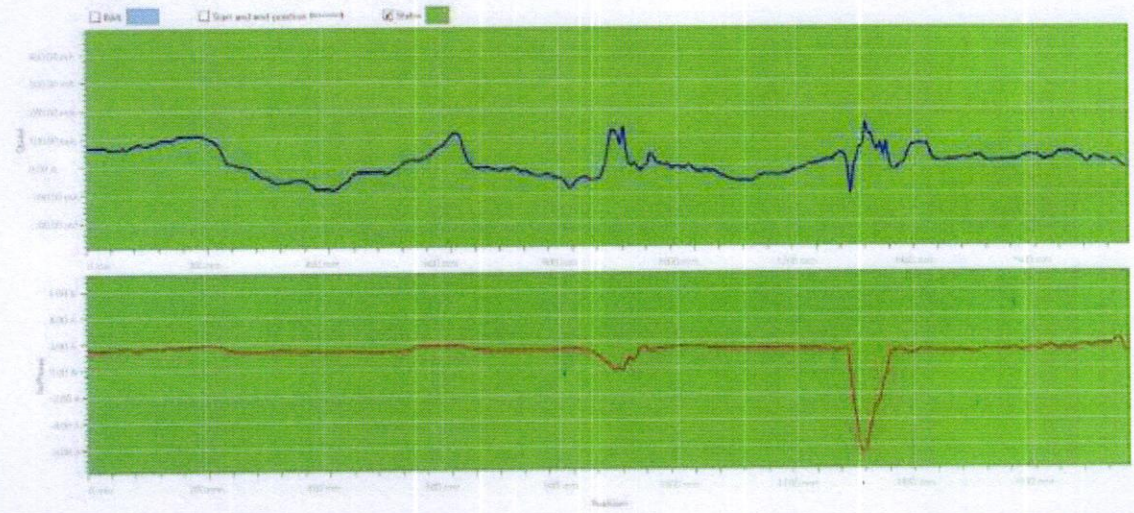


3410mm 5200 mm

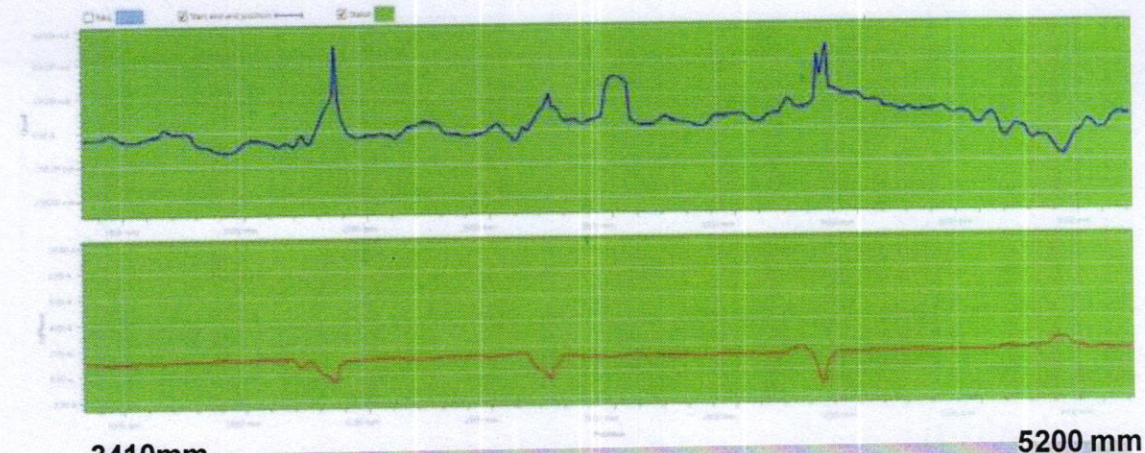


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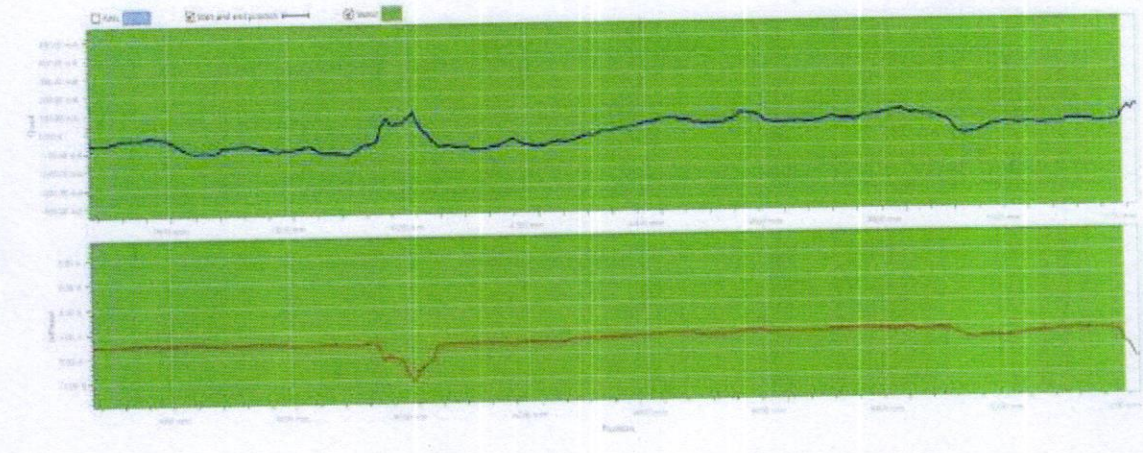
0mm 1760 mm



1700mm 3420 mm

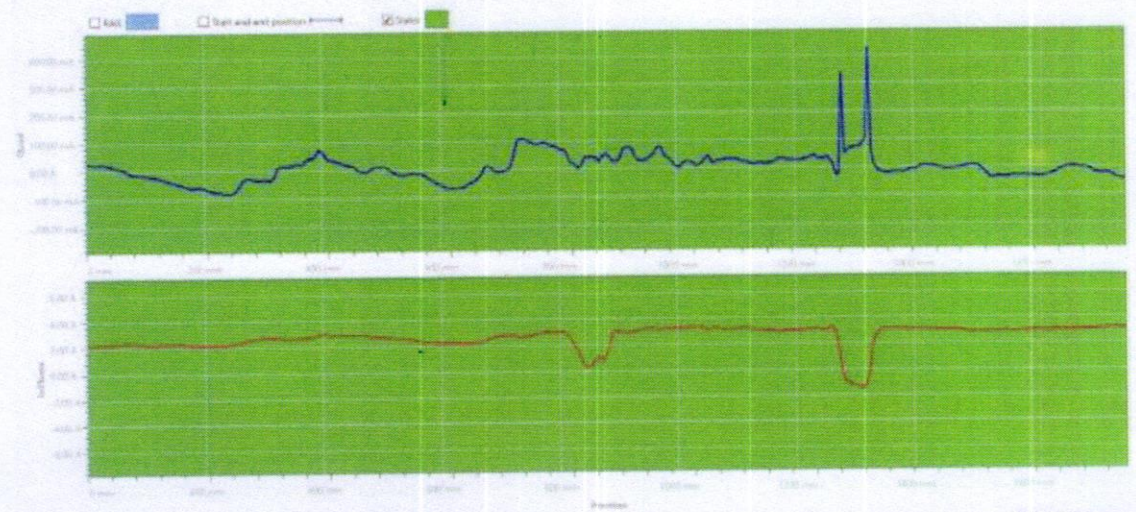


3410mm 5200 mm

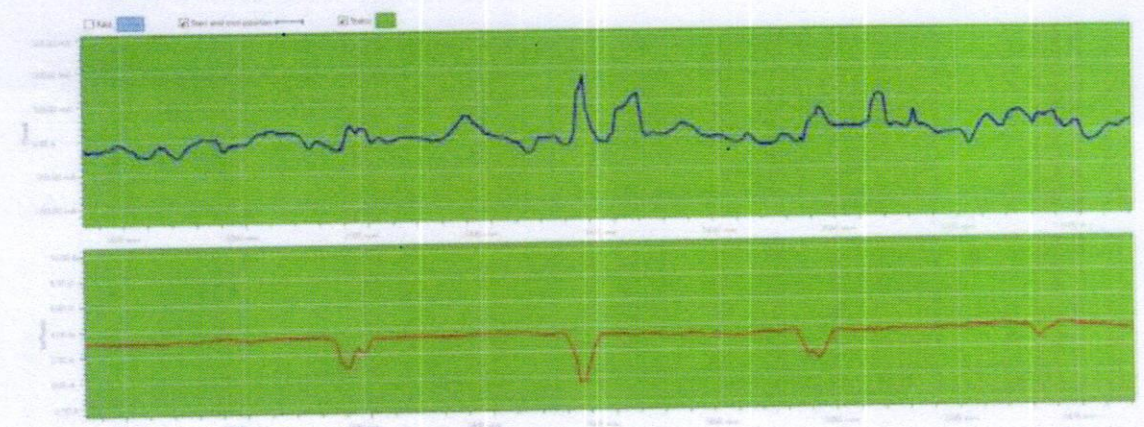


Slot 45

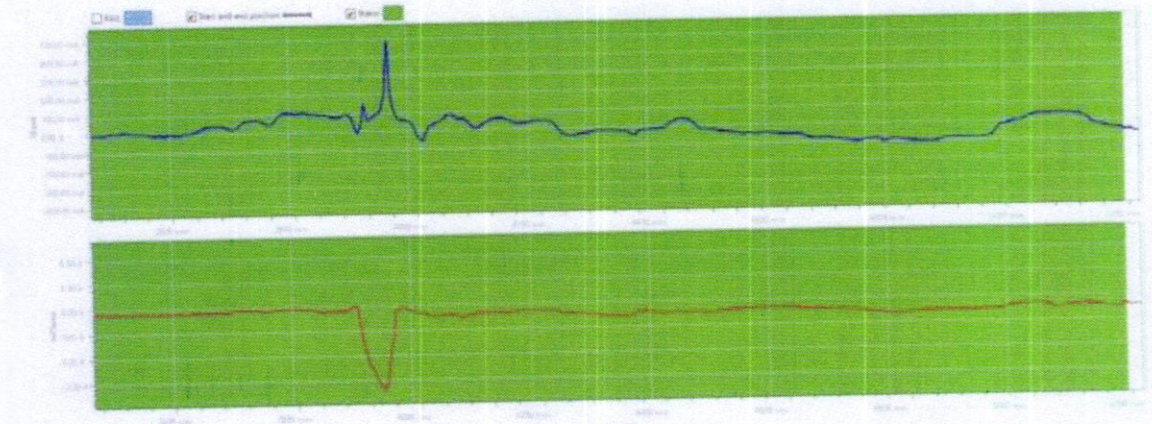
0mm 1760 mm



1700mm 3420 mm



3410mm 5200 mm

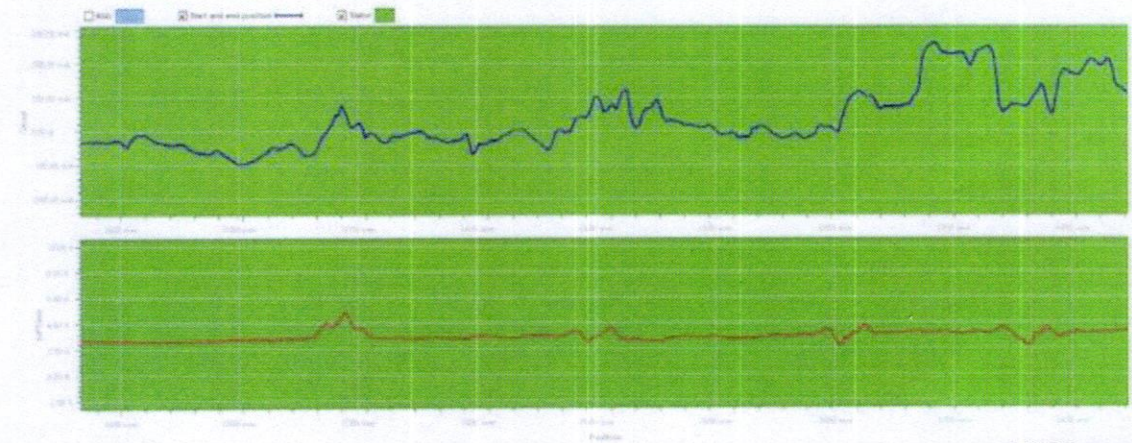


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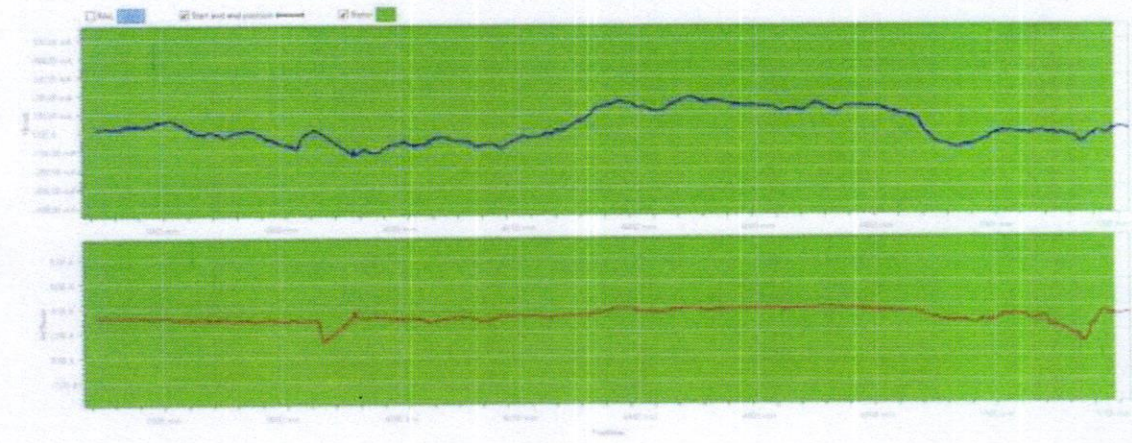
0mm 1760 mm



1700mm 3420 mm

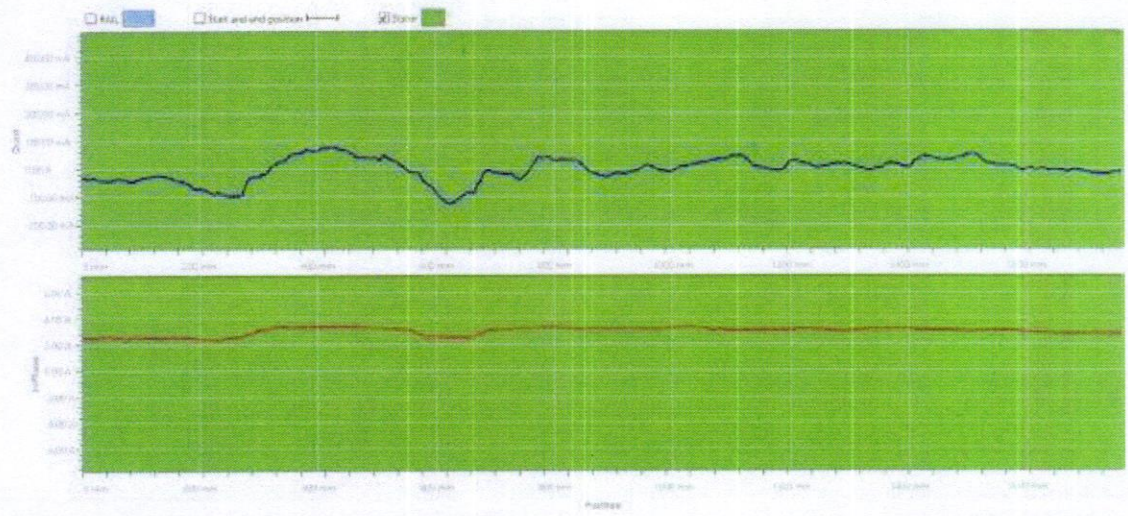


3410mm 5200 mm

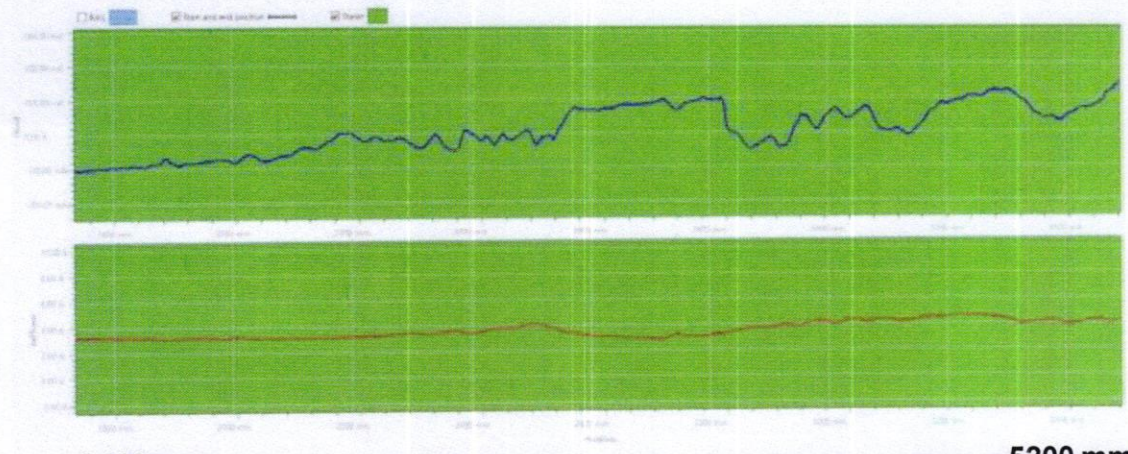


Slot 47

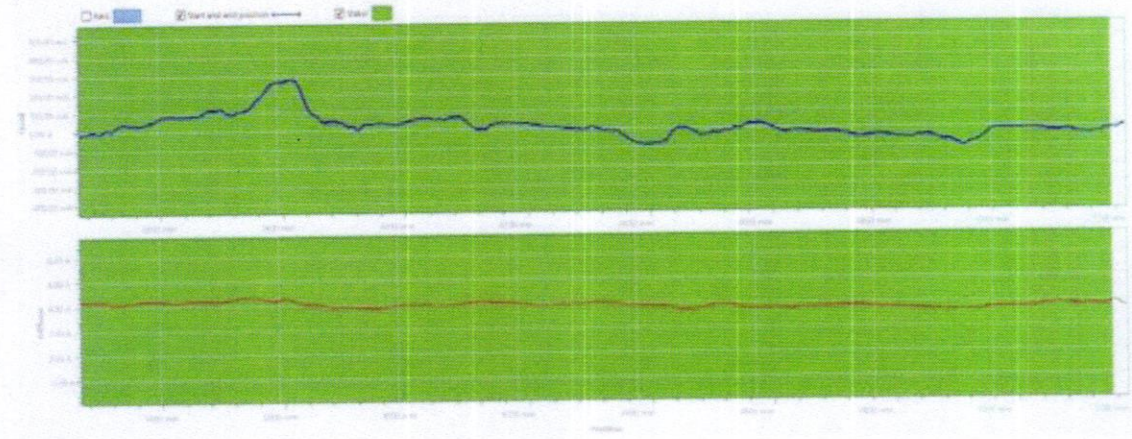
0mm 1760 mm



1700mm 3420 mm

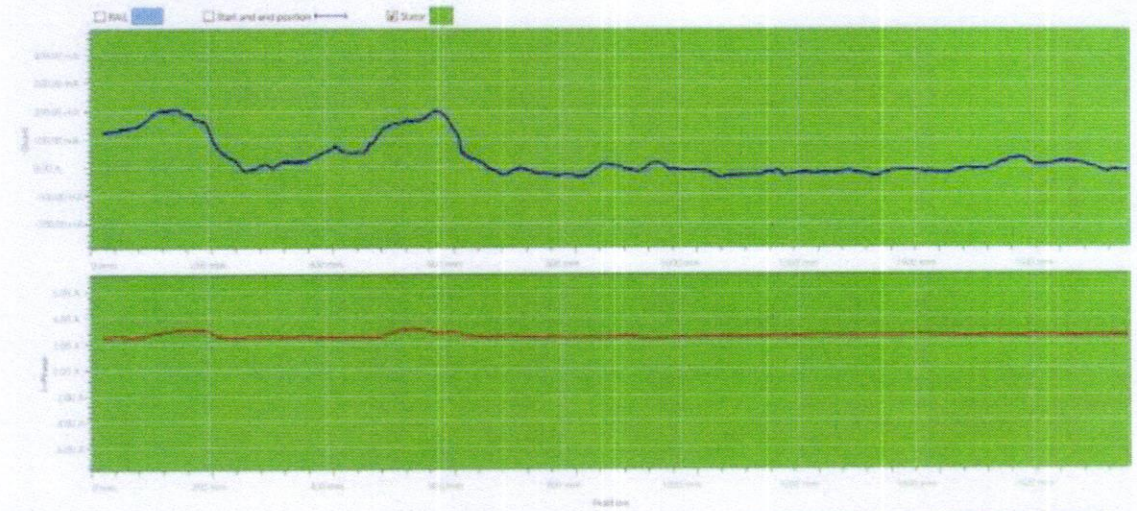


3410mm 5200 mm

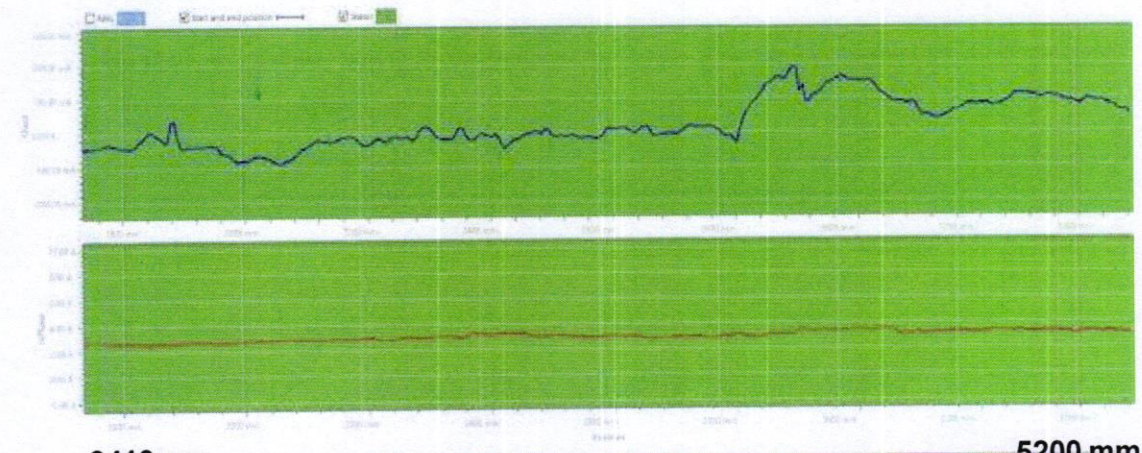


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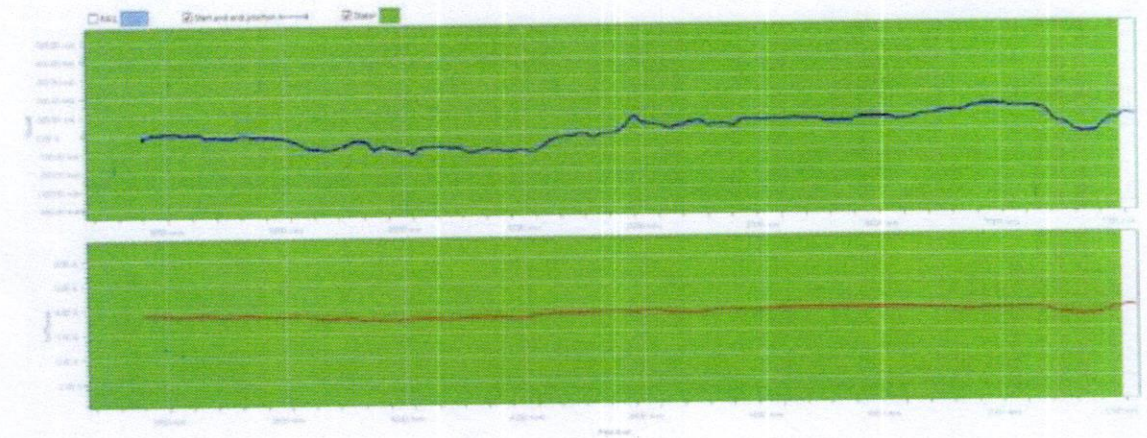
0mm 1760 mm



1700mm 3420 mm

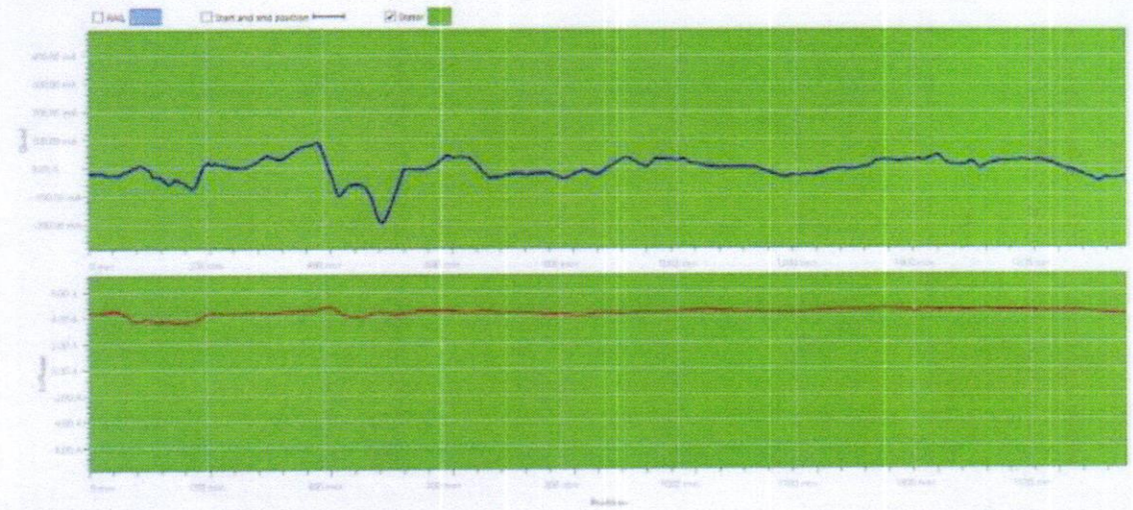


3410mm 5200 mm

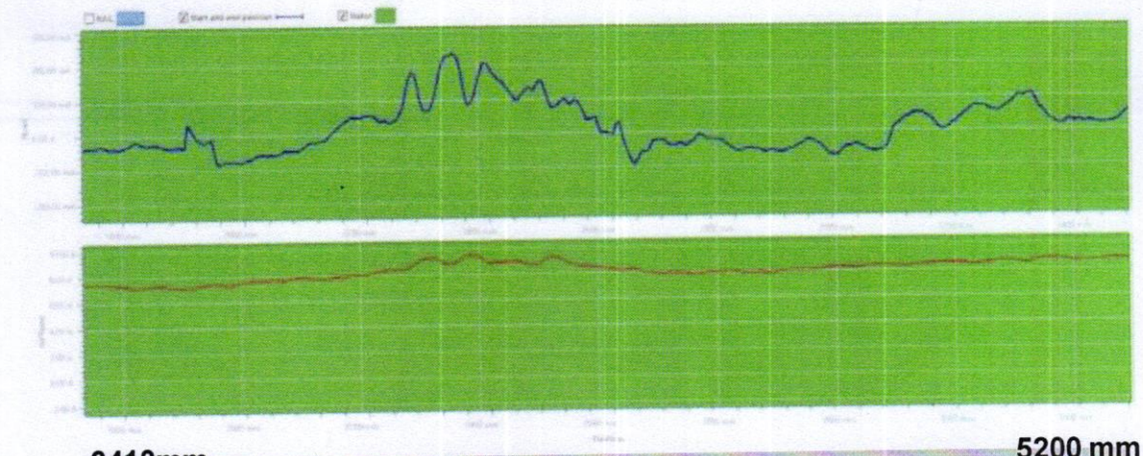


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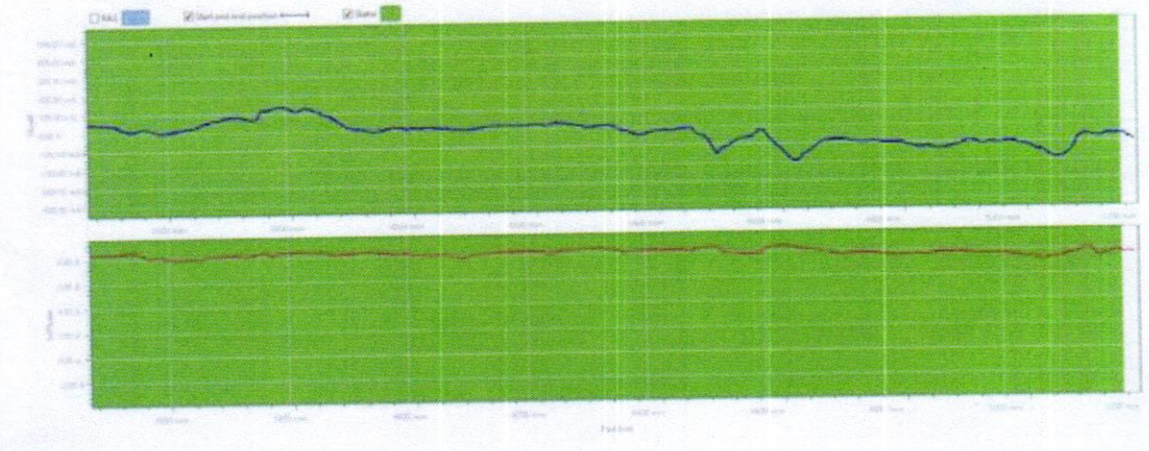
0mm 1760 mm



1700mm 3420 mm

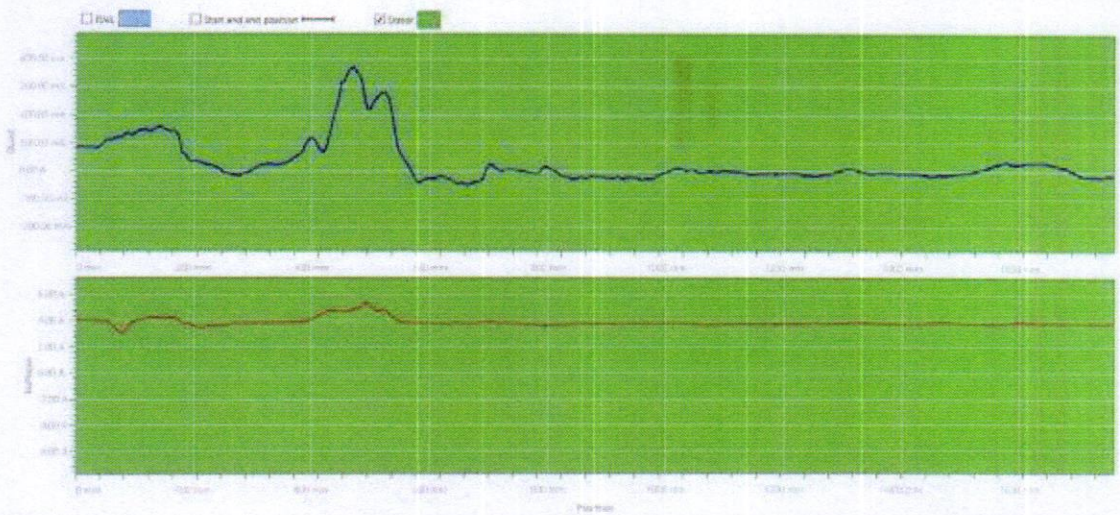


3410mm 5200 mm

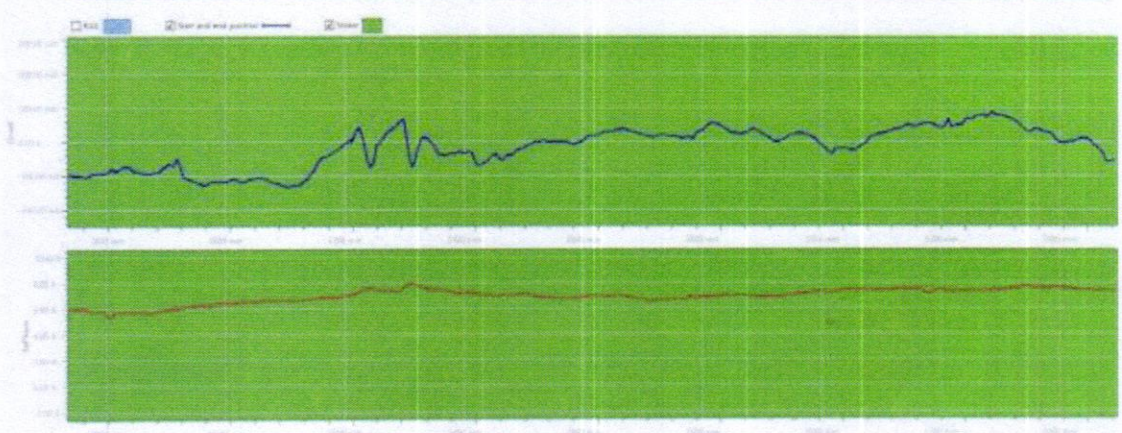


Slot 50

0mm 1760 mm



1700mm 3420 mm

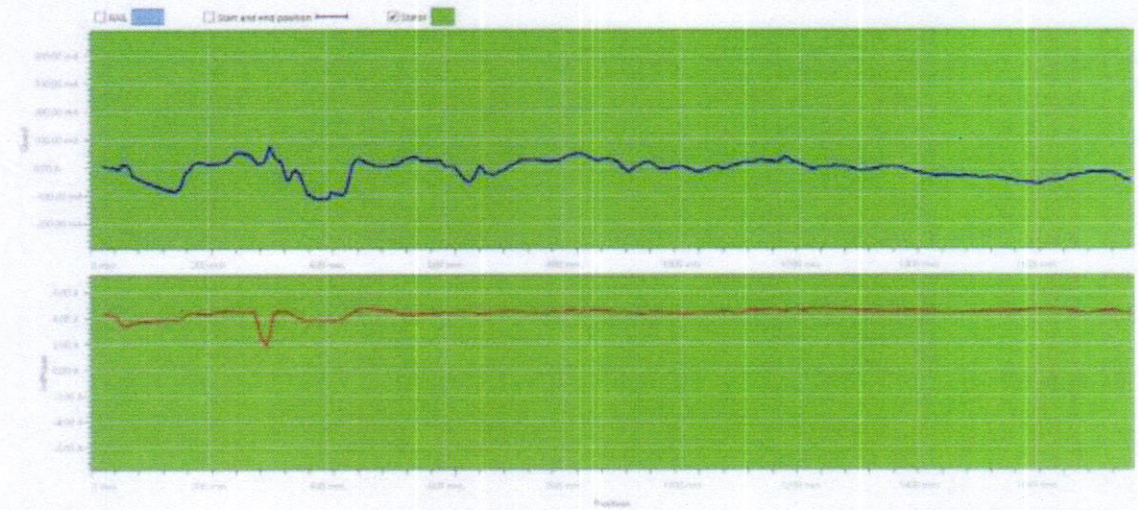


3410mm 5200 mm

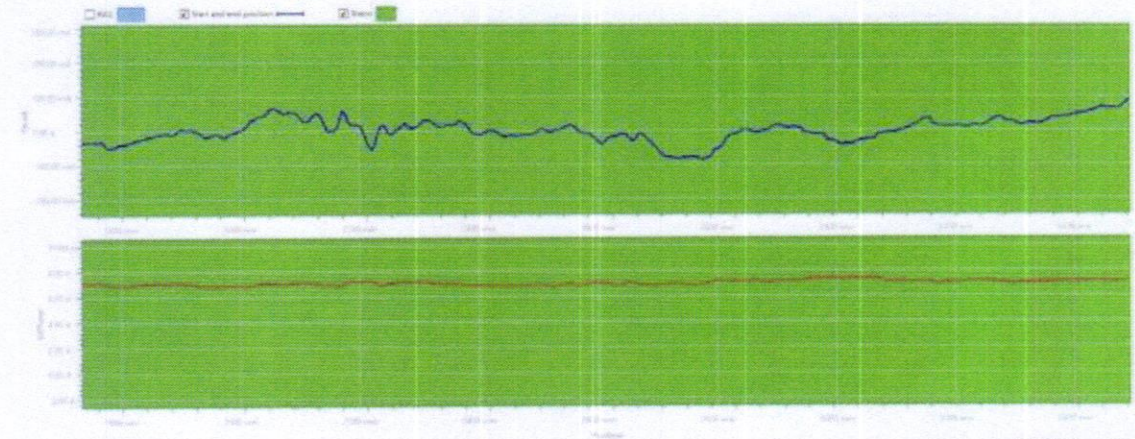


Slot 51

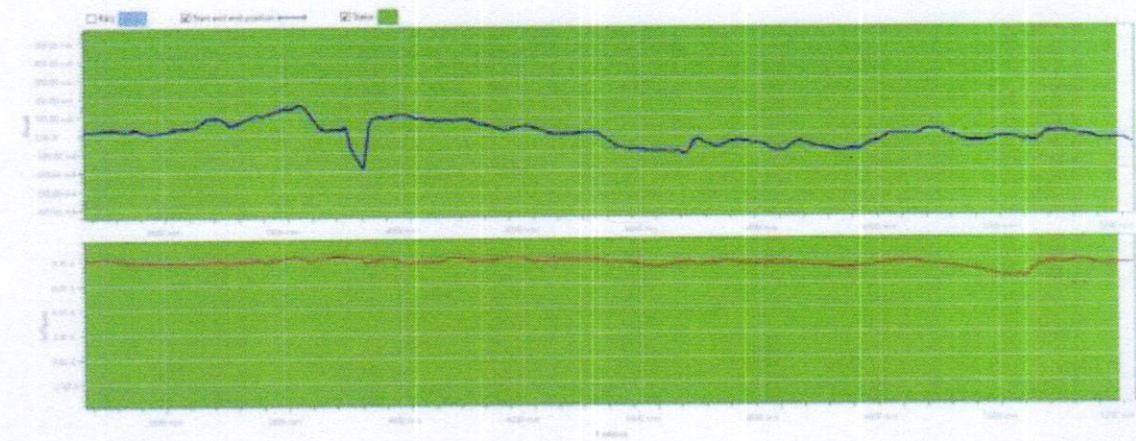
0mm 1760 mm



1700mm 3420 mm

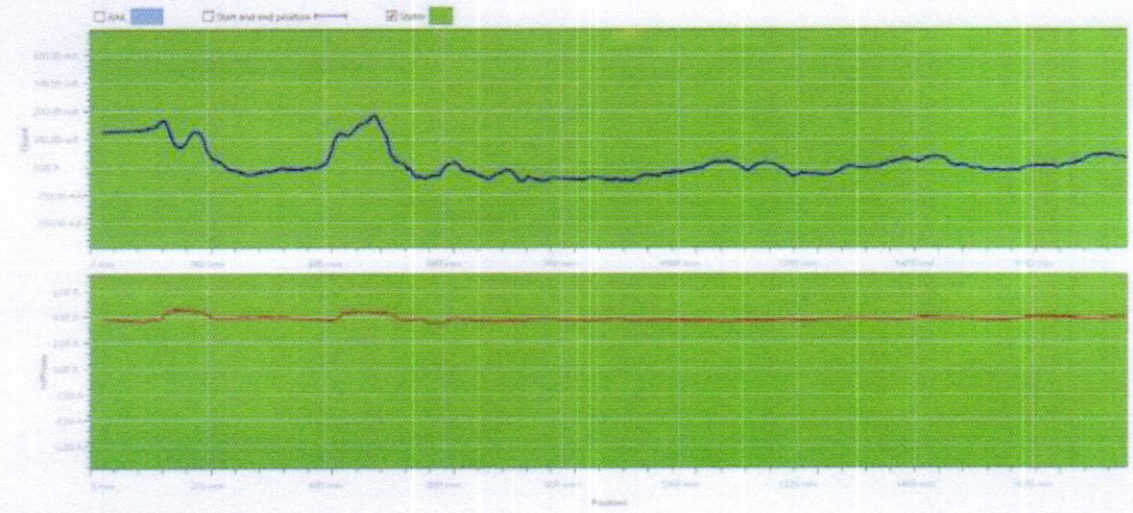


3410mm 5200 mm

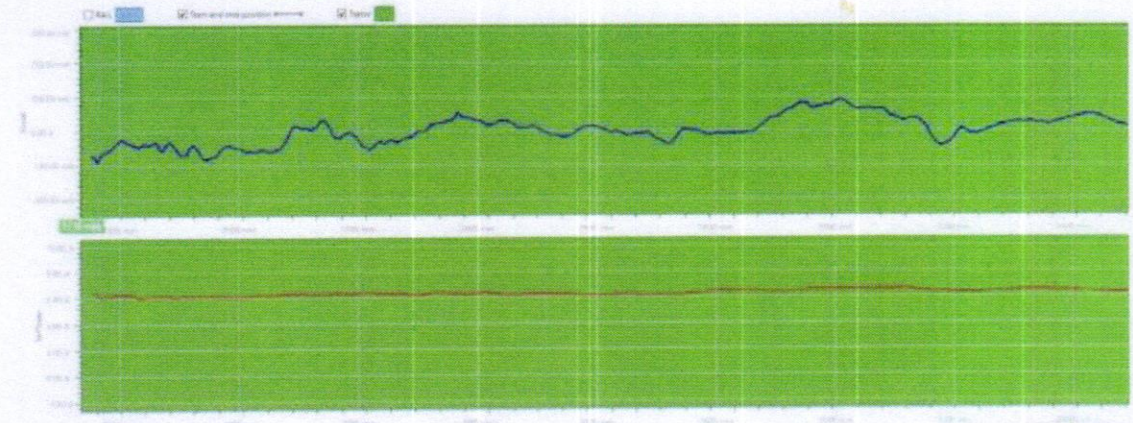


Slot 52

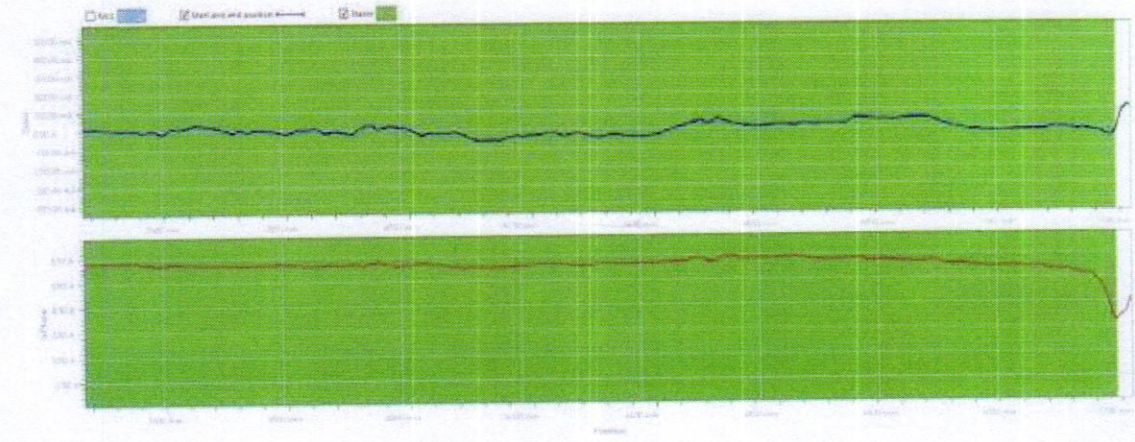
0mm 1760 mm



1700mm 3420 mm

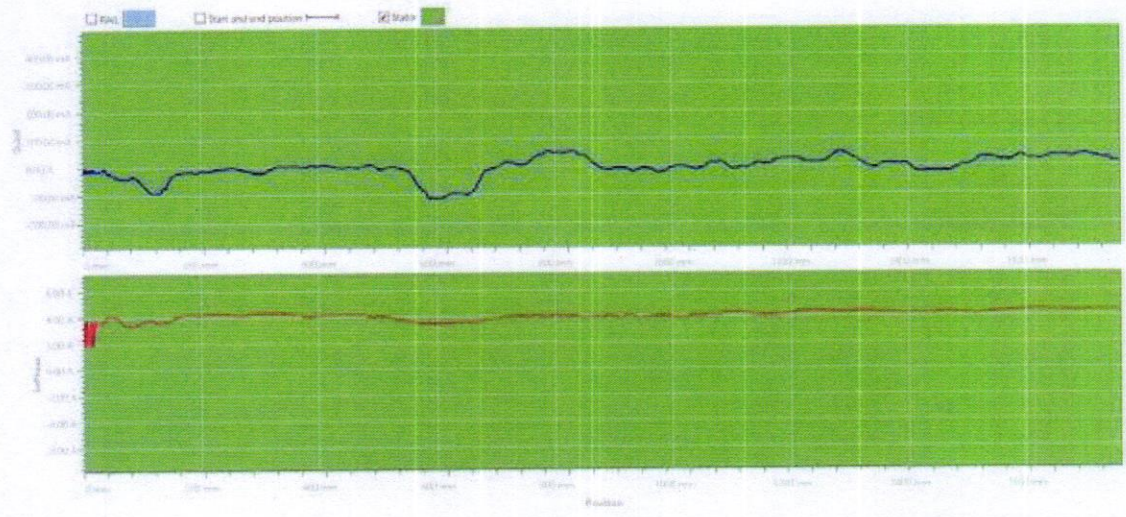


3410mm 5200 mm

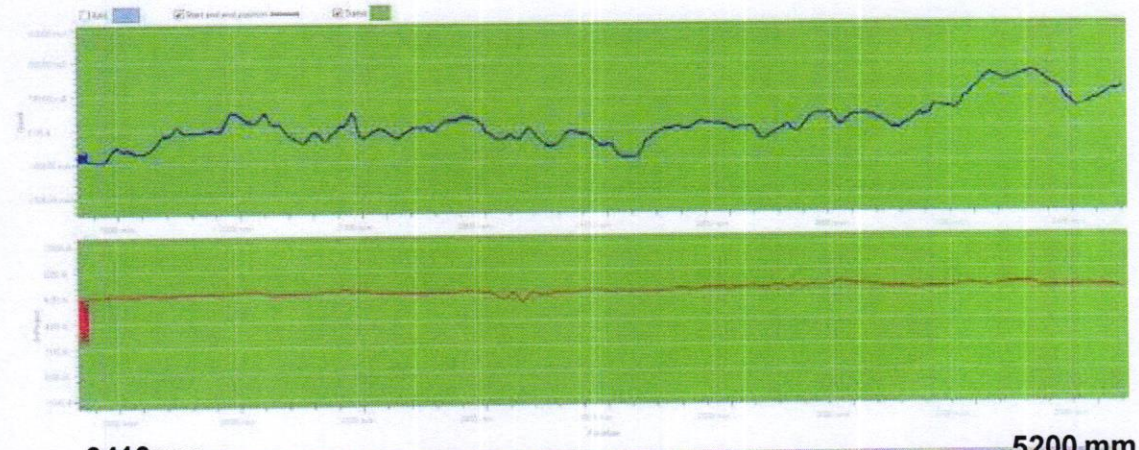


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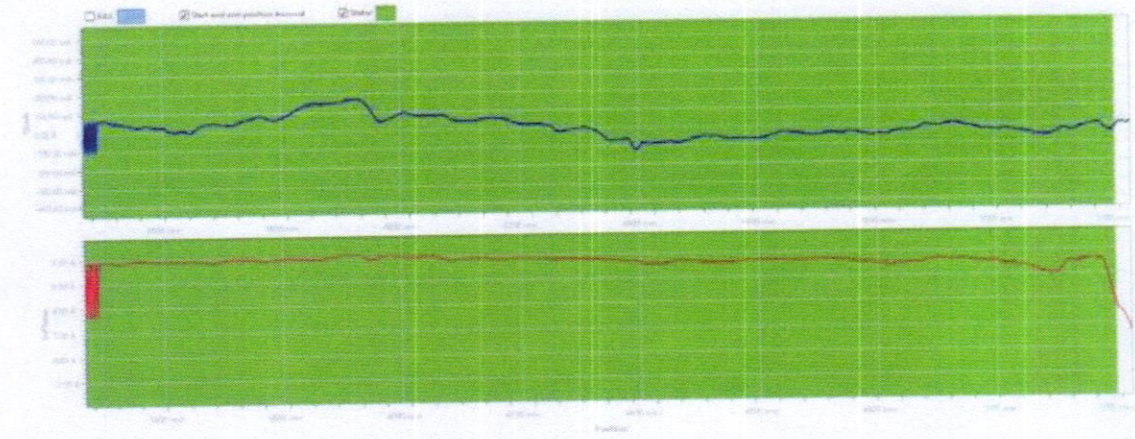
0mm 1760 mm



1700mm 3420 mm

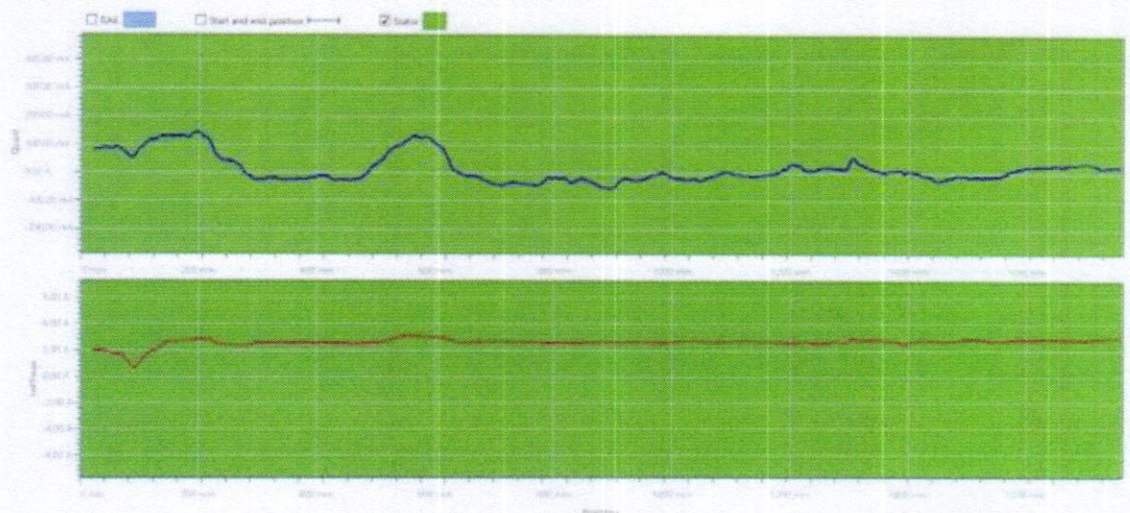


3410mm 5200 mm

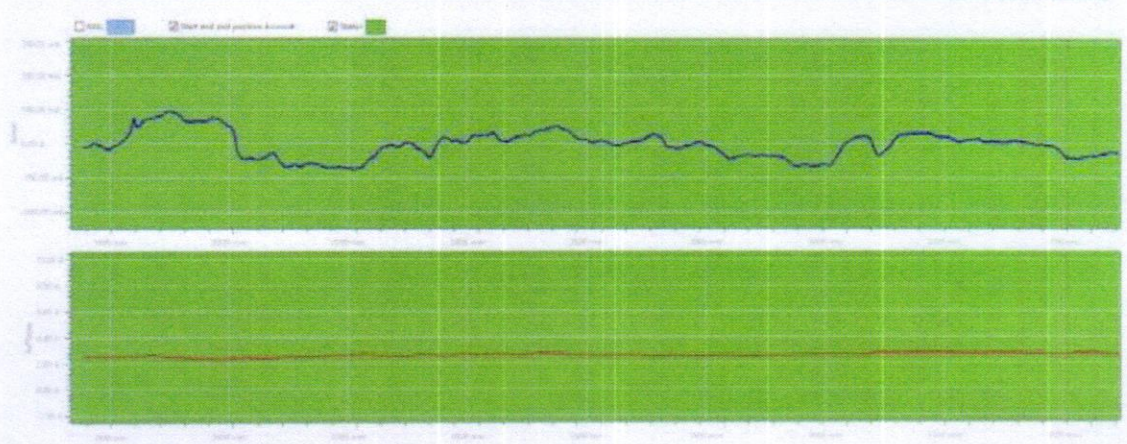


Slot 54

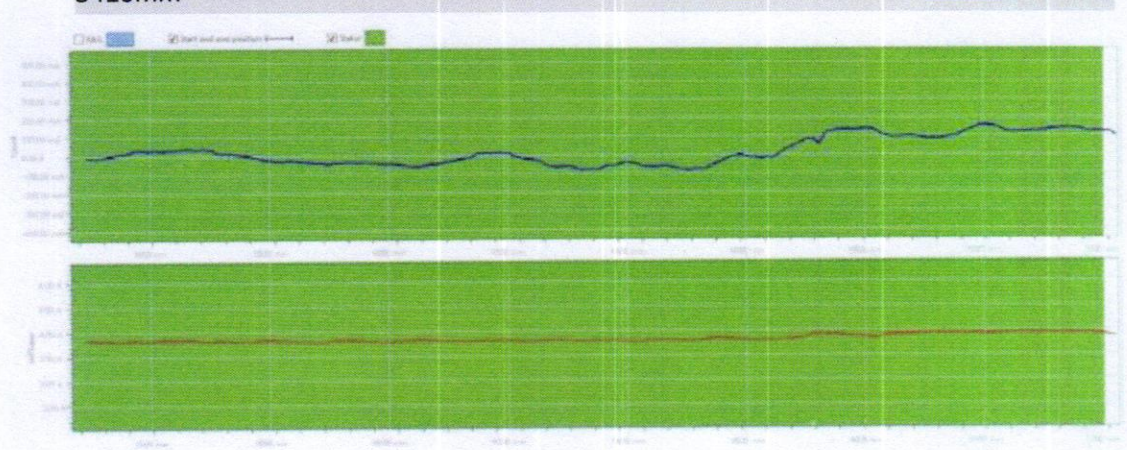
0mm 1760 mm



1700mm 3420 mm

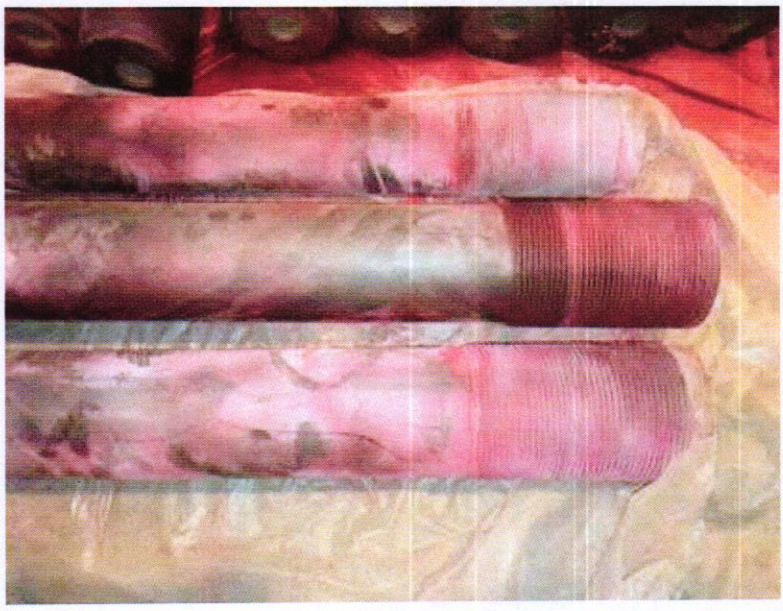


3410mm 5200 mm



NDT of Heating bolts

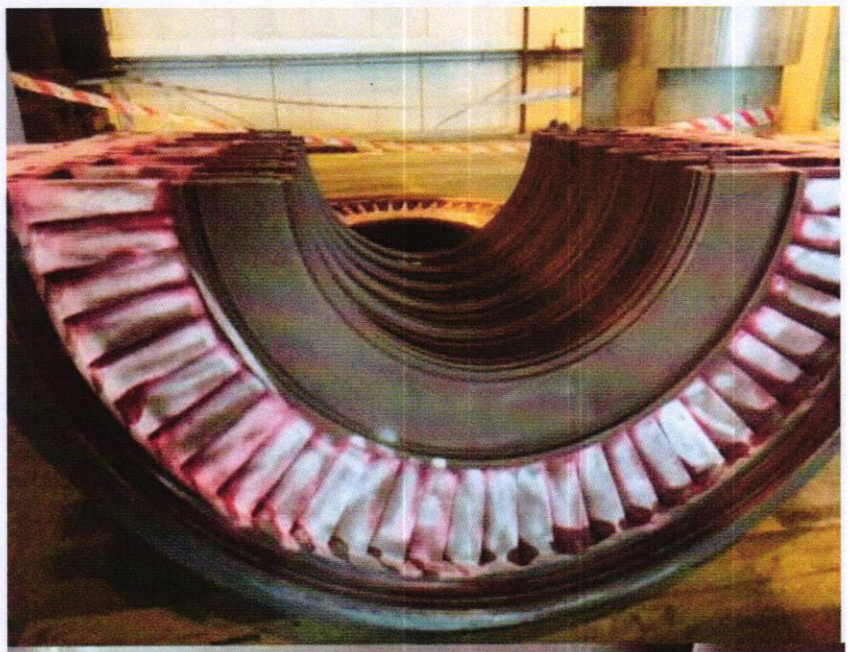
NDT was performed by certified inspection team in the presence of Consultant and client team.

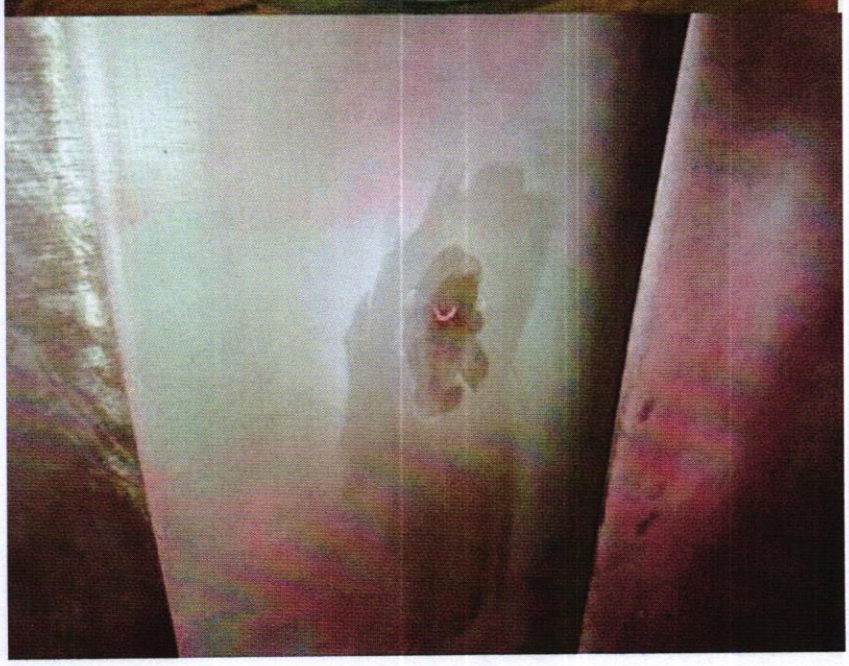




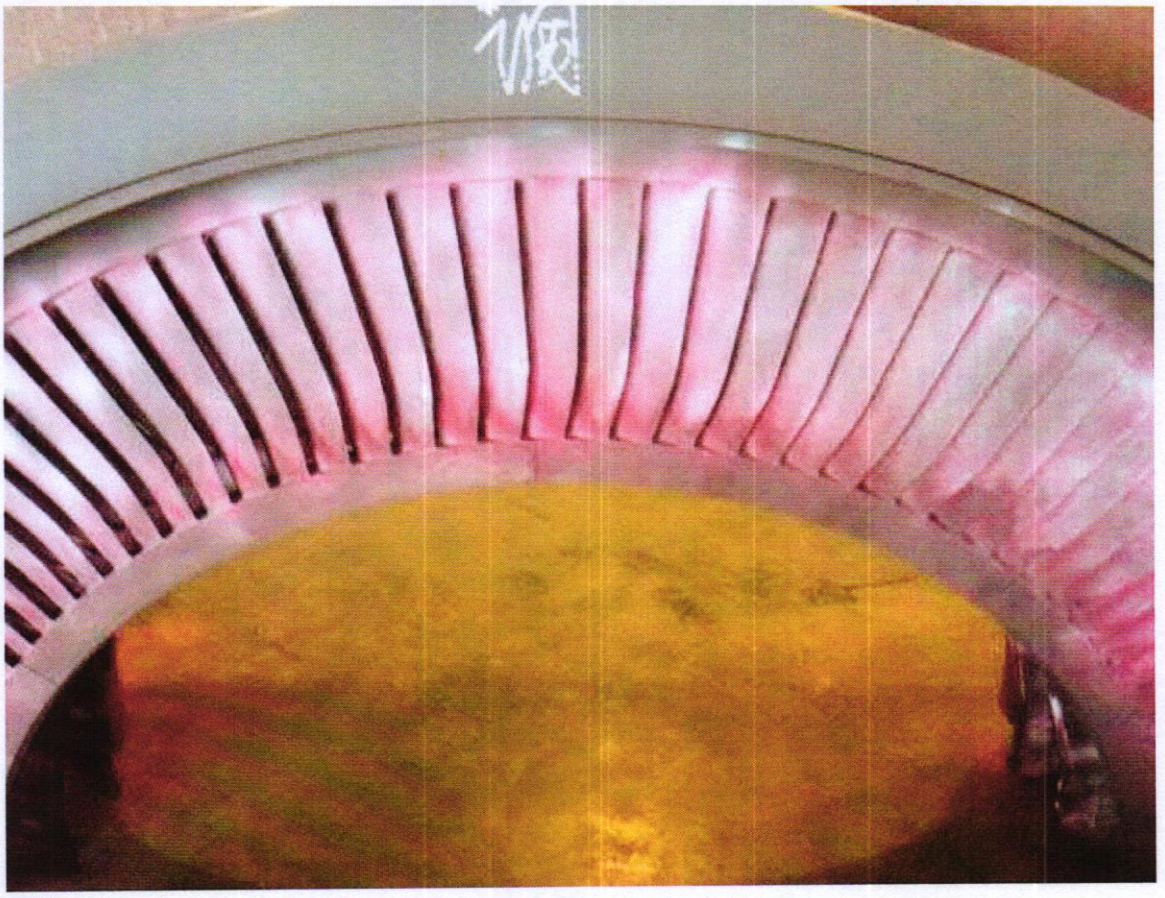


NDT of Diaphragm & Carriers





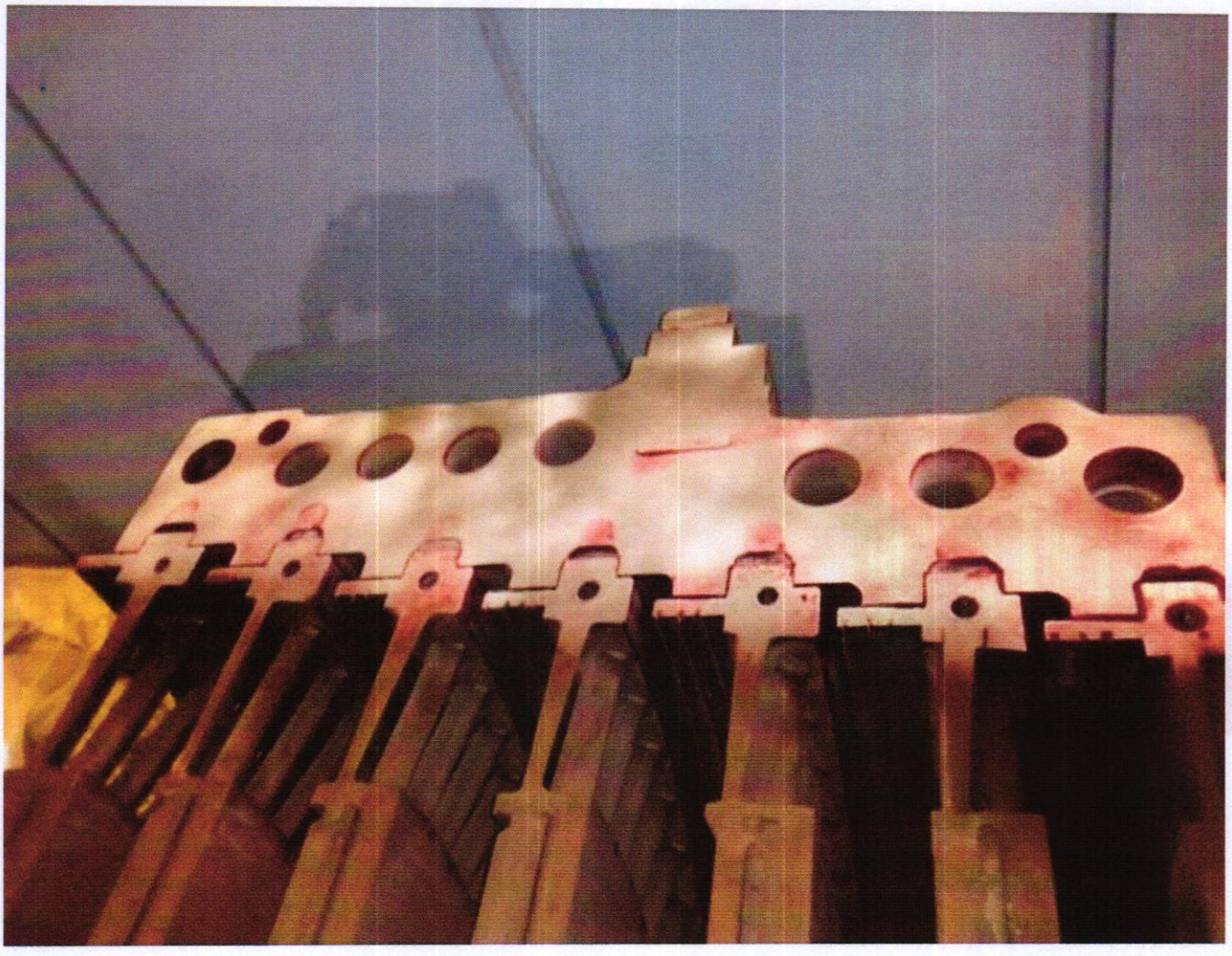














6.Measurement & Readings

1. Bearing box lid, oil seal (Unit: mm)

	Actual Measurement				Standard		
	Left	Right	Top	Down	Left - Right	Top	Down
# 1 After bearing	0.70	0.75	1.10	0.30	0.50	0.88	0.12
# 2 Before bearing	0.70	0.70	1.0	0.25	0.55	0.88	0.12
# 3 After bearing	0.75	0.75	1.3	0.30	0.55	0.88	0.12
# 4 Before bearing	0.70	0.70	1.0	0.30	0.55	0.88	0.12
# 4 After bearing	0.75	0.70	2.95	0.50	0.89	0.76	1.02

2. Before repair center measurement (Unit: mm)

	Standard		Actual measurement (full cylinder before repair)	Actual measurement (Half cylinder before repair)
IP-LP coupling	Face	face reading down side 0.152±0.02 face reading Left and right <0.03	Face reading up side 0.04 face reading left side 0.08	Face reading up side 0.07 Face reading left side 0.08
	High-low axial	IP rotor low 0.406 left-right deviation <0.03	IP rotor low1.24 IP rotor deviation to left 0.035	IP rotor low1.47 IP rotor deviation to left 0.01
LP-GE rotor	# 5 and # 4 Bearings are damaged and the data cannot be measured			

3. Shaft bearing housing clearance measurement (Unit: mm)

	Bearings top clearance (Shaft-bushing)		Bearing clearance (bushing-housing)	
	Standard	Actual measurement	Standard	Actual measurement
#1	**0.51-0.61**	left 0.66 right 0.71	0.08	0.03
#2	**0.61~0.71**	left 0.94 right 1.00	0.08	0.05
#3	**0.71-0.81**	left 1.35 right 1.25	0.08	0.02
#4	**0.71-0.81**	left 1.30 right 1.25	0.08	0.02

4. Seal ring of main oil pump, thrust tile oil seal ring and bearing oil seal ring clearance (Unit: mm)

	Main oil pump oil seal ring				Thrust tile oil seal ring		#1bearing		#2 bearing		#3 bearing		#4 bearing	
NO.	1	2	3	4	1	2	1	2	1	2	1	2	1	2
Standard	0.18-0.32				0.05-0.13		0.61-71		0.61-71		0.71-0.81			
Actual	0.40	0.75	0.75	0.40	0.85	0.80	0.85	0.95	0.85	0.80	Damage cannot be measured			

5. Gland sealing gap (Unit: mm)

Radial clearance table of HP stage 1-10 (movable vane)

Series	Standard		Actual	
	Left	Right	Left	Right

Radial clearance table of HP stage 1-10 (stator blade)

Series	Standard		Actual	
	Left	Right	Left	Right

L1	0.95	0.95	1.85	3.45
L2	0.95	0.95	0.95	2.3
L3	0.95	0.95	0.45	0.80
L4	0.95	0.95	0.20	0.90
L5	0.95	0.95	0.35	0.95
L6	0.95	0.95	0.30	0.95
L7	0.95	0.95	0.35	3.05
L8	0.95	0.95	1.30	1.70
L9	0.95	0.95	1.55	1.70
L10	0.95	0.95	1.50	1.90

Radial clearance table of IP stage 1-10 (movable vane)

S1	\	\	\	\
S2	1.0	1.0	0.70	1.30
S3	1.0	1.0	0.15	0.40
S4	1.0	1.0	0.10	0.60
S5	1.0	1.0	0.15	0.60
S6	1.0	1.0	0.20	0.55
S7	1.0	1.0	0.10	1.60
S8	1.0	1.0	0.80	0.85
S9	1.0	1.0	0.60	1.20
S10	1.0	1.0	0.60	1.10

Radial clearance table of IP stage 1-10 (stator blade)

Series	Standard		Actual	
	Left	Right	Left	Right
1	0.95	0.95	1.6	3.2
2	0.95	0.95	1.2	2.3
3	0.95	0.95	0.45	1.7
4	0.95	0.95	0.3	1.95
5	0.95	0.95	0.7	1.3
6	0.95	0.95	1.35	1.2
7	0.95	0.95	0.9	1.65

Series	Standard		Actual	
	Left	Right	Left	Right
1	\	\	\	\
2	1.0	1.0	0.15	1.30
3	1.0	1.0	0.20	1.30
4	1.0	1.0	0.10	1.60
5	1.0	1.0	0.50	1.0
6	1.0	1.0	0.75	1.20
7	1.0	1.0	0.35	1.10

8	0.95	0.95	1.2	2.45
9	0.95	0.95	1.2	1.3
10	0.95	0.95	2.0	2.5

8	1.0	1.0	0.45	0.75
9	1.0	1.0	0.70	0.95
10	1.0	1.0	0.65	1.10

High-pressure gland steam sealing ring
(IP side)

Series	Standard		Actual	
	Left	Right	Left	Right
1	0.77	0.77	0.40	1.9
2	0.77	0.77	0.50	2.0
3	0.77	0.77	0.45	1.7
4	0.77	0.77	0.35	2.0
5	0.77	0.77	0.60	1.70
6	0.77	0.77	0.50	2.0
7	0.45	0.45	0.40	1.9

Medium pressure steam seal
(LP side)

Series	Standard		Actual	
	Left	Right	Left	Right
1	0.45	0.45	0.60	0.90
2	0.45	0.45	0.50	0.90
3	0.45	0.45	0.60	0.80
4	0.70	0.70	0.80	1.30

High-pressure gland steam sealing ring
(B#1)

Series	Standard		Actual	
	Left	Right	Left	Right
1	0.45	0.45	0.70	1.60
2	0.45	0.45	0.90	1.50
3	0.45	0.45	0.70	1.60
4	0.45	0.45	0.65	1.70
5	0.45	0.45	0.50	1.80
6	0.45	0.45	0.70	1.60
7	0.45	0.45	0.70	1.60
8	0.45	0.45	0.90	1.50

6. Low pressure steam seal gap (Unit: mm)

Radial steam seal clearance between rotory blades-casing				
Series	Standard		Actual	
	Left	Right	Left	Right
TE1	1.2	1.2	0.96	1.65
TE2	1.2	1.2	1.75	0.9
TE3	1.2	1.2	1.05	1.05
TE4	1.2	1.2	1.05	1.0
TE5	5.4	5.4	4.5	5.5
TE6	11.9	11.9	12.5	12.3
GE1	1.2	1.2	0.5	1.25
GE 2	1.2	1.2	0.7	1.75
GE3	1.2	1.2	1.05	1.85
GE4	1.2	1.2	0.95	1.75
GE5	5.4	5.4	4.5	4.5
GE 6	11.9	11.9	12.7	12.3

Plate radial steam seal clearance between Stationary blades-shaft				
Series	Standard		Actual	
	Left	Right	Left	Right
TE1	/	/	/	/
TE2	1.25	1.25	0.75	1
TE3	1.35	1.35	0.80	1.15
TE4	1.35	1.35	0.95	1.15
TE5	1.95	1.95	1.5	1.5
TE6	2.65	2.65	1.75	2.55
GE1	/	/	/	/
GE 2	1.25	1.25	0.75	1.25
GE3	1.35	1.35	1	1.25
GE4	1.35	1.35	1.1	1.15
GE5	1.95	1.95	1.5	1.75
GE 6	2.65	2.65	2.55	1.20

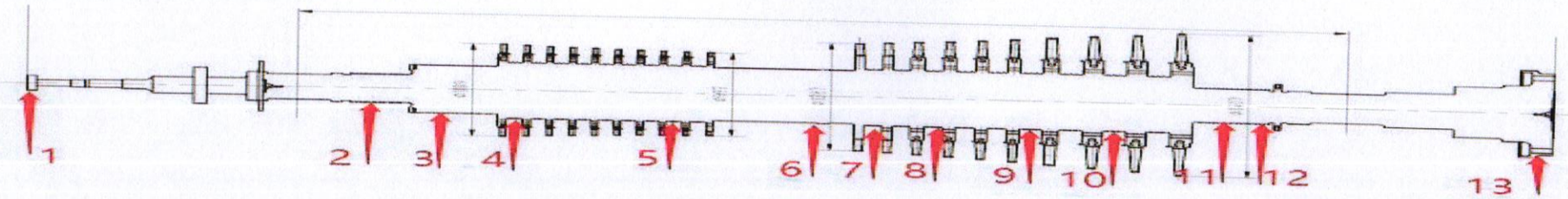
Low pressure front steam seal (T)

Series	Standard		Actual	
	Left	Right	Left	Right
1	0.46	0.46	0.6	0.9
2	0.46	0.46	0.5	0.9
3	0.46	0.46	0.6	0.8
4	0.71	0.71	0.8	1.3

After low pressure steam seal (GE)

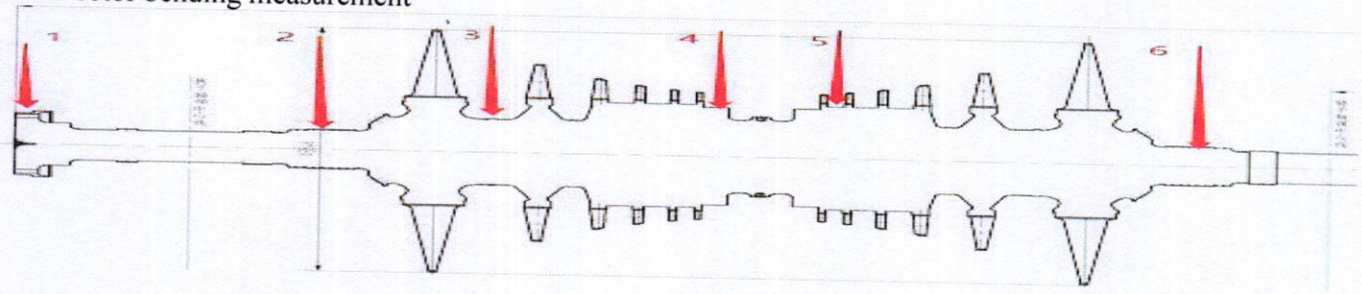
Series	Standard		Actual	
	Left	Right	Left	Right
1	0.46	0.46	0.6	0.9
2	0.46	0.46	0.5	0.9
3	0.46	0.46	0.6	0.8
4	0.71	0.71	0.8	1.3

7. HP-IP Rotor Axis bending measurement



Item	Position	1	2	3	4	5	6	7	8	9	10	11	12	13
1	90°	50	50	50	50	50	50	50	50	50	50	50	50	50
2	135°	52	49	48	47	48	51	41	48	48	50	56	48	52
3	180°	54	48	46	43	49	45	45	32	43	36	48	46	55
4	225°	58	47	45	45	42	41	45	24	42	39	47	45	56
5	270°	61	46	45	42	40	41	36	32	41	42	48	45	53
6	315°	61	47	46	42	43	49	53	28	44	52	49	46	50
7	0°	58	48	49	47	48	51	60	42	49	43	51	49	47
8	45°	54	49	50	47	52	53	66	47	50	52	57	50	47
Max-Min	Design requirement<0.05	0.11	0.04	0.05	0.08	0.10	0.12	0.21	0.18	0.09	0.14	0.10	0.05	0.09
Axis bending	design requireme<0.03	0.055	0.02	0.025	0.04	0.05	0.06	0.105	0.09	0.045	0.07	0.05	0.025	0.045

8. LP rotor bending measurement



Item	Position	1	2	3	4	5	6	7
1	0°	50	50	50	50	50	50	50
2	45°	50	50	50	50	50	49	53
3	90°	50	51	50	49	52	48	52
4	135°	50	51	51	56	55	49	51
5	180°	49	51	52	50	51	50	49
6	225°	48	52	50	50	50	50	49
7	270°	50	51	51	50	50	49	49
8	315°	48	50	51	50	49	48	49
Max-Min	Design requirement<0.05	0.02	0.02	0.02	0.06	0.06	0.01	0.04
Axis bending	design requireme<0.03	0.01	0.01	0.01	0.03	0.03	0.005	0.02

9. Low Pressure flow gap

Low-pressure TE -flow gap (T)										
Stage NO.	Location		A		B		E		F	
			Nominal	Measure	Nominal	Measure	Nominal	Measure	Nominal	Measure
LB1	0°	L	$29.11^{+0.13}_{-0.13}$	29.17	$29.11^{+3.0}_{-1.5}$	28.87	$22.89^{+3.0}_{-1.5}$	23.50	$22.89^{+3.0}_{-1.5}$	23.50
		R		29.84		29.64		23.03		23.03
LB2	0°	L	$34.11^{+3.0}_{-1.5}$	34.55	$33.11^{+3.0}_{-1.5}$	32.57			$56.89^{+3.0}_{-1.5}$	57.17
		R		34.88		33.09				56.76
LB3	0°	L	$35.11^{+3.0}_{-1.5}$	34.89	$34.11^{+3.0}_{-1.5}$	33.83			$40.89^{+3.0}_{-1.5}$	40.30
		R		36.25		34.58				40.60
LB4	0°	L	$47.06^{+4.5}_{-1.5}$	46.70	$34.56^{+4.5}_{-1.5}$	34			$19.39^{+4.5}_{-1.5}$	19.07
		R		46.90		34.23				18.37
LB5	0°	L	$32.7^{+4.5}_{-1.5}$	31.87	$34.25^{+4.5}_{-1.5}$	34.38			$17.89^{+4.5}_{-1.5}$	16.53
		R		31.39		34.9				16.24
LB6	0°	L	$57.61^{+4.5}_{-1.5}$	59.46	$32.11^{+4.5}_{-1.5}$	33.18				
		R		59.3		33.66				
Low-pressure GE flow gap (G)										
Stage NO.	Location		A		B		E		F	
			Nominal	Measure	Nominal	Measure	Nominal	Measure	Nominal	Measure
1	0°	L	$14.89^{+3.0}_{-1.5}$	15.13	$14.89^{+3.0}_{-1.5}$	14.58	$37.11^{+3.0}_{-1.5}$	37.9	$37.11^{+3.0}_{-1.5}$	36.95
		R		14.95		14.49		37.15		37.16

$19.89^{+3.0}_{-1.5}$

2	0°	L		20.6	$18.89^{+3.0}_{-1.5}$	18.74			$71.11^{+3.0}_{-1.5}$	72.0
		R		19.95		18.7				72.50
3	0°	L	$20.89^{+3.0}_{-1.5}$	21.19	$19.89^{+3.0}_{-1.5}$	20.34			$55.11^{+3.0}_{-1.5}$	55.87
		R		20.4		19.67				55.88
4	0°	L	$32.84^{+4.5}_{-1.5}$	32.83	$20.34^{+4.5}_{-1.5}$	19.59			$33.61^{+4.5}_{-1.5}$	32.74
		R		32.65		19.75				33.46
5	0°	L	$18.48^{+4.5}_{-1.5}$	18.9	$20.03^{+4.5}_{-1.5}$	20.96			$32.11^{+4.5}_{-1.5}$	31.2
		R		18.39		20.16				32.77
6	0°	L	$43.39^{+4.5}_{-1.5}$	43.60	$17.89^{+4.5}_{-1.5}$	18.6				
		R		43.70		19				

Low-pressure TE-flow gap (T)

Stage NO.	Location		A		B		E		F	
			Nominal	Measure	Nominal	Measure	Nominal	Measure	Nominal	Measure
LB1	90°	L	$29.11^{+0.13}_{-0.13}$	29.33	$29.11^{+3.0}_{-1.5}$	28.77	$22.89^{+3.0}_{-1.5}$	23.55	$22.89^{+3.0}_{-1.5}$	23.60
		R		29.64		29.84		23.63		23.33
LB2	90°	L	$34.11^{+3.0}_{-1.5}$	34.46	$33.11^{+3.0}_{-1.5}$	32.54			$56.89^{+3.0}_{-1.5}$	57.37
		R		34.88		33.10				56.74
LB3	90°	L	$35.11^{+3.0}_{-1.5}$	34.87	$34.11^{+3.0}_{-1.5}$	33.83			$40.89^{+3.0}_{-1.5}$	40.35
		R		36.25		34.68				40.60
LB4	90°	L	$47.06^{+4.5}_{-1.5}$	46.78	$34.56^{+4.5}_{-1.5}$	34.20			$19.39^{+4.5}_{-1.5}$	19.37
		R		46.80		34.33				19.17
LB5	90°	L	$32.7^{+4.5}_{-1.5}$	31.66	$34.25^{+4.5}_{-1.5}$	34.48			$17.89^{+4.5}_{-1.5}$	16.43
		R		31.69		34.92				16.44
LB6	90°	L	$57.61^{+4.5}_{-1.5}$	58.46	$32.11^{+4.5}_{-1.5}$	33.08				
		R		58.60		33.56				

Low-pressure GE flow gap (G)

Stage NO.	Location		A		B		E		F	
			Nominal	Measure	Nominal	Measure	Nominal	Measure	Nominal	Measure
1	90°	L	$14.89^{+3.0}_{-1.5}$	15.33	$14.89^{+3.0}_{-1.5}$	14.51	$37.11^{+3.0}_{-1.5}$	37.95	$37.11^{+3.0}_{-1.5}$	36.98
		R		14.95		14.39		37.55		37.26
2	90°	L	$19.89^{+3.0}_{-1.5}$	20.64	$18.89^{+3.0}_{-1.5}$	18.74			$71.11^{+3.0}_{-1.5}$	72.2
		R		19.95		18.76				72.52
3	90°	L	$20.89^{+3.0}_{-1.5}$	21.22	$19.89^{+3.0}_{-1.5}$	20.44			$55.11^{+3.0}_{-1.5}$	55.85
		R		21.84		19.97				55.88
4	90°	L	$32.84^{+4.5}_{-1.5}$	32.73	$20.34^{+4.5}_{-1.5}$	19.69			$33.61^{+4.5}_{-1.5}$	32.72
		R		32.85		19.95				33.48
5	90°	L	$18.48^{+4.5}_{-1.5}$	18.93	$20.03^{+4.5}_{-1.5}$	20.86			$32.11^{+4.5}_{-1.5}$	31.24
		R		18.32		20.66				32.67
6	90°	L	$43.39^{+4.5}_{-1.5}$	43.63	$17.89^{+4.5}_{-1.5}$	18.46				
		R		43.75		18.70				

10. HP flow path clearance

Axial clearance table of HP stage 1-10						
Stage NO.	Location		A		B	
			Nominal	Measure	Nominal	Measure
1	0°	L		11.94	12	11.23
		R		11.96		11.34
2	0°	L	12	12.04	12	11.9
		R		12.1		12.04
3	0°	L	12	11.44	12	11.41
		R		11.62		10.51
4	0°	L	12	12.25	12	11.84
		R		11.81		12.02
5	0°	L	12	12.15	12	12.02
		R		12.34		12.27
6	0°	L	12	11.62	12	11.76
		R		12.26		12.02
7	0°	L	12	12.91	12	12.2
		R		12.35		12.31
8	0°	L	12	12.17	12	12.12
		R		12.44		12.27
9	0°	L	12	12.6	12	12.36
		R		12.37		12.35
10	0°	L	12	12.52	12	12.53
		R		12.69		12.43
Tolerace			2.5～-1.4			

Axial clearance table of HP stage 1-10						
Stage NO.	Location		E		F	
			Nominal	Measure	Nominal	Measure
1	0°	L	9	8.62	9	8.41
		R		8.08		8.62
2	0°	L	12.5	12.17	9	9.6
		R		12.23		9.53
3	0°	L	11.5	11.76	9	8.81
		R		11.8		9.03
4	0°	L	10.5	10.5	9	9.01
		R		10.44		8.89
5	0°	L	10.5	10.47	9	9.09
		R		10.55		8.97
6	0°	L	10.5	10.65	9	9.39
		R		10.65		9.1
7	0°	L	10.5	10.86	9	9.14
		R		10.48		8.68
8	0°	L	10.5	11.46	9	8.86
		R		10.44		8.73
9	0°	L	13.5	13.14	9	8.83
		R		13.44		8.72
10	0°	L				
		R				
Tolerace			2.5～-1.4			

Axial clearance table of HP stage 1-10						
Stage NO.	Location		A		B	
			Nominal	Measure	Nominal	Measure
1	90°	L		11.96	12	11.39
		R		11.93		11.35
2	90°	L	12	12.29	12	11.98
		R		12		12
3	90°	L	12	11.66	12	11.44
		R		11.89		11.37
4	90°	L	12	12.38	12	11.88
		R		12.07		12.04
5	90°	L	12	12.05	12	12.06
		R		12.43		12.17
6	90°	L	12	11.76	12	11.86
		R		12.09		12.08
7	90°	L	12	12.97	12	12.27
		R		12.31		12.30
8	9	L	12	12.21	12	12.21

Axial clearance table of HP stage 1-10						
Stage NO.	Location		E		F	
			Nominal	Measure	Nominal	Measure
1	90°	L	9	8.62	9	8.36
		R		8.12		8.65
2	90°	L	12.5	12.51	9	9.56
		R		12.05		9.48
3	90°	L	11.5	11.55	9	9.24
		R		11.60		9.01
4	90°	L	10.5	10.43	9	9
		R		10.26		8.88
5	90°	L	10.5	10.45	9	9.12
		R		10.45		8.96
6	90°	L	10.5	10.58	9	9.42
		R		10.68		9.08
7	90°	L	10.5	10.74	9	9.02
		R		10.68		8.61
8	9	L	10.5	11.38	9	8.87

	0°	R		12.55		12.25
9	9 0°	L	12	12.61	12	12.37
		R		12.40		12.36
10	9 0°	L	12	12.51	12	12.54
		R		12.65		12.40
Toler ace			2.5～-1.4			

	0°	R		10.64		8.74
9	9 0°	L	13.5	13.63	9	8.78
		R		13.34		8.7
10	9 0°	L				
		R				
Toler ace			2.5～-1.4			

11. Medium/ Intermediate pressure flow path clearance:

Axial clearance table of IP stage 1-10						
Stage NO.	Location		A		B	
			Nominal	Measure	Nominal	Measure
11	0°	L	14.5	14	12	10.96
		R		14.32		11.33
12	0°	L	15	14.42	12	11.14
		R		14.18		10.73
13	0°	L	14.5	14.59	12	11.45
		R		14.33		11.2
14	0°	L	14.5	14.1	12	11.69
		R		14.06		11.4
15	0°	L	16	15.55	12	11.98
		R		15.6		11.64
16	0°	L	16	15.99	14	14.02
		R		15.92		13.76
17	0°	L	18	17.48	15	14.04
		R		17.56		14
18	0°	L	16	15.95	14	14
		R		15.95		14

Axial clearance table of IP stage 1-10						
Stage NO.	Location		E		F	
			Nominal	Measure	Nominal	Measure
11	0°	L	17.5	17.2	15	15.56
		R		17.36		15.92
12	0°	L	18	18.2	15	15.08
		R		19.32		15.56
13	0°	L	29	28.58	15	15.92
		R		29.28		15.55
14	0°	L	26.5	22.26	15	15.2
		R		26.86		15.28
15	0°	L	27.5	29.22	15.5	15.75
		R		27.94		15.71
16	0°	L	29	30.7	16	17.13
		R		30.34		17.38
17	0°	L	28.5	28.96	18	18.59
		R		29.64		18.33
18	0°	L	37	37.58	18	18.69
		R		38.14		18.98

19	0°	L	17	17.08	15	14.7
		R		16.71		14.62
20	0°	L	18.5	18.55	16	16.18
		R		18.58		16.64
Tolerace			2.5～-1.4			

19	0°	L	41.5	41.48	20	19.83
		R		43.94		20.72
20	0°	L			25	
		R				
Tolerace			2.5～-1.4			

Axial clearance table of IP stage 1-10

Stage NO.	Location		A		B	
			Nominal	Measure	Nominal	Measure
11	90°	L	14.5	14.53	12	12.1
		R		14.34		11.63
12	90°	L	15	14.56	12	11.08
		R		14.18		10.7
13	90°	L	14.5	14.45	12	11.45
		R		14.33		11.16
14	90°	L	14.5	14.35	12	11.67
		R		14.13		11.38
15	90°	L	16	15.61	12	11.97
		R		15.52		11.64
16	90°	L	16	15.59	14	13.95
		R		15.91		13.70
17	90°	L	18	17.64	15	14.15
		R		17.40		14.02
18	90°	L	16	16.07	14	14.02
		R		15.80		13.98
19	90°	L	17	17.15	15	14.70

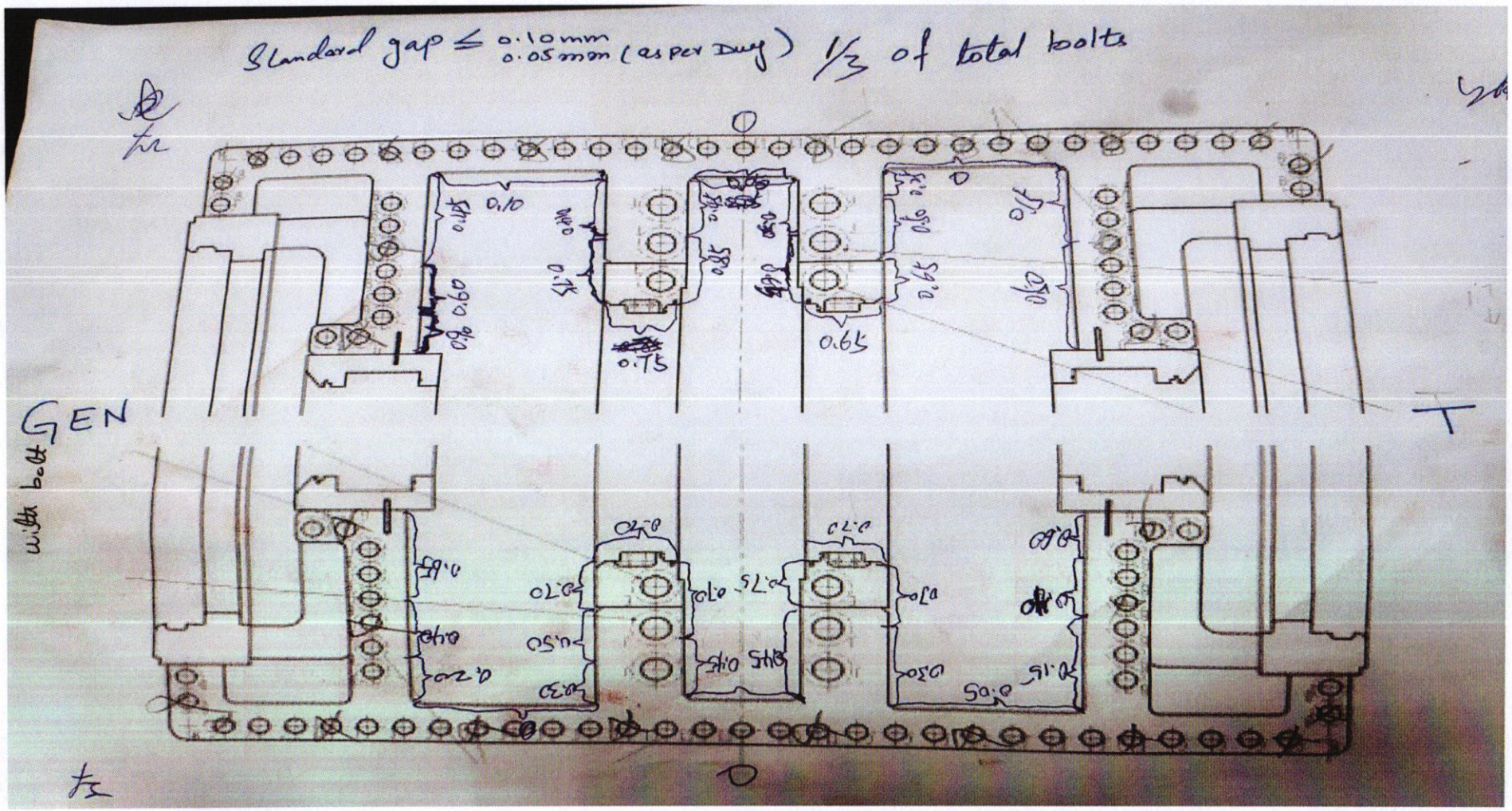
Axial clearance table of IP stage 1-10

Stage NO.	Location		E		F	
			Nominal	Measure	Nominal	Measure
11	90°	L	17.5	17.2	15	15.57
		R		17.44		16.19
12	90°	L	18	18.3	15	14.95
		R		19.04		15.65
13	90°	L	29	28.82	15	15.9
		R		28.98		15.55
14	90°	L	26.5	26.54	15	15.15
		R		27		15.27
15	90°	L	27.5	28.84	15.5	15.75
		R		28.28		15.75
16	90°	L	29	30.32	16	17.1
		R		30.94		17.36
17	90°	L	28.5	28.44	18	18.55
		R		30		18.32
18	90°	L	37	36.96	18	18.66
		R		38.46		18.95
19	90°	L	41.5	41.54	20	19.75

		R		16.68		14.67
20	90°	L	18.5	18.55	16	16.15
		R		18.40		16.76
Tolerace			2.5～-1.4			

		R		43.88		20.58
20	90°	L			25	25.30
		R				25.10
Tolerace			2.5～-1.4			

12. Low-pressure inner cylinder deformation measurement



7. NDT Report

Diaphragm Status

No.	Stage of Diaphragm	Inspection method	result
1	HP No1. Diaphragm	Visual inspection	OK
2	HP No2. Diaphragm	Visual inspection	OK
3	HP No3. Diaphragm	Visual inspection	OK
4	HP No4. Diaphragm	Visual inspection	OK
5	HP No5. Diaphragm	Visual inspection	OK
6	HP No6. Diaphragm	Visual inspection	**repair**
7	HP No7. Diaphragm	Visual inspection	OK
8	HP No8. Diaphragm	Visual inspection	OK
9	HP No9. Diaphragm	Visual inspection	OK
10	HP No10. Diaphragm	Visual inspection	OK
11	IP No1. Diaphragm	Visual inspection	OK
12	IP No2. Diaphragm	Visual inspection	OK
13	IP No3. Diaphragm	Visual inspection	OK
14	IP No4. Diaphragm	Visual inspection	OK
15	IP No5. Diaphragm	Visual inspection	OK
16	IP No6. Diaphragm	Visual inspection	OK
17	IP No7. Diaphragm	Visual inspection	OK
18	IP No8. Diaphragm	Visual inspection	OK
19	IP No9. Diaphragm	Visual inspection	OK
20	IP No10. Diaphragm	Visual inspection	OK
21	LP TE No.1 Diaphragm	Visual inspection	Replace
22	LP TE No.2 Diaphragm	Visual inspection	OK
23	LP TE No.3 Diaphragm	Visual inspection	OK
24	LP TE No.4 Diaphragm	Visual inspection	Replace
25	LP TE No.5 Diaphragm	Visual inspection	OK
26	LP TE No.6Diaphragm	Visual inspection	OK
27	LP GE No.1 Diaphragm	Visual inspection	Replace
28	LP GE No.2 Diaphragm	Visual inspection	OK
29	LP GE No.3 Diaphragm	Visual inspection	OK
30	LP GE No.4 Diaphragm	Visual inspection	OK
31	LP GE No.5 Diaphragm	Visual inspection	OK
32	LP GE No.6Diaphragm	Visual inspection	OK

Status of Blades:

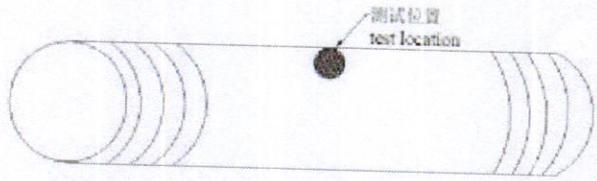
No.	Stage of Blade	Inspection method	result
1	HP No1. Blade	DPT	No defect fond but due to bending in rotor, replacement of the entire rotor
2	HP No2. Blade	DPT	
3	HP No3. Blade	DPT	
4	HP No4. Blade	DPT	
5	HP No5. Blade	DPT	
6	HP No6. Blade	DPT	**Heavy cavitation found**
7	HP No7. Blade	DPT	No defect fond but due to bending in rotor, replacement of the entire rotor
8	HP No8. Blade	DPT	
9	HP No9. Blade	DPT	
10	HP No10. Blade	DPT	
11	IP No1. Blade	DPT	

12	IP No2. Blade	DPT	
13	IP No3. Blade	DPT	
14	IP No4. Blade	DPT	
15	IP No5. Blade	DPT	
16	IP No6. Blade	DPT	
17	IP No7. Blade	DPT	
18	IP No8. Blade	DPT	
19	IP No9. Blade	DPT	1 blade shroud is damage
20	IP No10. Blade	DPT	No defect fond but due to bending in rotor, replacement of the entire rotor
21	LP TE No.1 Blade	DPT	**ok**
22	LP TE No.2 Blade	DPT	**ok**
23	LP TE No.3 Blade	DPT	**ok**
24	LP TE No.4 Blade	DPT	**ok**
25	LP TE No.5 Blade	DPT	**ok**
26	LP TE No.6 Blade	DPT	Replace
27	LP GE No.1 Blade	DPT	**ok**
28	LP GE No.2 Blade	DPT	**ok**
29	LP GE No.3 Blade	DPT	**ok**
30	LP GE No.4 Blade	DPT	**ok**
31	LP GE No.5 Blade	DPT	**ok**
32	LP GE No.6 Blade	DPT	Replace

No:GDJX-YD-001

Project name	747MW CCPP Guddu	Specimen Name	Left high and medium pressure outer cylinder horizontal split double head studs
Test location	Polished bolt	Specification	M105×4×925
Heat treatment state	In service testing	Material	2Cr12NiMo1W1V—Ⅳ
Detecting machine	Equotip Bambino2	Instrument accuracy	±4HLD
Hardness unit	HBHLD/☑:HRC/□:	Executive standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	299	295	301	298	LS- 10	297	302	299	299
LS-2	289	291	286	289	LS- 11	304	314	312	310
LS-3	303	302	311	305	LS- 12	305	311	312	309
LS-4	323	330	327	327	LS- 13	318	309	317	315
LS-5	304	298	304	302	LS- 14	296	298	300	298
LS-6	299	293	298	297	LS- 15	312	303	314	310
LS-7	307	302	304	304	LS- 16	305	298	300	301
LS-8	299	301	308	303	LS- 17	306	307	308	307
LS-9	285	291	283	286	LS- 18	298	301	306	302



Note: The standard requires that the hardness range is 277~331HBW, and the hardness value meets the standard requirements after the hardness test.

Test Person / Date	曹国安 2023.04.21	Reviewer/ Date	柳向军 2023.04.24

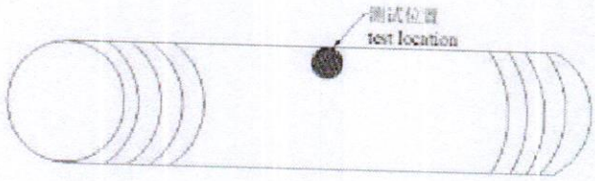
天津诚信金属检测技术有限公司 报告专用章

Hardness Test Report

No: GDJX-YD-002

Project Name	747MW CCPP Guddu	Specimen Name	Right high and medium pressure outer cylinder horizontal split double head stud
Test Location	Polished bolt	Specification	M105×4×925
Heat Treatment State	In service testing	Material	2Cr12NiMo1W1V—IV
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD☑ :HRC/□:	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	320	318	327	322	LS- 10	314	315	307	312
LS-2	303	303	304	303	LS- 11	329	324	324	326
LS-3	313	320	317	317	LS- 12	324	322	324	323
LS-4	310	307	307	308	LS- 13	315	318	317	317
LS-5	307	311	316	311	LS- 14	309	314	311	311
LS-6	317	319	316	317	LS- 15	315	305	313	311
LS-7	314	306	315	312	LS- 16	297	294	294	295
LS-8	309	308	308	308	LS- 17	317	309	315	314
LS-9	300	302	307	303	LS- 18	292	296	297	295



Note: The standard requires that the hardness range is 277~331HBW, and the hardness value meets the standard requirements after the hardness test.

Test Person / Date	曹国安 2023.04.21	Reviewer/ Date	柳向军 2023.04.24

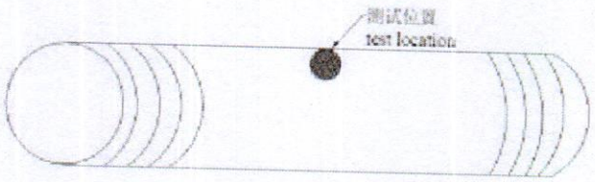
信达金属检测技术有限公司
报告专用章

Hardness Test Report

No: GDJX-YD-003

Project Name	747MW CCPP Guddu	Specimen Name	High and medium pressure outer cylinder horizontal split double head studs
Test Location	Polished bolt	Specification	M85×3×867
Heat Treatment State	In service testing	Material	2Cr12NiMo1W1V—Ⅳ
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/☑:HRC/□:	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	304	304	308	305					
LS-2	294	308	303	302					
LS-3	306	308	307	307					
LS-4	313	312	306	310					
LS-5	303	299	304	302					
LS-6	307	305	301	304					
/									



Note: The standard requires that the hardness range is 277~331HBW, and the hardness value meets the standard requirements after the hardness test.

Test Person / Date	曹国安 2023.04.21	Reviewer/ Date	柳向军 2023.04.24

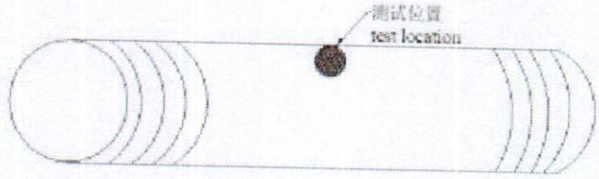
天津诚信达金属检测技术有限公司 报告专用章

Hardness Test Report

No: GDJX-YD-004

Project Name	747MW CCPP Guddu	Specimen Name	High and medium pressure outer cylinder horizontal split positioning double head studs
Test Location	Polished bolt	Specification	Φ95×790
Heat Treatment State	In service testing	Material	2Cr12NiMo1W1V—IV
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD☑ :HRC/□:	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	284	293	292	290					
LS-2	293	298	296	296					
/									



Note: The standard requires that the hardness range is 277~331HBW, and the hardness value meets the standard requirements after the hardness test.

Test Person / Date	曹国安 2023.04.21	Reviewer/ Date	柳向军 2023.04.24

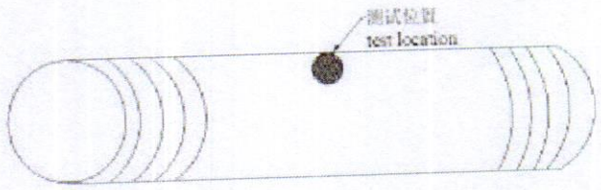
河南省信达金属检测技术有限公司
报告专用章

Hardness Test Report

No: GDJX-YD-005

Project Name	747MW CCPP Guddu	Specimen Name	High and medium pressure outer cylinder horizontal split positioning double head studs
Test Location	Polished bolt	Specification	Φ 105×975
Heat Treatment State	In service testing	Material	2Cr12NiMo1W1V—Ⅳ
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/☐ :HRC/□:	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	293	295	295	294					
LS-2	309	299	301	303					
/									



Note: The standard requires that the hardness range is 277~331HBW, and the hardness value meets the standard requirements after the hardness test.

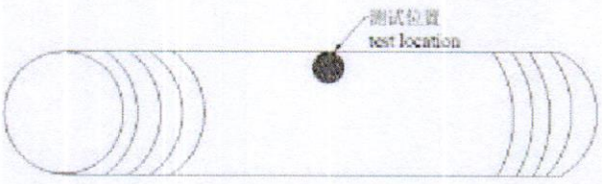
Test Person / Date	曹国安 2023.04.21	Reviewer/ Date	柳向军 2023.04.24

Hardness Test Report

No: GDJX-YD-006

Project Name	747MW CCPP Guddu	Specimen Name	High and medium pressure outer cylinder horizontal split double head studs
Test Location	Polished bolt	Specification	M72×3×388
Heat Treatment State	In service testing	Material	2Cr12NiMo1W1V－Ⅳ
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/☑ :HRC/□:	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	281	285	278	281					
LS-2	285	290	292	289					
LS-3	285	287	283	285					
LS-4	288	279	281	283					
/									



Note: The standard requires that the hardness range is 277~331HBW, and the hardness value meets the standard requirements after the hardness test.

Test Person / Date	曹国安 2023.04.22	Reviewer/ Date	柳向军 2023.04.24

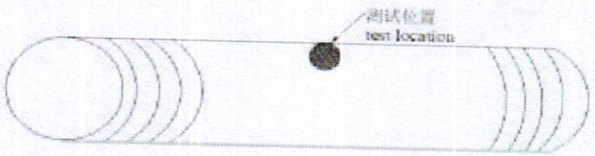
天津诚信达金属检测技术有限公司 报告专用章

Hardness Test Report

No: GDJX-YD-007

Project Name	747MW CCPP Guddu	Specimen Name	High and medium pressure outer cylinder horizontal split double head studs
Test Location	Polished bolt	Specification	M72×3×650
Heat Treatment State	In service testing	Material	2Cr12NiMo1W1V—Ⅳ
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/☑ :HRC/□:	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
left LS- 1	259	262	257	259	Right offsi LS- 1	286	291	286	288
LS-2	287	284	286	286	LS-2	292	288	292	291
LS-3	300	292	295	296	LS-3	260	259	262	260
LS-4	274	268	271	271	LS-4	265	266	271	267
LS-5	261	255	264	260	LS-5	300	309	311	307
/									



Note: The standard requires that the hardness value range is 277~331HBW. After the hardness test, there are 5 bolts whose hardness values do not meet the standard requirements. The numbers are: left LS-1/LS-4/LS-5/right LS-3 /LS-4, and the remaining 5 items meet the standard requirements.

Test Person / Date	曹国安 2023.04.22	Reviewer/ Date	柳向军 2023.04.24

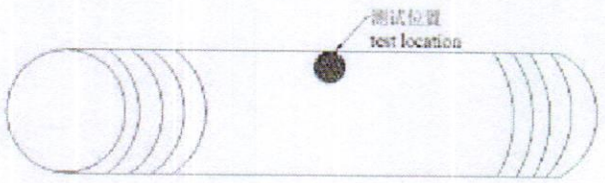
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Hardness Test Report

No:GDJX-YD-008

Project Name	747MW CCPP Guddu	Specimen Name	Left high and medium pressure outer cylinder horizontal split double head studs
Test Location	Polished bolt	Specification	M64×3×364
Heat Treatment State	In service testing	Material	2Cr12NiMo1W1V—Ⅳ
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/☑ :HRC/□:	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	293	286	290	290	LS- 10	291	283	288	287
LS-2	296	291	289	292	LS- 11	291	295	289	292
LS-3	258	266	260	261	LS- 12	280	279	279	279
LS-4	272	272	271	272	LS- 13	292	290	297	293
LS-5	254	259	261	258	LS- 14	300	292	299	297
LS-6	283	278	285	282	LS- 15	272	274	276	274
LS-7	278	277	279	278	/				
LS-8	290	298	286	291					
LS-9	280	279	280	280					



Note: The standard requires that the hardness value range is 277~331HBW. After the hardness test, the number is: LS-3/LS-4/LS-5. The hardness value does not meet the standard requirements, and the rest of the bolt hardness values meet the standard requirements.

Test Person / Date	曹国安 2023.04.22	Reviewer/ Date	柳向军 2023.04.24

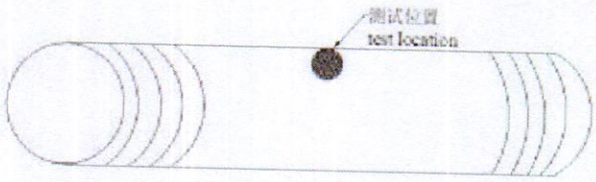
报告专用章

Hardness Test Report

No: GDJX-YD-009

Project Name	747MW CCPP Guddu	Specimen Name	Right high and medium pressure outer cylinder horizontal split double head stud
Test Location	Polished bolt	Specification	M63×3×364
Heat Treatment State	In service testing	Material	2Cr12NiMo1W1V—Ⅳ
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/☑:HRC/□:	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	306	315	307	309	LS- 10	285	290	297	291
LS-2	297	292	302	297	LS- 11	299	297	295	297
LS-3	299	304	297	300	LS- 12	283	286	290	286
LS-4	289	297	287	291	LS- 13	294	292	293	293
LS-5	287	284	279	283	LS- 14	300	294	301	298
LS-6	308	315	319	314	LS- 15	304	299	298	300
LS-7	294	293	301	296	/				
LS-8	278	285	284	282					
LS-9	297	287	291	292					



Note: The standard requires that the hardness range is 277~331HBW, and the hardness value meets the standard requirements after the hardness test.

Test Person / Date	曹国安 2023.04.22	Reviewer/ Date	柳向军 2023.04.24

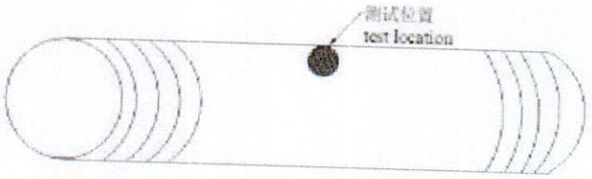
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报告专用章

Hardness Test Report

No:GDJX-YD-010

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	Medium Pressure # 1 Bulkhead Set Studs
Test Location	Polished bolt	Specification	M72×3×435
Heat Treatment State	In service testing	Material	2Cr12NiMo1W1V—IV
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/☑ :HRC/□:	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	320	315	313	316	LS- 10	291	290	281	287
LS-2	287	290	289	289	LS- 11	280	285	289	285
LS-3	286	281	289	285	LS- 12	260	265	271	265
LS-4	298	305	297	300		/			
LS-5	291	297	292	293					
LS-6	294	298	299	297					
LS-7	251	247	251	250					
LS-8	299	293	296	296					
LS-9	285	286	289	287					



Note: The standard requires that the hardness value range is 277~331HBW. After the hardness test, the hardness value of No. LS-7/LS- 12 does not meet the standard requirements, and the hardness values of the rest of the bolts meet the standard requirements.

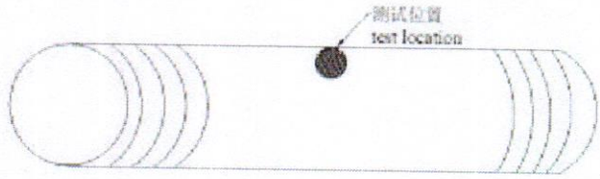
Test Person / Date	曹国安 2023.04.23	Reviewer/ Date	柳向军 2023.04.27

Hardness Test Report

No: GDJX-YD-011

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	Medium Pressure # 1 Bulkhead Sleeve Locating Studs
Test Location	Polished bolt	Specification	M72×3×485
Heat Treatment State	In service testing	Material	2Cr12NiMo1W1V—Ⅳ
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD☑ :HRC/□:	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	240	239	247	242					
LS-2	259	260	250	256					
LS-3	319	328	323	323					
LS-4	293	283	289	288					
/									



Note: The standard requires that the hardness value range is 277~331HBW. After the hardness test, the hardness value of No. LS- 1/LS-2 does not meet the standard requirements, and the hardness values of the rest of the bolts meet the standard requirements.

Test Person / Date	曹国安 2023.04.24	Reviewer/ Date	柳向军 2023.04.27

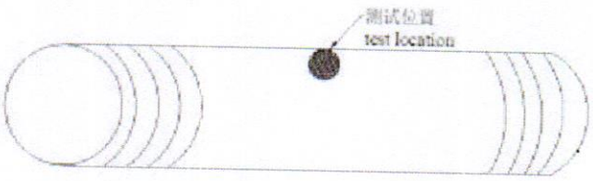
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Hardness Test Report

No: GDJX-YD-012

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	High pressure inner cylinder stud
Test Location	Polished bolt	Specification	M120×4×730
Heat Treatment State	In service testing	Material	1Cr11MoNiW1VNbN—IV
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/☑ :HRC/□:	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	302	294	292	296					
LS-2	290	89	290	223					
LS-3	302	295	295	297					
LS-4	295	301	297	298					
LS-5	94	289	292	225					
LS-6	310	306	302	306					
/									



Note: The standard requires that the hardness range is 277~331HBW, and the hardness value meets the standard requirements after the hardness test.

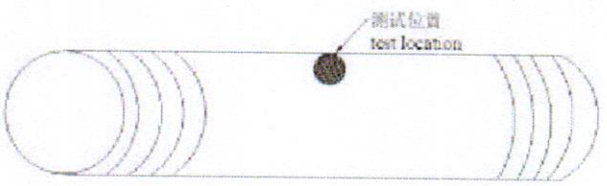
Test Person / Date	曹国安 2023.04.24	Reviewer/ Date	柳向军 2023.04.27

Hardness Test Report

No: GDJX-YD-013

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	High pressure inner cylinder positioning stud
Test Location	Polished bolt	Specification	Φ 124×810
Heat Treatment State	In service testing	Material	1Cr11MoNiW1VNbN－Ⅳ
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/□ :HRC/□:	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	293	296	293	294					
LS-2	298	297	304	300					
LS-3	287	291	289	289					
LS-4	296	289	287	291					
/									



Note: The standard requires that the hardness range is 277~331HBW, and the hardness value meets the standard requirements after the hardness test.

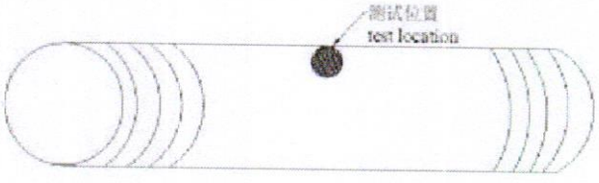
Test Person / Date	曹国安 2023.04.24	Reviewer/ Date	柳向军 2023.04.27

Hardness Test Report

No: GDJX-YD-014

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	High pressure inner cylinder stud
Test Location	Polished bolt	Specification	M76×3×427
Heat Treatment State	In service testing	Material	1Cr11MoNiW1VNbN－Ⅳ
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD☑ :HRC/□:	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	280	284	281	282					
LS-2	286	282	283	284					
LS-3	279	285	278	281					
LS-4	278	279	281	279					
/									



Note: The standard requires that the hardness range is 277~331HBW, and the hardness value meets the standard requirements after the hardness test.

Test Person / Date	曹国安 2023.04.24	Reviewer/ Date	柳向军 2023.04.27

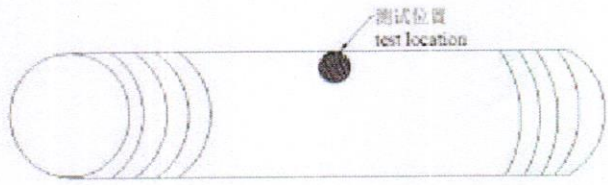
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报告专用章

Hardness Test Report

No: GDJX-YD-015

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	High pressure steam inlet stud
Test Location	Polished bolt	Specification	M60×3×334
Heat Treatment State	In service testing	Material	1Cr11MoNiW1VNbN－IV
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/ :HRC/□: ☑	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	240	241	239	240					
LS-2	260	264	259	261					
/									



Note: The standard requires that the hardness value range is 277~331HBW, and the hardness value does not meet the standard requirements after the hardness test.

Test Person / Date	曹国安 2023.04.24	Reviewer/ Date	柳向军 2023.04.27

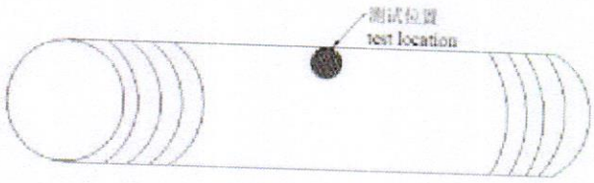
大连诚信达金属检测技术有限公司 报告专用章

Hardness Test Report

No:GDJX-YD-016

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	Medium and low pressure wheel bolts
Test Location	Polished bolt	Specification	/
Heat Treatment State	In service testing	Material	25Cr2MoV
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD☑ :HRC/□:	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	253	254	250	252	LS- 10	249	247	251	249
LS-2	258	253	256	256	LS- 11	275	270	274	273
LS-3	252	254	253	253	LS- 12	269	259	267	265
LS-4	267	257	259	261	LS- 13	254	266	258	259
LS-5	265	273	268	269	LS- 14	266	271	268	268
LS-6	265	273	268	269	LS- 15	255	254	260	256
LS-7	249	257	255	254	LS- 16	262	266	260	263
LS-8	248	253	248	250	LS- 17	255	259	261	258
LS-9	259	261	258	259	LS- 18	276	279	279	278



Note: The standard requires that the hardness range is 248~293HBW, and the hardness value meets the standard requirements after the hardness test.

Test Person / Date	曹国安 2023.04.26	Reviewer/ Date	孙向军 2023.04.27

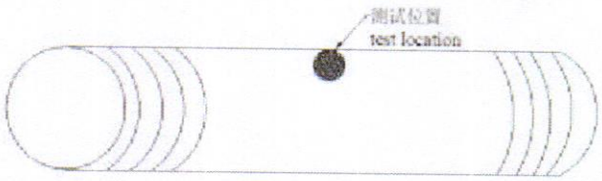
大连诚信达金属检测技术有限公司 报告专用章

Hardness Test Report

No: GDJX-YD-017

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	Medium and low pressure wheel bolts
Test Location	Polished bolt	Specification	/
Heat Treatment State	In service testing	Material	25Cr2MoV
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/ :HRC/□: ☑	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 19	253	259	260	257					
LS-20	249	254	253	252					
LS-21	259	261	260	260					
LS-22	271	261	264	265					
LS-23	249	258	248	252					
LS-24	269	265	261	265					
/									



Note: The standard requires that the hardness range is 248~293HBW, and the hardness value meets the standard requirements after the hardness test.

Test Person / Date	曹国安 2023.04.26	Reviewer/ Date	柳向军 2023.04.27

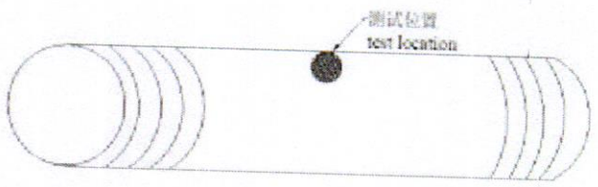
诚信达金属检测技术有限公司
报告专用章

Hardness Test Report

No:GDJX-YD-018

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	Low pressure bulkhead bolts
Test Location	Polished bolt	Specification	M72×3×579
Heat Treatment State	In service testing	Material	20Cr1Mo1VTiB- IV
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD☑ :HRC/□:	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	243	251	249	248					
LS-2	265	269	273	269					
LS-3	293	296	293	294					
LS-4	251	254	246	250					
LS-5	269	275	263	269					
LS-6	229	222	229	227					
LS-7	256	261	251	256					
LS-8	270	270	268	269					
/									



The standard requires that the hardness value range is 255~302HBW. After the hardness test, the hardness values of the numbered LS- 1/ LS-4/ LS-6 do not meet the standard requirements, and the hardness values of the rest of the bolts meet the standard requirements.

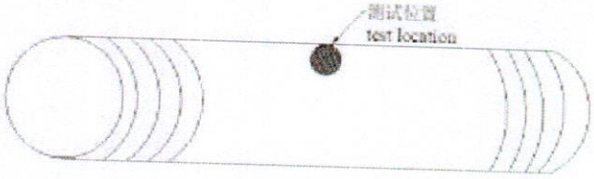
Test Person / Date	曹国安 2023.04.25	Reviewer/ Date	柳向军 2023.04.27

Hardness Test Report

No: GDJX-YD-019

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	LP Locating studs
Test Location	Polished bolt	Specification	Φ58×591
Heat Treatment State	In service testing	Material	20Cr1Mo1VTiB- Ⅳ
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/ :HRC/□: ☑	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	273	278	275	275					
LS-2	256	251	249	252					
LS-3	246	250	253	250					
LS-4	246	242	243	244					
/									



The standard requires that the hardness value range is 255~302HBW. After the hardness test, the hardness values of the numbered LS-2/ LS-3/ LS-4 do not meet the standard requirements, and the hardness values of the rest of the bolts meet the standard requirements.

Test Person / Date	曹国安 2023.04.25	Reviewer/ Date	柳向军 2023.04.27

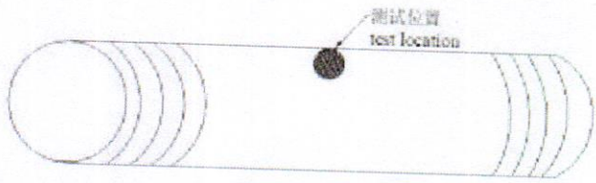
天津诚信金属检测技术有限公司 报告专用章

Hardness Test Report

No: GDJX-YD-020

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	LP Studs
Test Location	Polished bolt	Specification	M45×3×827
Heat Treatment State	In service testing	Material	20Cr1Mo1VTiB- Ⅳ
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/ :HRC/□: ☑	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	255	259	264	259					
LS-2	272	272	279	274					
LS-3	291	287	288	289					
LS-4	250	245	250	248					
LS-5	245	250	243	246					
LS-6	256	259	257	257					
LS-7	256	267	263	262					
LS-8	267	270	263	267					
/									



The standard requires that the hardness value range is 255~302HBW. After the hardness test, the hardness values of the numbered LS-4/ LS-5/ do not meet the standard requirements, and the hardness values of the rest of the bolts meet the standard requirements.

Test Person / Date	曹国安 2023.04.25	Reviewer/ Date	柳向军 2023.04.27

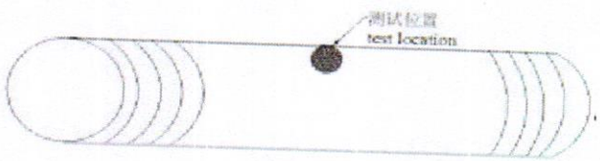
天津诚信达金属检测技术有限公司 报告专用章

Hardness Test Report

No: GDJX-YD-021

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	LP Studs
Test Location	Polished bolt	Specification	M76×3×298
Heat Treatment State	In service testing	Material	20Cr1Mo1VTiB- IV
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/ :HRC/□: ☑	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	257	266	255	259					
LS-2	262	256	259	259					
LS-3	264	264	270	266					
LS-4	260	260	255	263					
/									
/									



The standard requires that the hardness value range is 255~302HBW, and the hardness value of the bolt meets the standard requirements after the hardness test.

Test Person / Date	曹国安 2023.04.25	Reviewer/ Date	柳向军 2023.04.27

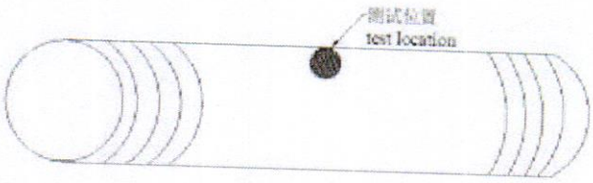
安徽诚信达金属检测技术有限公司
报告专用章

Hardness Test Report

No: GDJX-YD-022

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	LP Locating studs
Test Location	Polished bolt	Specification	Φ58×331
Heat Treatment State	In service testing	Material	20Cr1Mo1VTiB- Ⅳ
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/ :HRC/□: ☑	Executive Standard	GB/T17394. 1-2014

编号	1	2	3	average	编号	1	2	3	average
LS-1	228	237	227	228					
LS-2	239	247	244	239					
LS-3	259	259	264	259					
/									



The standard requires that the hardness value range is 255~302HBW. After the hardness test, the hardness
values of the numbered LS- 1/ LS-2 do not meet the standard requirements, and the hardness values of the
rest of the bolts meet the standard requirements.

Test Person / Date	曹国安 2023.04.25	Reviewer/ Date	柳向军 2023.04.27

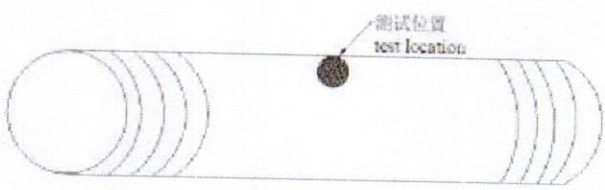
陕西信达金属检测技术有限公司
报告专用章

Hardness Test Report

No: GDJX-YD-023

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	LP Locating studs
Test Location	Polished bolt	Specification	Φ76×343
Heat Treatment State	In service testing	Material	20Cr1Mo1VTiB- Ⅳ
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/ :HRC/□: ☑	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	266	257	255	259					
/									



The standard requires that the hardness value range is 255~302HBW, and the hardness value of the bolt meets the standard requirements after the hardness test.

Test Person / Date	曹国安 2023.04.25	Reviewer/ Date	柳向军 2023.04.27

天津诚信达金属检测技术有限公司 报告专用章

Hardness Test Report

No: GDJX-YD-024

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	LP Stud bolt
Test Location	Polished bolt	Specification	M52×3×248
Heat Treatment State	In service testing	Material	20Cr1Mo1VTiB- Ⅳ
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/ :HRC/□: ☑	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS-1	247	245	240	244	LS-14	255	241	251	249
LS-2	265	258	260	261	LS-15	255	243	244	247
LS-3	263	264	256	261	LS-16	270	262	270	267
LS-4	234	234	224	263	LS-17	272	261	260	264
LS-5	266	271	265	267	LS-18	275	271	272	273
LS-6	231	237	238	235	LS-19	263	256	263	261
LS-7	257	263	259	260	LS-20	249	243	243	245
LS-8	259	268	261	263	LS-21	233	234	231	233
LS-9	238	233	232	234	LS-22	259	255	260	258
LS-10	255	255	256	255	LS-23	259	255	260	258
LS-11	255	262	259	259	LS-24	269	264	261	265
LS-12	267	269	264	267	LS-25	222	229	232	228
LS-13	268	259	264	264	/				

The standard requires that the hardness value range is 255~302HBW. After the hardness test, there are 8 bolts whose hardness values do not meet the standard requirements. The numbers are LS- 1/LS-6/LS-9/LS- 14/LS- 15/LS-20 /LS-21/LS-25. The hardness values of the remaining bolts meet the standard requirements.

Test Person / Date	曹国安 2023.04.25	Reviewer/ Date	柳向军 2023.04.27

Hardness Test Report

No: GDJX-YD-025

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	LP Stud bolt
Test Location	Polished bolt	Specification	M52×3×248
Heat Treatment State	In service testing	Material	25Cr2MoV
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/ :HRC/□: ☑	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS-1	232	234	240	235	LS- 17	277	287	281	282
LS-2	221	226	231	226	LS-18	236	241	244	240
LS-3	276	270	275	274	LS-19	215	212	211	213
LS-4	236	229	235	233	LS-20	249	255	258	254
LS-5	231	243	241	238	LS-21	225	222	231	226
LS-6	244	252	244	247	LS-22	247	248	250	248
LS-7	261	259	268	263	LS-23	259	250	249	253
LS-8	255	257	250	254	LS-24	259	254	261	258
LS-9	260	252	261	258	LS-25	230	224	231	228
LS- 10	248	246	251	248	LS-26	254	245	251	250
LS-11	203	209	210	207	LS-27	278	269	269	272
LS-12	230	228	231	230	LS-28	268	269	273	270
LS- 13	263	265	261	263	LS-29	234	235	235	235
LS- 14	263	266	273	267	LS-30	251	250	250	250
LS- 15	266	253	255	258	LS-31	246	245	239	243
LS- 16	276	266	271	271	LS-32	261	255	256	257

Test Person / Date	曹国安 2023.04.25	Reviewer/ Date	柳向军 2023.04.27

Hardness Test Report

No: GDJX-YD-026

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	LP Stud bolt
Test Location	Polished bolt	Specification	M52×3×248
Heat Treatment State	In service testing	Material	25Cr2MoV
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/ :HRC/□: ☑	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS-33	220	215	223	219	LS-49	261	266	265	264
LS-34	261	255	259	258	LS-50	255	259	261	258
LS-35	255	253	249	252	LS-51	262	255	261	259
LS-36	258	261	257	259	LS-52	271	266	262	266
LS-37	225	223	224	224	LS-53	202	204	213	206
LS-38	244	234	241	240	LS-54	218	214	221	218
LS-39	248	239	251	246	LS-55	251	254	259	255
LS-40	222	230	229	227	LS-56	234	232	230	232
LS-41	232	231	240	234	LS-57	223	229	231	228
LS-42	257	251	249	252	LS-58	244	247	253	248
LS-43	211	220	215	215	LS-59	238	235	234	236
LS-44	222	218	220	220	LS-60	215	2220	214	216
LS-45	212	216	220	216	LS-61	215	220	214	216
LS-46	219	217	214	217	LS-62	265	260	254	260
LS-47	220	214	218	217	LS-63	219	209	213	214
LS-48	225	221	230	225	LS-64	211	206	216	211

Test Person / Date	曹国安 2023.04.25	Reviewer/ Date	柳向军 2023.04.27

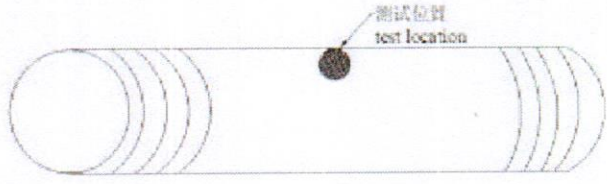
湖南金属检测技术有限公司 报告专用章

Hardness Test Report

No: GDJX-YD-027

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	LP Stud bolt
Test Location	Polished bolt	Specification	M52×3×248
Heat Treatment State	In service testing	Material	25Cr2MoV
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/ :HRC/□: ☑	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS-65	**222**	**221**	**217**	**220**	**LS-73**	**235**	**241**	**240**	**239**
LS-66	**225**	**226**	**236**	**229**	LS-74	250	249	249	249
LS-67	**233**	**229**	**238**	**233**	LS-75	260	258	264	261
LS-68	**216**	**218**	**209**	**214**	LS-76	254	263	252	256
LS-69	265	260	257	261	LS-77	255	259	258	257
LS-70	**229**	**227**	**230**	**229**	**LS-78**	**232**	**237**	**233**	**234**
LS-71	**213**	**211**	**215**	**213**	**LS-79**	**226**	**218**	**223**	**222**
LS-72	250	249	261	253	/				



The standard requires that the hardness range is 248~293HBW. After the hardness test, there are 42 bolts whose hardness values do not meet the standard requirements (the above yellow fonts are bold), and the hardness values of the rest of the bolts meet the standard requirements.

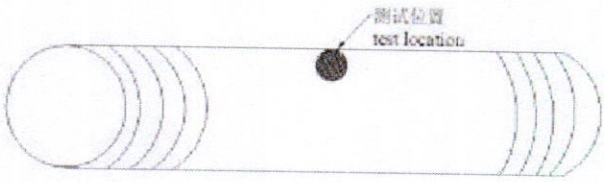
Test Person / Date	曹国安 2023.04.25	Reviewer/ Date	柳向军 2023.04.27

Hardness Test Report

No: GDJX-YD-028

Project Name	Turbo Generator of Unit- 16 of 747MW CCPP Guddu	Specimen Name	LP Locating studs
Test Location	Polished bolt	Specification	Φ76×343
Heat Treatment State	In service testing	Material	20Cr1Mo1VTiB- Ⅳ
Detecting Machine	Equotip Bambino2	Instrument Accuracy	±4HLD
Hardness Unit	HBHLD/ :HRC/□: ☑	Executive Standard	GB/T17394. 1-2014

Item	1	2	3	Average value	Item	1	2	3	Average value
LS- 1	266	257	255	259					
/									



The standard requires that the hardness value range is 255~302HBW, and the hardness value of the bolt meets the standard requirements after the hardness test.

Test Person / Date	曹国安 2023.04.25	Reviewer/ Date	柳向军 2023.04.27

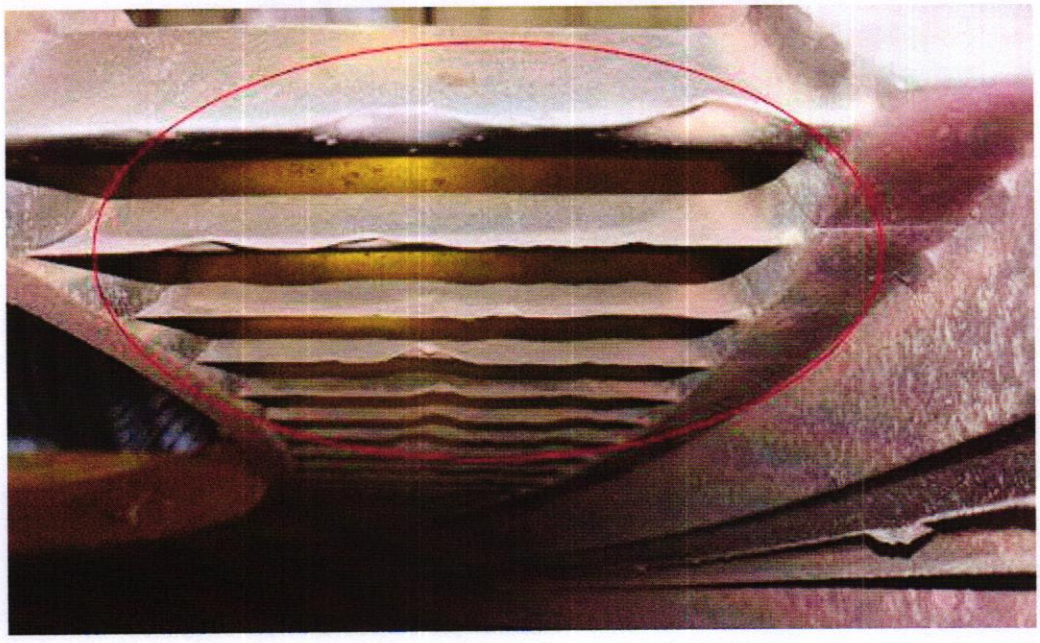
诚信达金属性测技术有限公司
报告专用章

Penetrant testing report

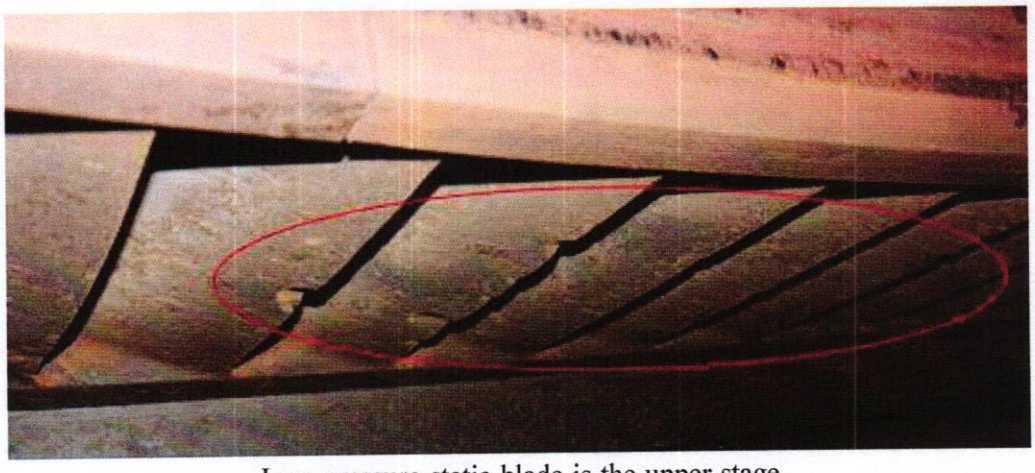
Entrusted by the construction party, conduct penetration testing on high and medium pressure rotor blades, low pressure rotor blades, bearing bushes and other components of the steam turbine body, in accordance with NB/T47013.5-2015, DL/T438-2016 standards. A damage was found on the outer circumference of the IP rotor stage 9, and no cracks were found around it in the penetrant test. The sixth-stage blade on the high-pressure side had serious cavitation, and the first-stage blade also had surface cavitation; the last-stage blade of the low-pressure rotor The cavitation phenomenon occurred at the root of the stage blade, and the IP turbine side LP turbine 1st and 2nd stage blades were deformed and damaged in 5 places.

The visual inspection of the high pressure and low pressure diaphragm found that:The upper and lower parts of the low-pressure static blades are deformed and damaged in the whole circle of the first stage. There is a damage and crack in the lower part, which is suspected to be caused by the impact of foreign objects. The lower stator blades of HP No.6 Diaphragm were damaged in 6 places. No crack defects were found in the penetration detection of the above damaged parts, and no obvious defects were found in the other partition plates.





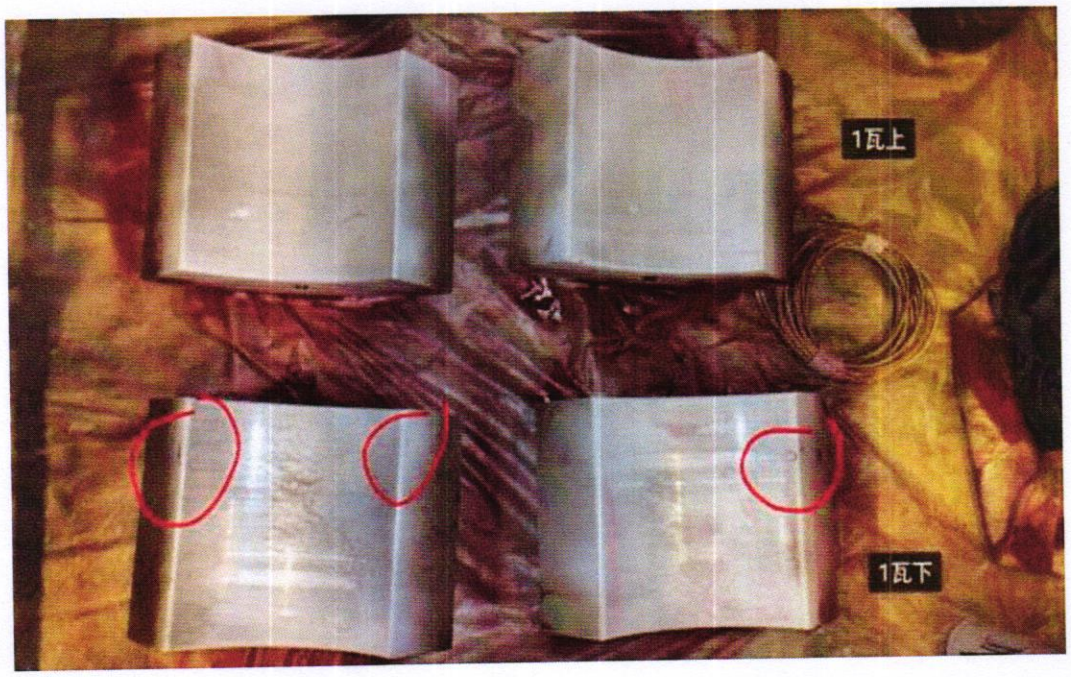
Lower lower stage of low pressure static blade



Low pressure static blade is the upper stage

Penetrant Testing Report			No:GDJX-PT-001
Requester	HEI	Penetrant brand	Mega check
Specimen number	/	Penetrant type	Coloring penetrant
Specimen name	# 1 Bearing	Visualization method	Dry
Specimen material	/	Penetration time	10 min
Specimen specifications	/	Development time	10 min
Number of test pieces	4	Method of operation	IIc-d
Test purpose	Check for surface defects	Technical standard	NB/T47013.5-2015

Inspection result: After penetrant testing, the upper and lower parts of tile # 1 totaled 4 pieces, and it was found that the lower tile had a fusion line has crack .



Test person	曹国安	Reviewer	桃向军
Test date	2023.04.24	Review date	2023.04.27

武汉诚信达金属检测技术有限公司 报告专用章

Penetrant Testing Report			No:GDJX-PT-002
Requester	HEI	Penetrant brand	Mega check
Specimen number	/	Penetrant type	Coloring penetrant
Specimen name	Thrust pad	Visualization method	Dry
Specimen material	/	Penetration time	10 min
Specimen specifications	/	Development time	10 min
Number of test pieces	16	Method of operation	IIc-d
Test purpose	Check for surface defects	Technical standard	NB/T47013.5-2015

Inspection result: A total of 16 thrust tiles were tested by penetration testing, among which scratches were found on the surface of DS1 and DS2, and no other defects were found .

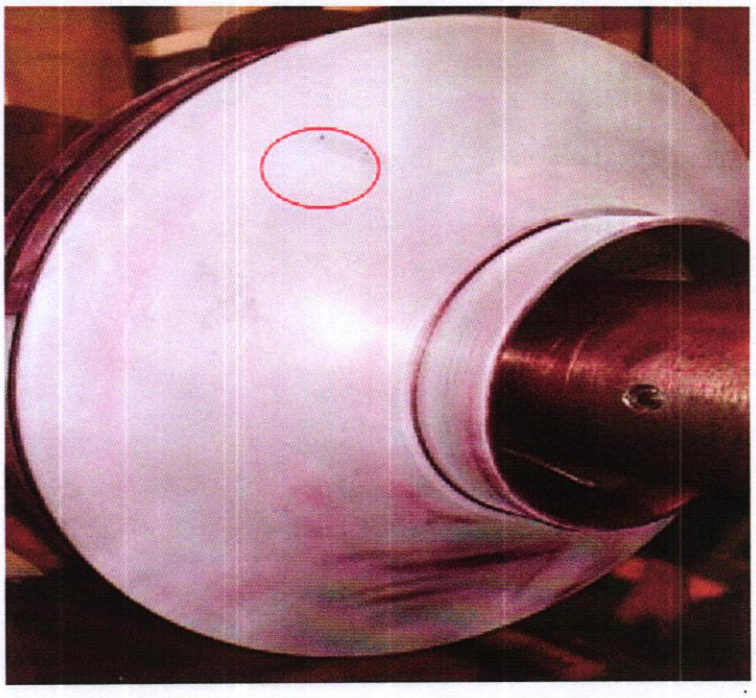


Test person	曹国安	Reviewer	柳向军
Test date	2023.04.24	Review date	2023.04.27

天津诚信达金属检测技术有限公司 报告专用章

Penetrant Testing Report			No:GDJX-PT-003
Requester	HEI	Penetrant brand	Mega check
Specimen number	/	Penetrant type	Coloring penetrant
Specimen name	High pressure rotor impeller	Visualization method	Dry
Specimen material	/	Penetration time	10 min
Specimen specifications	/	Development time	10 min
Number of test pieces	1	Method of operation	IIc-d
Test purpose	Check for surface defects	Technical standard	NB/T47013.5-2015

Inspection result: Small hole defects were found on the right side of the impeller surface through penetration testing, and no surface defects were found in other positions .

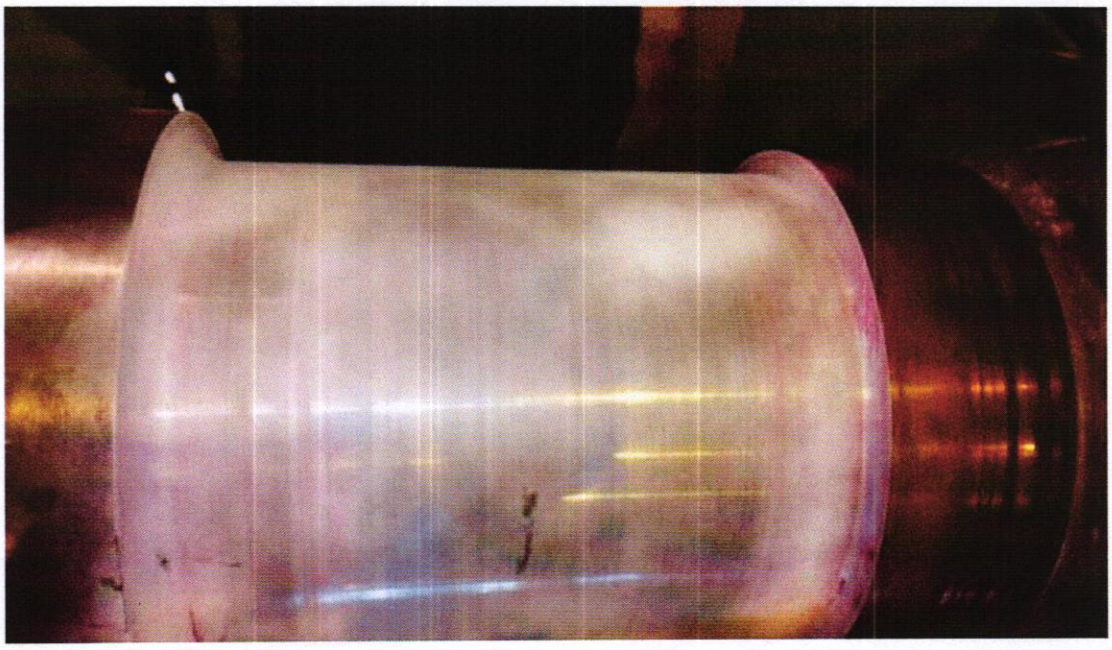


Test person	曹国安	Reviewer	柳向军
Test date	2023.04.24	Review date	2023.04.27

天津诚信达金属检测技术有限公司 报告专用章

Penetrant Testing Report			No:GDJX-PT-004
Requester	HEI	Penetrant brand	Mega check
Specimen number	/	Penetrant type	Coloring penetrant
Specimen name	High and medium pressure rotor shaft diameter	Visualization method	Dry
Specimen material	/	Penetration time	10 min
Specimen specifications	/	Development time	10 min
Number of test pieces	2	Method of operation	IIc-d
Test purpose	Check for surface defects	Technical standard	NB/T47013.5-2015

Inspection result: No surface defects were found by penetrant testing .

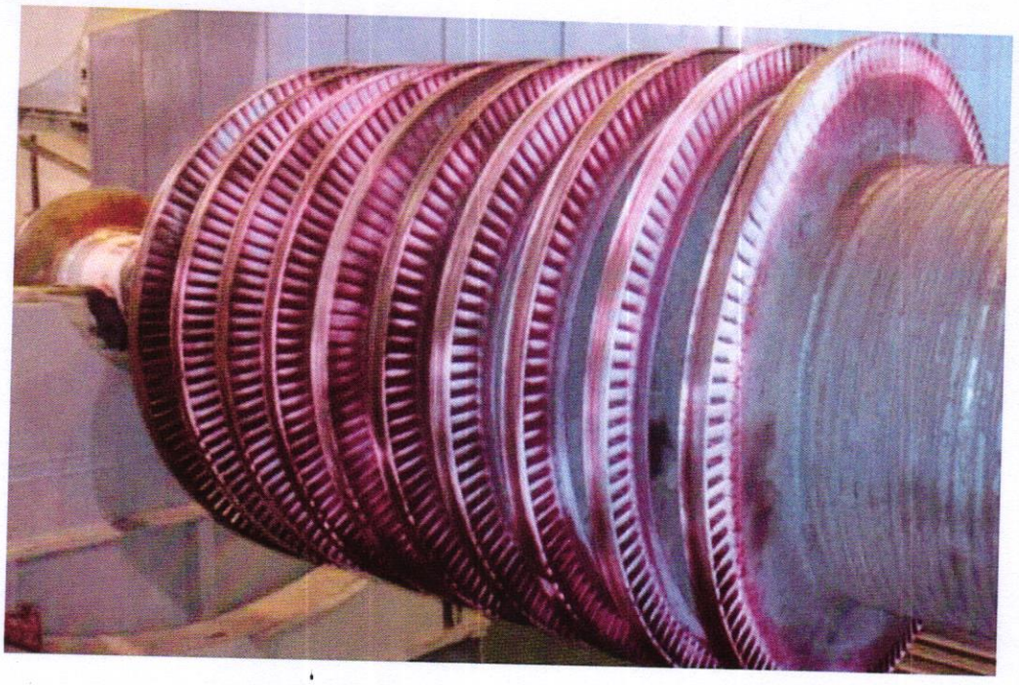


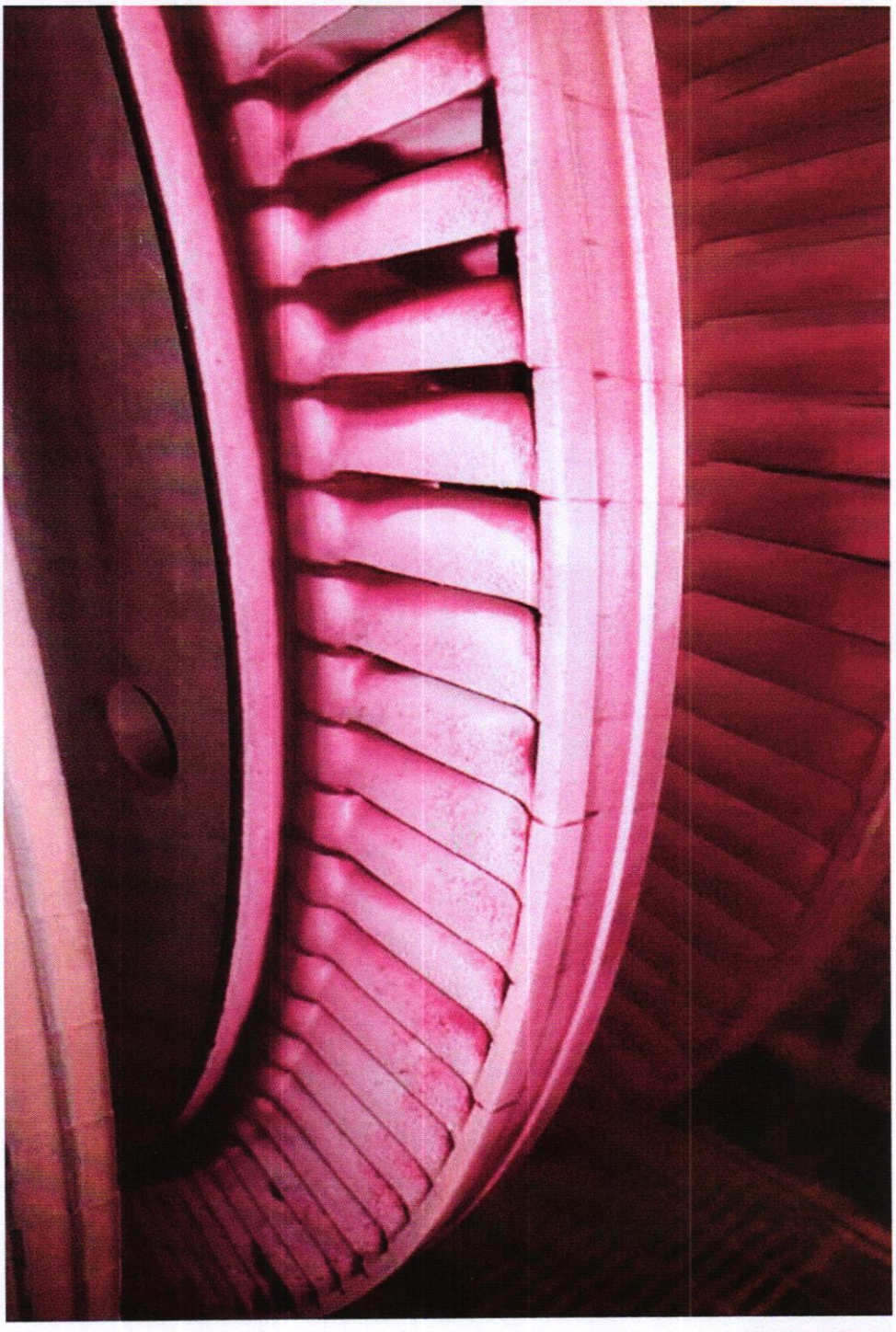
Test person	曹国安	Reviewer	柳向军
Test date	2023.04.24	Review date	2023.04.27

天津诚信达金属检测技术有限公司 报告专用章

Penetrant Testing Report			No:GDJX-PT-005
Requester	HEI	Penetrant brand	Mega check
Specimen number	/	Penetrant type	Coloring penetrant
Specimen name	High and medium pressure rotor blades	Visualization method	Dry
Specimen material	/	Penetration time	10 min
Specimen specifications	/	Development time	10 min
Number of test pieces	/	Method of operation	IIc-d
Test purpose	Check for surface defects	Technical standard	NB/T47013.5-2015

Inspection result: Penetration testing found serious cavitation on the surface of the sixth-stage blade on the high-pressure side .



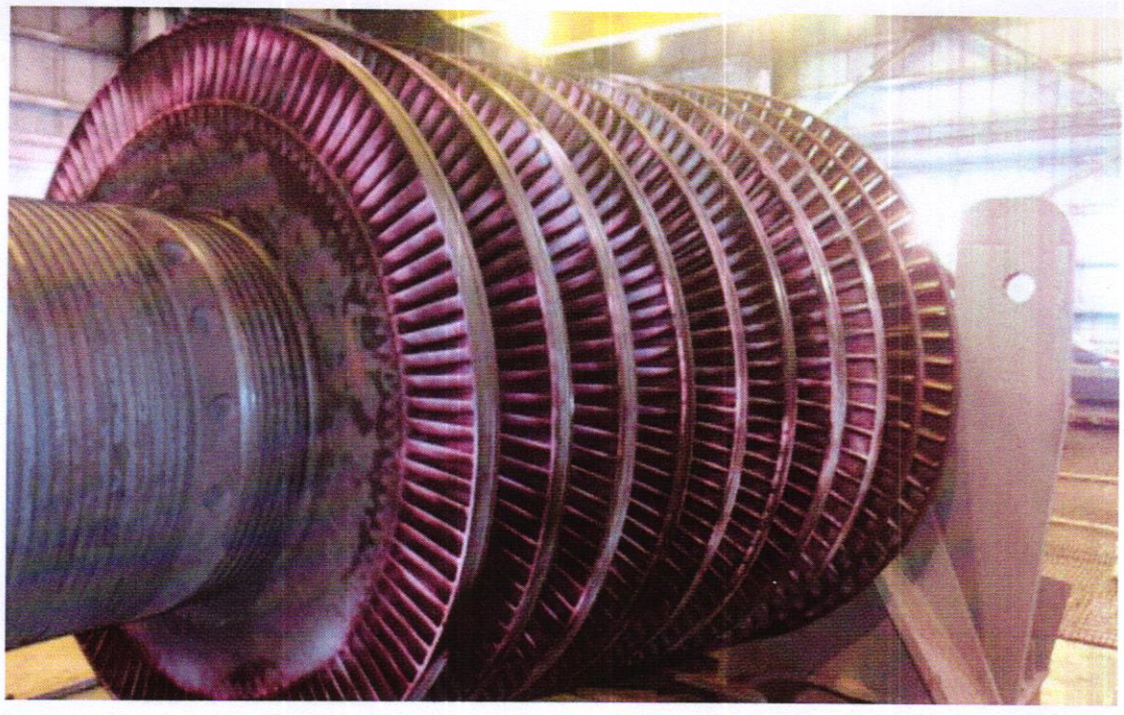


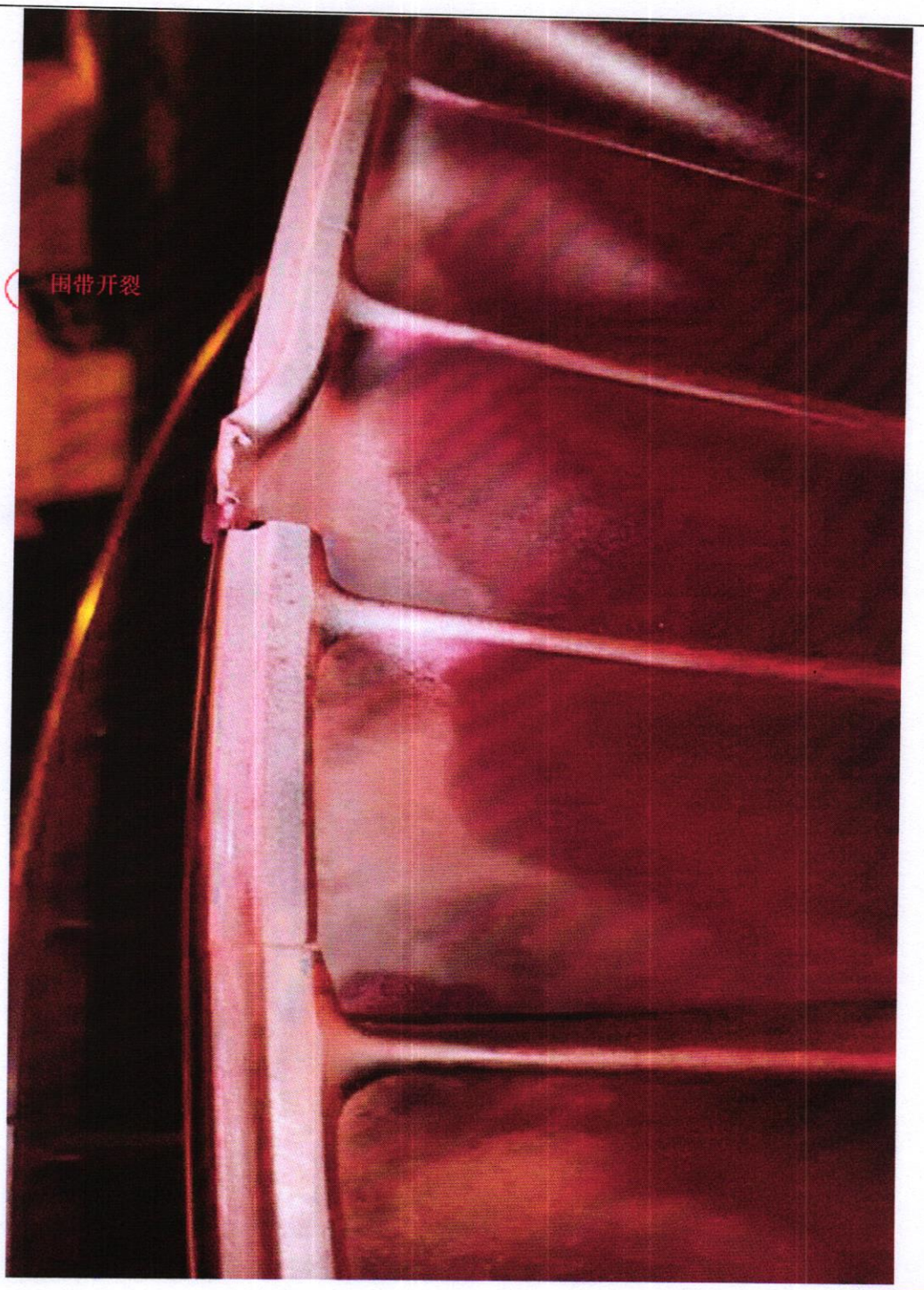
Test person	曹国安	Reviewer	柳向军
Test date	2023.04.25	Review date	2023.04.27

天津诚信达金属检测技术有限公司 报告专用章

Penetrant Testing Report			No:GDJX-PT-006
Requester	HEI	Penetrant brand	Mega check
Specimen number	/	Penetrant type	Coloring penetrant
Specimen name	High and medium pressure rotor blades	Visualization method	Dry
Specimen material	/	Penetration time	10 min
Specimen specifications	/	Development time	10 min
Number of test pieces	/	Method of operation	IIc-d
Test purpose	Check for surface defects	Technical standard	NB/T47013.5-2015

Inspection result: On the appearance, it was found that the shroud of the 9th stage blade on the medium pressure side was damaged and cracked, and no surface defects were found in other positions .



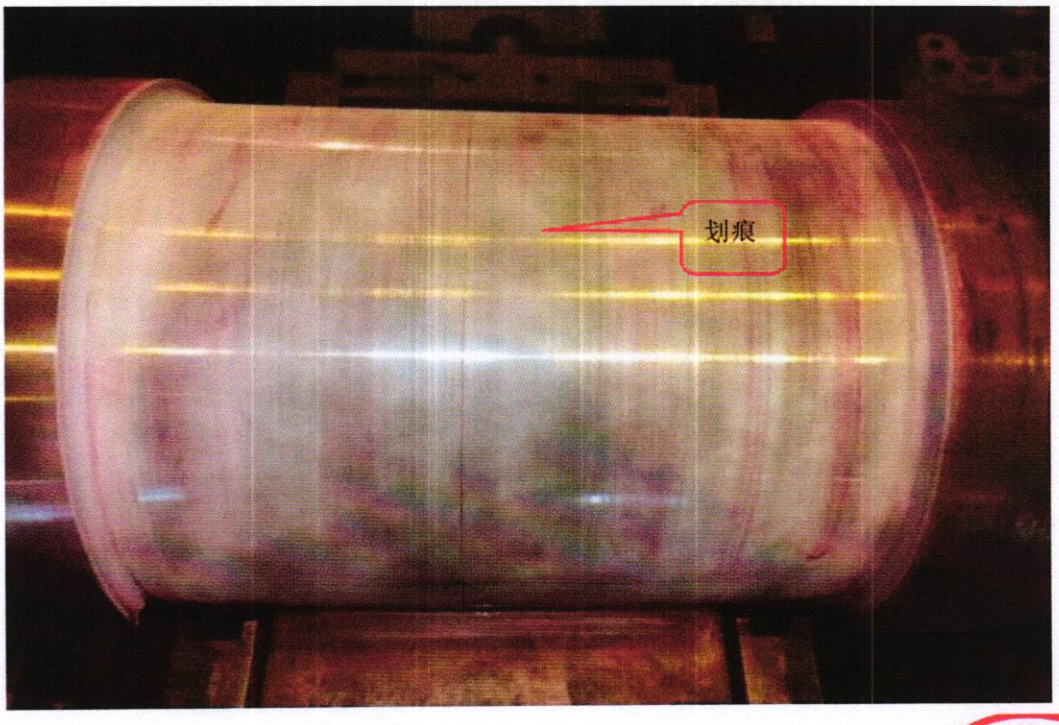


Test person	曹国安	Reviewer	柳向军
Test date	2023.04.25	Review date	2023.04.27

天津诚信达金属检测有限公司 报告专用章

Penetrant Testing Report			No:GDJX-PT-007
Requester	HEI	Penetrant brand	Mega check
Specimen number	/	Penetrant type	Coloring penetrant
Specimen name	Low pressure rotor shaft diameter	Visualization method	Dry
Specimen material	/	Penetration time	10 min
Specimen specifications	/	Development time	10 min
Number of test pieces	2	Method of operation	IIc-d
Test purpose	Check for surface defects	Technical standard	NB/T47013.5-2015

Inspection result: After penetrate testing, it was found that there was a scratch on the shaft diameter by electrical measurement , and no surface defects were found in other parts .

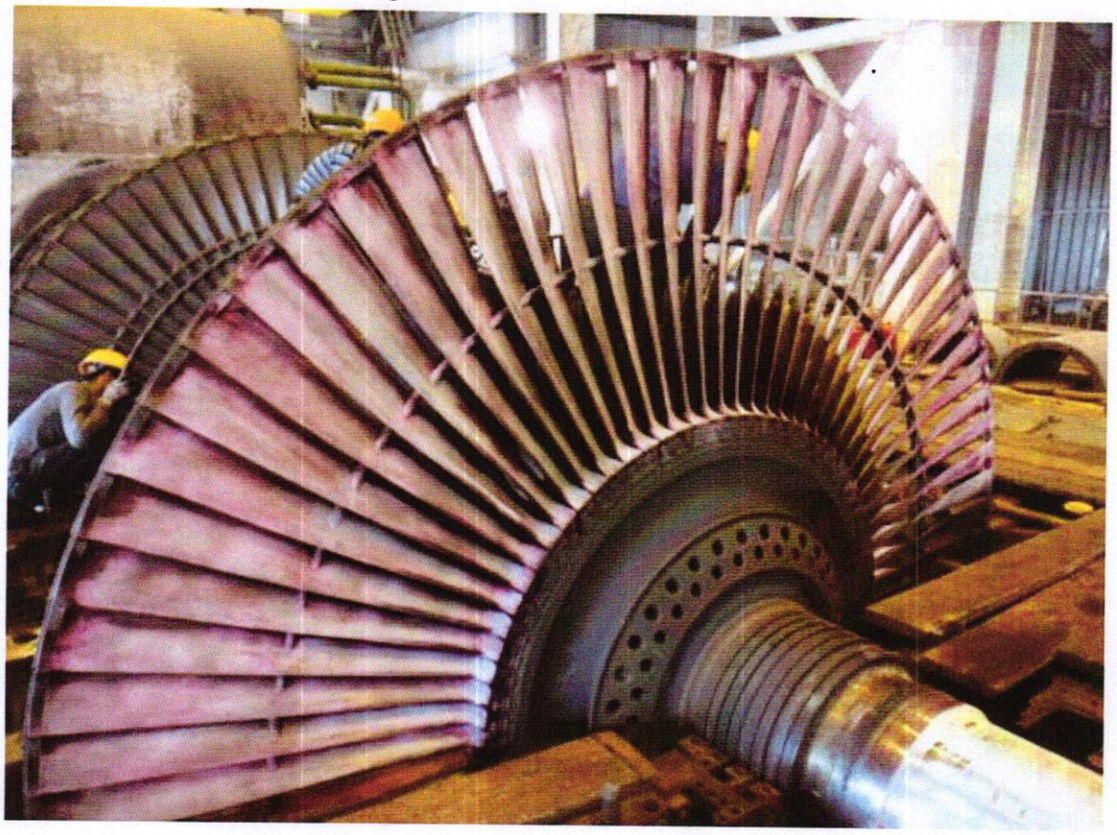


Test person	曹国安	Reviewer	柳向军
Test date	2023.04.25	Review date	2023.04.27

天津诚信达金属检测技术有限公司 报告专用章

Penetrant Testing Report			No:GDJX-PT-008
Requester	HEI	Penetrant brand	Mega check
Specimen number	/	Penetrant type	Coloring penetrant
Specimen name	Low Pressure Rotor Blades	Visualization method	Dry
Specimen material	/	Penetration time	10 min
Specimen specifications	/	Development time	10 min
Number of test pieces	/	Method of operation	Ⅱc-d
Test purpose	Check for surface defects	Technical standard	NB/T47013.5-2015

Inspection result: Penetration testing of the 6 Generator and turbine side blades of the low-pressure rotor revealed 5 surface damages on the turbine side 1st and 2nd blades, which were caused by impacts from foreign objects . There was cavitation at the root of the last blade of both side , and no surface defects were found in other parts .





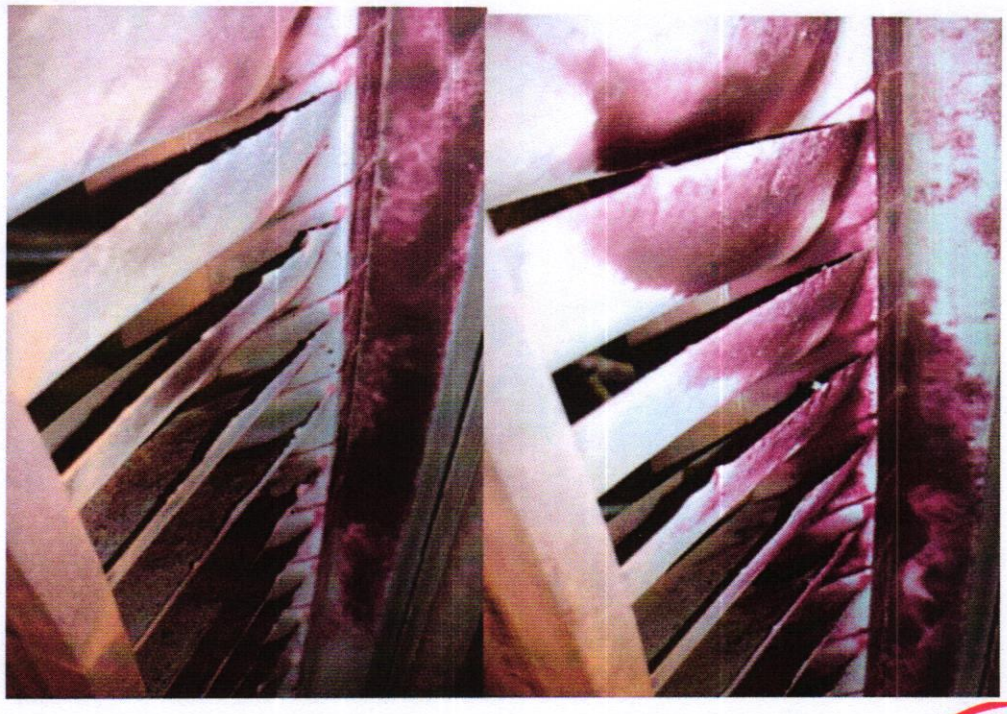


Test person	曹国安	Reviewer	柳向军
Test date	2023.04.25	Review date	2023.04.27

天津诚信达金属检测技术有限公司 报告专用章

Penetrant Testing Report			No:GDJX-PT-009
Requester	HEI	Penetrant brand	Mega check
Specimen number	/	Penetrant type	Coloring penetrant
Specimen name	Medium pressure lower vane	Visualization method	Dry
Specimen material	/	Penetration time	10 min
Specimen specifications	/	Development time	10 min
Number of test pieces	/	Method of operation	IIc-d
Test purpose	Check for surface defects	Technical standard	NB/T47013.5-2015

Inspection result: No surface crack defects were found in the penetrant inspection of the damaged and deformed parts .



Test person	曹国安	Reviewer	柳向军
Test date	2023.04.27	Review date	2023.04.27

天津诚信达金属检测技术有限公司 报告专用章

Penetrant Testing Report			No:GDJX-PT-010
Requester	HEI	Penetrant brand	Mega check
Specimen number	/	Penetrant type	Coloring penetrant
Specimen name	IP lower vane	Visualization method	Dry
Specimen material	/	Penetration time	10 min
Specimen specifications	/	Development time	10 min
Number of test pieces	6	Method of operation	IIc-d
Test purpose	Check for surface defects	Technical standard	NB/T47013.5-2015

Inspection result: No surface crack defects were found in the penetrant inspection of the damaged and deformed parts .

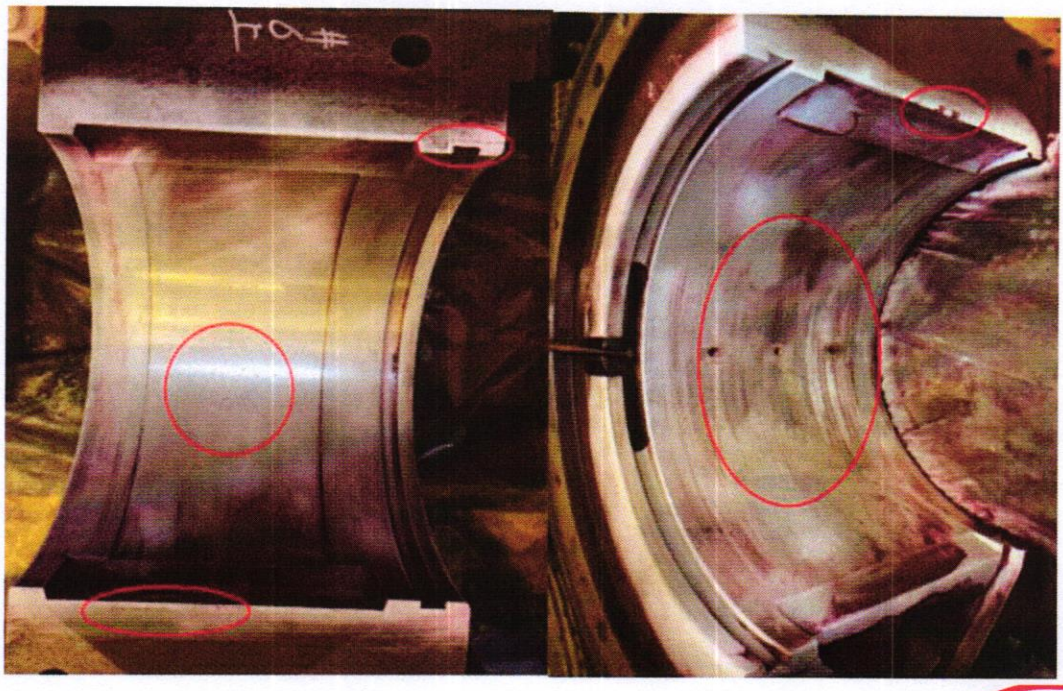


Test person	曹国安	Reviewer	柳向军
Test date	2023.04.27	Review date	2023.04.27

天津诚信达金属检测技术有限公司 报告专用章

Penetrant Testing Report			No:GDJX-PT-011
Requester	HEI	Penetrant brand	Mega check
Specimen number	/	Penetrant type	Coloring penetrant
Specimen name	#6 Bearing	Visualization method	Dry
Specimen material	/	Penetration time	10 min
Specimen specifications	/	Development time	10 min
Number of test pieces	2	Method of operation	IIc-d
Test purpose	Check for bodily defects	Technical standard	NB/T47013.5-2015

Inspection result: Penetration testing of the upper and lower parts of the Bearing# 6 pad revealed that the upper bushing had babbit material melt material detached from surface, and the babbit surface of the lower tile was severely scratched and material detached .

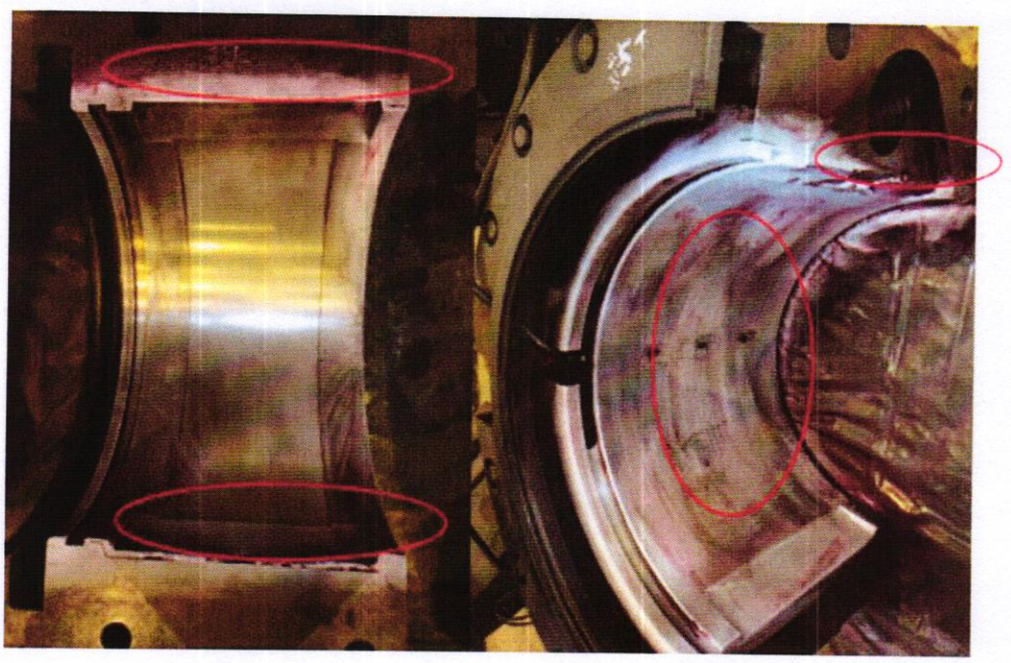


Test person	曹国安	Reviewer	柳向军
Test date	2023.04.27	Review date	2023.04.27

天津诚信达金属检测技术有限公司 报告专用章

Penetrant Testing Report			No:GDJX-PT-012
Requester	HEI	Penetrant brand	Mega check
Specimen number	/	Penetrant type	Coloring penetrant
Specimen name	#5 Bearing	Visualization method	Dry
Specimen material	/	Penetration time	10 min
Specimen specifications	/	Development time	10 min
Number of test pieces	2	Method of operation	IIc-d
Test purpose	Check for bodily defects	Technical standard	NB/T47013.5-2015

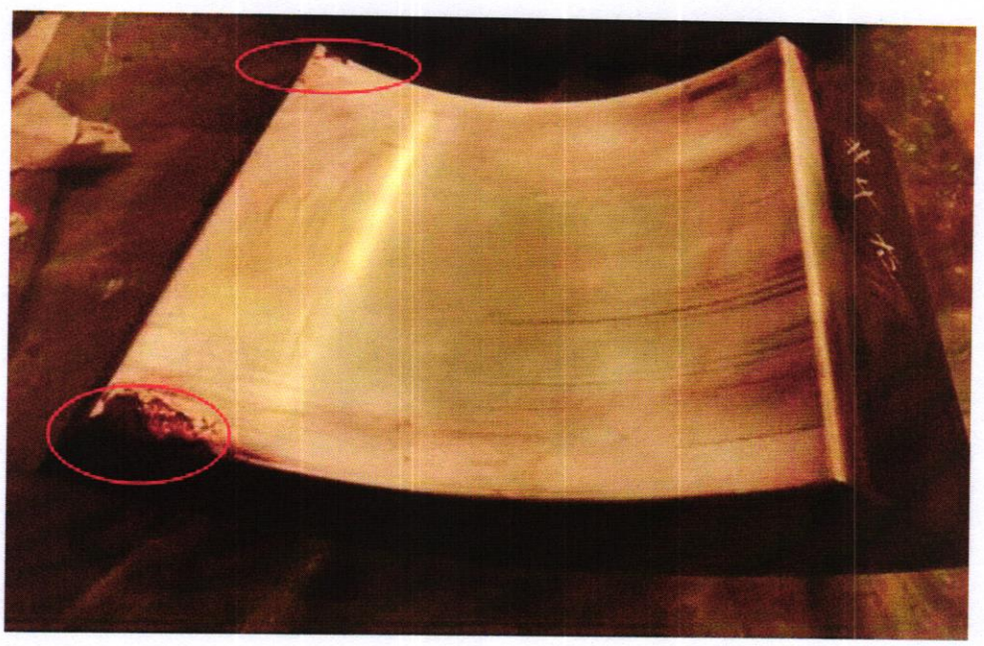
Inspection result: Penetration testing of the upper and lower parts of the bearing#5 tile revealed that the upper tile was seriously material detachment, one side of the babbit fell off, and the babbit surface of the lower tile was severely scratched and material detachment .



Test person	曹国安	Reviewer	柳向军
Test date	2023.04.27	Review date	2023.04.27

Penetrant Testing Report			No:GDJX-PT-013
Requester	HEI	Penetrant brand	Mega check
Specimen number	/	Penetrant type	Coloring penetrant
Specimen name	#4 Bearing	Visualization method	Dry
Specimen material	/	Penetration time	10 min
Specimen specifications	/	Development time	10 min
Number of test pieces	4	Method of operation	IIc-d
Test purpose	Check for bodily defects	Technical standard	NB/T47013.5-2015

Inspection result: Bearing#4 of penetration testing were carried out on the upper and lower parts of the bearing. It was found that the right side of the upper tile was severely damaged, the babbit fell off, the babbit surface of the lower tile was severely scratched, and the babbit surface on the left and right sides were both bodiless.

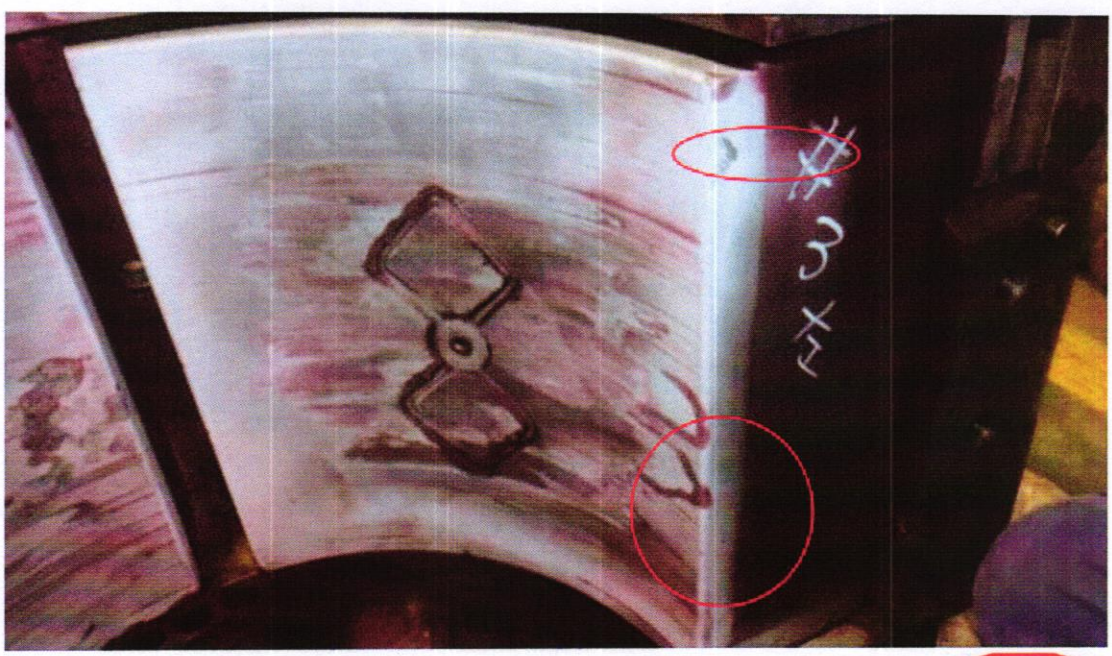


Test person	曹国安	Reviewer	柳向军
Test date	2023.04.27	Review date	2023.04.27

天津诚信达金属检测技术有限公司 报告专用章

Penetrant Testing Report			No:GDJX-PT-014
Requester	HEI	Penetrant brand	Mega check
Specimen number	/	Penetrant type	Coloring penetrant
Specimen name	#3 Bearing	Visualization method	Dry
Specimen material	/	Penetration time	10 min
Specimen specifications	/	Development time	10 min
Number of test pieces	4	Method of operation	IIc-d
Test purpose	Check for bodily defects	Technical standard	NB/T47013.5-2015

Inspection result: Penetration testing was carried out on bearing#3, and it was found that the babbit surface was severely scratched, Both the left and right sides detached.

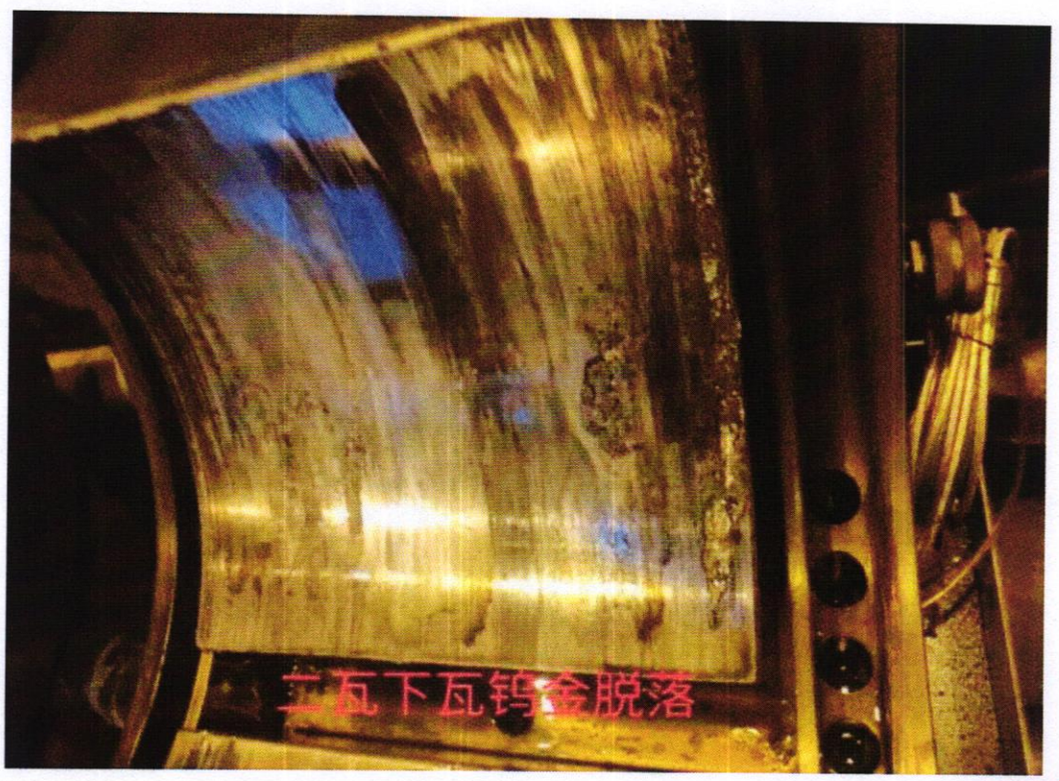


Test person	曹国安	Reviewer	柳向军
Test date	2023.04.27	Review date	2023.04.27

天津诚信达金属检测技术有限公司 报告专用章

Penetrant Testing Report			No:GDJX-PT-015
Requester	HEI	Penetrant brand	Mega check
Specimen number	/	Penetrant type	Coloring penetrant
Specimen name	#2 Bearing	Visualization method	Dry
Specimen material	/	Penetration time	10 min
Specimen specifications	/	Development time	10 min
Number of test pieces	4	Method of operation	IIc-d
Test purpose	Check for bodily defects	Technical standard	NB/T47013.5-2015

Inspection result: Penetration testing was carried out on bearing#2, and it was found that the babbit surface was severely scratched, Both the left and right sides detached.

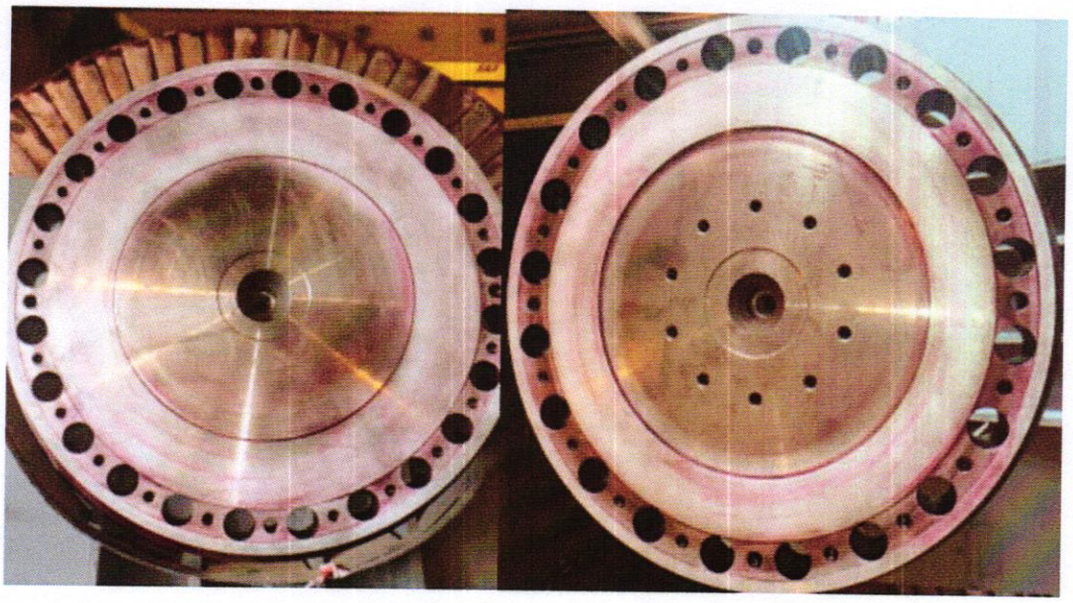


Test person	曹国安	Reviewer	柳向军
Test date	2023.04.27	Review date	2023.04.27

天津诚信达金属检测技术有限公司 报告专用章

Penetrant Testing Report			No:GDJX-PT-016
Requester	HEI	Penetrant brand	Mega check
Specimen number	/	Penetrant type	Coloring penetrant
Specimen name	Low pressure rotor shaft end face	Visualization method	Dry
Specimen material	/	Penetration time	10 min
Specimen specifications	/	Development time	10 min
Number of test pieces	2	Method of operation	IIc-d
Test purpose	Check for surface defects	Technical standard	NB/T47013.5-2015

Inspection result: No surface defects were found in the penetrant inspection of the end faces of both sides of the low-pressure rotor.



Test person	曹国安	Reviewer	柳向军
Test date	2023.04.27	Review date	2023.04.27

天津诚信达金属检测技术有限公司 报告专用章

8. Repair plan/ Restoration plan

Electric
Generator
General & Special Tools Preparation
Site Cleaning
Change new Generator Stator
Change new Generator Rotor along with CT
Electrical Test
Other Electric Equipment
Change excitier cabinet
Change new AC-DC busbar
Change new excition transformer
Change new Closed bus bar along with Micro positive current equipment
Change new Output Circult Breaker
Change New PT and Lighting arrest Cabinet
Change Hydrogen ,stator cooling water system ,oil system pipe and valve
Change Hydrogen dryer
Change hydrogen analysis system
Change Main Oil Pump along with motor
Steam Turbine
Turbine MSV ,RV IV repair and inspection.
HIP Cylinder
Change new HIP rotor
Change New bearing NO.1&No.2 bearing
Change New thrust bearing
Change all New Sealing Element
Change complet set of bolt , nut and gasket, The parts is consumable part, and some parts have been found to be unqualified. For the long-term safe operation of the unit, it is recommended to replace.
Change tooths sealing
check and inspection HIP all stage diaphragm, according to the maintenance procedure, it need to check and clean before installation.
Check cylinder clearance
Ventalition clearance adjusment
Change new oil defector
LP Cylinder
Change New bearing No.3 * No.4
Change new oil defector
Change new Coupling Bolt both EE and TE side

Change new sealing Element			
LP rotor return to OEM for end stage blade change			
LP inner cylinder upper half return to OEM for surface grouding			
Check and insepction LP all stage diaphragm according to the maintenance procedure, it need to check and clean before installation.			
Change fully set of inner casing and diaphragm set bolt Nut &gasket, The parts is consumable part, and some parts have been found to be unqualified. For the long-term safe operation of the unit, it is recommended to replace.			
Chage the gasket of vacuum diaphragm			
Change all the sealing gasket of manhole and joint connection pipe .			
Change all set of new turning gear system , the parts has been damaged by the fire.			
Change condersor control panel			
Oil Tank			
Change AC &DC oil pump along with motor, the parts is not included in the inspection work scope, However, the maintenance has not been carried out according to procedure since installation,,as the important auxiliary equipment. it is recommended to replace to ensure smooth start-up.			
Change DC oil pump AC oil pump start oil pump test module and connection pipe			
I&C			
Clean and change the bearing box and pipe, replace the lubricating oil and filter the oil.			
Chang the whole set of TSI system Cable installation			
intall the whole set of H2 system pressure gauge , I&C element and sampling valves & electric actuator			
cooling water Pipe I&C element installation			
sealing oil system I&C Element installation			
Turbine Main body temperature meansurement point installation			
Lub oil jacking Oil and turning gear system check point i&C gauge and sampling valves			
Fire alarm chek point I&C gauge			
Change Turbin K terminal cabinet repair cable and cable tray change			
Change Turbin L terminal cabinet repair cable and cable tray change			
Change Turbin V terminal cabinet repair cable and cable tray change			
Others:			
Overhead Crane repair			
Responsibility Matrix			
Item	Work Description	HEI	SLPGC
1	New Generator stator	V	
2	New Generator rotor	V	
3	New Excition transformer	V	
4	New Excition system	V	
5	New Bus Bar	V	
6	New HIP rotor	V	
7	LP rotor OEM house repair	V	
8	LP cylinder upper half repair	V	
9	I&C element mentioned on report	V	
10	General tools and special tools	V	

11	Material and consumables	V	
12	By pass system vlave inspection	V	
13	Open circuling Cooling water system		V
14	Oil system	V	
15	Close circuling Cooling water system		V
16	Condenser water Pump		V
17	Gland seal fan		V
18	high pressure vessel		V
19	safety vlave		V
20	rubber ball system		V
21	Main transformer ,high voltage plant transformer		V
22	start up and back up transformer		V
23	Boost up station		V
24	Site electric test for generator	V	
25	Electric equipment commission	V	
26	UPS and DC battery system		V
27	6KV switch cabinet		V
28	380KV distribuation cabinet		V
29	HP and LP motor		V
30	Commissing after repair	V	

9.Replacement parts list

Sr. No.	Description		Unit	Qty
	GENERATOR			
1	One lot of Steam Turbine Generator unit including all accessories and auxiliaries	QFSN-280-2	SET	1
	STEAM TURBINE			
	Bearings			
1	Bearing No.1-No.4		SET	1
	HP & IP OUTER CYLINDER	**152.012Z-1**		
1.1	RADIAL PIN	152.012.12Z	SET	1
1.2	SPHERICAL KEY	G18.011.026	SET	1
1.3	PRESS RING	152.012.023	PC	1
1.4	OUTSIDE SEALING RING	152.012.024	PC	4
1.5	EXTERNAL SEALING RING	152.012.025	PC	4
1.6	M20×42 SCREW	152.012.026	PC	20
1.7	DRAIN PIPE	152.012.5.001-1	PC	1
1.8	PIPE	152.012.5.002-1	PC	1
1.9	NUT	152.012.5.003-1	SET	1
1.10	BOLT M16*65	00.001.120	SET	1
1.11	NUT M16	152.065.001-1	SET	1
1.12	FRANGE	152.012.5.004-1	PC	1
1.13	STEEL PIPE 60*7.5	152.012.032	SET	1
1.14	NUT M10	73D.012.021	SET	1
1.15	ELECTRIC CHECK VALVE DN100	J941Y-100 (152.012.9Z-1)	PC	1
1.16	BALANCE SCREW	152.01204Z-1	SET	1
	HP INNER CYLINDER	**152.013Z-1**		
2.1	STEAM SEAL RING	152.013.2Z	SET	1
2.2	STEAM SEAL RING	152.013.2Z-1	SET	6
2.3	PLATE SPRING	152.013.021	PC	4
2.4	SPRING	75A.037.055	PC	36
2.5	PIN	152.013.032	PC	2
2.6	SPECIAL SCREW	152.013.033	PC	4
2.7	SCREW M4*12	152.013.034	PC	56
2.8	SCREW M12*30	152.013.025	PC	28
2.9	SCREW M10*27	152.013.031	PC	16
2.10	GASKET	152.013.030	PC	8
	IP THERMAL INSULATION COVER	**152.017Z**		
3.1	PLATE SPRING	73D.017.027	PC	80
3.2	SEAL RING	152.017.5Z	SET	1
3.3	SEAL RING	152.017.7Z	SET	1
3.4	SEAL RING	73D.017.047	PC	2
3.5	SEAL RING	73D.017.048	PC	1

3.6	SCREW	73D.017.049	PC	6
3.7	ADJUSTABLE SHIM	73D.017.050	PC	2
3.8	ADJUSTABLE SHIM	73D.017.051	PC	2
3.9	ADJUSTABLE SHIM	73D.017.052	PC	1
3.10	ADJUSTABLE SHIM	73D.017.053	PC	1
3.11	BOLT M12*25	73D.017.054	PC	12
3.12	BOLT			10
	HP & IP CYLINDER BOLTS	**152.019Z-1**		
4.1	Φ95×790 REAMER STUD BOLT	152.019.2.001	PC	2
4.2	M64X3X460 STUD BOLT	152.019.1.001-1	PC	2
4.3	M100×4×925 STUD BOLT	152.019.2.002	PC	10
4.4	Φ105×975 REAMER STUD BOLT	152.019.2.003	PC	2
4.5	M85×3×867 STUD BOLT	152.019.2.004	PC	3
4.6	M72×3×650 STUD BOLT	152.019.2.005	PC	5
4.7	M72×3×388 STUD BOLT	152.019.2.006	PC	3
4.8	M64×3×364 STUD BOLT	152.019.2.009	PC	10
4.9	Φ70×369 REAMER STUD BOLT	152.019.2.012	PC	3
4.10	M64×3×315 STUD BOLT	152.019.2.010	PC	5
4.11	M42×3×238 STUD BOLT	152.019.2.013	PC	3
4.12	90 SPHERICAL WASHER （CONCAVE）	152.019.2.022	PC	2
4.13	64 SPHERICAL WASHER （CONCAVE）	152.019.2.026	PC	20
4.14	100 SPHERICAL WASHER （CONCAVE）	152.019.2.023	PC	20
4.15	85 SPHERICAL WASHER （CONCAVE）	152.019.2.024	PC	5
4.16	72 SPHERICAL WASHER （CONCAVE）	152.019.2.025	PC	8
4.17	42 SPHERICAL WASHER （CONCAVE）	152.019.2.031	PC	2
4.18	90 SPHERICAL WASHER （CONVEW）	152.019.2.027	PC	2
4.19	64 SPHERICAL WASHER （CONVEW）	152.019.2.014	PC	20
4.20	100 SPHERICAL WASHER （CONVEW）	152.019.2.028	PC	20
4.21	85 SPHERICAL WASHER （CONVEW）	152.019.2.029	PC	4
4.22	72 SPHERICAL WASHER （CONVEW）	152.019.2.030	PC	8
4.23	42 SPHERICAL WASHER （CONVEW）	152.019.2.032	PC	2
4.24	M90×3 EXT. BOX NUT	152.019.2.015	PC	4
4.25	M64×3 EXT. BOX NUT	152.019.2.019	PC	20
4.26	M100×4 EXT. BOX NUT	152.019.2.016	PC	20
4.27	M85×3 EXT. BOX NUT	152.019.2.017	PC	6
4.28	M72×3 EXT. BOX NUT	152.019.2.018	PC	6

4.29	M42×3 EXT. BOX NUT	152.019.2.020	PC	6
4.30	M27 SCREW	00.019.607	PC	20
4.31	M30 SCREW	00.019.602	PC	20
4.32	M33 SCREW	00.019.608	PC	20
4.33	M36 SCREW	00.019.603	PC	20
4.34	M72X3 HEXAGON SOCKET HEAD NUT	152.019.1.002-1	PC	2
4.35	M120×4×730 STUD BOLT	152.019.1.001	PC	3
4.36	Φ124×810 REAMER STUD BOLT	152.019.1.002	PC	3
4.37	M76×3×427 STUD BOLT	152.019.1.003	PC	3
4.38	M120×4 EXT. BOX NUT	152.019.1.004	PC	5
4.39	M76×3 EXT. BOX NUT	152.019.1.005	PC	4
4.40	120 SPHERICAL WASHER （CONVEW）	152.019.1.006	PC	5
4.41	120 SPHERICAL WASHER （CONCAVE）	152.019.1.007	PC	5
4.42	76 SPHERICAL WASHER （CONVEW）	152.019.1.008	PC	3
4.43	76 SPHERICAL WASHER （CONCAVE）	152.019.1.009	PC	3
4.44	M39 SCREW	152.019.1.010	PC	5
4.45	M45 SCREW	152.019.1.011	PC	5
4.46	M27 SCREW	152.019.1.012	PC	2
4.47	M30 SCREW	152.019.1.013	PC	2
	LP OUTER CYLINDER BOLTS	**152.026Z-1**		
5.1	M33×110 HEXAGON HEAD BOLT	B20.23	PC	10
5.2	M20×50 CYLINDER SOCKET HEAD NUT	B20.55	PC	10
5.3	REAMER STUD BOLT	73.026.002	PC	5
5.4	M33 HEXAGON HEAD NUT	B20.2.1	PC	5
5.5	M33×95 HEXAGON HEAD BOLT	B20.23	PC	20
5.6	REAMER STUD BOLT	73.026.005	PC	2
5.7	HEXAGON HEAD NUT	73.026.006	PC	10
5.8	REAMER TAPER PIN	73.026.004	PC	2
5.9	M39×3×95 HEXAGON HEAD BOLT	B20.23	PC	4
5.10	HEXAGON HEAD BOLT	73.026.003	PC	4
5.11	M36×3×140 STUD BOLT	152.026.001-1	PC	4
5.12	M39×3×130 HEXAGON HEAD BOLT	B20.23	PC	8
5.13	M39×3×210 HEXAGON HEAD BOLT	B20.23	PC	10
5.14	REAMER STUD BOLT	73.026.008	PC	8
5.15	M39×3×190 HEXAGON HEAD BOLT	B20.23	PC	10
5.16	REAMER STUD BOLT	73.026.011	PC	2
5.17	39×3×110 HEXAGON HEAD BOLT	B20.23	PC	2
5.18	M36X3 EXT. BOX NUT	162.011.042	PC	6
5.19	STUD BOLT	75B.026.001	PC	2

5.20	M33×90 HEXAGON HEAD BOLT	B20.23	PC	4
	LP INNER CYLINDER	**152.027Z-1**		
6.1	STEAM SEAL RING	CH01.029.4Z	SET	2
6.2	JAM-PACK STRIP	CH01.029.050	PC	50
6.3	Φ76X343 REAMER STUD BOLT	CCH01A.027.062	PC	4
6.4	WASHER	H01.027.056	PC	4
6.5	M72×3×137 EXT. BOX NUT	H01.027.057	PC	4
6.6	M30 SCREW	73.019.024	PC	12
6.7	M27 SCREW	73.019.023	PC	12
6.8	M76X3X298 STUD BOLT	CCH01A.027.063	PC	8
6.9	WASHER	H01.027.070	PC	8
6.10	M76×3×143 EXT. BOX NUT	H01.027.071	PC	8
6.11	M52×3×100 HEXAGON HEAD NUT	H01.027.062	PC	98
6.12	WASHER	H01.027.063	PC	98
6.13	M52X3X248 STUD BOLT	CCH01A.027.064	PC	10
6.14	M16 SCREW	73.071.038	PC	94
6.15	M20 SCREW	73.071.039	PC	94
6.16	Φ58×286 REAMER STUD BOLT	H01.027.061	PC	4
6.17	M52×3×248 STUD BOLT	H01.027.067	PC	84
6.18	GASKET	CCH01A.027.065	PC	2
6.19	BOLT M12*45	B20.23	PC	20
6.20	GASKET	CCH01A.027.059	PC	4
6.21	DOUBLE STUD BOLT M30*100	B20.21	PC	20
6.22	NUT M30	B20.2.1	PC	20
6.23	BOLT M42*110	CH01.029.059	PC	4
6.24	SCREW	CH01.029.051	PC	4
6.25	SCREW M30×80	B20.55	PC	24
6.26	PIN	CH01.029.053	PC	6
6.27	PIN	CH01.029.054	PC	6
6.28	SLEEVE	CH01.029.055	PC	6
	LP CYLINDER STEAM INLET GUIDE RING	**152.028Z-1**		
7.1	STEAM SEAL RING ASS'Y	73D.028.1Z	SET	2
7.2	BOLT	CCH01A.028.005	PC	4
7.3	NUT M27	B20.2.1B	PC	16
7.4	PIN A6*70	B20.40	PC	4
7.5	PIN A5*50	B20.51	PC	4
7.6	NUT M30	B20.2.1B	PC	2
7.7	BOLT Φ34*170	H01.028.012	PC	2
7.8	BOLT	CCHO01A.029.006	PC	6
	STEAM VALVE	**73.035Z**		
8.1	LEAD PLATE	73.035.007	PC	2
	HP DIAPHRAGM	**152.037Z**		
9.1	STEAM SEAL RING	152.037.2Z	PC	3

9.2	SPRING	75A.037.055	PC	24
9.3	SPECIAL PIN	152.013.022	PC	2
9.4	50 FLAT KEY	00.102.137	PC	2
9.5	SEALING KEY	152.037.009	PC	2
9.6	SCREW M4*12	GB68-85	PC	4
9.7	SCREW M16*30	GB68-85	PC	6
9.8	55 WASHER	00.102.040	PC	2
9.9	M30 EXT. BOX NUT	00.011.026	PC	7
9.10	MONAURAL CHECK WASHER	74.036.004	PC	7
9.11	M30 STUD BOLT	152.037.010	PC	5
9.12	Φ32 REAMER STUD BOLT	152.037.011	PC	2
9.13	M36 EXT. BOX NUT	152.037.014	PC	2
9.14	M36 STUD BOLT	152.037.013	PC	2
9.15	GASKET	152.037.012	PC	4
	IP 1# DIAPHRAGM	**152.038Z-1**		
10.1	STEAM SEAL RING	152.038.2Z	SET	1
10.2	STEAM SEAL RING	152.038.2Z-1	SET	3
10.3	STEAM SEAL RING	152.038.3Z-1	SET	2
10.4	STEAM SEAL RING	152.038.4Z-1	SET	1
10.5	SPRING	152.013.021	PC	8
10.6	SPRING	75.013.037	PC	30
10.7	PIN	152.038.043	PC	2
10.8	PIN	152.038.041	PC	12
10.9	SCREW M3*12	152.013.034	PC	30
10.10	SCREW M16*30	152.038.036	PC	14
10.11	SPECIAL SCREW	152.013.033	PC	14
10.12	SCREW M30	152.019.1.013	PC	8
10.13	SCREW M27	152.019.1.014	PC	8
10.14	BOLT M72*3*485	152.038.030	PC	4
10.15	BOLT M72*3*435	152.038.031	PC	6
10.16	GASKET 72	152.038.032	PC	10
10.17	WASHER 72	152.038.033	PC	10
10.18	NUT M72*3	152.038.038	PC	10
	IP 2# DIAPHRAGM	**152.039Z-1**		
11.1	STEAM SEAL RING	152.038.4Z-1	SET	3
11.2	SPRING	75.013.037	PC	12
11.3	PIN	152.039.01-1	PC	6
11.4	SPECIAL SCREW	152.013.033	PC	6
11.5	M30 EXT. BOX NUT	00.011.026	PC	14
11.6	MONAURAL CHECK WASHER	74.036.004	PC	14
11.7	M30*100 STUD BOLT	00.011.150	PC	12
11.8	BOLT	74.036.003	PC	2
11.9	BOLT M16*60	B20.24	PC	2
	LP DIAPHRAGM	**152.041Z-1/042Z-1**		

12.1	STEAM SEAL RING	152.042.3Z	SET	2
12.2	STEAM SEAL RING	152.042.4Z	SET	2
12.3	STEAM SEAL RING	152.027.10Z	SET	2
12.4	STEAM SEAL RING	152.027.9Z	SET	2
12.5	STEAM SEAL RING	CH01.041.3Z	SET	6
12.6	SEAL RING	CH01.041.4Z-28	SET	2
12.7	SCREW M12	73.037.049	PC	10
12.8	SCREW M16	73.041.022	PC	2
12.9	SCREW	73.027.134	PC	2
12.10	BOLT Φ58*331	CH01.041.2.001-28	PC	2
12.11	WASHER	H01.043.009	PC	12
12.12	NUT	152.041.2.001-1	PC	10
12.13	BOLT M72*3*579	CH01.041.2.002-28	PC	4
12.14	WASHER 72	00.019.617	PC	4
12.15	NUT M72*3*137	152.041.2.002-1	PC	2
12.16	NUT M72*3*300	152.041.2.003-1	PC	2
12.17	BOLT M45*3*300	CH01.041.2.005-28	PC	4
12.18	WASHER	H01.043.008	PC	6
12.19	NUT M45*3*250	152.041.2.004-1	PC	2
12.20	NUT M45*3*300	152.041.2.005-1	PC	2
12.21	BOLT Φ58*981	CH01.041.2.008-28	PC	2
12.22	NUT M52*3*300	152.041.2.006-1	PC	2
12.23	BOLT	CCH01A.041.2.002	PC	8
12.24	NUT	152.041.2.007-1	PC	2
12.25	BOLT	CCH01A.041.2.001	PC	2
	HP & IP OUTER CLINDER GLAND SEALING(ADJUST)	**152.065Z-1**		
13.1	STEAM SEAL RING	152.065.4Z-1	SET	1
13.2	STEAM SEAL RING	152.065.5Z-1	SET	2
13.3	STEAM SEAL RING	152.065.6Z-1	SET	5
13.4	PLATE SPRING	73A.065.005	PC	12
13.5	M6×21 STOP SCREW	K01B.066.014	PC	32
13.6	PLATE SPRING	73B.069.020	PC	20
13.7	SCREW M4*12	B20.28	PC	8
13.8	BOLT M16*50	B20.21	PC	4
13.9	WASHER 16	B22.1.H	PC	8
13.10	NUT M16	152.065.001-1	PC	4
13.11	BOLT M16*85	G18.067.011	PC	2
13.12	WASHER 16	B22.4K	PC	2
13.13	NUT M16	B20.9.1	PC	4
13.14	NUT M20	00.011.043	PC	14
13.15	WASHER 16	B22.4K	PC	12
13.16	BOLT M20*85	B20.21	PC	14
13.17	BOLT M16*150	161.066.001	PC	2
13.18	WASHER	152.065.002-1	PC	2

13.19	BOLT M24*90	B20.21	PC	6
13.20	NUT M24	00.011.045	PC	6
13.21	WASHER	00.066.003	PC	8
13.22	NUT M24	B20.9.1	PC	2
13.23	BOLT M24	00.066.007	PC	2
13.24	WASHER	152.065.034	PC	16
13.25	SCREW M6*12	B20.28	PC	16
	HP & IP OUTER CLINDER GLAND SEALING (GENERATION)	**152.066Z**		
14.1	STEAM SEAL RING	152.066.2Z	SET	1
14.2	STEAM SEAL RING	152.066.3Z	SET	3
14.3	PLATE SPRING	73A.065.005	PC	16
14.4	SCREW M6*21	K01B.066.014	PC	16
14.5	BOLT M16*50	GB898-88	PC	8
14.6	NUT M16	GB6175-86	PC	10
14.7	BOLT M16*85	G18.067.011	PC	2
	LP OUTER CLINDER GLAND SEALING	**73B.069Z**		
15.1	STEAM SEAL RING ASS'Y	73B.069.1Z	SET	2
15.2	STEAM SEAL RING ASS'Y	73B.069.2Z	SET	6
	HP & IP BALANCE RING(STEAM)	**152.071Z-1**		
16.1	STEAM SEAL RING	152.071.2Z	SET	1
16.2	STEAM SEAL RING	152.071.3Z	SET	6
16.3	PLATE SPRING	152.071.030	PC	28
16.4	SCREW	73.071.001	PC	28
16.5	SCREW M4*12	152.071.033	PC	4
16.6	BOLT M60*3*334	152.071.022	PC	4
16.7	BOLT Φ65*334	152.071.023	PC	4
16.8	WASHER 60	152.071.024	PC	8
16.9	WASHER 60	152.071.025	PC	8
16.10	NUT M69*3	152.071.026	PC	8
16.11	SCREW M8*30	152.071.027	PC	14
16.12	WASHER	152.071.028	PC	14
	OIL RETAINING RING (FRONT BEARING BOX)	**73.076Z**		
17.1	OIL SEALING STRIP	73.076.006	PC	30
	OIL RETAINING RING OUTSIDE THE REAR BEARING BOX (ADJUST)	**73.077Z**		
18.1	OIL SEALING STRIP	73.077.005	PC	24
	INNER RETAINING RING (BEARING BOX)	**73.078Z**		
19.1	OIL SEALING STRIP	73.078.004	PC	48
	OUTER OIL BAFFLE RING OF BEARING BOX	**73.079Z**		
20.1	OIL SEALING STRIP	73.079.003	PC	24

	CONNECTION PIPE	**152.091Z-1**		
21.1	M39×3 EXT. BOX NUT	73.091.047	PC	20
21.2	M39×3×180 STUD BOLT	152.091.1.008	PC	20
21.3	M33×115 HEXAGON HEAD BOLT	73.091.049	PC	20
21.4	SHIM	152.091.1.001	PC	1
21.5	SHIM	152.091.1.002	PC	1
21.6	SHIM	152.091.1.003	PC	1
21.7	M33×185 HEXAGON HEAD BOLT	152.091.1.004	PC	20
21.8	M33 HEXAGON HEAD NUT	75C.091.041	PC	20
21.9	Φ1027/Φ1110 SHIM	152.091.1.006	PC	2
21.10	M33×110 HEXAGON HEAD BOLT	152.091.1.011	PC	20
	HP 1-10# DIAPHRAGM	**152.101Z-110Z**		
22.1	LOCKING STRIP	152.101.007	PC	16
22.2	SEALING STRIP	152.101.008	PC	8
22.3	SEALING STRIP	152.101.009	PC	8
22.4	LOCKING STRIP	152.102.007	PC	16
22.5	SEALING STRIP	152.102.008	PC	8
22.6	SEALING STRIP	152.102.009	PC	8
22.7	LOCKING STRIP	152.103.006	PC	16
22.8	SEALING STRIP	152.103.007	PC	8
22.9	SEALING STRIP	152.103.008	PC	8
22.10	LOCKING STRIP	152.104.008	PC	16
22.11	SEALING STRIP	152.104.009	PC	8
22.12	SEALING STRIP	152.104.010	PC	8
22.13	LOCKING STRIP	152.105.005	PC	16
22.14	SEALING STRIP	152.105.006	PC	8
22.15	SEALING STRIP	152.105.007	PC	8
22.16	LOCKING STRIP	152.106.007	PC	16
22.17	SEALING STRIP	152.106.008	PC	8
22.18	SEALING STRIP	152.106.009	PC	8
22.19	LOCKING STRIP	152.107.005	PC	16
22.20	SEALING STRIP	152.107.006	PC	8
22.21	SEALING STRIP	152.107.007	PC	8
22.22	LOCKING STRIP	152.108.007	PC	16
22.23	SEALING STRIP	152.108.008	PC	8
22.24	SEALING STRIP	152.108.009	PC	8
22.25	LOCKING STRIP	152.109.007	PC	16
22.26	SEALING STRIP	152.109.008	PC	8
22.27	SEALING STRIP	152.109.009	PC	8
22.28	LOCKING STRIP	152.110.005	PC	16
22.29	SEALING STRIP	152.110.006	PC	8
22.30	SEALING STRIP	152.110.007	PC	8
22.31	KEY 57	152.101.006	PC	2

22.32	SCREW M6*18	152.101.012	PC	40
22.33	SCREW M10*30	152.101.013	PC	20
	IP 1-10# DIAPHRAGM	**152.121Z-130Z-1**		
23.1	LOCKING STRIP	152.121.007	PC	16
23.2	SEALING STRIP	152.121.008	PC	8
23.3	SEALING STRIP	152.121.009	PC	8
23.4	LOCKING STRIP	152.122.007	PC	16
23.5	SEALING STRIP	152.122.008	PC	8
23.6	SEALING STRIP	152.122.009	PC	8
23.7	LOCKING STRIP	152.123.005	PC	16
23.8	SEALING STRIP	152.123.006	PC	8
23.9	SEALING STRIP	152.123.007	PC	8
23.10	LOCKING STRIP	152.124.006	PC	16
23.11	SEALING STRIP	152.124.007	PC	8
23.12	SEALING STRIP	152.124.008	PC	8
23.13	LOCKING STRIP	152.125.005	PC	16
23.14	SEALING STRIP	152.125.006	PC	8
23.15	SEALING STRIP	152.125.007	PC	8
23.16	LOCKING STRIP	152.126.006	PC	16
23.17	SEALING STRIP	152.126.007	PC	8
23.18	SEALING STRIP	152.126.008	PC	8
23.19	LOCKING STRIP	152.127.005	PC	16
23.20	SEALING STRIP	152.127.006	PC	8
23.21	LONG SEALING STRIP	152.127.007	PC	8
23.22	SEALING STRIP	152.128.007-1	PC	8
23.23	LONG SEALING STRIP	152.128.008-1	PC	8
23.24	LOCKING STRIP	152.128.009-1	PC	16
23.25	SEALING STRIP	152.129.007-1	PC	8
23.26	LONG SEALING STRIP	152.129.008-1	PC	8
23.27	LOCKING STRIP	152.129.009-1	PC	16
23.28	SEALING STRIP	152.130.007-1	PC	8
23.29	LONG SEALING STRIP	152.130.008-1	PC	8
23.30	LOCKING STRIP	152.130.009-1	PC	16
23.31	KEY 130	152.101.005	PC	2
	LP FORWARD, REVERSE, STAGE 5 DIAPHRAGM	**152.135Z-1/145Z-1**		
24.1	STEAM SEAL RING ASS'Y	G08.136.3Z	SET	2
24.2	PIN	K02.135.004	PC	8
	LP FORWARD, REVERSE, STAGE 6 DIAPHRAGM	**152.136Z-1/146Z-1**		
25.1	STEAM SEAL RING	152.136.2Z-1	SET	2
25.2	SPRING	152.136.002-1	PC	20
25.3	SCREW M8*8	CH01.137.007-2	PC	4
25.4	PIN Φ6*44	CH01.137.006-2	PC	4
	HP & IP ROTOR	**152.271Z-1**		

26.1	HP ROTOR	152.271.001-1	PC	1
26.2	HEXAGON HEAD BOLT	73.276.009	PC	48
26.3	SPECIAL WASHER	73.276.010	PC	48
26.4	SPECIAL NUT	73.276.008	PC	48
26.5	COUPLING REAMER BOLT	152.271.002	PC	24
26.6	DYNAMIC BALANCE PARTS	158.271.001	PC	20
26.7	SCREW	158.271.003	PC	20
26.8	M39 DYNAMIC BALANCE PLUG	B20.261-95	PC	15
26.9	DYNAMIC BALANCE PLUG	GHQ01.654.001	PC	15
26.10	SCREW	161.271.006	PC	15
26.11	M22 DYNAMIC BALANCE PLUG	B20.261-95	PC	8
	LP ROTOR	**152.273Z-1**		
27.1	M45 DYNAMIC BALANCE PLUG	B20.261-95	PC	16
27.2	M52×3 NUT	73.276.005	PC	20
27.3	COUPLING REAMER BOLT	152.273.002	PC	20
27.4	NUT	73.276.008	PC	20
27.5	HEXAGON HEAD BOLT	73.276.009	PC	20
27.6	WASHER	73.276.010	PC	20
27.7	GEAR	73B.273.502	PC	1
27.8	22 DYNAMIC BALANCE PLUG	B20.261-95	PC	16
27.9	OIL SEALING STRIP	73.288.022	PC	4
27.10	BLADES OF LAST STAGES		SET	2
27.11	BLADES OF SECOND END STAGES		SET	2
	HP MAIN STEAM ADJUST VALVE	**152.301Z**		
28.1	MAIN STEAM VALVE STEM	152.301.022	PC	2
28.2	BOLT	152.301.002	PC	8
28.3	NUT	152.301.003	PC	8
28.4	SHIM	152.301.005	PC	1
28.5	MAIN STEAM VALVE DISC	152.301.023	PC	2
28.6	EXT. BOX NUT	152.301.024	PC	2
28.7	HEXAGON SOCKET HEAD STUD BOLT	152.301.011	PC	24
28.8	SHIM	152.301.029	PC	2
28.9	HOLD-DOWN RING	152.301.025	PC	2
28.10	VALVE DISC FOR HP GV	152.301.027	PC	2
28.11	HEXAGON SOCKET HEAD STUD BOLT	152.301.014	PC	10
28.12	SHAFT RING	152.301.015	PC	10
28.13	NUT	152.301.016	PC	10
28.14	VALVE SLEEVE FOR HP GV	152.301.028	PC	2
28.15	VALVE STEM FOR HP CONTROL VALVE	152.301.017	PC	2
28.16	HEXAGON SOCKET SCREW	152.301.018	PC	8
28.17	SHIM	152.301.030	PC	4
28.18	HEXAGON SOCKET SCREW	152.301.020	PC	8

28.19	STUD BOLT	152.301.019	PC	8
28.20	SHIM	152.301.033	PC	2
28.21	BOLT	152.301.006	PC	8
28.22	HEXAGON HEAD NUT	152.301.012	PC	8
	IP REHEAT ADJUST COMBINED VALVE(L & R)	**152.306Z**		
29.1	STRAINER ASS'Y	73D.306.9Z	SET	2
29.2	M30X172 STUD BOLT	152.306.1.001	PC	12
29.3	M30 HEXAGON SOCKET NUT	73D.306.003	PC	12
29.4	30 SPHERICAL WASHER （CONVEW）	152.306.1.002	PC	10
29.5	30 SPHERICAL WASHER （CONCAVE）	152.306.1.003	PC	10
29.6	WOUND GASKET	CH01.306.114	PC	2
29.7	M33X286 STUD BOLT	152.306.1.007	PC	16
29.8	M33 NUT	73D.306.011	PC	20
29.9	33 SPHERICAL WASHER （CONVEW）	152.306.1.008	PC	20
29.10	33 SPHERICAL WASHER （CONCAVE）	152.306.1.009	PC	20
29.11	SLEEVE	152.306.1.010	PC	2
29.12	WOUND GASKET	152.306.1.025	PC	2
29.13	M30X171 STUD BOLT	152.306.1.011	PC	6
29.14	M30 NUT	73D.306.015	PC	6
29.15	VALVE DISC	152.306.1.012	PC	2
29.16	M60X3 NUT	152.306.1.013	PC	1
29.17	SLEEVE	152.306.1.015	PC	1
29.18	SLEEVE	73D.306.022	PC	4
29.19	SHAFT	73D.306.025	PC	1
29.20	SHAFT	73D.306.057	PC	1
29.21	SLEEVE	152.306.1.019	PC	2
29.22	KEY	152.306.1.020	PC	3
29.23	SLEEVE	152.306.1.022	PC	2
29.24	M8X12 HEXAGON HEAD BLOT	GB5782-86	PC	10
29.25	M33X273 STUD BOLT	152.306.1.023	PC	15
29.26	SHIM	152.306.1.024	PC	2
	IP ADJUST VALVE	**152.314Z**		
30.1	VALVE DISC FOR IP CONTROL VALVE	K01B.314.2Z	SET	2
30.2	PRE-INLET VALVE	K01B.314.006	PC	2
30.3	CONNECTING SLEEVE FOR IP GV	K01B.314.007	PC	2
30.4	LOCKING NUT FOR IP GV	K01B.314.009	PC	2
30.5	WOUND GASKET	152.314.001	PC	2
30.6	SCREW PLUG	K01B.314.010	PC	2
30.7	VALVE STEM	K01B.314.011	PC	2
30.8	SLEEVE	K01B.314.012	PC	2

30.9	PIN	K01B.314.013	PC	4
30.10	SEAL RING	K01B.314.014	PC	2
30.11	CONNECTING NUT	K01B.314.015	PC	2
30.12	PIN	K01B.314.016	PC	2
30.13	PIN	152.314.002	PC	4
30.14	M22X90 HEXAGON SOCKET SCREW	152.314.003	PC	8
30.15	22 SPHERICAL WASHER (CONVEW)	152.314.004	PC	8
30.16	22 SPHERICAL WASHER (CONCAVE)	152.314.005	PC	8
30.17	12N6X38 PIN	152.314.006	PC	2
	GLAND SEALING PIPE	**152.501Z-1**		
31.1	STRAINER WELDING ASS'Y	73.501.12Z	PC	2
31.2	STRAINER WELDING ASS'Y	73.501.14Z	PC	3
31.3	Φ64×Φ32×1.5 WASHER	152.501.004-1	PC	2
31.4	M16×100 STUD BOLT	75D.501.024	PC	8
31.5	M16 NUT	B20.9.1B	PC	16
31.6	16 WASHER	B22.1	PC	16
31.7	DRAINAGE JOINT	73.501.043	PC	10
	BOLT HEATER	**152.606Z-1**		
32.1	BOLT HEATER	152.606.1Z-1	PC	16
32.2	BOLT HEATER	152.606.2Z-1	PC	4
32.3	BOLT HEATER	152.606.3Z-1	PC	4
32.4	BOLT HEATER	152.606.4Z-1	PC	4
32.5	BOLT HEATER	152.606.5Z-1	PC	16
32.6	BOLT HEATER	152.606.6Z-1	PC	16
32.7	BOLT HEATER	152.606.7Z-1	PC	4
32.8	BOLT HEATER	152.606.8Z-1	PC	16
32.9	BOLT HEATER	152.606.9Z-1	PC	4
32.10	BOLT HEATER	152.606.10Z-1	PC	6
32.11	BOLT HEATER	152.606.11Z-1	PC	4
32.12	BOLT HEATER	152.606.12Z-1	PC	12
32.13	BOLT HEATER	152.606.13Z-1	PC	4
32.14	BOLT HEATER	152.606.14Z-1	PC	4
32.15	BOLT HEATER	152.606.15Z-1	PC	4
32.16	BOLT HEATER	152.606.17Z-1	PC	4
32.17	BOLT HEATER	152.606.16Z-1	PC	8
32.18	BOLT HEATER	152.606.18Z-1	PC	4
32.19	BOLT HEATER	152.606.19Z-1	PC	4
32.20	BOLT HEATER	152.606.20Z-1	PC	4
32.21	BOLT HEATER	152.606.21Z-1	PC	4
32.22	BOLT HEATER	152.606.22Z-1	PC	4
32.23	POWER BOX	LD-3	PC	1
32.24	DRY CABINET	GZ-102	PC	1
32.25	SOCKET	73.606.44Z	PC	1

32.26	CABLE CONNECTOR	73.606.45Z	PC	55
	TOP SHAFT DEVICE	**152.570Z-1**		
33.1	AXIAL PLUNGER PUMP	A3H37-FRO1KK-10-X33	SET	1
	1# SUPPORT BEARING	**152.050Z-1**		
34.1	BEARING SHELL ASS'Y	152.050.1Z-1	SET	1
34.2	OIL SEAL RING	73.050.5Z	SET	2
	2# SUPPORT BEARING	**73C.052Z**		
35.1	BEARING PAD ASS'Y	73.052.4Z	SET	1
35.2	OIL SEAL RING	73.052.7Z	SET	2
	3# SUPPORT BEARING	**5C.053Z**		
36.1	BEARING PAD ASS'Y	75B.055.5Z	SET	1
36.2	OIL SEAL RING	75B.055.8Z	SET	2
	4# SUPPORT BEARING	**75C.054Z**		
37.1	BEARING PAD ASS'Y	73B.054.12Z	SET	1
37.2	OIL SEAL RING	75B.055.8Z	SET	2
38	THRUST PAD	152.051Z	SET	1
39	**MAIN OIL PUMP**	**73B.401Z**	SET	1
40	**TURNING GEAR**	**73B.178Z-28**	SET	1
	OIL EJECTOR	**73B.407Z**		
41.1	STRAINER OF OIL EJECTOR	75.407.2Z	SET	2
	TOP SHAFT ADJUST DEVICE	**K09.571Z-2**		
42.1	THROTTLE VALVE		PC	4
	TOP SHAFT PIPE AND PARTS	**152.553Z-1**		
43.1	SAFETY VALVE		PC	1
43.2	HIGH PRESSURE CONTROLLER		PC	1
43.3	DN20 ONE-WAY CHECK VALVE		PC	4
	INNER CYLINDER TOP SHAFT DEVICE PIPE	**152.554Z**		
44.1	ONE-WAY THROTTLE VALVE		PC	4
	HP MAIN STEAM VALVE SEAT	**152.302Z-1**		
45.1	BIG SPRING	152.302.031	PC	2
45.2	SMALL SPRING	152.302.032	PC	2
45.3	DISPLACEMENT SENSOR	152.302Z-1	PC	2
45.4	TRAVEL SWITCH	152.302Z-1	PC	2
	IP REHEAT MAIN STEAM VALVE SEAT(L & R)	**152.307Z-1, 152.308Z-1**		
46.1	Φ154 SPRING	73.307.019	PC	2
46.2	Φ220 SPRING	73.307.020	PC	2
	HP ADJUST VALVE SEAT	**152.318Z-1**		
47.1	DISPLACEMENT SENSOR		PC	2

47.2	TRAVEL SWITCH		PC	2
47.3	1 3/8-8 N.MOD STUD BOLT	152.318.013	PC	10
47.4	SPRING	152.318.039	PC	2
	IP ADJUST VALVE SEAT	**152.319Z-1**		
48.1	SPRING	73D.319.005	PC	2
48.2	SPRING	73D.319.006	PC	2
48.3	SPRING	73D.319.007	PC	2
	EH OIL SYSTEM	**152.000.3M-1**		
49.1	FILTER FOR HP OIL SERVO-MOTOR	HQ25.12Z	PC	10
49.2	FILTER CORE FOR OIL DRIVING BACK	HQ25.600.15Z	PC	4
49.3	FILTER CORE FOR INLET OF REGENERATIVE PUMP	HQ25.600.12Z	PC	4
49.4	FILTER CORE FOR INLET OF MAIN PUMP	HQ25.600.11Z	PC	4
49.5	FLUORIN RUBBER O TYPE SEAL RING FOR EH SYSTEM		SET	1
49.6	FILTER CORE FOR OUTLET OF MAIN PUMP	HQ25.600.14Z	PC	4
49.7	FILTER FOR IP OIL SERVO-MOTOR	HQ25.10Z	PC	8
49.8	RESIN FILTER	HQ25.300.20Z	PC	2
49.9	FILTER CORE FOR THE FRIST STAGE OF REGENERATIVE PUMP	HQ25.300.16Z	PC	2
49.10	10 L RUBBER BALLOON （INCLUDING SEALING PARTS）	10L	PC	2
49.11	40 L RUBBER BALLOON （INCLUDING SEALING PARTS）	40L	PC	2
49.12	4 L RUBBER BALLOON（INCLUDING SEALING PARTS）	4L	PC	2
	OPC/AST	**152.776Z-1**		
50.1	OPC SOLENOID VALVE	HQ16.08Z	PC	2
50.2	AST SOLENOID VALVE	HQ16.09Z	PC	4
	CONDENSOR	**N519.00Z**		
51.1	Φ25×0.7,L=12746 COOLING WATER PIPE	N519.00.003	PC	200
51.2	Φ25×0.5,L=12746 COOLING WATER PIPE	N519.00.004	PC	400
51.3	42 WASHER	B22.1	PC	100
51.4	M42 NUT	B20.2.1B	PC	100
51.5	M42×180 STUD BOLT	B20.21C	PC	50
51.6	10×20×100000	N519.00.006	PC	1
	GLAND SEALING COOLER	**QL56.00Z-3**		
52.1	NUT M30	B20.2.1B	PC	20
52.2	GASKET 30	B22.1	PC	20
52.3	STUD	QL22.00.001	PC	10
52.4	NUT M20	B20.2.1	PC	20
52.5	GASKET 20	B22.1	PC	20
52.6	BOLT M20×80	B20.23	PC	10

53	SUPPORT OF HP ROTOR		SET	1
54	SUPPORT OF LP ROTOR		SET	1
55	SPECIAL LIFT TOOLS		SET	1
56	SPECIAL TAP FOR CYLINDER BOLT THROUGH HOLE		SET	1
57	SPECIAL SPANNER		SET	1
58	WHEEL BOLT REAMING TOOL		SET	1
59	EH MAIN OIL PUMP	HQ39.01Z-1	PC	1
60	HP MAIN VALVE OIL MOTOR (LEFT)	152.331Z-1	PC	1
61	HP MAIN VALVE OIL MOTOR (RIGHT)	152.331Z-2	PC	1
62	MP REHEAT MAIN VALVE OIL MOTOR (LEFT)	K02A.332Z-1	PC	1
63	MP REHEAT MAIN VALVE OIL MOTOR (RIGHT)	K02A.332Z	PC	1
64	HP REGULATOR OIL MOTIVE (LEFT)	152.357Z-1	PC	1
65	HP REGULATOR OIL MOTIVE (RIGHT)	152.357Z-2	PC	1
66	PRESSURE REGULATOR OIL MOTIVE (LEFT)	152.358Z-1	PC	1
67	PRESSURE REGULATOR OIL MOTIVE (RIGHT)	152.358Z-2	PC	1
68	PERMANENT FILTER	73D.306.10Z	PC	1
69	SPECIAL SCREW	152.013.033	PC	70
70	SPRING PIECE	75.013.037	PC	10
71	MEASURING BEARING TEMPERATURE DEVICE	CH01B.671.1Z-8	PC	10
72	PLATINUM RESISTANCE	B/Z14.1-96	PC	2
73	ADJUST GASKET	73.052.006	PC	2
74	ADJUST GASKET	73.052.007	PC	2
75	ADJUST GASKET	73.052.008	PC	2
76	ADJUST GASKET	73.052.009	PC	1
77	ADJUST GASKET	73.052.010	PC	4
78	ADJUST GASKET	73.052.011	PC	4
79	ADJUST GASKET	73.052.012	PC	4
80	ADJUST GASKET	73.052.013	PC	2
81	ADJUST GASKET Δ=0.08	H01.053.010	PC	4
82	ADJUST GASKET Δ=0.2	H01.053.011	PC	4
83	ADJUST GASKET Δ=0.4	H01.053.012	PC	4
84	ADJUST GASKET Δ=0.8	H01.053.013	PC	2
85	ADJUST GASKET Δ=0.08	H01.053.006	PC	4
86	ADJUST GASKET Δ=0.2	H01.053.007	PC	8
87	ADJUST GASKET Δ=0.4	H01.053.008	PC	8
88	SCREW PIN	73B.401.005	PC	8
89	SCREW M8×16	GB73-85	PC	4

90	CASING ROLLER	152.642Z-1,φ25×0.7/0.5	PC	10
91	PIPE CUTTER	152.642Z-1,φ25×0.7/0.5	PC	10
92	TORSION SPRING	73.378.024	PC	1
93	PULL SPRING	73.378.028	PC	1
94	PULL SPRING	73.376.009	PC	1
95	ELECTRO-HYDRAULIC CONVERTER	CCH01.320Z	PC	2
96	ELECTRO-HYDRAULIC CONVERTER	CCH01.321Z	PC	2
97	HP ACCUMULATOR SKIN CAPSULE	152.643Z-1,10L	PC	2
98	HP ACCUMULATOR SKIN CAPSULE	152.643Z-1,40L	PC	2
99	HP ACCUMULATOR SKIN CAPSULE	152.643Z-1,40L	PC	4
100	JACKING OIL PUMP	K09.571Z-2	SET	1
101	MAIN OIL PUMP AC	152.451Z-1	SET	1
102	MAIN OIL PUMP DC	152.452Z-1	SET	1
	BYPASS SYSTEM VALVE SPARES			
1	SEALING SET FOR HP CV		SET	1
2	SEALING SET FOR HP CWCV		SET	1
3	SEALING SET FOR HP SHUT-OFF VALVE		SET	1
4	SEALING SET FOR IP CV		SET	1
5	SEALING SET FOR IP CWCV		SET	1
6	SEALING SET FOR IP SHUT-OFF VALVE		SET	1
7	SEALING SET FOR LP CV		SET	1
8	SEALING SET FOR LP CWCV		SET	1
9	SEALING SET FOR LP SHUT-OFF VALVE		SET	1
10	SPINDLE COMBINATION FOR HPCV		SET	1
11	SEAT FOR HP CV		SET	1
12	SPINDLE COMBINATION FOR IPCV		SET	1
13	SEAT FOR IP CV		SET	1
14	SPINDLE COMBINATION FOR LPCV		SET	1
15	SEAT FOR LP CV		SET	1
16	FILTER INSERT		SET	2
17	SEALING SET FOR HYDRAULIC STATION		SET	2
18	AMPLIFIER CARD SD6		SET	6
19	LEVEL AND TEMPERATURE SWITCH		SET	1
	I&C SYSTEM			
	TSI SYSTEM			
1	RLVB4X	330103-00-05-10-02-00	SET	1
2	RLVB5X	330103-00-05-10-02-00	SET	1
3	DE L	LVDT DIFFERENTIAL EXPANSION 19047-01 2INCH	PC	1
4	RLVB4Y	330103-00-05-10-02-00	SET	1

5	RLVB5Y	330103-00-05-10-02-00	SET	1
6	TSI SPEED	330103-00-05-10-02-00	SET	1
7	TSI SPEED	330103-00-05-10-02-00	SET	1
8	TSI SPEED	330103-00-05-10-02-00	SET	1
9	ASVB4	9200-06-05-10-00	PC	1
10	ASVB5	9200-06-05-10-00	PC	
11	RLVB6X	330103-00-05-10-02-00	SET	1
12	RLVB6Y	330103-00-05-10-02-00	SET	1
13	ASVB6	9200-06-05-10-00	PC	1
14	RLVB6X PROBE BRACKET	\	PC	2
15	RLVB1X	330103-00-05-10-02-00	SET	1
16	RLVB1Y	330103-00-05-10-02-00	SET	1
17	ASVB1	9200-06-05-10-00	PC	1
18	RLVB2X	330103-00-05-10-02-00	SET	1
19	RLVB2Y	330103-00-05-10-02-00	SET	1
20	ASVB2	9200-06-05-10-00	SET	1
21	RLVB3X	330103-00-05-10-02-00	SET	1
22	RLVB3Y	330103-00-05-10-02-00	SET	1
23	ASVB3	9200-06-05-10-00	PC	1
24	TSI SPEED	330103-00-05-10-02-00	SET	1
25	TSI ZS	330103-00-05-10-02-00	SET	1
26	DEH SPEED1	ZS-04	PC	1
27	DEH SPEED2	ZS-04	PC	1
28	DEH SPEED3	ZS-04	PC	1
29	SPEED LOCAL	ZS-04	PC	1
30	KΦ	330103-00-05-10-02-00	SET	1
31	RX	330103-00-05-10-02-00	SET	1
32	AS1（RP1）	330703-000-050-10-02-00	SET	1
33	AS2（RP2）	330703-000-050-10-02-00	SET	1
34	SPARE FOR VIBRATION、SPEED、KΦ	330103-00-05-10-02-00	SET	3
35	SPARE FOR THRUST POSITION	330703-000-050-10-02-00	SET	2
36	SPARE FOR ASVB	9200-06-05-10-00	SET	2
37	SPARE FOR DEH SPEED	ZS-04	PC	2
	H2 SYSTEM			
1	TEMPERATURE GAUGE	WSS 0~100℃L=100 M27x2	PC	8
2	ELECTRIC ACTUATOR	IQ10-F10-A	PC	1
3	RTD	WZP2-231(K) l=200 M27×2	PC	1
4	LEVLE SWITCH	\	PC	1
5	LEVLE SWITCH	\	PC	1
6	LEVLE SWITCH	\	PC	1
7	PRESS TRANSMITTER	\	PC	1
8	PRESS SWITCH	\	PC	1
9	PRESS SWITCH	\	PC	1
10	SS PRE GAUGE	\	PC	1
11	SS PRE GAUGE	\	PC	1
12	SS PRE GAUGE	\	PC	1
13	FLOW GAUGE	\	PC	1
14	FLOW GAUGE	\	PC	1
15	TEMPERATURE GAUGE	WSS 0~100℃L=150 M27x2	PC	1
16	TEMPERATURE GAUGE	WSS 0~100℃L=150 M27x2	PC	1
17	TEMPERATURE GAUGE	WSS 0~100℃L=150	PC	1

		M27x2		
18	TEMPERATURE GAUGE	\	PC	1
19	TEMPERATURE GAUGE	XMTC	PC	1
20	TEMPERATURE GAUGE	LH1500	PC	1
21	GAS LEAKAGE DETECTOR SENSOR	LH1500	PC	8
22	GAS LEAKAGE DETECTOR SENSOR	SERIES5	PC	1
23	GAS LEAKAGE DETECTOR SENSOR	XFG-1F	PC	1
	STATOR COOLING WATER SYSTEM			
1	TEMP SWITCH	GEN STAT COOLING WTR INT TEMP H	PC	1
2	RTD	GEN STAT COOLING WTR INT TEMP	PC	1
3	TEMP SWITCH	GEN STAT COOLING WTR OTL TEMP H	PC	1
4	RTD	GEN STAT COOLING WTR OTL TEMP	PC	1
5	DP SWITCH	H2 AND WATER DP L	PC	1
6	FLOW ORIFICE PLATE	GEN STAT CW FLOW	PC	1
7	FLOW ORIFICE PLATE	GEN STAT CW SMALL JOINTING PIPE FLOW	PC	1
	SEALING OIL SYSTEM			
1	LEVLE SWITCH	EXC END DEFOAMING TANK LVL H	PC	1
2	LEVLE SWITCH	TURBINE END DEFOAMING TANK LVL H	PC	1
3	RTD	H2 SIDE RETURNING OIL TEMP 1	PC	1
4	RTD	H2 SIDE RETURNING OIL TEMP 2	PC	1
	TEMPERATURE SENSOR			
1	RTD	WZPM2-001，PT100，L=5m，18mm，76mm，Φ6，105mm（WZPM2-001，L=5m，Platen type，RTD 18mm，fixation tube 76mm，Φ6，insertion depth 105mm）	PC	1
2	RTD	WZPM2-001，PT100，L=5m，压板式，元件18mm，固定管76mm，Φ6，孔深105mm（WZPM2-001，L=5m，Platen type，RTD 18mm，fixation tube 76mm，Φ6，insertion depth 105mm）	PC	1
3	RTD	WZPM2-001，L=5m，18mm，85mm，Φ6，M8x0.75，120mm（WZPM2-001，L=5m，Compression spring type，RTD	PC	1

		18mm，fixation tube 85mm，Φ6，M8x0.75，insertion depth 120mm）		
4	RTD	WZPM2-001，L=5m，18mm，85mm，Φ6，M8x0.75，120mm（WZPM2-001，L=5m，Compression spring type，RTD 18mm，fixation tube85mm，Φ6，M8x0.75，insertion depth 120mm）	PC	1
5	RTD	WZP2-221 PT100 Φ12×250 M27x2	PC	1
6	RTD	WZP2-221 PT100 Φ12x200 M27x2	PC	1
7	RTD	WZPM2-001，L=5m，18mm，85mm，Φ6，M8x0.75，120mm（WZPM2-001，L=5m，Compression spring type，RTD 18mm，fixation tube 85mm，Φ6，M8x0.75，insertion depth 120mm）	PC	1
8	RTD	WZPM2-001，L=5m，18mm，85mm，Φ6，M8x0.75，120mm（WZPM2-001，L=5m，Compression spring type，RTD 18mm，fixation tube 85mm，Φ6，M8x0.75，insertion depth 120mm）	PC	1
9	RTD	WZP2-221 PT100 Φ12x200 M27x2	PC	1
10	RTD	WZP2-221 PT100 Φ12x300 M27x2	PC	2
11	RTD	WZP2-221 PT100 Φ12x300 M27x2	PC	2
12	RTD	WZP2-221 PT100 Φ12x150 M27x2	PC	1
13	RTD	WZP2-231(K) PT100 Φ12x300 M27x2	PC	1
14	BIMETALLIC THERMOMETER WITH ELECTRIC CONTACT	WSSX-411Φ10 0~200℃L=250 M27x2	PC	1
15	BIMETALLIC THERMOMETER WITH ELECTRIC CONTACT	WSSX-411Φ10 0~200℃L=250 M27x2	PC	1
16	BIMETALLIC THERMOMETER WITH ELECTRIC CONTACT	WSSX-401Φ10 0~100℃L=150 M27x2	PC	1
17	BIMETALLIC THERMOMETER WITH ELECTRIC CONTACT	WSSX-411Φ10 0~200℃L=250 M27x2	PC	1

18	BIMETALLIC THERMOMETER WITH ELECTRIC CONTACT	WSSX-411Φ10 0~200℃L=250 M27x2	PC	1
19	BIMETALLIC THERMOMETER WITH ELECTRIC CONTACT	WSSX-411Φ10 0~200℃L=250 M27x2	PC	1
20	BIMETALLIC THERMOMETER WITH ELECTRIC CONTACT	WSSX-411Φ10 0~200℃L=250 M27x2	PC	1
21	BIMETALLIC THERMOMETER WITH ELECTRIC CONTACT	WSSX-401Φ10 0~300℃L=100 M27x2	PC	1
22	RTD	WZPM2-001，PT100，L=5m，Φ6，25mm（WZPM2-001，PT100，L=5m，Platen type，Φ6，insertion depth 25mm）	PC	1
23	RTD	WZPM2-001，PT100，L=5m，Φ6，25mm（WZPM2-001，PT100，L=5m，Platen type，Φ6，insertion depth 25mm）	PC	1
24	RTD	WZPM2-001，PT100，L=5m，Φ6，25mm（WZPM2-001，PT100，L=5m，Platen type，Φ6，insertion depth 25mm）	PC	1
25	RTD	WZPM2-001，PT100，L=5m，Φ6，25mm（WZPM2-001，PT100，L=5m，Platen type，Φ6，insertion depth 25mm）	PC	1
26	RTD	WZPM2-001，PT100，L=5m，18mm，27mm，Φ6，60mm（WZPM2-001，L=5m，Platen type，RTD 18mm，fixation tube 27mm，Φ6，insertion depth 60mm）	PC	1
27	RTD	WZPM2-001，PT100，L=5m，18mm，27mm，Φ6，60mm（WZPM2-001，L=5m，Platen type，RTD 18mm，fixation tube 27mm，Φ6，insertion depth 60mm）	PC	1
28	RTD	WZPM2-001，PT100，L=5m，元件18mm，40mm，Φ6，70mm（WZPM2-001，L=5m，Platen type，	PC	1

		RTD 18mm，fixation tube 40mm，Φ6，insertion depth 70mm）		
29	RTD	WZPM2-001，PT100，L=5m，18mm，40mm，Φ6，70mm（WZPM2-001，L=5m，Platen type，RTD 18mm，fixation tube 40mm，Φ6，insertion depth 70mm）	PC	1
30	RTD	WZPM2-001，PT100，L=5m，18mm，76mm，Φ6，105mm（WZPM2-001，L=5m，Platen type，RTD 18mm，fixation tube 76mm，Φ6，insertion depth 105mm）	PC	1
31	RTD	WZPM2-001，PT100，L=5m，18mm，76mm，Φ6，105mm（WZPM2-001，L=5m，Platen type，RTD 18mm，fixation tube 76mm，Φ6，insertion depth 105mm）	PC	1
32	RTD	WZPM2-001,PT100，L=5m,Φ6,M8x0.75 (WZPM2-001,L=5m,Compression spring type,Φ6,M8x0.75)	PC	4
33	RTD	WZPM2-001,PT100,L=5m, Φ6 (WZPM2-001,L=5m,Platen type,Φ6,M8x0.75)	PC	4
34	RTD	WZP2-221 PT100 Φ12x200 M27x2	PC	2
35	STAINLESS STEEL TUBE	Φ6x0.5 (external diameter)6mm(pipe thickness)0.5mm	M	2
	S.T.G. LUBE OIL/JACKING OIL SYSTEM P&ID			
1	SOLENOID	MCSCJ240AG000010	PC	2
2	SOLENOID	MCSCJ240AG000010	PC	2
3	PRESS SWITCH	BH-038015-038	PC	2
4	PRESS SWITCH	BH-038015-038	PC	2
5	PRESS SWITCH	BH-038015-038	PC	2
6	PRESS SWITCH	6NN-EE5-N4-B1A-TTX371	PC	1
7	PRESS SWITCH	BH-038068-038	PC	2

8	SS PRE GAUGE	RF63 Gly 0/4bar/psi G1/4 Rad kl.1.6 D701 DRS0.7	PC	4
9	SS PRE GAUGE	RF63 Gly 0/4bar/psi G1/4 Rad kl.1.6 D701 DRS0.7	PC	4
10	SS PRE GAUGE	Y-100 0~40MPa M20x1.5	PC	5
11	SS PRE GAUGE	YZ-100,-0.1~0.15Mpa	PC	5
12	SS PRE GAUGE）	Y-100,0~0.6Mpa	PC	5
	CASING TEMPERATURE			
1	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×5000 k	PC	1
2	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×5000 k	PC	1
3	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×3000 k	PC	1
4	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×3000 k	PC	1
5	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×3000 k	PC	1
6	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×5000 k	PC	1
7	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×5000 k	PC	1
8	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×5000 k	PC	1
9	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×5000 k	PC	1
10	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×1000 k	PC	1
11	HOT SLEEVE THERMOCOUPLE	WRN-625 k	PC	1
12	SHEATHED THERMOCOUPLE	WRNK2-331	PC	1
13	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×3000 k	PC	1
14	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×3000 k	PC	1
15	SHEATHED THERMOCOUPLE	WRNK2-291Φ5×5000 k	PC	1
16	COMPENSATING LEAD WIRE	KX-VPVPA-0.5-90-2X2X1.5	M	50
17	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×4000 k	PC	1
18	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×4000 k	PC	1
19	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×5000 k	PC	1
20	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×5000 k	PC	1
21	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×5000 k	PC	1
22	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×5000 k	PC	1
23	SHEATHED THERMOCOUPLE	WRNK2-291 Φ5×5000 k	PC	1
24	HOT SLEEVE THERMOCOUPLE	WRN-625 k	PC	1
25	HOT SLEEVE THERMOCOUPLE	WRN-625 k	PC	1
26	HOT SLEEVE THERMOCOUPLE	WRN-625 k	PC	1
27	HOT SLEEVE THERMOCOUPLE	WRN2-625 k	PC	1
28	HOT SLEEVE THERMOCOUPLE	WRN2-625 k	PC	1
29	SHEATHED THERMOCOUPLE	WRNK2-221Φ5×300 k	PC	1

30	SHEATHED THERMOCOUPLE	WRNK2-221 Φ5×300 k	PC	1
31	HOT SLEEVE THERMOCOUPLE	WRN-625 k	PC	1
32	HOT SLEEVE THERMOCOUPLE	WRN-625 k	PC	1
	FIRE ALARM			
1	SPOT-TYPE HEAT FIRE DETECTOR	JTWB-BCD-5151EIS	PC	10
2	AUTOMATIC FIRE DETECTOR BASE FOR OPEN AREA	DZ-B401	PC	10
	CABLE			
1	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
2	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
3	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
4	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
5	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
6	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
7	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
8	CABLE	ZR-JKYJPVP-0.5KV-90	M	120
9	CABLE	ZR-JKYJPVP-0.5KV-90	M	120
10	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
11	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
12	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
13	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
14	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
15	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
16	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
17	CABLE	ZR-JKYJPVP-0.5KV-90	M	120
18	CABLE	ZR-JKYJPVP-0.5KV-90	M	120
19	CABLE	ZR-JKYJPVP-0.5KV-90	M	120
20	CABLE	ZR-JKYJPVP-0.5KV-90	M	120
21	CABLE	ZR-JKYJPVP-0.5KV-90	M	120
22	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
23	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
24	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
25	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
26	CABLE	ZR-JKYJPVP-0.5KV-90	M	
27	CABLE	ZR-JKYJPVP-0.5KV-90	M	
28	CABLE	ZR-JKYJVP-0.6KV-90	M	120
29	CABLE	ZR-JKYJVP-0.6KV-90	M	120
30	CABLE	ZR-JKYJPVP-0.5KV-90	M	120
31	CABLE	ZR-JKYJVP-0.6KV-90	M	120
32	CABLE	ZR-JKYJVP-0.6KV-90	M	120
33	CABLE	ZR-JKYJVP-0.6KV-90	M	120
34	CABLE	ZR-JKYJVP-0.6KV-90	M	120

35	CABLE	ZR-JKYJVP-0.6KV-90	M	120
36	CABLE	ZR-JKYJVP-0.6KV-90	M	120
37	CABLE	ZR-JKYJVP-0.6KV-90	M	120
38	CABLE	ZR-JKYJVP-0.6KV-90	M	120
39	CABLE	ZR-JKYJVP-0.6KV-90	M	120
40	CABLE	ZR-JKYJVP-0.6KV-90	M	120
41	CABLE	ZR-JKYJVP-0.6KV-90	M	120
42	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
43	CABLE	ZR-KYJV-0.6KV	M	120
44	CABLE	ZR-JKYJPVP-0.6KV-90	M	120
45	CABLE	ZR-JKYJVP-0.6KV-90	M	120
46	CABLE	ZR-JKYJVP-0.6KV-90	M	120
47	CABLE	ZR-KYJV-0.6KV-90	M	120
48	CABLE	ZR-KYJV-0.6KV-90	M	120
49	CABLE	ZR-KYJV-0.6KV-90	M	120
50	CABLE	ZR-JKYJVP-0.6KV-90	M	120
51	CABLE	ZR-JKYJVP-0.6KV-90	M	120
52	CABLE	ZR-JKYJVP-0.6KV-90	M	120
53	CABLE	ZR-JKYJVP-0.5KV-90	M	120
54	CABLE	ZR-JKYJVP-0.6KV-90	M	120
55	CABLE	ZR-KYJVP-0.6KV-90	M	120
56	CABLE	ZR-KYJVP-0.6KV-90	M	120
57	CABLE	ZR-JKYJVP-0.6KV-90	M	120
58	CABLE	ZR-JKYJVP-0.6KV-90	M	120
59	CABLE	ZR-KYJVP-0.6KV-90	M	120
60	CABLE	ZR-KYJVP-0.6KV-90	M	120
61	CABLE	ZR-JKYJPVP-0.6KV-90	M	120
62	CABLE	ZR-KYJVP-0.6KV-90	M	20
63	CABLE	ZR-JKYJVP-0.6KV-90	M	120
64	CABLE	ZR-KYJVP-0.6KV-90	M	20
65	CABLE	ZR-JKYJPVP-0.6KV-90	M	120
66	CABLE	ZR-JKYJPVP-0.6KV-90	M	120
67	CABLE	ZR-KYJVP-0.6KV-90	M	120
68	CABLE	ZR-JKYJPVP-0.5KV-90	M	120
69	CABLE	ZR-JKYJPVP-0.5KV-90	M	120
70	CABLE	ZR-JKYJPVP-0.5KV-90	M	120
71	CABLE	ZR-JKYJPVP-0.5KV-90	M	120
72	CABLE	ZR-JKYJPVP-0.5KV-90	M	120
73	CABLE	ZR-JKYJPVP-0.5KV-90	M	120
74	CABLE	ZR-JKYJPVP-0.5KV-90	M	120
75	CABLE	ZR-JKYJPVP-0.5KV-90	M	120
76	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
77	CABLE	ZR-JKYJPVP-0.5KV-105	M	120
78	CABLE	NH-RVVP	M	200
79	CABLE	ZR-KYJVPR-0.6KV-90	M	120
80	CABLE	ZR-RVVP	M	150
	INSTALLATION MATERIAL			
1	**PLASTIC COATED METAL HOSE**			
1.1	PLASTIC COATED METAL HOSE	Φ16	M	100
1.2	PLASTIC COATED METAL HOSE	Φ20	M	200
1.3	PLASTIC COATED METAL HOSE	Φ25	M	200
1.4	PLASTIC COATED METAL HOSE	Φ32	M	50
1.5	PLASTIC COATED METAL HOSE	Φ40	M	50
2	**PLASTIC-COATED METAL HOSE CONNECTOR**			
2.1	EXTERNAL THREAD METAL	Φ16 G1/2	PC	50

	CONNECTOR			
2.2	EXTERNAL THREAD METAL CONNECTOR	φ20 G3/4	PC	50
2.3	EXTERNAL THREAD METAL CONNECTOR	Φ20 M16X1.5	PC	50
2.4	EXTERNAL THREAD METAL CONNECTOR	Φ20 M20X1.5	PC	50
2.5	EXTERNAL THREAD METAL CONNECTOR	Φ25 M20X1.5	PC	50
2.6	EXTERNAL THREAD METAL CONNECTOR	Φ25 G1/2	PC	50
2.7	EXTERNAL THREAD METAL CONNECTOR	φ25 G3/4	PC	50
2.8	EXTERNAL THREAD METAL CONNECTOR	φ25 G1	PC	50
2.9	EXTERNAL THREAD METAL CONNECTOR	Φ32 G1-1/4	PC	50
2.10	CIRCLIP SELF-FIXED METAL CONNECTOR	Φ25	PC	50
2.11	CIRCLIP SELF-FIXED METAL CONNECTOR	Φ32	PC	50
2.12	CIRCLIP SELF-FIXED METAL CONNECTOR	Φ40	PC	50
3	**CHANNEL TYPE CABLE TRAY**			
3.1	CHANNEL TYPE CABLE TRAY	100×100×1.0mm	M	100
3.2	CHANNEL TYPE CABLE TRAY	150×100×1.2mm	M	100
3.3	CHANNEL TYPE CABLE TRAY	200×100×1.5mm	M	100
4	**FIREPROOFING MUD**		KG	30
5	**TERMINAL**			
5.1	GUIDE RAIL	DG-L-C45	M	30
5.2	TERMINAL	UL-UK2.5B	PC	500
5.3	TERMINAL FASTENER	E/UK	PC	50
5.4	MARKER BAR	ZB6(1-10)	SET	50
6	**TERMINAL BOX**			
6.1	TURBINE TB K	750×200×700mm	PC	1
6.2	TURBINE TB L	750×300×750mm	PC	1
6.3	TURBINE TB V	500×200×500mm	PC	1
7	**GASKET**			
7.1	ANNEALED COPPER GASKET	φ18×8×3	PC	1000
7.2	PTFE GASKET	φ18×8×3	PC	1000
7.3	ANNEALED COPPER GASKET	φ22×14×2	PC	500
7.4	ANNEALED COPPER GASKET	φ43×30×2	PC	500
8	**VALVE**			
8.1	NEEDLE VALVE	GIGALOK NGS1-UJ8-7K-L 344BAR@-54-38℃ HZW121201915	PC	16
8.2	NEEDLE VALVE	J23W-160P DN10 316L	PC	10
8.3	NEEDLE VALVE	14MM-SWSW VX1-14-SW-316-6HG/10	PC	8
8.4	NEEDLE VALVE	PN32 DN10 Φ14 250℃	PC	6
8.5	NEEDLE VALVE	J21W-64P DN6 Φ14	PC	10
8.6	NEEDLE VALVE	J24W 20×1.5 14×1.5 304SS	PC	4
8.7	NEEDLE VALVE	J13W-160P DN15	PC	2
9	**COTTON VARNISHED SLEEVE**			
9.1	COTTON VARNISHED SLEEVE	φ10mm	M	200
9.2	COTTON VARNISHED SLEEVE	φ8mm	M	200

10	**HEAT SHRINK TUBING**	φ10mm	M	100
11	**STAINLESS STEEL TUBE**	φ14x2	M	100
12	**THREADED ADAPTER**			
12.1	THREADED ADAPTER	NPT1/2,M20X1.5 male thread NPT1/2, male thread M20X1.5	PC	50
12.2	THREADED ADAPTER	NPT1/4,M20X1.5 male thread NPT1/4, male thread M20X1.5	PC	50
	DEH(SERVOS/BLADDER)			
1	HP SERVOS		PC	2
2	IP SERVOS		PC	2
3	LP SERVOS		PC	1
4	10L RUBBER BALLOON (INCLUDING SEALING PARTS)		PC	4
	DEH(SOLENOID)			
1	HP QUICK CLOSING VALVE		PC	4
2	IP QUICK CLOSING VALVE		PC	2
3	LP QUICK CLOSING VALVE		PC	2
4	HP GOVERNING VALVE		PC	2
5	IP GOVERNING VALVE		PC	2
6	LP GOVERNING VALVE		PC	1
	DEH(POSITION SWITCHES)			
1	HP QUICK CLOSING VALVE		PC	8
2	IP QUICK CLOSING VALVE		PC	8
3	LP QUICK CLOSING VALVE		PC	2
	DEH(PILOT SEQUENCE DRAIN VALVE)			
1	LP GOVERNING (SMALL)		PC	1
2	LP GOVERNING (LARGE)		PC	1
3	LP QUICK CLOSING VALVE(SMALL)		PC	1
4	LP QUICK CLOSING VALVE(LARGE)		PC	1
	DEH(LVDTS)			
1	HP GOVERNING VALVE		PC	4
2	IP GOVERNING VALVE		PC	4
3	HP QUICK CLOSING VALVE		PC	2
	DEH(FEEDBACK POSITIONER)			
1	LP GOVERNING VALVE		PC	1
	DEH(PRESSURE SWITCH)			
1	OIL PRESSURE SWITCH INSPECTION, CALIBRATION.		PC	1
	DEH(PRESSURE TRANSMITTER)			
1	OIL PRESSURE TRANSMITTER		PC	1
1	AXIAL DISPLACEMENT SENSOR	330703-00-05-10-02-00	PC	4
2	AXIAL DISPLACEMENT PREPROCESSOR	330780-90-00	PC	4
3	AXIAL DISPLACEMENT CABLE	330730-080-00-00	PC	4
4	SHAFT VIBRATION SENSOR	330103-00-05-10-02-00	PC	14

5	SHAFT VIBRATION PREPROCESSOR	330180-90-00	PC	14
6	SHAFT VIBRATION CABLE	330130-080-00-00	PC	14
7	COVER VIBRATION SENSOR	9200-06-05-10-00	PC	7
8	EXPANSION SENSOR	330851-02-000-050-90-01-00	PC	2
9	EXPANSION PREPROCESSOR	330850-90-00	PC	2
10	KEY PHASE SENSOR	330103-00-05-10-02-00	PC	1
11	KEY PHASE PREPROCESSOR	330180-90-00	PC	1
12	KEY PHASE CABLE	330130-080-00-00	PC	1
13	SPEED SENSOR	330103-00-05-10-02-00	PC	3
14	SPEED PREPROCESSOR	330180-90-00	PC	3
15	SPEED CABLE	330130-080-00-00	PC	3
16	THERMAL EXPANSION SENSOR	24765-02-01	PC	2
Others				
1	Exciter Cabinet	OEM: HEC	SET	1
2	AC-DC Busbar	OEM：Huayuan Tianwei	SET	1
3	Exciton transformer	OEM: HEC	SET	1
4	Closed bus bar with Micro positive current equipment	OEM：Huayuan Tianwei	SET	1
5	Output circlet Breaker	OEM: ABB	SET	1
6	PT and lighting Arrest Cabinet	OEM: HEC	SET	1
7	Hydrogen, stator cooling water system, oil system pipe and valve	OEM: HEC	SET	1
8	Hydrogen dryer	OEM: HEC	SET	1
9	hydrogen analysis system	OEM: HEC	SET	1
10	Main Oil Pump along with motor		SET	1
11	bearing box and pipe, replace the lubricating oil and filter the oil.		SET	1
12	TSI system Cable		SET	1
13	H2 system pressure gauge, I&C element and sampling valves & electric actuator(damaged)		SET	1
14	cooling water Pipe I&C element installation		SET	1
15	sealing oil system, I&C Element installation		SET	1
16	Turbine Main body temperature measurement point		SET	1
17	Lub oil jacking Oil and turning gear system check point i&C gauge and sampling valves		SET	1
18	Turbin K,V,L terminal cabinet ,cable and cable tray		SET	1
19	Overhead Crane repair kit		SET	1

10.Storage Recommendation

NO.	Parts	Storage	Additional requirement
1	Rotor	Moisture-proof ventilation dustproof corrosion prevention loss prevention damage	Turn over 180degree for each 3 months Covered with Dust Cloth
2	Diaphragm	Moisture-proof ventilation dustproof corrosion prevention loss prevention damage	Covered with Dust Cloth
3	Inner cover of Turbine	Moisture-proof ventilation dustproof corrosion prevention loss prevention damage	Covered with Dust Cloth
4	Outer cover of Turbine	Moisture-proof ventilation dustproof corrosion prevention loss prevention damage	Covered with Dust Cloth
5	Turbine of cylinder	Moisture-proof ventilation dustproof corrosion prevention loss prevention damage	Covered with Dust Cloth
6	Bolt & nut	Moisture-proof ventilation dustproof corrosion prevention loss prevention damage	Covered with Dust Cloth
7	Bearing	Moisture-proof ventilation dustproof corrosion prevention loss prevention damage	Covered with Dust Cloth

哈电集团

哈尔滨电机厂有限责任公司

HARBIN ELECTRIC MACHINERY COMPANY LIMITED

我们已经收到由哈电国际转来的电子邮件，关于发电机工作范围中第 2.1.6 清理发电机定子及转子及 2.2 发电机定子检查及实验，2.3 发电机转子检查及实验做如下说明:

We have received the email from HEI, regarding item 2.1.6 clean generator stator and rotor, and item 2.2 generator stator inspection and test, item 2.3 generator rotor inspection and test in the scope of generator works, the explanations are as follows:

1. 古杜电厂最终目标是对发电机发生火灾之后对发电机的各个部套进行事故鉴定，所有工作包括发电机及其辅助系统的检查、检验及试验都是围绕最终目标进行服务的，根据检查、检验及试验做出故障鉴定结论

The final purpose of the GUDDU power plant is to carry out fault identification for each part of the generator after fire. The work scope includes inspection and test of generator and its auxiliary system. These works are carried out for the final purpose, and the related fault identification conclusions were made as per the inspection and test results.

2. 发电机转子抽出后，我们通过目视检查并通过相关实验结果分别对发电机定子及转子进行了检查，如下现象在检查中被发现

After the rotor was taken out, we carried out visual inspection, and inspected the rotor and stator as per the related test results. What we have found is as follows:

I. 发电机转子 Generator rotor:

1) 检查试验 Inspection and test

a. 发电机转子密封瓦在火灾中严重损毁，火灾温度超过 600℃

The generator rotor sealing pads were severely damaged in the fire, with the fire temperature exceeding 600℃.

b. 测速齿轮在火灾中严重损毁

The speed-measuring gear was seriously damaged in the fire.

c. 密封瓦在火灾中已经融化，转子过热

The sealing ring were melted in the fire and the rotor was overheated.

d. RSO 实验显示转子存在匝间短路现象

The RSO result showed an inter-turn short-circuit in the rotor.

e. 转子通风口中存在大量碳粉及油污

There is plenty of carbon powder and oil in the rotor ventilation holes.

f. 转子由于长时间未盘车，大齿未在正确位置，转子轴会有弯曲

Because the rotor has not been turned for a long time, the large teeth are not in the correct position, and the rotor shaft would bend.

g. 发电机转子所有绝缘件均在火灾中由于过热而失效

All the insulation parts of the generator rotor have failed in the fire due to overheating.

h. 发电机转子表面绝缘漆已经全部过热后破损

The surface insulation coating of the generator rotor has been completely overheated and damaged.

i. 锻件例如护环、集电环和风扇座环等过热

Forging parts such as retaining ring, collector ring and fan seat ring etc. of rotor were overheated.

2) 结论：根据以上对转子的检查、检验及试验，我们得出结论，需要更换全新转子，即使对转子进去全面清理，也不能改变转子弯曲、绝缘过热失效等，得出同样结论

Conclusion: According to the above inspection and test results of the rotor, the conclusion is that a damaged rotor needs to be replaced. Even if the rotor is cleaned up, the bending of the rotor and the insulation overheating cannot be solved, etc., so the only conclusion is to replace the old rotor to new rotor.

II. 发电机定子 Generator stator

1)检查试验 Inspection and test

a. 发电机定子线棒在火灾中过热，出现大面积烧毁

The generator stator coils were overheated in the fire and a large portion was damaged.

b. 在发电机线圈中发现大量的油及碳粉

Plenty of oil and carbon powder is found in the generator coil.

c. IR 实验结果证明发电机定子绝缘不合格

The IR results prove that the insulation of the generator stator is unqualified.

d. 绝缘引水管在火灾中损毁或变形

Insulated cooling water pipe is damaged and deformed due to the fire.

e. RTD 全部损坏

The RTDs are completely damaged.

f. 发电机定子通风口内遍布大量油污及碳粉

Plenty of oil and carbon powder is found all over the generator stator ventilation holes.

g. 发电机定子所有绝缘均在火灾中由于过热而失效（F 级绝缘不允许超过 185 度）

All the insulation of the generator stator failed in the fire due to overheating (class F insulation is not allowed to work under the temperature of 185 °C or above).

h. 发电机端盖和内端盖变形

Deformation of generator end cover and inner cover.

i. 发电机轴承在火灾中损伤

Generator bearings were damaged during the fire.

j. 导风环变形

Deformation of ventilation guide ring.

k. 氢气冷却器在火灾中损坏，翅片中有大量的碳粉

Hydrogen cooler was damaged during the fire, plenty of carbon powder was found inside the fins of the cooler.

l. 定子绕组主引线和套管损坏

Stator winding main lead and bushings were damaged.

m. CT 和中性点损坏

CT and neutral points were damaged.

n. 发电机接地碳刷损坏

Generator ground brush was damaged.

2) 结论：根据以上对定子的检查、检验及试验，我们得出结论，需要更换全部定子绕组及相关绝缘件。

Conclusion: According to the above inspection and test results of the stator, It is required to replace all the stator windings and related insulation parts.

III. 定子铁芯 Stator core

1) 检查试验 Inspection and test

a. 发电机定子堂内有冲片逸出

There is core lamination displacement in the generator stator.

b. 发电机定子铁芯背部有变形

The bottom of the generator stator core is deformed.

c. 发电机定子铁芯测温原件引出线烧毁

The RTD of generator stator core is damaged.

d. 铁损实验显示发电机汽端定子铁芯大面积过热

The iron loss test shows that the stator core at turbine end is massively overheated.

2) 结论：通过对发电机定子铁芯检查及实验，发电机背部铁芯已经过热变形，需要更换铁芯冲片，测温引线烧毁无法现场更换，因此按照 HEC 标准，需更换新的发电机定子铁芯

Conclusion: Through the inspections and tests of the generator stator core, we have found that the stator core at turbine end is overheated and deformed, and the stator core laminations have to be replaced, and the RTDs cannot be replaced on site. Therefore, a new generator stator core should be replaced according to HEC standard.

3. 综上所述，发电机定子及转子现场检查、检验及试验完全符合 HEC 事故诊断的流程及标准，故障描述及诊断清晰无误，无需对发电机进行清理后再次检查、检验及试验

In conclusion, the site inspections and tests for stator and rotor were all carried out as per HEC fault diagnosis procedure and standard, the fault description and diagnosis are clear and right, and there is no need to clean the generator and conduct inspections and tests again.

哈尔滨电机厂有限责任公司
HARBIN ELECTRIC MACHINERY COMPANY LIMITED
2023.04.23

Hitachi Energy

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To : HARBIN ELECTRIC INTERNATIONAL CO. LTD.

Date : 2023-05-22

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Dear Sir,

After checking the inspection reports of GCB for Guddu project, we are sorry to inform you the mentioned generator circuit breaker is severely damaged. It is hardly to repair it or recover it for normal operation.

In this event, our proposal is to replace the damaged GCB with a new set.

If you have any questions, please feel free to contact us.

Regards,

Yan Weiming
Service Manager, GCB

Zheng Xianliang
Sales Manager, GCB

Prepared for
Hitachi Energy Hong Kong Limited
Hitachi Energy Hong Kong Limited

.....
Signature(s)

ANNEXURES..... 179

- Technical Proposal for Integrity Assessment of Turbo-Generator at 747MW Guddu
- Technical Assessment Report for 9F HRSG Assessment Work at 747MW Guddu
- Repair Schedule for Turbo-Generator and HRSG
- Commercial Proposal for Turbo Generator and HRSG work

ANNEX-2

Structural Assessment Report for Steam Turbine-16 at Guddu Power Plant

CENTRAL POWER GENERATION CO. LTD
Thermal Power Station, Barrage Road, Guddu-79220



STRUCTURAL ASSESSMENT REPORT FOR STEAM TURBINE-16 AT GUDDU POWER PLANT

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1. OBJECTIVE OF SITE VISIT

The Guddu Thermal Power Plant, also known as Central Power Generation Company Limited, and GENCO-II, is a thermal power station located in Guddu, Sindh, Pakistan.

On July 10, 2022, a fire incident occurred on Steam Turbine-16 of 747 MW Guddu Thermal Power Plant, which has substantially affected the steam turbine operation.

NESPAK, the Consultant, has been hired to verify the structural adequacy building structure and as well as the ST foundation.

2. METHODOLOGY

The comprehensive methodology has been implemented to properly investigate the impact of fire incident and its effect on the structural elements. The following procedure has been adopted;

a) *Conducting Site Reconnaissance*
This will provide an idea about the extent of fire impact and critical structural elements to be further selected for structural assessment.

b) *Non-Destructive Testing*
Schmidt Hammer has been used to find the approximate concrete compressive strength of different elements.

c) Destructive Testing
The critical structural elements have been selected for the core extraction and subsequently testing has been done to determine the concrete compressive.

d) Conclusion on Critical Issues
Refer to Item No. 5 for details.

e) Remedial Measures
Refer to Item No. 6 for details.

3. SITE OBSERVATIONS

Overall building structures, ST foundation and other structural components were thoroughly observed, and subsequently following are the pivotal issues which are highlighted as follows;

3.1. Stream Turbine-16



Figure-1 Level-2 Floor Concrete has been damaged at various areas specially near the manhole and edges



Figure-2 Level-2 Concrete topping which was casted above the ST foundation/beam has been severely damaged/cracked at the right side of ST-16.



Figure-3 Level-2 Concrete topping which was casted above the ST foundation/beam has been severely damaged/cracked at the right side of ST-16.



Figure-4 Level-2 Concrete topping underneath ST-16 is severely damaged.



Figure-5 Bracing Beam at Level-01 is severely damaged nearly in the mid-span due to inherent fire passage at the bottom



Figure-6 Shear Reinforcement of Bracing Beam at Level-01 is exposed due to fire.



Figure-7 Another Bracing Beam at Level-01 is smoky underneath without impairing the beam physically and structurally.



Figure-8 Another Bracing Beam at Level-01 is smoky underneath without impairing the beam physically and structurally.

3.2. Building Structural Steel



Figure-9 All Steel beams at Roof level are smoky due to fire incident and as well as the paint is deteriorated at various locations.



Figure-10 All Steel beams, purlins and corrugated sheets at Roof level are smoky due to fire incident. Paint is severely deteriorated at several locations.



Figure-11 All Steel beams at Level-01 are smoky due to fire incident without adversely affecting the structural strength.



Figure-12 All Steel beams at Level-01 are smoky due to fire incident without adversely affecting the structural strength. Furthermore, the paint of almost all steel beams is deteriorated.



Figure-13 Smoke deposits from the steel beams were cleaned manually, and inherent color of steel beam can be seen.



Figure-14 Smoke deposits from the steel beams were cleaned manually, and inherent color of steel beam can be seen.

3.3. Roof Corrugated Sheets



Figure-15 Corrugated sheets at roof is badly burnt at several location which makes the structural adequacy of corrugated sheets doubtful.



Figure-16 Absence of rivets/screws has enlarged the gap at the sheets overlapping location which ultimately results in leakage of rain water down the Stream Turbine Hall.



Figure-17 Absence of rivets/screws and water proofing paint at almost all the roof has substantially deteriorated the corrugated sheet.



Figure-18 Absence of rivets/screws and water proofing paint at almost all the roof has substantially deteriorated the corrugated sheet

4. DESTRUCTIVE TESTING

In order to validate the residual concrete compressive strength of structural elements, three (03) cores of Ø75 x 175/225 mm (Dia x length) samples were extracted from the concrete topping above ST foundation and bracing beams. Ferro Scanner were used at all the cores location to avoid unnecessary cutting of existing rebars, subsequently the core holes were filled with non-shrinkable cementitious grout. The following are the few images taken during the core extractions;



Figure-19 Implementation of Ferro Scanner to Avoid Unnecessary cutting of reinforcement.



Figure-20 A pictorial glimpse of core cutting machine.

The extracted core samples of concrete were tested as per ASTM C-42. The following are summary of results extracted from the report submitted by Building Standard Ltd.

CLIENT	Central Power Generation Co. Ltd.	B.S. NO.	BS/220810-054
CONSULTANT	NESPAK	CLIENT NO./DATE	10-08-2022
CONTRACTOR	--	SPECIMEN	Concrete Core
LOCATION	Thermal Power Station, Barrage Road, Guddu.	CONCRETE STRENGTH	Unknown
PROJECT	Destructive Testing of RCC Turbo Generator (ST-16, 747MW) Foundation		

S. NO.	SAMPLE NO.	ASTM RATIO OF LENGTH TO DIAMETER (L/D)	ASTM SIZE FACTOR	DATE OF TEST	LOAD KGS.	AREA CM^2	STRENGTH		FINAL READING
							KGS/CM^2	PSI	PSI
1.	Core No. 1 ST-16, Topping Slab (Control Area)	1.35	0.95	10-08-2022	12,011	37.4	321.2	4568	4340
2.	Core No. 2 ST-16, Topping Slab (Damaged Area)	1.81	1.00	10-08-2022	7,688	37.4	205.6	2924	2924
3.	Core No. 3 ST-16, Bracing Beam	1.25	0.93	10-08-2022	11,376	37.4	304.2	4326	4024

Building Standard Ltd report for destructive testing is attached as Annexure-A.

5. CONCLUSIONS ON CRITICAL ISSUES

The followings are the critical issues which shall be rectified as soon as possible to avoid any further adverse consequences;

a) Figure 1 to 4 clearly depict that the concrete topping on the top of ST foundation at Level-02 is critically deteriorated at numerous locations. Additionally, the concrete compressive strength of extracted core Sample-2 provides relatively low values (2924 psi) as compared to other samples (in the range of 4000 psi), which also strengthen our stance of replacing the concrete topping at the damaged locations.

b) Mostly the concrete bracing beams and columns are unaffected during the fire incident, however, all of such members were having smoke layer which can be easily cleaned by hand. Refer to Figure 7 & 8.
Nevertheless, there is one bracing beam which was partially damaged due to inherent fire passage on the bottom which has damaged the side concrete of the bracing beams. Refer to Figure 5 & 6.

c) Overall building steel members seems structurally safe and no adverse effect has been found except the deposition of smoke layer on the beam surfaces which can be easily removed by manual cleaning. Refer to Figure 9 to 14.

d) Roof corrugated sheets are extremely deteriorated, rusted and even their lapping is impropriated almost on all the roof which may cause further unforeseen circumstances, if left untreated. Figure 15 to 18.

6. REMEDIAL MEASURES

The followings remedial measures shall be considered on the critical issues as highlighted in the above section;

a) Concrete topping shall be chipped off at the affected areas without cutting the existing reinforcement. Subsequently, the surfaces shall be thoroughly cleaned and epoxy resin or any other bonding agent shall be applied between the new and old concrete. Minimum concrete compressive strength shall be kept as 4000 psi and the size of coarse aggregates shall not be more than 3/8".

b) The damaged bracing beam side face shall be chipped manually and all the disintegrated concrete shall be removed thoroughly without cutting any reinforcement. The remaining procedure shall be adopted same as mentioned in item-a.

c) In order to enhanced the long-term durability of overall building structure, we recommend to apply Fire Rated Intumescent Paint on all the steel elements after thoroughly removing the smoke layer and proper cleaning.

d) The following remedial measures shall be promptly considered for the roof corrugated sheets at all locations;

- Thoroughly clean the corrugated sheets and apply the waterproofing paint on the top surfaces.
- The corrugated sheets shall be safely secured with rivets/screws at the lapping locations, and no gap shall be left at any locations.
- New concrete slab of 75mm along with fabric mesh shall be casted on the existing corrugated sheets. (75mm from the higher point of corrugated sheet).

e) Yearly structural monitoring of ST foundation and overall building structure should be done to avoid propagation of unforeseen structural issues.

ANNEX-3

List of As-built Drawings/Documents

747 MW Combined Cycle Power Plant, Guddu

J-Series Drawings

Sr No.	Drawing No.	File Name
	J0101	
1	F6311Z-J0101+A	F6311Z-J0101+A-MECHANICAL PART GENERAL DESCRIPTION
	J0201	
1	33-F6311Z-J0201-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J0201-01+A	LEGENDS AND NOTES
3	33-F6311Z-J0201-ML	SUMMARY OF MECHANICAL SYSTEM FLOW DIAGRAM
	J0202	
1	33-F6311Z-J0202-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J0202-01+A	POWER ISLAND LAYOUT AT EL 0M
3	33-F6311Z-J0202-02+A	POWER ISLAND LAYOUT AT EL 6.3M
4	33-F6311Z-J0202-03+A	POWER ISLAND LAYOUT AT EL 12.6M
5	33-F6311Z-J0202-04+A	SECTION DRAWING OF GT AND HRSG ZONE
6	33-F6311Z-J0202-05+A	SECTION DRAWING (S.T. HALL)
7	33-F6311Z-J0202-06+A	EQUIPMENT LIST OF MECHANICAL PART
8	33-F6311Z-J0202-ML	POWER ISLAND LAYOUT
	J0601	
1	33-F6311Z-J0601-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J0601-01+A	HP MAIN STEAM, REHEAT STEAM LP MAIN STEAM AND BYPASS STEAM FLOW DIAGRAM
3	33-F6311Z-J0601-02+A	HP MAIN STEAM, REHEAT STEAM LP MAIN STEAM AND BYPASS STEAM VALVES LIST (1 OF 4)
4	33-F6311Z-J0601-03+A	HP MAIN STEAM, REHEAT STEAM LP MAIN STEAM AND BYPASS STEAM VALVES LIST (2 OF 4)
5	33-F6311Z-J0601-04+A	HP MAIN STEAM, REHEAT STEAM LP MAIN STEAM AND BYPASS STEAM VALVES LIST (3 OF 4)
6	33-F6311Z-J0601-05+A	HP MAIN STEAM, REHEAT STEAM LP MAIN STEAM AND BYPASS STEAM VALVES LIST (4 OF 4)
7	33-F6311Z-J0601-ML	HP MAIN STEAM, REHEAT STEAM LP MAIN STEAM AND BYPASS STEAM VALVES LIST
	J0602	
1	33-F6311Z-J0602-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J0602-01+A	HP MAIN STEAM PIPING SYSTEM FLOW DIAGRAM
3	33-F6311Z-J0602-02+A	HP MAIN STEAM PIPING ARRANGEMNT DIAGRAM
4	33-F6311Z-J0602-03+A	HP MAIN STEAM PIPING ISOMETRIC DRAWING (1)
5	33-F6311Z-J0602-04+A	HP MAIN STEAM PIPING ISOMETRIC DRAWING (2)
6	33-F6311Z-J0602-05+A	HP MAIN STEAM PIPING MATERIAL SUMMARY LIST
7	33-F6311Z-J0602-ML	HP MAIN STEAM PIPING INSTALLATION DIAGRAM
	J0603	
1	33-F6311Z-J0603-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J0603-01+A	HOT REHEAT STEAM PIPING SYSTEM DRAWING
3	33-F6311Z-J0603-02+A	HOT REHEAT STEAM PIPING SYSTEM PIPING ARRANGEMENT DRAWING
4	33-F6311Z-J0603-03+A	HOT REHEAT STEAM PIPING ISOMETRIC DRAWING (1 OF 2)
5	33-F6311Z-J0603-04+A	HOT REHEAT STEAM PIPING ISOMETRIC DRAWING (2 OF 2)
6	33-F6311Z-J0603-05+A	HOT REHEAT STEAM PIPING MATERIAL SUMMARY LIST
7	33-F6311Z-J0603-ML	HOT REHEAT STEAM PIPING INSTALLATION DRAWING
	J0604	
1	33-F6311Z-J0604-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J0604-01+A	COLD REHEAT STEAM PIPING SYSTEM FLOW DIAGRAM
3	33-F6311Z-J0604-02+A	COLD REHEAT STEAM PIPING ARRANGEMENT DIAGRAM
4	33-F6311Z-J0604-03+A	COLD REHEAT STEAM PIPING ISOMETRIC DRAWING (1)
5	33-F6311Z-J0604-04+A	COLD REHEAT STEAM PIPING ISOMETRIC DRAWING (2)
6	33-F6311Z-J0604-05+A	COLD REHEAT STEAM PIPING ISOMETRIC DRAWING (3)
7	33-F6311Z-J0604-06+A	COLD REHEAT STEAM PIPING ISOMETRIC DRAWING (4)
8	33-F6311Z-J0604-07+A	COLD REHEAT STEAM PIPING MATERIAL SUMMARY LIST (1)
9	33-F6311Z-J0604-08+A	COLD REHEAT STEAM PIPING MATERIAL SUMMARY LIST (2)
10	33-F6311Z-J0604-ML	COLD REHEAT STEAM PIPING INSTALLTION DRAWING
	J0605	
1	33-F6311Z-J0605-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J0605-01+A	LP MAIN STEAM PIPING SYSTEM DIAGRAM
3	33-F6311Z-J0605-02+A	LP MAIN STEAM PIPING ARRANGEMENT DRAWING
4	33-F6311Z-J0605-03+A	LP MAIN STEAM PIPING ISOMETRIC DRAWING (1 OF 2)
5	33-F6311Z-J0605-04+A	LP MAIN STEAM PIPING ISOMETRIC DRAWING (2 OF 2)
6	33-F6311Z-J0605-05+A	LP MAIN STEAM DRAIN PIPING ARRAGNEMENT SCHEMATIC DRAWING
7	33-F6311Z-J0605-06+A	LP MAIN STEAM PIPING MATERIAL SUMMARY LIST (1 OF 2)
8	33-F6311Z-J0605-07+A	LP MAIN STEAM PIPING MATERIAL SUMMARY LIST (2 OF 2)
9	33-F6311Z-J0605-ML	LP MAIN STEAM PIPING INSTALLTION DRAWING

747 MW Combined Cycle Power Plant, Guddu

J-Series Drawings

Sr No.	Drawing No.	File Name
	J0606	
1	33-F6311Z-J0606-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J0606-01+A	ST HP. BYPASS STEAM PIPING SYSTEM DIAGRAM
3	33-F6311Z-J0606-02+A	ST HP. BYPASS STEAM PIPING ARRANGMENT DIAGRAM
4	33-F6311Z-J0606-03+A	ISOMETRIC DRAWING OF HP BYPASS STEAM PIPING AT #1 HRSG SIDE
5	33-F6311Z-J0606-04+A	ISOMETRIC DRAWING OF HP BYPASS STEAM PIPING AT #2 HRSG SIDE
6	33-F6311Z-J0606-05+A	MATERIAL LIST OF ST HP BYPASS STEAM PIPING
7	33-F6311Z-J0606-ML	INSTALLATION DRAWING OF ST HP BYPASS STEAM PIPING
	J0607	
1	33-F6311Z-J0607-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J0607-01+A	REHEAT BYPASS STEAM PIPING SYSTEM DRAWING
3	33-F6311Z-J0607-02+A	REHEAT BYPASS STEAM PIPING ARRANGEMENT DRAWING
4	33-F6311Z-J0607-03+A	REHEAT BYPASS STEAM PIPING ISOMETRIC DRAWING (1 OF 2)
5	33-F6311Z-J0607-04+A	REHEAT BYPASS STEAM PIPING ISOMETRIC DRAWING (2 OF 2)
6	33-F6311Z-J0607-05+A	REHEAT BYPASS STEAM PIPING MATERIAL SUMMARY LIST
7	33-F6311Z-J0607-ML	REHEAT BYPASS STEAM PIPING INSTALLATION DRAWING
	J0608	
1	33-F6311Z-J0608-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J0608-01+A	LP BYPASS STEAM PIPING SYSTEM DRAWING
3	33-F6311Z-J0608-02+A	LP BYPASS STEAM PIPING ARRANGMENT DRAWING
4	33-F6311Z-J0608-03+A	LP BYPASS STEAM PIPING ISOMETRIC DRAWING (1 OF 2)
5	33-F6311Z-J0608-04+A	LP BYPASS STEAM PIPING ISOMETRIC DRAWING (2 OF 2)
6	33-F6311Z-J0608-05+A	LP BYPASS STEAM DRAIN PIPING ARRANGEMENT SCHEMATIC DRAWING
7	33-F6311Z-J0608-06+A	LP BYPASS STEAM PIPING MATERIAL SUMMARY LIST
8	33-F6311Z-J0608-ML	LP BYPASS STEAM PIPING INSTALLATION DRAWING
	J0609	
1	33-F6311Z-J0609-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J0609-01+A	FLOW DIAGRAM OF MAIN STEAM SUPPLY TO GLAND STEAM PIPING
3	33-F6311Z-J0609-02+A	PIPING ARRANGEMENT OF MAIN STEAM SUPPLY TO GLAND STEAM PIPING
4	33-F6311Z-J0609-03+A	PIPING ISOMETRIC OF MAIN STEAM SUPPLY TO GLAND STEAM PIPING
5	33-F6311Z-J0609-04+A	MATERIAL SUMMARY OF MAIN STEAM SUPPLY TO GLAND STEAM PIPING
6	33-F6311Z-J0609-ML	INSTALLTION DRAWING OF MAIN STEAM SUPPLY TO GLAND STEAM PIPING
	J0610	
1	33-F6311Z-J0610-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J0610-01+A	HP MAIN STEAM DRAIN PIPING SYSTEM FLOW DIAGRAM
3	33-F6311Z-J0610-02+A	ARRANGMENT OF HP MAIN STEAM DRAIN PIPING (1 OF 3)
4	33-F6311Z-J0610-03+A	ARRANGMENT OF HP MAIN STEAM DRAIN PIPING (2 OF 3)
5	33-F6311Z-J0610-04+A	ARRANGMENT OF HP MAIN STEAM DRAIN PIPING (3 OF 3)
6	33-F6311Z-J0610-05+A	HP MAIN STEAM DRAIN PIPING ISOMETRIC DRAWING (1 OF 7)
7	33-F6311Z-J0610-06+A	HP MAIN STEAM DRAIN PIPING ISOMETRIC DRAWING (2 OF 7)
8	33-F6311Z-J0610-07+A	HP MAIN STEAM DRAIN PIPING ISOMETRIC DRAWING (3 OF 7)
9	33-F6311Z-J0610-08+A	HP MAIN STEAM DRAIN PIPING ISOMETRIC DRAWING (4 OF 7)
10	33-F6311Z-J0610-09+A	HP MAIN STEAM DRAIN PIPING ISOMETRIC DRAWING (5 OF 7)
11	33-F6311Z-J0610-10+A	HP MAIN STEAM DRAIN PIPING ISOMETRIC DRAWING (6 OF 7)
12	33-F6311Z-J0610-11+A	HP MAIN STEAM DRAIN PIPING ISOMETRIC DRAWING (7 OF 7)
13	33-F6311Z-J0610-12+A	MATERIAL LIST OF HP MAIN STEAM DRAIN PIPING
14	33-F6311Z-J0610-ML-01	INSTALLATION DRAWING OF HP MAIN STEAM DRAIN PIPING (PAGE 1 OF 2)
15	33-F6311Z-J0610-ML-02	INSTALLATION DRAWING OF HP MAIN STEAM DRAIN PIPING (PAGE 2 OF 2)
	J0611	
1	33-F6311Z-J0611-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J0611-01+A	HOT REHEAT SYSTEM & REHEAT BYPASS STEAM DRAIN PIPING SYSTEM DIAGRAM
3	33-F6311Z-J0611-02+A	HOT REHEAT SYSTEM & REHEAT BYPASS STEAM DRAIN PIPING ARRANGEMENT SCHEMATIC DRAWING (1 OF 2)
4	33-F6311Z-J0611-03+A	HOT REHEAT SYSTEM & REHEAT BYPASS STEAM DRAIN PIPING ARRANGEMENT SCHEMATIC DRAWING (2 OF 2)
5	33-F6311Z-J0611-04+A	HOT REHEAT SYSTEM & REHEAT BYPASS STEAM DRAIN PIPING ISOMETRIC DRAWING (1 OF 7)
6	33-F6311Z-J0611-05+A	HOT REHEAT SYSTEM & REHEAT BYPASS STEAM DRAIN PIPING ISOMETRIC DRAWING (2 OF 7)
7	33-F6311Z-J0611-06+A	HOT REHEAT SYSTEM & REHEAT BYPASS STEAM DRAIN PIPING ISOMETRIC DRAWING (3 OF 7)
8	33-F6311Z-J0611-07+A	HOT REHEAT SYSTEM & REHEAT BYPASS STEAM DRAIN PIPING ISOMETRIC DRAWING (4 OF 7)
9	33-F6311Z-J0611-08+A	HOT REHEAT SYSTEM & REHEAT BYPASS STEAM DRAIN PIPING ISOMETRIC DRAWING (5 OF 7)
10	33-F6311Z-J0611-09+A	HOT REHEAT SYSTEM & REHEAT BYPASS STEAM DRAIN PIPING ISOMETRIC DRAWING (6 OF 7)
11	33-F6311Z-J0611-10+A	HOT REHEAT SYSTEM & REHEAT BYPASS STEAM DRAIN PIPING ISOMETRIC DRAWING (7 OF 7)
12	33-F6311Z-J0611-11+A	MATERIAL SUMMARY LIST OF HOT REHEAT SYSTEM & REHEAT BYPASS STEAM DRAIN PIPING
13	33-F6311Z-J0611-ML-01	HOT REHEAT SYSTEM & REHEAT BYPASS STEAM DRAIN PIPING INSTALLTION DRAWING (PAGE 1 OF 2)
14	33-F6311Z-J0611-ML-02	HOT REHEAT SYSTEM & REHEAT BYPASS STEAM DRAIN PIPING INSTALLTION DRAWING (PAGE 2 OF 2)
	J0612	
1	33-F6311Z-J0612-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J0612-01+A	COLD REHEAT STEAM DRAIN PIPING SYSTEM FLOW DIAGRAM
3	33-F6311Z-J0612-02+A	LAYOUT OF COLD REHEAT STEAM DRAIN PIPING
4	33-F6311Z-J0612-03+A	COLD REHEAT STEAM DRAIN PIPING ISOMETRIC DRAWING (1 OF 6)
5	33-F6311Z-J0612-04+A	COLD REHEAT STEAM DRAIN PIPING ISOMETRIC DRAWING (2 OF 6)
6	33-F6311Z-J0612-05+A	COLD REHEAT STEAM DRAIN PIPING ISOMETRIC DRAWING (3 OF 6)
7	33-F6311Z-J0612-06+A	COLD REHEAT STEAM DRAIN PIPING ISOMETRIC DRAWING (4 OF 6)
8	33-F6311Z-J0612-07+A	COLD REHEAT STEAM DRAIN PIPING ISOMETRIC DRAWING (5 OF 6)
9	33-F6311Z-J0612-08+A	COLD REHEAT STEAM DRAIN PIPING ISOMETRIC DRAWING (6 OF 6)
10	33-F6311Z-J0612-09+A	MATERIAL LIST OF COLD REHEAT STEAM DRAIN PIPING
11	33-F6311Z-J0612-ML	INSTALLTION DRAWING OF COLD REHEAT STEAM DRAIN PIPING (PAGE 1 OF 1)

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J-Series Drawings

Sr No.	Drawing No.	File Name
	J0652	
1	33-F6311Z-J0652-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J0652-01+A	LIST OF SUPPORTS AND HANGERS FOR HP MAIN STEAM PIPING (1)
3	33-F6311Z-J0652-02+A	LIST OF SUPPORTS AND HANGERS FOR HP MAIN STEAM PIPING (2)
4	33-F6311Z-J0652-03+A	#101 CONSTANT HANGER OF HP MAIN STEAM PIPING
5	33-F6311Z-J0652-28+A	#303 RIGID HANGER OF HP MAIN STEAM PIPING
6	33-F6311Z-J0652-29+A	#3031 Y LIMITED HANGER OF HP MAIN STEAM PIPING
7	33-F6311Z-J0652-30+A	#401 SPRING HANGER OF HP MAIN STEAM PIPING
8	33-F6311Z-J0652-31+A	#402 SPRING HANGER OF HP MAIN STEAM PIPING
9	33-F6311Z-J0652-32+A	#4021 X SNB HANGER OF HP MAIN STEAM PIPING
10	33-F6311Z-J0652-33+A	#403 SPRING HANGER OF HP MAIN STEAM PIPING
11	33-F6311Z-J0652-34+A	#501 SPRING HANGER OF HP MAIN STEAM PIPING
12	33-F6311Z-J0652-35+A	#502 SPRING HANGER OF HP MAIN STEAM PIPING
13	33-F6311Z-J0652-36+A	#5021 X SNB HANGER OF HP MAIN STEAM PIPING
14	33-F6311Z-J0652-37+A	#503 SPRING HANGER OF HP MAIN STEAM PIPING
15	33-F6311Z-J0652-ML-01	SUPPORTS AND HANGERS INSTALLTION DRAWINGS OF HP MAIN STEAM PIPING (PAGE 1 OF 4)
16	33-F6311Z-J0652-ML-02	SUPPORTS AND HANGERS INSTALLTION DRAWINGS OF HP MAIN STEAM PIPING (PAGE 2 OF 4)
17	33-F6311Z-J0652-ML-03	SUPPORTS AND HANGERS INSTALLTION DRAWINGS OF HP MAIN STEAM PIPING (PAGE 3 OF 4)
18	33-F6311Z-J0652-ML-04	SUPPORTS AND HANGERS INSTALLTION DRAWINGS OF HP MAIN STEAM PIPING (PAGE 4 OF 4)
	J0653	
1	33-F6311Z-J0653-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J0653-01+A	LIST OF SUPPORTS AND HANGERS FOR HOT REHEAT STEAM PIPING (1 OF 2)
3	33-F6311Z-J0653-02+A	LIST OF SUPPORTS AND HANGERS FOR HOT REHEAT STEAM PIPING (2 OF 2)
4	33-F6311Z-J0653-03+A	#101 SPRING HANGER OF HOT REHEAT STEAM PIPING
5	33-F6311Z-J0653-04+A	#102 SPRING HANGER OF HOT REHEAT STEAM PIPING
6	33-F6311Z-J0653-05+A	#103 SPRING HANGER OF HOT REHEAT STEAM PIPING
7	33-F6311Z-J0653-06+A	#104 RIGID ROD HANGER OF HOT REHEAT STEAM PIPING
8	33-F6311Z-J0653-07+A	#1041 RESTRAINT Y DIRECTION OF HOT REHEAT STEAM PIPING
9	33-F6311Z-J0653-08+A	#105 CONSTANT HANGER OF HOT REHEAT STEAM PIPING
10	33-F6311Z-J0653-09+A	#1051 RESTRAINT X DIRECTION OF HOT REHEAT STEAM PIPING
11	33-F6311Z-J0653-10+A	#106 CONSTANT HANGER OF HOT REHEAT STEAM PIPING
12	33-F6311Z-J0653-11+A	#108 CONSTANT HANGER OF HOT REHEAT STEAM PIPING
13	33-F6311Z-J0653-12+A	#109 CONSTANT HANGER OF HOT REHEAT STEAM PIPING
14	33-F6311Z-J0653-13+A	#1091 RESTRAINT X DIRECTION OF HOT REHEAT STEAM PIPING
15	33-F6311Z-J0653-14+A	#110 CONSTANT HANGER OF HOT REHEAT STEAM PIPING
16	33-F6311Z-J0653-15+A	#111 CONSTANT HANGER OF HOT REHEAT STEAM PIPING
17	33-F6311Z-J0653-16+A	#1101 RESTRAINT Y DIRECTION OF HOT REHEAT STEAM PIPING
18	33-F6311Z-J0653-17+A	#112 CONSTANT HANGER OF HOT REHEAT STEAM PIPING
19	33-F6311Z-J0653-18+A	#114 SPRING HANGER OF HOT REHEAT STEAM PIPING
20	33-F6311Z-J0653-19+A	#113 SPRING HANGER OF HOT REHEAT STEAM PIPING
21	33-F6311Z-J0653-20+A	#201 SPRING HANGER OF HOT REHEAT STEAM PIPING
22	33-F6311Z-J0653-21+A	#202 SPRING HANGER OF HOT REHEAT STEAM PIPING
23	33-F6311Z-J0653-22+A	#203 SPRING HANGER OF HOT REHEAT STEAM PIPING
24	33-F6311Z-J0653-23+A	#2021 RESTRAINT Y DIRECTION OF HOT REHEAT STEAM PIPING
25	33-F6311Z-J0653-24+A	#204 SPRING HANGER OF HOT REHEAT STEAM PIPING
26	33-F6311Z-J0653-25+A	#205 SPRING HANGER OF HOT REHEAT STEAM PIPING
27	33-F6311Z-J0653-26+A	#301 RIGID ROD HANGER OF HOT REHEAT STEAM PIPING
28	33-F6311Z-J0653-27+A	#302 SPRING HANGER OF HOT REHEAT STEAM PIPING
29	33-F6311Z-J0653-28+A	#303 SPRING HANGER OF HOT REHEAT STEAM PIPING
30	33-F6311Z-J0653-29+A	#3031 RESTRAINT Y DIRECTION OF HOT REHEAT STEAM PIPING
31	33-F6311Z-J0653-30+A	#304 SPRING HANGER OF HOT REHEAT STEAM PIPING
32	33-F6311Z-J0653-31+A	#3061 RESTRAINT Y DIRECTION OF HOT REHEAT STEAM PIPING
33	33-F6311Z-J0653-32+A	#305 SPRING SUPPORT OF HOT REHEAT STEAM PIPING
34	33-F6311Z-J0653-33+A	#306 SPRING SUPPORT OF HOT REHEAT STEAM PIPING
35	33-F6311Z-J0653-ML-01	SUPPORTS AND HANGERS INSTALLTION DRAWINGS OF HOT REHEAT STEAM PIPING (1 OF 4)
36	33-F6311Z-J0653-ML-02	SUPPORTS AND HANGERS INSTALLTION DRAWINGS OF HOT REHEAT STEAM PIPING (2 OF 4)
37	33-F6311Z-J0653-ML-03	SUPPORTS AND HANGERS INSTALLTION DRAWINGS OF HOT REHEAT STEAM PIPING (3 OF 4)
38	33-F6311Z-J0653-ML-04	SUPPORTS AND HANGERS INSTALLTION DRAWINGS OF HOT REHEAT STEAM PIPING (4 OF 4)
	J0654	
1	33-F6311Z-J0654-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J0654-01+A	LIST OF SUPPORTS AND HANGERS OF COLD REHEAT STEAM PIPING (1 OF 2)
3	33-F6311Z-J0654-02+A	LIST OF SUPPORTS AND HANGERS OF COLD REHEAT STEAM PIPING (2 OF 2)
4	33-F6311Z-J0654-03+A	#601 CONSTANT HANGER OF COLD REHEAT STEAM PIPING
5	33-F6311Z-J0654-04+A	#602 SPRING HANGER OF COLD REHEAT STEAM PIPING
6	33-F6311Z-J0654-05+A	#603 RIGID HANGER OF COLD REHEAT STEAM PIPING
7	33-F6311Z-J0654-06+A	#6031 Y LIMITED SUPPORT OF COLD REHEAT STEAM PIPING
8	33-F6311Z-J0654-07+A	#604 SPRING HANGER OF COLD REHEAT STEAM PIPING
9	33-F6311Z-J0654-08+A	#6041 X LIMITED SUPPORT OF COLD REHEAT STEAM PIPING
10	33-F6311Z-J0654-09+A	#605 SPRING HANGER OF COLD REHEAT STEAM PIPING
11	33-F6311Z-J0654-10+A	#606 CONSTANT HANGER OF COLD REHEAT STEAM PIPING
12	33-F6311Z-J0654-11+A	#6061 X LIMITED SUPPORT OF COLD REHEAT STEAM PIPING
13	33-F6311Z-J0654-12+A	#607 CONSTANT HANGER OF COLD REHEAT STEAM PIPING
14	33-F6311Z-J0654-13+A	#608 CONSTANT HANGER OF COLD REHEAT STEAM PIPING
15	33-F6311Z-J0654-14+A	#609 SPRING HANGER OF COLD REHEAT STEAM PIPING
16	33-F6311Z-J0654-15+A	#701 CONSTANT HANGER OF COLD REHEAT STEAM PIPING
17	33-F6311Z-J0654-16+A	#702 SPRING HANGER OF COLD REHEAT STEAM PIPING
18	33-F6311Z-J0654-17+A	#801 SPRING HANGER OF COLD REHEAT STEAM PIPING

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J-Series Drawings

Sr No.	Drawing No.	File Name
19	33-F6311Z-J0654-18+A	#802 RIGID HANGER OF COLD REHEAT STEAM PIPING
20	33-F6311Z-J0654-19+A	#803 SPRING HANGER OF COLD REHEAT STEAM PIPING
21	33-F6311Z-J0654-20+A	#804 SPRING HANGER OF COLD REHEAT STEAM PIPING
22	33-F6311Z-J0654-21+A	#805 SPRING HANGER OF COLD REHEAT STEAM PIPING
23	33-F6311Z-J0654-22+A	#8051 Y LIMITED SUPPORT OF COLD REHEAT STEAM PIPING
24	33-F6311Z-J0654-23+A	#806 SPRING HANGER OF COLD REHEAT STEAM PIPING
25	33-F6311Z-J0654-24+A	#807 SPRING HANGER OF COLD REHEAT STEAM PIPING
26	33-F6311Z-J0654-25+A	#808 SPRING HANGER OF COLD REHEAT STEAM PIPING
27	33-F6311Z-J0654-26+A	#809 SPRING HANGER OF COLD REHEAT STEAM PIPING
28	33-F6311Z-J0654-27+A	#810 SNUBER HANGER OF COLD REHEAT STEAM PIPING
29	33-F6311Z-J0654-28+A	#811 RESTRAINT X, Y DIRECTION OF COLD REHEAT STEAM PIPING
30	33-F6311Z-J0654-29+A	#812 SNUBER HANGER OF COLD REHEAT STEAM PIPING
31	33-F6311Z-J0654-30+A	#813 SPRING HANGER OF COLD REHEAT STEAM PIPING
32	33-F6311Z-J0654-31+A	#814 RESTRAINT X, Y DIRECTION OF COLD REHEAT STEAM PIPING
33	33-F6311Z-J0654-32+A	#815 SNUBER HANGER OF COLD REHEAT STEAM PIPING
34	33-F6311Z-J0654-33+A	#816 SPRING HANGER OF COLD REHEAT STEAM PIPING
35	33-F6311Z-J0654-34+A	#817 RESTRAINT X, Y DIRECTION OF COLD REHEAT STEAM PIPING
36	33-F6311Z-J0654-35+A	#6081 Y LIMITED SUPPORT OF COLD REHEAT STEAM PIPING
37	33-F6311Z-J0654-36+A	#8041 X LIMITED SUPPORT OF COLD REHEAT STEAM PIPING
38	33-F6311Z-J0654-ML-01	SUPPORTS AND HANGERS INSTALLTION DRAWINGS OF COLD REHEAT STEAM PIPING (PAGE 1 OF 4)
39	33-F6311Z-J0654-ML-02	SUPPORTS AND HANGERS INSTALLTION DRAWINGS OF COLD REHEAT STEAM PIPING (PAGE 2 OF 4)
40	33-F6311Z-J0654-ML-03	SUPPORTS AND HANGERS INSTALLTION DRAWINGS OF COLD REHEAT STEAM PIPING (PAGE 3 OF 4)
41	33-F6311Z-J0654-ML-04	SUPPORTS AND HANGERS INSTALLTION DRAWINGS OF COLD REHEAT STEAM PIPING (PAGE 4 OF 4)
	J1501	
1	33-F6311Z-J1501-01+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J1501-02+A	ST GLAND SEALING STEAM SYSTEM FLOW DIAGRAM
3	33-F6311Z-J1501-03+A	ST PROPER DRAIN SYSTEM DIAGRAM (1 OF 2)
4	33-F6311Z-J1501-04+A	ST PROPER DRAIN SYSTEM DIAGRAM (2 OF 2)
5	33-F6311Z-J1501-05+A	DRAIN FLASH TANK RELATED PIPE SYSTEM FLOW DIAGRAM
6	33-F6311Z-J1501-06+A	VALVE LIST OF STEAM TURBINE GLAND SEALING STEAM, DRAIN AND VENT SYSTEM (1 OF 3)
7	33-F6311Z-J1501-07+A	VALVE LIST OF STEAM TURBINE GLAND SEALING STEAM, DRAIN AND VENT SYSTEM (2 OF 3)
8	33-F6311Z-J1501-08+A	VALVE LIST OF STEAM TURBINE GLAND SEALING STEAM, DRAIN AND VENT SYSTEM (3 OF 3)
9	33-F6311Z-J1501-ML	STEAM TURBINE GLAND SEALING STEAM, DRAIN AND VENT SYSTEM FLOW DIAGRAM AND VALVES LIST
	J1502	
1	33-F6311Z-J1502-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J1502-01+A	ST GLAND SEALING STEAM SUPPLY PIPING SYSTEM FLOW DIAGRAM
3	33-F6311Z-J1502-02+A	LAYOUT OF ST GLAND SEALING STEAM SUPPLY PIPING SYSTEM
4	33-F6311Z-J1502-03+A	ST GLAND SEALING STEAM SUPPLY PIPING ISOMETRIC DRAWING (1 OF 9)
5	33-F6311Z-J1502-04+A	ST GLAND SEALING STEAM SUPPLY PIPING ISOMETRIC DRAWING (2 OF 9)
6	33-F6311Z-J1502-05+A	ST GLAND SEALING STEAM SUPPLY PIPING ISOMETRIC DRAWING (3 OF 9)
7	33-F6311Z-J1502-06+A	ST GLAND SEALING STEAM SUPPLY PIPING ISOMETRIC DRAWING (4 OF 9)
8	33-F6311Z-J1502-07+A	ST GLAND SEALING STEAM SUPPLY PIPING ISOMETRIC DRAWING (5 OF 9)
9	33-F6311Z-J1502-08+A	ST GLAND SEALING STEAM SUPPLY PIPING ISOMETRIC DRAWING (6 OF 9)
10	33-F6311Z-J1502-09+A	ST GLAND SEALING STEAM SUPPLY PIPING ISOMETRIC DRAWING (7 OF 9)
11	33-F6311Z-J1502-10+A	ST GLAND SEALING STEAM SUPPLY PIPING ISOMETRIC DRAWING (8 OF 9)
12	33-F6311Z-J1502-11+A	ST GLAND SEALING STEAM SUPPLY PIPING ISOMETRIC DRAWING (9 OF 9)
13	33-F6311Z-J1502-ML-01	INSTALLTION DRAWING OF ST GLAND SEALING STEAM SUPPLY PIPING (1 OF 2)
14	33-F6311Z-J1502-ML-02	INSTALLTION DRAWING OF ST GLAND SEALING STEAM SUPPLY PIPING (2 OF 2)
	J1503	
1	33-F6311Z-J1503-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J1503-01+A	SYSTEM DIAGRAM OF STEAM TURBINE GLAND SEALING AND VALVE STEM STEAM LEAKAGE PIPING
3	33-F6311Z-J1503-02+A	LAYOUT DIAGRAM OF STEAM TURBINE GLAND SEALING AND VALVE STEM STEAM LEAKAGE PIPING
4	33-F6311Z-J1503-03+A	PIPING ISOMETRIC OF STEAM TURBINE GLAND SEALING LEAKAGE PIPING (1 OF 2)
5	33-F6311Z-J1503-04+A	PIPING ISOMETRIC OF STEAM TURBINE GLAND SEALING LEAKAGE PIPING (2 OF 2)
6	33-F6311Z-J1503-05+A	PIPING ISOMETRIC OF VALVE STEM STEAM LEAKAGE PIPING (1 OF 2)
7	33-F6311Z-J1503-06+A	PIPING ISOMETRIC OF VALVE STEM STEAM LEAKAGE PIPING (2 OF 2)
8	33-F6311Z-J1503-ML	STEAM TURBINE GLAND SEALING AND VALVE STEM STEAM LEAKAGE PIPING INSTALLATION DRAWING
	J1504	
1	33-F6311Z-J1504-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J1504-01+A	DRAIN FLASH TANK RELATED PIPE SYSTEM FLOW DIAGRAM
3	33-F6311Z-J1504-02+A	LAYOUT OF DRAIN FLASH TANK RELATE PIPING
4	33-F6311Z-J1504-ML	INSTALLTION DRAWING OF DRAIN FLASH TANK RELATED PIPE SYSTEM
	J1505	
1	33-F6311Z-J1505-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J1505-01+A	ST PROPER DRAIN SYSTEM DIAGRAM (1/2)
3	33-F6311Z-J1505-02+A	ST PROPER DRAIN SYSTEM DIAGRAM (2/2)
4	33-F6311Z-J1505-03+A	SIZES AND NAME LISTS OF DRAIN BRANCH PIPING
5	33-F6311Z-J1505-04+A	ST PROPER DRAIN PIPING ARRANGEMENT SCHEMATIC DRAWING
6	33-F6311Z-J1505-ML	STEAM TURBINE PROPER DRAIN PIPING INSTALLTION DRAWING
	J1506	
1	33-F6311Z-J1506-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J1506-01+A	GLAND STEAM CONDENSER VENT PIPING SYSTEM FLOW DIAGRAM
3	33-F6311Z-J1506-02+A	GLAND STEAM CONDENSER VENT PIPING ARRANGEMENT DRAWING
4	33-F6311Z-J1506-03+A	GLAND STEAM CONDENSER VENT PIPING ISOMETRIC DRAWING
5	33-F6311Z-J1506-ML	INSTALLATION DRAWING OF GLAND STEAM CONDENSER VENT PIPING
	J1507	
1	33-F6311Z-J1507-00+A	INSTRUCTIONS FOR AS BUILT DRAWING

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J-Series Drawings

Sr No.	Drawing No.	File Name
2	33-F6311Z-J1507-01+A	GLAND STEAM CONDENSER DRAIN PIPING SYSTEM DIAGRAM
3	33-F6311Z-J1507-02+A	GLAND STEAM CONDENSER DRAIN PIPING ARRANGEMENT DRAWING
4	33-F6311Z-J1507-ML	GLAND STEAM CONDENSER DRAIN PIPING INSTALLATION DRAWING
	J1601	
1	33-F6311Z-J1601-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J1601-01+A	STEAM TURBINE, LUBE OIL PURIFICATION, STORAGE, VENT, VAPOR EXHAUST AND OIL RELEASE SYSTEM VALVES LIST
3	33-F6311Z-J1601-02+A	STEAM TURBINE, LUBE OIL PURIFICATION, STORAGE, VENT, VAPOR EXHAUST AND OIL RELEASE SYSTEM FLOW DIAGRAM
4	33-F6311Z-J1601-ML	STEAM TURBINE, LUBE OIL PURIFICATION, STORAGE, VENT, VAPOR EXHAUST AND OIL RELEASE SYSTEM FLOW DIAGRAM
	J1602	
1	33-F6311Z-J1602-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J1602-01+A	STEAM TURBINE LUBE OIL PIPING FLOW DIAGRAM
3	33-F6311Z-J1602-02+A	STEAM TURBINE LUBE OIL PIPING SUPPORTS AND HANGER ARRANGEMENT DRAWING
4	33-F6311Z-J1602-ML	STEAM TURBINE LUBE OIL PIPING SUPPORTS AND HANGER INSTALLATION DRAWING
	J1603	
1	33-F6311Z-J1603-02+A	MAIN LUBE OIL TANK VENT PIPING AND OIL PURIFICATION PIPING ARRANGEMENT DRAWING
2	33-F6311Z-J1603-ML	MAIN LUBE OIL TANK VENT PIPING AND OIL PURIFICATION PIPING INSTALLTION DRAWING
	J1703	
1	33-F6311Z-J1703-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
	J1705	
1	33-F6311Z-J1705-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J1705-01+A	STG PROPER H2, CO2 SYSTEM FLOW DIAGRAM
3	33-F6311Z-J1705-02+A	STG PROPER H2, CO2 SYSTEM PIPING ARRANGMENT SCHEMATIC DRAWING
4	33-F6311Z-J1705-ML	STG PROPER H2, CO2 SYSTEM PIPING INSTALLTION DRAWING
	J1706	
1	33-F6311Z-J1706-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J1706-01+A	HYDROGEN DELIVERY PIPING SYSTEM FLOW DIAGRAM
3	33-F6311Z-J1706-02+A	HYDROGEN DELIVERY PIPING ARRANGEMENT SCHEMATIC DIAGRAM
4	33-F6311Z-J1706-ML	HYDROGEN DELIVERY PIPING INSTALLTION DRAWING
	J1707	
1	33-F6311Z-J1707-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J1707-01+A	GENERATOR WATER COOLING SYSTEM PIPING FLOW DIAGRAM
3	33-F6311Z-J1707-02+A	GENERATOR WATER COOLING SYSTEM PIPING ARRANGEMENT DRAWING
4	33-F6311Z-J1707-03+A	GENERATOR WATER COOLING SYSTEM PIPING ISOMETRIC DRAWING (1 OF 2)
5	33-F6311Z-J1707-04+A	GENERATOR WATER COOLING SYSTEM PIPING ISOMETRIC DRAWING (2 OF 2)
6	33-F6311Z-J1707-ML	GENERATOR WATER COOLING SYSTEM PIPING INSTALLATION DRAWING
	J1801	
1	33-F6311Z-J1801-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J1801-01+A	FLOW DIAGRAM OF CONDENSER VACUUM EXTRACTION PIPE
3	33-F6311Z-J1801-02+A	VALVE LIST OF CONDENSER VACUUM EXTRACTION PIPE SYSTEM
4	33-F6311Z-J1801-ML	CONDENSER AIR EXTRACTION SYSTEM FLOW DIAGRAM AND VALVES LIST
	J1802	
1	33-F6311Z-J1802-00+A	INSTRUCTIONS FOR AS BUILT DRAWING
2	33-F6311Z-J1802-01+A	CONDENSER VACCUM EXTRACTION PIPE SYSTEM DIAGRAM
3	33-F6311Z-J1802-02+A	ARRANGEMENT OF CONDENSER VACCUM EXTRACTION PIPE AND VACUUM BREAK PIPE
4	33-F6311Z-J1802-03+A	ARRANGEMENT OF CONDENSER VACCUM EXTRACTION PIPE OF CONDENSATE WATER BOX
5	33-F6311Z-J1802-ML	CONDENSER VACCUM EXTRACTION PIPE INSTALLTION DRAWING

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Z-Series Drawings

Sr No.	Drawing No.	Drawing Full Name
	Z0101	
1	F6311Z-Z0101-00+A	F6311Z-Z0101-00+A INSTRUCTIONS FOR AS BUILT DRAWING
2	F6311Z-Z0101-01+A	F6311Z-Z0101-01+A GENERAL LAYOUT (PART 1)
3	F6311Z-Z0101-02+A	F6311Z-Z0101-02+A GENERAL LAYOUT (PART 2)
4	F6311Z-Z0101-03+A	F6311Z-Z0101-03+A GENERAL LAYOUT (PART 3)
5	F6311Z-Z0101-ML	F6311Z-Z0101-ML GENERAL LAYOUT
	Z0201	
1	F6311Z-Z0201-00	F6311Z-Z0201-00 INSTRUCTIONS FOR AS BUILT DRAWING
2	F6311Z-Z0201-01	F6311Z-Z0201-01 PLANT AREA GRADING (PART 1)
3	F6311Z-Z0201-02	F6311Z-Z0201-02 PLANT AREA GRADING (PART 2)
4	F6311Z-Z0201-ML	F6311Z-Z0201-ML PLANT AREA GRADING
	Z0202	
1	F6311Z-Z0202-00+A	F6311Z-Z0202-00+A INSTRUCTIONS FOR AS BUILT DRAWING
2	F6311Z-Z0202-01+A	F6311Z-Z0202-01+A ROAD ARRANGEMENT DRAWING (PART 1)
3	F6311Z-Z0202-02+A	F6311Z-Z0202-02+A ROAD ARRANGEMENT DRAWING (PART 2)
4	F6311Z-Z0202-ML	F6311Z-Z0202-ML ROAD ARRANGEMENT DRAWING
	Z0203	
1	F6311Z-Z0203-00+A	F6311Z-Z0203-00+A INSTRUCTIONS FOR AS BUILT DRAWING
2	F6311Z-Z0203-01+A	F6311Z-Z0203-01+A INSTRUCTIONS OF SUBGRADE AND PAVEMENT
3	F6311Z-Z0203-02+A	F6311Z-Z0203-02+A DETAILED DRAWING OF ROAD AND PAVEMENT
4	F6311Z-Z0203-03+A	F6311Z-Z0203-03+A DETAILED DRAWING OF CONCRETE OUTDOOR GROUND
5	F6311Z-Z0203-ML	F6311Z-Z0203-ML DETAILED DRAWING OF ROAD AND PAVEMENT
	Z0204	
1	F6311Z-Z0204-00+A	F6311Z-Z0204-00+A INSTRUCTIONS FOR AS BUILT DRAWING
2	F6311Z-Z0204-01+A	F6311Z-Z0204-01+A PLANT LAYOUT OF FENCING
3	F6311Z-Z0204-02+A	F6311Z-Z0204-02+A DETAIL DRAWING OF FENCING
4	F6311Z-Z0204-03+A	F6311Z-Z0204-03+A DETAIL DRAWING OF FENCING
5	F6311Z-Z0204-04+A	F6311Z-Z0204-04+A DETAILED DRAWING OF ALLIANCE DOOR
6	F6311Z-Z0204-ML	F6311Z-Z0204-ML DETAILED DRAWING OF FENCE
	Z0205	
1	F6311Z-Z0205-00+A	F6311Z-Z0205-00+A INSTRUCTIONS FOR AS BUILT DRAWING
2	F6311Z-Z0205-01+A	F6311Z-Z0205-01+A LAYOUT OF PERMANENT WALL
3	F6311Z-Z0205-02+A	F6311Z-Z0205-02+A DETAILED DRAWING OF PERMANENT WALL
4	F6311Z-Z0205-03+A	F6311Z-Z0205-03+A CALCULATION REPORT OF PERMANENT WALL
5	F6311Z-Z0205-ML	F6311Z-Z0205-ML PERMANENT WALL AND FENCE OF PLANT BOUNDARY
	Z0206	
1	F6311Z-Z0206-00+A	F6311Z-Z0206-00+A INSTRUCTIONS FOR AS BUILT DRAWING
2	F6311Z-Z0206-01+A	F6311Z-Z0206-01+A GENERAL PIPLELINES ARRANGEMENT DRAWING (PART 1)
3	F6311Z-Z0206-02+A	F6311Z-Z0206-02+A GENERAL PIPLELINES ARRANGEMENT DRAWING (PART 2)
4	F6311Z-Z0206-03+A	F6311Z-Z0206-03+A GENERAL PIPLELINES ARRANGEMENT DRAWING (PART 3)
5	F6311Z-Z0206-ML	F6311Z-Z0206-ML GENERAL PIPLELINES ARRANGEMENT DRAWING
	Z0207	
1	F6311Z-Z0207-00+A	F6311Z-Z0207-00+A INSTRUCTIONS FOR AS BUILT DRAWING
2	F6311Z-Z0207-01+A	F6311Z-Z0207-01+A SECTION DRAWING OF PIPERACK
3	F6311Z-Z0207-ML	F6311Z-Z0207-ML SECTION DRAWING OF PIPERACK
	Z0208	
1	F6311Z-Z0208-00+A	F6311Z-Z0208-00+A INSTRUCTIONS FOR AS BUILT DRAWING
2	F6311Z-Z0208-01+A	F6311Z-Z0208-01+A LANDSCAPING PLAN OF POWER PLANT (PART 1)
3	F6311Z-Z0208-02+A	F6311Z-Z0208-02+A LANDSCAPING PLAN OF POWER PLANT (PART 2)
4	F6311Z-Z0208-ML	F6311Z-Z0208-ML LANDSCAPING PLAN OF POWER PLANT

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Electrical Drawings

Sr No.		Drawing No.	File Name
	1) ELECTRICAL DRAWINGS		
	1b	**Power Plant single Line Diagrams**	
		D0101	
1		F6311Z-D0101-00	INSTRUCTIONS FOR AS BUILT DRAWING
2		F6311Z-D0101-01	MAIN ELECTRICAL SYSTEM KEY ONE-LINE DIAGRAM
3		F6311Z-D0101-02	MAIN ELECTRICAL LAYOUT PLANT DIAGRAM
4		F6311Z-D0101-ML	GENERAL DRAWING OF ELECTRICAL
	1c	**Short Circuit Calculation**	
	2) STEAM TURBINE GENERATOR		
1	**2a**	**O&M Manuals**	
	2b	**Generator Projection Drawings (Panel A&B)**	
1		RP-12019B001-01	Steam Generator Drawings-Generator Protection-A
2		RP-12019B002-01	Steam Generator Drawings-Generator Protection-B
	2c	**Generator Data**	
1		0EA.140.1613EN	Generator Technical Data and Capability Curve
	2d, 2e, 2g, 2i	**Interconnection, Generator Protection, Excitation System EX2100, NGR Drawings**	
1		33-F6311Z-D0610-00	INSTRUCTIONS FOR AS BUILT DRAWING
2		33-F6311Z-D0610-01	UWD OF GENERATOR CT TERMINAL BOX
3		33-F6311Z-D0610-02	UWD (1/3) OF GENERATOR PT TERMINAL BOX
4		33-F6311Z-D0610-03	UWD (2/3) OF GENERATOR PT TERMINAL BOX
5		33-F6311Z-D0610-04	UWD (3/3) OF GENERATOR PT TERMINAL BOX
6		33-F6311Z-D0610-05	UWD OF GENERATOR NEUTRAL GROUNDING PANEL
7		33-F6311Z-D0610-12	WIRING DIAGRAM (1/2) OF GEN. CURRENT CIRCUIT
8		33-F6311Z-D0610-13	WIRING DIAGRAM (2/2) OF GEN. CURRENT CIRCUIT
9		33-F6311Z-D0610-14	WIRING DIAGRAM (1/3) OF GEN. VOLTAGE CIRCUIT
10		33-F6311Z-D0610-15	WIRING DIAGRAM (2/3) OF GEN. VOLTAGE CIRCUIT
11		33-F6311Z-D0610-16	WIRING DIAGRAM (3/3) OF GEN. VOLTAGE CIRCUIT
12		33-F6311Z-D0610-17	WIRING DIAGRAM OF GEN. NEUTRAL GROUNDING PANEL CURRENT AND VOLTAGE CIRCUIT
13		33-F6311Z-D0610-18	WIRING DIAGRAM (1/2) OF GEN PROTECTION TO DCS SIGNAL CIRCUIT
14		33-F6311Z-D0610-19	WIRING DIAGRAM (2/2) OF GEN PROTECTION TO DCS SIGNAL CIRCUIT
15		33-F6311Z-D0610-20	WIRING DIAGRAM (1/2) OF GEN PROTECTION TO FAULT RECORDER SIGNAL CIRCUIT
16		33-F6311Z-D0610-21	WIRING DIAGRAM (2/2) OF GEN PROTECTION TO FAULT RECORDER SIGNAL CIRCUIT
17		33-F6311Z-D0610-22	WIRING DIAGRAM (1/2) OF GEN MEASUREMENT CIRCUIT
18		33-F6311Z-D0610-23	WIRING DIAGRAM (2/2) OF GEN MEASUREMENT CIRCUIT
19		33-F6311Z-D0610-24	WIRING DIAGRAM OF G-T UNIT PROTECTION TRIP TURBINE CIRCUIT
20		33-F6311Z-D0610-25	WIRING DIAGRAM OF MANUAL EMERGENCY TRIP BUTTON
21		33-F6311Z-D0610-26	WIRING DIAGRAM OF EXCITATION TRANSFORMER CURRENT CIRCUIT
22		33-F6311Z-D0610-27	WIRING DIAGRAM OF EXCITATION TRANSFORMER TEMPERATURE CONTROLLER
23		33-F6311Z-D0610-28	WIRING DIAGRAM OF EXCITATION SYSTEM AUX. POWER SUPPLY
24		33-F6311Z-D0610-29	WIRING DIAGRAM (1/2) OF EXCITATION SYSTEM CONTROL CIRCUIT
25		33-F6311Z-D0610-30	WIRING DIAGRAM (2/2) OF EXCITATION SYSTEM CONTROL CIRCUIT
26		33-F6311Z-D0610-31	WIRING DIAGRAM OF EXCITATION SYSTEM SIGNAL CIRCUIT
27		33-F6311Z-D0610-32	WIRING DIAGRAM OF EXCITATION SYSTEM MEASUREMENT CIRCUIT
28		33-F6311Z-D0610-33	WIRING DIAGRAM OF GCB CURRENT CIRCUIT
29		33-F6311Z-D0610-34	WIRING DIAGRAM OF GCB VOLTAGE CIRCUIT
30		33-F6311Z-D0610-35	WIRING DIAGRAM OF GCB CONTROL CIRCUIT
31		33-F6311Z-D0610-36	WIRING DIAGRAM OF GEN. DS AND ES CONTROL CIRCUIT
32		33-F6311Z-D0610-37	WIRING DIAGRAM OF GCB TERMINAL BOX TO DCS SIGNAL CIRCUIT
33		33-F6311Z-D0610-38	WIRING DIAGRAM OF GCB TO G-T UNIT PROTECTION CIRCUIT
34		33-F6311Z-D0610-39	WIRING DIAGRAM OF GCB TO DEH SIGNAL CIRCUIT
35		33-F6311Z-D0610-40	WIRING DIAGRAM OF GCB TERMINAL BOX TO FAULT RECORDER SIGNAL CIRCUIT
36		33-F6311Z-D0610-41	WIRING DIAGRAM OF GCB TERMINAL BOX AUX POWER SUPLY
37		33-F6311Z-D0610-42	EQUIPMENT AND MATERIAL LIST
38		33-F6311Z-D0610-43	EXCITATION SYSTEM MANUFACTURER TO DRAWINGS
39		33-F6311Z-D0610-44	GCB MANUFACTURERS TO DRAWINGS
40		33-F6311Z-D0610-45	WIRING DIAGRAM BETWEEN G-T UNIT PROTECTION PANEL (1/2)
41		33-F6311Z-D0610-46	WIRING DIAGRAM BETWEEN G-T UNIT PROTECTION PANEL (2/2)
42		33-F6311Z-D0610-47	WIRING DIAGRAM BETWEEN G-T UNIT PROTECTION PANEL
	2f	**Generator Protection Settings**	
	2h	**Synchronization Panel Drawings**	
1		CP-12019B018-01	Steam Generator Drawings-Synchronous Panel

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Electrical Drawings

Sr No.		Drawing No.	File Name
	3) GENERATOR		
	4) ISSOLATED PHASE BUS		
		Layout and section Drawings (Soft Not Included)	
1			ISOLATED PHASE BUS FACTORY TEST REPORT
2			ISOLATED PHASE BUS CERTIFICATE
3			ENCLOSED BUSBAR MATERIAL INSPECTION REPORTS
4			ON-LINE TEMPERATURE MONITORING DEVICES
5			INSPECTION REPORTS OF ISOLATED-PHASE ENCLOSED BUS INSULATOR
6			PAKISTAN GUDDU 747MW COMBINED CYCLE POWER GENERATION PROECT #3 TURBINE ITP INSTALLATION DRAWINGS
7			MANUAL OF ENCLOSED BUS-WAY
8			MICRO-PRESSURE CONTROL DEVICE CABINET USE AND INSTALLATION INSTRUCTION
	5) NPB BUSBAR		
1		33-F6311Z-D0402-00	INSTRUCTIONS FOR AS BUILT DRAWING
2		33-F6311Z-D0402-01	VOLUME NOTES FOR INSTALLATION OF 6.6kV NPB
3		33-F6311Z-D0402-02	SINGLE LINE DIAGRAM OF NPB
4		33-F6311Z-D0402-03	LAYOUT OF NPB
5		33-F6311Z-D0402-04	SECTIONAL DRAWINGS OF NPB
6		33-F6311Z-D0402-05	STRUCTURAL DRAWING OF NPB
7		33-F6311Z-D0402-06	STRUCTURAL DRAWING OF NPB'S JOINT TO SWITCHGEAR
8		33-F6311Z-D0402-07	STRUCTURAL DRAWING OF NPB'S JOINT TO TRANSFORMER
9		33-F6311Z-D0402-08	STRUCTURAL DRAWING OF NPB'S THROUGH-WALL
10		33-F6311Z-D0402-09	SUPPORTING STRUCTURAL DRAWING OF NPB
11		33-F6311Z-D0402-10	SUSPENDING STRUCTURAL DRAWING OF NPB (TRANSFORMER'S SIDE)
12		33-F6311Z-D0402-11	SUSPENDING STRUCTURAL DRAWING OF NPB (SWITCHGEAR'S SIDE)
13		33-F6311Z-D0402-12	STRUCTURAL DRAWING OF NPB SECTION CONNECTION
14		33-F6311Z-D0402-13	STRUCTURAL DRAWING OF NPB EXPANSION JOINT
15		33-F6311Z-D0402-14	SUMMARY LIST OF EQUIPMENTS AND MATERIALS FOR INSTALLATION OF NPB
	7) SWITCH GEARS		
	7a	**STG MCC Switchgear Drawings**	
1		33-F6311Z-D0701-00	INSTRUCTIONS FOR AS BUILT DRAWINGS
2		33-F6311Z-D0701-01	VOLUME NOTES AND SYMBOLS
3		33-F6311Z-D0701-02	CWD OF LOCAL CONTROL PUSH BUTTON BOX
4		33-F6311Z-D0701-03	CWD OF LOCAL EMERGENCY TRIP PUSH BUTTON
5		33-F6311Z-D0701-04	CONTROL WIRING DIAGRAM OF CONDENSATE EXTRACTION PUMP A
6		33-F6311Z-D0701-05	CONTROL WIRING DIAGRAM OF CONDENSATE EXTRACTION PUMP B
7		33-F6311Z-D0701-06	CONTROL WIRING DIAGRAM OF #3 TURBINE CLOSE CYCLE COOLING WATER BOOSTER PUMP A
8		33-F6311Z-D0701-07	CONTROL WIRING DIAGRAM OF #3 TURBINE CLOSE CYCLE COOLING WATER BOOSTER PUMP B
9		33-F6311Z-D0701-08	CONTROL WIRING DIAGRAM OF #3 TURBINE AUXILIARY COOLING WATER PUMP A
10		33-F6311Z-D0701-09	CONTROL WIRING DIAGRAM OF #3 TURBINE AUXILIARY COOLING WATER PUMP B
11		33-F6311Z-D0701-10	CONTROL WIRING DIAGRAM OF AIR COMPRESSOR FOR INSTRUMENT AIR MOTOR A
12		33-F6311Z-D0701-11	CONTROL WIRING DIAGRAM OF AIR COMPRESSOR FOR INSTRUMENT AIR MOTOR B
13		33-F6311Z-D0701-12	CONTROL WIRING DIAGRAM OF CONDENSATE EXTRACTION PUMP C
14		33-F6311Z-D0701-13	CONTROL WIRING DIAGRAM II OF CONDENSATE EXTRACTION PUMP C
15		33-F6311Z-D0701-14	CONTROL WIRING DIAGRAM OF WATER RING MECHANICAL VACUUM PUMP A
16		33-F6311Z-D0701-15	CONTROL WIRING DIAGRAM OF WATER RING MECHANICAL VACUUM PUMP B
17		33-F6311Z-D0701-16	CONTROL WIRING DIAGRAM OF AUXILIARY SHUT DOWN COOLING WATER PUMP
18		33-F6311Z-D0701-17	CONTROL WIRING DIAGRAM OF LUBE OIL AUXILIARY PUMP
19		33-F6311Z-D0701-18	CONTROL WIRING DIAGRAM OF JACKING OIL PUMP #A
20		33-F6311Z-D0701-19	CONTROL WIRING DIAGRAM OF JACKING OIL PUMP #B
21		33-F6311Z-D0701-20	CONTROL WIRING DIAGRAM OF AIR SIDE SEAL OIL PUMP
22		33-F6311Z-D0701-21	CONTROL WIRING DIAGRAM OF HP PRIMER OIL PUMP
23		33-F6311Z-D0701-22	CONTROL WIRING DIAGRAM OF HYDROGEN SIDE SEAL OIL PUMP
24		33-F6311Z-D0701-23	CONTROL WIRING DIAGRAM OF CONDENSATE BOOSTER PUMP A
25		33-F6311Z-D0701-24	CONTROL WIRING DIAGRAM OF CONDENSATE BOOSTER PUMP B
26		33-F6311Z-D0701-25	CONTROL WIRING DIAGRAM OF STATOR COOLING WATER SYSTEM PUMP A
27		33-F6311Z-D0701-26	CONTROL WIRING DIAGRAM OF STATOR COOLING WATER SYSTEM PUMP B

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Electrical Drawings

Sr No.		Drawing No.	File Name
28		33-F6311Z-D0701-27	CONTROL WIRING DIAGRAM OF EH OIL PUMP A
29		33-F6311Z-D0701-28	CONTROL WIRING DIAGRAM OF EH OIL PUMP B
30		33-F6311Z-D0701-29	CONTROL WIRING DIAGRAM OF GLAND STEAM CONDENSER EXHAUSTER FAN A
31		33-F6311Z-D0701-30	CONTROL WIRING DIAGRAM OF GLAND STEAM CONDENSER EXHAUSTER FAN B
32		33-F6311Z-D0701-31	CONTROL WIRING DIAGRAM OF CONDENSER WATER BOX VACUUM PUMP A
33		33-F6311Z-D0701-32	CONTROL WIRING DIAGRAM OF CONDENSER WATER BOX VACUUM PUMP B
34		33-F6311Z-D0701-33	CONTROL WIRING DIAGRAM OF STG MIST EXHAUSTER A
35		33-F6311Z-D0701-34	CONTROL WIRING DIAGRAM OF STG MIST EXHAUSTER B
36		33-F6311Z-D0701-35	CONTROL WIRING DIAGRAM OF OIL MIST EXHAUST FAN A
37		33-F6311Z-D0701-36	CONTROL WIRING DIAGRAM OF OIL MIST EXHAUST FAN B
38		33-F6311Z-D0701-37	CONTROL WIRING DIAGRAM OF HOTWELL BLOWDOWN PUMP
39		33-F6311Z-D0701-38	CONTROL WIRING DIAGRAM OF #1(2) ATOMIZING AIR COMPRESSOR
40		33-F6311Z-D0701-39	CWD OF POWER SUPPLY BOX FOR DC EMERGENCY LUBE OIL PUJMP
41		33-F6311Z-D0701-40	CONTROL WIRING DIAGRAM OF DC EMERGENCY OIL PUMP
42		33-F6311Z-D0701-41	CWD OF POWER SUPPLY BOX FOR AIR SIDE SEAL OIL STANDBY PUMP
43		33-F6311Z-D0701-42	CONTROL WIRING DIAGRAM OF AIR SIDE SEAL OIL STANDBY PUMP
44		33-F6311Z-D0701-43	CWD OF POWER SUPPLY BOX FOR HYDROGEN SIDE SEAL OIL STANDBY PUMP
45		33-F6311Z-D0701-44	CONTROL WIRING DIAGRAM OF HYDROGEN SIDE SEAL OIL STANDBY PUMP
46		33-F6311Z-D0701-45	SUMMRY OF EQUIPMENT AND MATERIALS FOR CONTROL WIRING DIAGRAM OF TURBINE MOTOR
47		33-F6311Z-D0701-46	CONTROL WIRING DIAGRAM OF EH OIL REGENERATIVE PUMP
48		33-F6311Z-D0701-47	CONTROL WIRING DIAGRAM OF EH OIL COOLING PUMP
49		33-F6311Z-D0701-48	CONTROL WIRING DIAGRAM OF EH OIL HEATER
	7b	**6.6 KV UNIT Board Drawings**	
1		33-F6311Z-D0618-00	INSTRUCTIONS FOR AS BUILT DESIGN
2		33-F6311Z-D0618-01	UWD(1/3) OF 6.6kV SWITCHBOARD FOR TRANSFORMER
3		33-F6311Z-D0618-02	UWD(2/3) OF 6.6kV SWITCHBOARD FOR TRANSFORMER
4		33-F6311Z-D0618-03	UW0(3/3) OF 6.6kV SWITCHBOARD FOR TRANSFORMER
5		33-F6311Z-D0618-04	UWD(1/3) OF 6.6kV SWITCHBOARD FOR TRANSFORMER WITH DIFFERENTIAL PROTECTION
6		33-F6311Z-D0618-05	UWD(2/3) OF 6.6kV SWITCHBOARD FOR TRANSFORMER WITH DIFFERENTIAL PROTECTION
7		33-F6311Z-D0618-06	UWD(3/3) OF 6.6kV SWITCHBOARD FOR TRANSFORMER WITH DIFFERENTIAL PROTECTION
8		33-F6311Z-D0618-07	UWD(1/3) OF 6.6kV F-C SWITCHBOARD FOR TRANSFORMER
9		33-F6311Z-D0618-08	UW0(2/3) OF 6.6kV F~C SWITCHBOARD FOR TRANSFORMER
10		33-F6311Z-D0618-09	UWD(3/3) OF 6.6kV F-C SWITCHBOARD FOR TRANSFORMER
11		33-F6311Z-D0618-10	UWD(1/3) OF 6.6kV SWITCHBOARD FOR MOTOR CASE A
12		33-F6311Z-D0618-11	UWD(2/3) OF 6.6kV SWITCHBOARD FOR MOTOR CASE A
13		33-F6311Z-D0618-12	UWD(3/3) OF 6.6kV SWITCHBOARD FOR MOTOR CASE A
14		33-F6311Z-D0618-13	UWD(1/3) OF 6.6kV SWITCHBOARD FOR MOTOR CASE B
15		33-F6311Z-D0618-14	UWD(2/3) OF 6.6kV SWITCHBOARD FOR MOTOR CASE B
16		33-F6311Z-D0618-15	UWD(3/3) OF 6.6kV SWITCHBOARD FOR MOTOR CASE B
17		33-F6311Z-D0618-16	UWD(1/3) OF 6.6kV SWITCHBOARD FOR MOTOR CASE A WITH DIFFERENTIAL PROTECTION
18		33-F6311Z-D0618-17	UWD(2/3) OF 6.6kV SWITCHBOARD FOR MOTOR CASE A WITH DIFFERENTIAL PROTECTION
19		33-F6311Z-D0618-18	UWD(3/3) OF 6.6kV SWITCHBOARD FOR MOTOR CASE A WITH DIFFERENTIAL PROTECTION
20		33-F6311Z-D0618-19	UWD(1/3) OF 6.6kV SWITCHBOARD FOR MOTOR CASE B WITH DIFFERENTIAL PROTECTION
21		33-F6311Z-D0618-20	UWD(2/3) OF 6.6kV SWITCHBOARD FOR MOTOR CASE B WITH DIFFERENTIAL PROTECTION
22		33-F6311Z-D0618-21	UWD(3/3) OF 6.6kV SWITCHBOARD FOR MOTOR CASE B WITH DIFFERENTIAL PROTECTION
23		33-F6311Z-D0618-22	UWD(1/3) OF 6.6kV F-C SWITCHBOARD FOR MOTOR CASE A
24		33-F6311Z-D0618-23	UWD(2/3) OF 6.6kV F-C SWITCHBOARD FOR MOTOR CASE A
25		33-F6311Z-D0618-24	UWD(3/3) OF 6.6kV F-C SWITCHBOARD FOR MOTOR CASE A
26		33-F6311Z-D0618-25	UWD(1/3) OF 6.6kV F-C SWITCHBOARD FOR MOTOR CASE B
27		33-F6311Z-D0618-26	UWD(2/3) OF 6.6kV F-C SWITCHBOARD FOR MOTOR CASE B
28		33-F6311Z-D0618-27	UWD(3/3) OF 6.6kV F-C SWITCHBOARD FOR MOTOR CASE B
29		33-F6311Z-D0618-28	UWD(1/3) OF 6.6kV UNIT BOARD INCOMING SWITCHBOARD
30		33-F6311Z-D0618-29	UWD(2/3) OF 6.6kV UNIT BOARD INCOMING SWITCHBOARD
31		33-F6311Z-D0618-30	UWD(3/3) OF 6.6kV UNIT BOARD INCOMING SWITCHBOARD
32		33-F6311Z-D0618-31	UWD(1/3) OF 6.6kV CWP BOARD INCOMING SWITCHBOARD
33		33-F6311Z-D0618-32	UWD(2/3) OF 6.6kV CWP BOARD INCOMING SWITCHBOARD
34		33-F6311Z-D0618-33	UWD(3/3) OF 6.6kV CWP BOARD INCOMING SWITCHBOARD

747 MW Combined Cycle Power Plant, Guddu

Electrical Drawings

Sr No.		Drawing No.	File Name
35		33-F6311Z-D0618-34	UWD(1/3) OF 6.6W UNIT BOARD CWP OUTGOING FEDER SWITCHBOARD
36		33-F6311Z-D0618-35	UW0(2/3) OF 6.6W UNIT BOARD CWP OUTGOING FEEDER SWITCHBOARD
37		33-F6311Z-D0618-36	UWD(3/3) OF 6.6kV UNIT BOARD CWP OUTGOING FEEDER SWITCHBOARD
38		33-F6311Z-D0618-37	UWD(1/3) OF 6.6kV SWITCHBOARD FOR LCI TRANSFORMER
39		33-F6311Z-D0618-38	UWD(2/3) OF 6.6kV SWITCHBOARD FOR LCI TRANSFORMER
40		33-F6311Z-D0618-39	UWD(3/3) OF 6.6kV SWITCHBOARD FOR LCI TRANSFORMER
41		33-F6311Z-D0618-40	UWD(1/3) OF 6.6kV SWITCHBOARD FOR TIE BRANCH
42		33-F6311Z-D0618-41	UWD(2/3) OF 6.6kV SWITCHBOARD FOR TIE BRANCH
43		33-F6311Z-D0618-42	UWD(3/3) OF 6.6kV SWITCHBOARD FOR TIE BRANCH
44		33-F6311Z-D0618-43	UWD(1/2) OF 8.6kV BUSBAR PT
45		33-F6311Z-D0618-44	UWD(2/2) OF 6.6kV BUSBAR PT
46		33-F6311Z-D0618-45	UWD OF 6.6kV INCOMING PT
47		33-F6311Z-D0618-46	UWD OF 6.6kV COUPLER ISOLATION PT SWITCHBOARD
48		33-F6311Z-D0618-47	UWD(1/3) OF 6.6kV SWITCHBOARD FOR MOTOR CASE C
49		33-F6311Z-D0618-48	UWD(2/3) OF 6.6kV SWITCHBOARD FOR MOTOR CASE C
50		33-F6311Z-D0618-49	UWD(3/3) OF 6.6kV SWITCHBOARD FOR MOTOR CASE C
51		33-F6311Z-D0618-50	UWD(1/3) OF 6.6kV F-C SWITCHBOARD FOR MOTOR CASE C
52		33-F6311Z-D0618-51	UWD(2/3) OF 6.6kV F-C SWITCHBOARD FOR MOTOR CASE C
53		33-F6311Z-D0618-52	UWD(3/3) OF 6.6kV F-C SWITCHBOARD FOR MOTOR CASE C
	8) Cables		
1		As in Folder (2d)	

747 MW Combined Cycle Power Plant, Guddu

Instrumentation & Control Drawings

Sr No.		Drawing No.	File Name	Drawing Full Name
	I&C DRAWINGS			
	1b	**Power Plant single Line Diagrams**		
		K0201		
1		F6311Z-K0201-01	CONFIGURATION OF DCS	F6311Z-K0201-01 CONFIGURATION OF DCS

ANNEX-4

General Layout of Plant

竣 工 图 编 制 说 明

INSTRUCTIONS

序号 NO	竣工图号 DWG NO	CSD号 CSD NO	修改依据 DOCUMENT	修改内容 CONTENTS	修改原因 REASONS

747MW CCPP Guddu

The drawing / document has been checked to ensure compliance with the Contract. The approval status shall be interpreted as laid down in the Contract and shall not relieve the Contractor from his contractual obligations.

Cat. 1 [ ] APPROVED
Cat. 2 [ ] APPROVED EXCEPT AS NOTED
Cat. 3 [ ] NOT APPROVED
Cat. 4 [ ] FOR INFORMATION ONLY

COMMENTS SHEET NUMBER:
DATE:

SIGNATURES

Lead Engineer ENGINEER | Project Manager ENGINEER

REV	REFERENCE	DESCRIPTION	PRP'D BY	CHK'D BY	REV'D BY	APP'D BY

CENTRAL POWER GENERATION COMPANY LIMITED (CPGCL)

NATIONAL ENGINEERING SERVICES PAKISTAN(PVT) LIMITED | PAKISTAN ENGINEERING SERVICES

PROJECT: 747 MW (GROSS) COMBINED CYCLE POWER PLANT GUDDU — AS BUILT DESIGN

CSD: 3001-HC-5301-N-101 A — REV A

HARBIN POWER ENGINEERING CO., LTD

ZEPDI ZHEJIANG ELECTRIC POWER DESIGN INSTITUTE

APP'D BY		DSN'D BY	
REV'D BY		SCALE	—
CHK'D BY		DATE	2014.6

TITLE: 竣工图编制说明

INSTRUCTIONS FOR AS BUILT DRAWING

DWG NO: 33-F6311Z-Z0101-00 — REV A

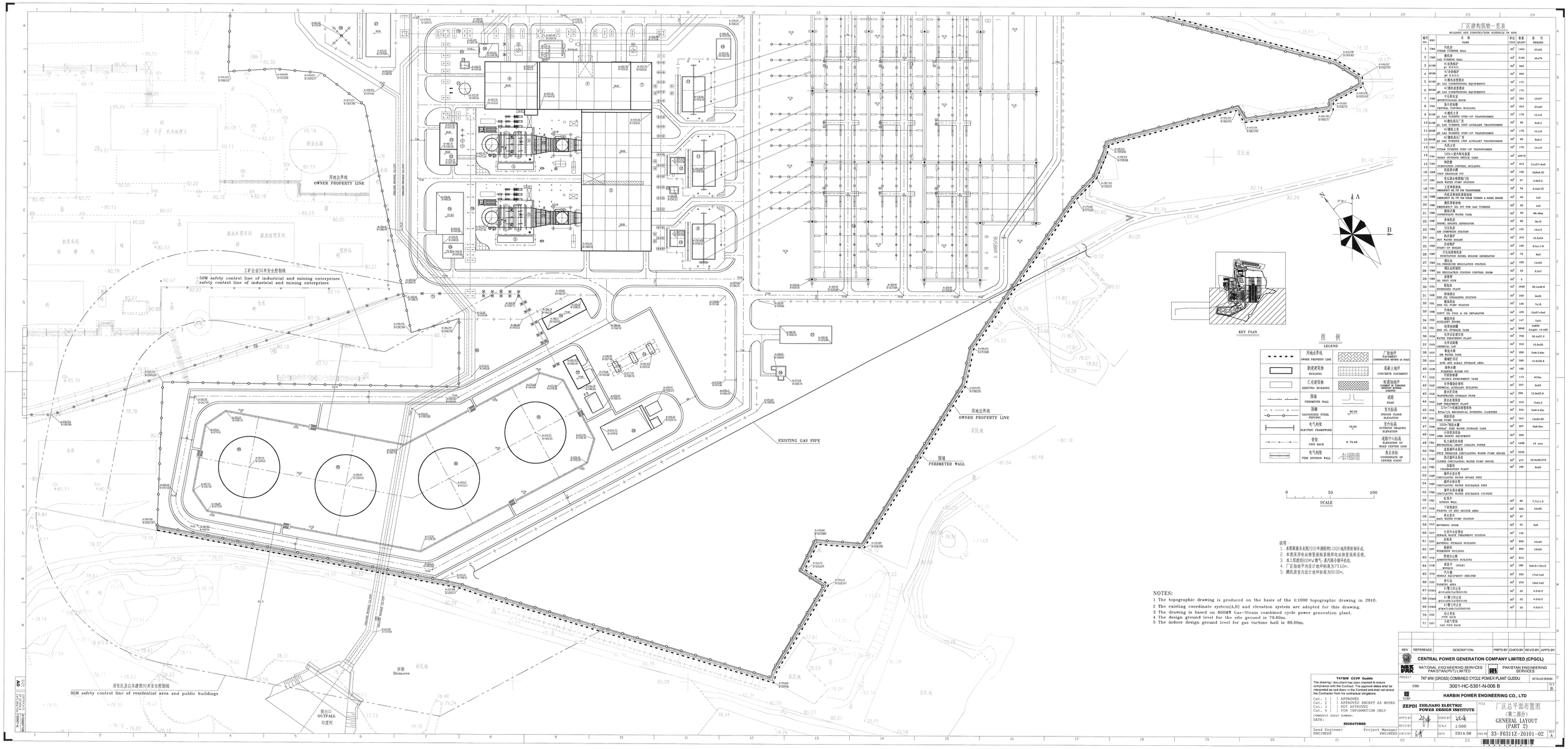
SIZE A3

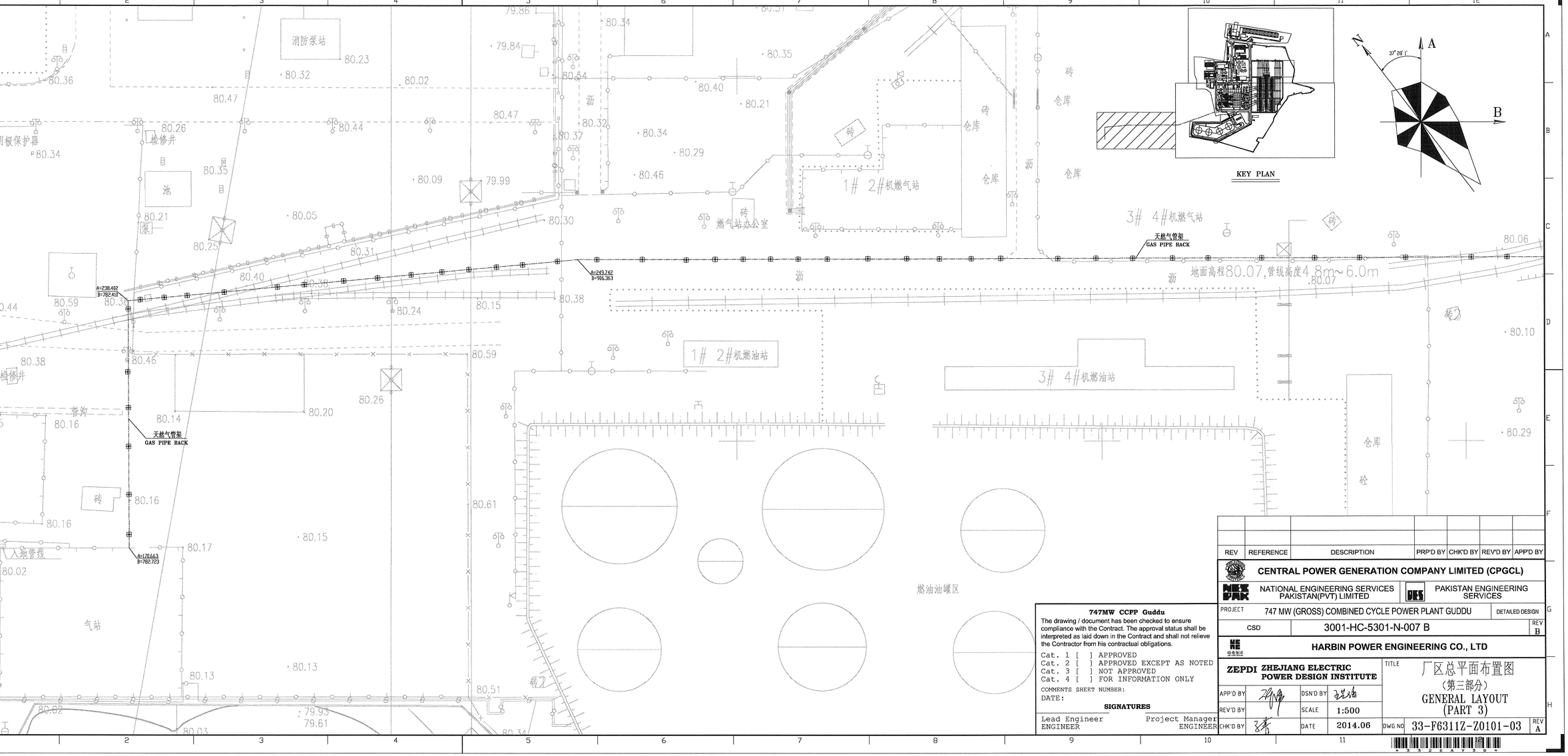
CERTIFICATE OF DESIGN & EXPLORATION A133007109

120001-kj

332EAYT2

NOTES:
1. The topographic drawing is produced on the basis of the 1:1000 topographic drawing in 2010.
2. The coordinate system is consistent with that adopted for the drawing.
3. The drawing is based on 6000KW Gas-Steam combined cycle power generation plant.
4. The design ground level for the site ground is 79.00m.
5. The finished design ground level for gas turbine hall is 80.00m.
LEGEND
SCALE
KEY PLAN
EXISTING PERIMETER WALL
OWNER PROPERTY LINE
EXISTING ROAD
THE THIRD ENTRANCE
SECONDARY ENTRANCE
MAIN ENTRANCE
EXISTING CW DRAINAGE CULVERT
BUSBAR
OIL SEPERATION PIT
CENTRAL POWER GENERATION COMPANY LIMITED (CPGCL)
NATIONAL ENGINEERING SERVICES PAKISTAN(PVT) LIMITED
747 MW (GROSS) COMBINED CYCLE POWER PLANT GUDDU
3001-HC-5301-N-005 B
ZEPZI ZHEJIANG ELECTRIC POWER DESIGN INSTITUTE
HARBIN POWER ENGINEERING CO., LTD
GENERAL LAYOUT (PART I)
33-TC5112-Z0101-01
A1
A0
1:500
2014.6.05
B
747MW CCPP Guddu
A1330DP1109
T25001-N


厂区建构筑物一览表
BUILDING AND CONSTRUCTION SCHEDULE OF SITE
编号 No.
KKS
名 称 NAME
单位 UNIT
数量 QUANT
备 注 REMARK
1 UMA 汽机房 STEAM TURBINE HALL m² 1404 37x50
2 UMB 燃机房 GAS TURBINE HALL m² 3160 40x79
3 H10U 81#余热炉 #1 H.R.S.G. m² 840
4 H20U 82#余热炉 #2 H.R.S.G. m² 840
5 H10C #1燃机冷却塔 #1 GAS CONDITIONING EQUIPMENTS m² 175
6 H20C #2燃机冷却塔 #2 GAS CONDITIONING EQUIPMENTS m² 175
7 UBB 中压除氧间 MVHTCHICKAN ROOM m² 324 12x27
8 UBA 集中控制楼 CENTRAL CONTROL BUILDING m² 810 27x30
9 U10F #1燃机主变 #1 GAS TURBINE STEP-UP TRANSFORMER m² 176 11x16
10 U10E #1燃机启动厂变 #1 GAS TURBINE UNIT AUXILIARY TRANSFORMER m² 66 8x8.2
11 U20F #2燃机主变 #2 GAS TURBINE STEP-UP TRANSFORMER m² 176 11x16
12 U20E #2燃机启动厂变 #2 GAS TURBINE UNIT AUXILIARY TRANSFORMER m² 66 8x8.2
13 UBC 汽机主变 STEAM TURBINE STEP-UP TRANSFORMER m² 176 11x16
14 UAA 500kV室外配电装置 500kV OUTDOOR SWITCH YARD m² 43570
15 UAB 网控楼 DISTRIBUTION CONTROL BUILDING m² 813 51x37+6x6
16 UBW 机组排水槽 UNIT DRAINAGE PIT m² 100 0x8x6.25
17 UBC 变压器水喷雾脱门架 MAIN WATER PUMP STATION m² 37 3.8x9.5
18 UBJ 主变事故油池 EMERGENCY OIL PIT FOR TRANSFORMER m² 54 6.2x8.75
19 UBH 汽机主厂房给排水泵房值班室 SWITCH GR.PIT FOR STEAM TURBINE & DIESEL ENGINE m² 30 6x5
20 UBH 消防车库值班室 SWITCH GR.PIT FOR GAS TURBINE m² 30 6x5
21 UBH 凝结水泵房 CONDENSATE WATER TANK m² 30 40.48m
22 UBF 柴油机房 DIESEL ENGINE GENERATOR m² 90 9x10
23 UBQ 空压机房 AIR COMPRESS STATION m² 150 10x15
24 UBL 热水锅炉 HOT WATER BOILER m² 372 15.5x24
25 UBD 启动锅炉 START-UP BOILER m² 100 8.5x11.8
26 UBK 升压站事故柴油机房 SUBSTATION DIESEL ENGINE GENERATOR m² 70 8x9
27 UBG 调压站 AC PRESSURE REGULATION STATION m² 462 14x33
28 UBC 凝结水泵房 AC INDICATION STATION CONTROL ROOM m² 23 3.9x7
29 UBG 生活水泵房 AC WATER PUMP m² 3
30 UTC 制氧站 HYDROGEN PLANT m² 1045 22.4x46.8
31 UBK 卸油综合 ADM OIL UNLOADING STATION m² 240 8x30
32 UBL 潜油泵站 SUB OIL PUMP STATION m² 108 7x18
33 UBW 污油池 SOOTY OIL POOL & OIL SEPARATOR m² 470 10x37+9x5
34 UBL 辅助间 AUXILIARY ROOMS m² 147 7x21
35 UBJ 轻柴油储罐 DEO OIL STORAGE TANK m² 3648 64#35 h=42ft 13.42M
36 UCW 化学水处理车间 WATER TREATMENT PLANT m² 709 25.4x37.3
37 UCA 化学试验楼 CHEMICAL LAB m² 318 15.8x20
38 UCT 事故水箱 EMERGENCY TANK m² 200 2x#13.8m
39 UCV 酸碱贮区 ACID & CAUSTIC STORAGE AREA m² 590 14.8x39.8
40 UCW 原水水箱 PURIFIED WATER PIT m² 185
41 UCE 污泥浓缩池 SLUDGE ENHANCEMENT TANK m² 113 #18m
42 UCP 化学建筑物 CHEMICAL AUXILIARY BUILDING m² 357 9x40
43 UCB 蒸发贮水池 WASTEWATER STORAGE POND m² 295 12.8x23.2
44 UGC 蒸发处理室 RAW TREATMENT PLANT 3040 m² 319 7x45.6
45 UCL 30m³/h机械澄清器 600mm 7.2h MECHANICAL SEDIMENT CLARIFIER m² 344 2x#14.8m
46 UBC 消防泵房 FIRE PUMP HOUSE m² 310 12x25.85
47 UBM 3000m³消防水罐 3000m³ FIRE WATER STORAGE TANK m² 567 2x#19m
48 UBB 石灰投加设备 LIME DOSING EQUIPMENT m² 223
49 UBA 机力通风冷却塔 MECHANICAL DRAFT COOLING TOWER m² 1408 18 sets
50 UQA 直流循环水泵房 ONCE THROUGH CIRCULATING WATER PUMP HOUSE m² 1020
51 UQB 闭式循环水泵房 CLOSED CIRCULATING WATER PUMP HOUSE m² 477 16.8x38.2?5
52 UQS 加氯间 CHLORINATION PLANT m² 160 8x20
53 UQW 循环水进水管 CIRCULATING WATER INTAKE PIPE
54 UQR 循环水排水 CIRCULATING WATER DISCHARGE PIPE
55 UQC 循环水排水暗渠 CIRCULATING WATER DISCHARGE CULVERT
56 UQS 虹吸井 SIPHON WELL m² 86 7.7x11.2
57 UCB 灰渣场防灰 PILEING OF DRY SLUDGE AREA m² 300 10x30
58 UCR 取水泵房 RAIN WATER PUMP STATION m² 47
59 UWS 格栅间 MITTERING ROOM m² 35 5x5
60 UQV 生活污水处理站 SEWAGE WASTE TREATMENT STATION m² 142
61 UGC 材料库 MATERIAL STORAGE BUILDING m² 600 15x40
62 UGC 修配间 WORKSHOP BUILDING m² 600 15x50
63 UYE 综合办公楼 ADMINISTRATION BUILDING m² 810
64 UYB 警卫传达室 GUARD HOUSE m² 189 2x6.8+13x15
65 UYS 汽车库 VEHICLE EQUIPMENT SHELTER m² 255 17x7.5x6
66 UYG 停车场 PARKING AREA m² 270 18x2.5x6
67 UYH01 #1警卫传达室 #1GUARD/GATEHOUSE m² 32 4.5x5.2
68 UYH02 #2警卫传达室 #2GUARD/GATEHOUSE m² 32 4.5x5.2
69 UYH03 #3警卫传达室 #3GUARD/GATEHOUSE m² 32 4.5x5.2
70 UGZ 综合泵房 PIPE RACK
71 UGY 污油气管架 GAS PIPE RACK
图 例
LEGEND
厂房地坪 PAVEMENT COMBUSTION METHOD AT ROAD
厂房建筑物 BUILDING
混凝土地坪 CONCRETE PAVEMENT
已有建筑物 EXISTING BUILDING
矿渣碾压地坪 TAMPED IN FURNACE SLAG PAVEMENT
围墙 PERIMETER WALL
建筑 BUILDING
镀锌钢丝网围栏 GALVANIZED STEEL FENCING
80.00 室内标高 INDOOR FLOOR ELEVATION
电气构架 ELECTRIC FRAMEWORK
79.80 室外标高 OUTDOOR GRADING ELEVATION
管架 PIPE RACK
+79.40 建筑中心标高 ELEVATION OF ROAD CENTER LINE
电气构架 FIRE DIVISION WALL
A=1000.00 B=1500.00 角点坐标 COORDINATE OF CENTER POINT
0 50 100
SCALE
KEY PLAN
EXISTING GAS PIPE
围墙 PERIMETER WALL
厂区围墙 OWNER PROPERTY LINE
厂区围墙 OWNER PROPERTY LINE
50M safety control line of industrial and mining enterprises
工矿企业50米安全控制线
90M safety control line of residential area and public buildings
居住区及公共建筑90米安全控制线
拆除 Remove
排出口 OUTFALL
印度河
居民地
说明：
1. 本图根据东北院2010年测绘的1:1000地形图绘制而成。
2. 本图采用电站恢复座标系统和电站恢复高程系统。
3. 本工程建设800MW燃气-蒸汽联合循环机组。
4. 厂区场地平均设计地坪标高为79.60m。
5. 燃机房室内设计地坪标高为80.00m。
NOTES:
1 The topographic drawing is produced on the basis of the 1:1000 topographic drawing in 2010.
2 The existing coordinate system(A,B) and elevation system are adopted for this drawing.
3 The drawing is based on 800MW Gas-Steam combined cycle power generation plant.
4 The design ground level for the site ground is 79.60m.
5 The indoor design ground level for gas turbine hall is 80.00m.
747MW CCPP Guobu
The drawing / document has been checked to ensure conformity with the Contract. Any deviation shall be interpreted as laid down in the Contract and shall not relieve the Contractor from his contractual obligations.
Cat. 1 [ ] APPROVED
Cat. 2 [ ] APPROVED EXCEPT AS NOTED
Cat. 3 [ ] NOT APPROVED
Cat. 4 [ ] FOR INFORMATION ONLY
CONSULTANT SIGNATURE:
DATE:
SIGNATURES
Lead Engineer ENGINEER
Project Manager ENGINEER
REV REFERENCE DESCRIPTION PREP'D BY CHK'D BY REV'D BY APP'D BY
CENTRAL POWER GENERATION COMPANY LIMITED (CPGCL)
NATIONAL ENGINEERING SERVICES PAKISTAN(PVT) LIMITED
PAKISTAN ENGINEERING SERVICES
PROJECT 747 MW (GROSS) COMBINED CYCLE POWER PLANT GUDDU
DETAILED DESIGN
CSD 3001-HC-5301-N-006 B
REV B
CLIENT HARBIN POWER ENGINEERING CO., LTD
ZEPDI ZHEJIANG ELECTRIC POWER DESIGN INSTITUTE
TITLE 厂区总平面布置图（第二部分） GENERAL LAYOUT (PART 2)
APP'D BY 刘峰
CHK'D BY 沈峰
REV'D BY
SCALE 1:500
DATE 2014.06
DWG NO. 33-F631IZ-Z0101-02
REV A
A0



REV	REFERENCE	DESCRIPTION	PRP'D BY	CHK'D BY	REV'D BY	APP'D BY

747MW CCPP Guddu

The drawing / document has been checked to ensure compliance with the Contract. The approval status shall be interpreted as laid down in the Contract and shall not relieve the Contractor from his contractual obligations.

Cat. 1 [ ] APPROVED
Cat. 2 [ ] APPROVED EXCEPT AS NOTED
Cat. 3 [ ] NOT APPROVED
Cat. 4 [ ] FOR INFORMATION ONLY

COMMENTS SHEET NUMBER:
DATE:

SIGNATURES

Lead Engineer / ENGINEER
Project Manager / ENGINEER

CENTRAL POWER GENERATION COMPANY LIMITED (CPGCL)

NATIONAL ENGINEERING SERVICES PAKISTAN(PVT) LIMITED
PAKISTAN ENGINEERING SERVICES

PROJECT: 747 MW (GROSS) COMBINED CYCLE POWER PLANT GUDDU — DETAILED DESIGN
CSD: 3001-HC-5301-N-007 B — REV B

HARBIN POWER ENGINEERING CO., LTD

ZEPDI ZHEJIANG ELECTRIC POWER DESIGN INSTITUTE

TITLE: 厂区总平面布置图 (第三部分) GENERAL LAYOUT (PART 3)

APP'D BY		DSN'D BY	
REV'D BY		SCALE	1:500
CHK'D BY		DATE	2014.06

DWG NO: 33-F6311Z-Z0101-03 — REV A

SIZE A2

CERTIFICATE OF REGISTRATION EXPLORATION A133007109 I20001-Hj

ANNEX-5

Kandhkot Gas Specifications

SCHEDULE-1: SPECIFICATION GAS

Gas delivered under this GSA shall have the following specifications at the Delivery Point, provided however that Gas delivered which deviates from the Gas Specifications for a total period not exceeding four (4) hours on any Day shall be deemed Specification Gas and any such Gas delivered thereafter shall be Off-Specification Gas;

i) Purity: be commercially free from foreign materials and dust, or other solid or liquid matter, or waxes, gums and gum formatting constituents which might cause interference with the proper operation of the Buyer's Facilities; and

ii) Water Content: have a water content not greater than seven (7) pounds per MMscf at Atmospheric Pressure; and

iii) Sulphur: contain not more than twenty (20) grains of total Sulphur per hundred (100) scf and

iv) Hydrogen Sulphide: Hydrogen Sulphide (H2S) concentration may vary up to forty (40) grains per 100 scf and

v) Carbon Dioxide: contain not more than ten mole percent (10% mole) of Carbon Dioxide; and

vi) Oxygen: contain not more than one mole percent (1.0% mole) of Oxygen; and

vii) Gross Calorific Value: have a Gross Calorific Value not less than seven hundred and twenty five (725) Btu per scf; and

viii) Temperature: have a temperature, which is not more than one hundred and forty (140) degrees Fahrenheit.

ANNEX-6

Parameters of ST, STG & HRSG

CENTRAL POWER GENERATION COMPANY LIMITED, (GENCO-II), 747MW CCPP, TPS, GUDDU

DATE: 09-07-2022

STEAM TURBINE (ST-16) LOG SHEET # 1

DAY:- Saturday

TIME	Main Steam Parameters						Reheat Steam Parameters				HP Cylinder Exhaust Steam Parameters						LP Steam Parameters				Gland Sealing Chamber						Condenser			
	Left			Right			Left		Right		Left			Right																
	Flow	Pres:	Temp:	Flow	Pres:	Temp:	Pres:	Temp:	Pres:	Temp:	Flow	Pres:	Temp:	Flow	Pres:	Temp:	Flow	Flow	Pres:	Temp:	Header Pres:	Header Temp:	HP Temp:	IP Temp:	LP Pres:	LP Temp:	Vacuum	Steam Temp:	Water Level	Water Temp:
UNIT	t/h	Bar	°C	t/h	Bar	°C	Bar	°C	Bar	°C	t/h	Bar	°C	t/h	Bar	°C	t/h	t/h	Bar	°C	Bar	°C			Bar	°C	Bar	°C	mm	°C
RATED	555.4	114.5	560.6	555.4	114.5	560.6	25.4	560	25.4	560	538	29.03	362.5	538	29.03	362.5	48.57	48.57	4.7	305.3	0.07-0.02			150			7.4			
01:00	274	110	560	274	112	553	21	554	21	560	236	23	350	216	22	358	-	-	-	-	.30	300	316	316	.20	-	-.867	52	686	50
02:00	280	111	562	272	113	554	21	556	21	561	237	23	351	219	23	351	-	-	-	-	.30	299	316	316	.30	-	-.859	52	685	50
03:00	281	112	560	277	114	554	21	555	21	560	240	23	358	220	23	358	-	-	-	-	.28	300	316	316	.29	-	-.859	53	713	50
04:00	285	113	558	281	115	553	22	553	22	557	244	23	349	222	23	349	-	-	-	-	.26	300	314	314	.26	-	-85.9	52	708	50
05:00	284	113	559	280	115	554	22	554	22	559	242	23	350	222	23	350	-	-	-	-	.26	300	314	314	.26	-	-85.9	52	703	50
06:00	284	113	560	280	115	553	22	555	22	558	242	23	350	220	23	349	-	-	-	-	.25	300	314	314	.23	-	-86	51	707	50
07:00	280	113	561	282	115	554	22	556	22	559	242	23	350	222	23	350	-	-	-	-	.26	300	315	315	.26	-	-86	51	706	50
08:00	284	113	562	284	115	553	22	557	22	559	241	23	351	220	23	351	-	-	-	-	.26	300	316	316	.26	-	-86.2	52	700	50
09:00	279	112	562	278	114	555	22	557	22	561	240	23	351	219	23	351					.24	300	316	316	.24		-86.2	52	714	50
10:00	279	113	563	283	115	553	21	558	21	559	243	23	350	222	23	350					.25	298	316	316	.25		-86.1	52	682	50
11:00	266	107	561	262	109	554	20	557	20	561	228	22	351	209	22	351	-				.25	300	316	316	.25	-	-86.8	51	674	49
12:00	249	107	562	286	109	559	20	556	20	564	232	22	353	202	21	353					.25	301	316	316	.25	-	-86.5	51	697	49
13:00	226	105	557	292	108	557	20	559	20	559	229	22	350	197	21	349	-				.25	300	316	316	.25	-	-86.4	51	670	49
14:00	283	113	559	279	115	558	22	554	21	557	242	23	352	221	23	352	-				.24	298	312	312	.24	-	-85.5	51	706	49
15:00	267	106	560	260	109	557	20	554	20	554	226	22	351	206	20	351	-	-	-	-	.24	298	314	314	.24	-	-86.2	52	680	50
16:00	265	105	559	257	107	554	20	552	20	553	224	22	351	204	21	351	-	-	-	-	.27	299	312	312	.27	-	-86.2	52	673	50
17:00	264	105	560	257	107	557	20	553	20	555	225	22	352	204	22	351	-			-	.30	300	313	313	.30	-	-86	52	695	50
18:00	264	105	560	258	108	558	20	555	20	555	225	22	354	204	22	354	-	-	-	-	.30	300	314	314	.30	-	-86	52	700	50
19:00	265	106	560	258	108	558	20	555	20	556	225	22	354	205	22	354	-	-	-	-	.30	300	314	314	.30	-	-86	52	690	50
20:00	284	113	560	280	116	560	22	556	22	558	243	24	354	223	23	354	-	-	-	-	.30	300	315	315	.30	-	-85.5	53	710	51
21:00	285	114	560	280	116	560	22	555	22	557	244	24	354	223	23	354	-	-	-	-	.30	300	315	315	.30	-	-85	54	690	51
22:00	285	114	560	280	116	558	22	554	22	557	245	24	353	223	23	353	-	-	-	-	.29	299	314	314	.29	-	-85.7	53	688	51
23:00	286	112	561	279	116	559	22	554	22	557	243	24	353	223	23	353					.29	300	314	314	.29	-	-85.9	53	688	50
24:00	286	114	562	280	116	559	22	554	22	557	244	24	354	223	23	354					.30	300	314	314	.30	-	-85.8	52	695	51

Prepared By: M. Amin HDM

CamScanner

CENTRAL POWER GENERATION COMPANY LIMITED, (GENCO-II), 747MW CCPP, TPS, GUDD

	Main	
	Left	
Flow	Pres:	
	Bar	
UNIT	t/h	
RATED	555.4	114.5
01:00	282	112

TIME	Lube Oil			Bearing Return Oil Temperature						Electric Hydraulic Oil			Hydrogen Parameters				Oil & Hydrogen Pres: Diff:	Sealing Inlet Oil		Stator Cooling Water			Condenser Cooling Water Parameters								Condensate Wa	
																							Left				Right					
	Pres:	Temp:	Level	Thrust Pad 1	Thrust Pad 2	Bear: # 1	Bear: # 2	Bear: # 3	Bear: # 4	Level	Pres:	Temp:	Press:	Temp:	Purity	Humidity		Hydrogen Side	Air Side	Pres:	Temp:	Flow	Inlet Pres:	Outlet Pres:	Inlet Temp:	Outlet Temp:	Inlet Pres:	Outlet Pres:	Inlet Temp:	Outlet Temp:	Pres:	TIME
UNIT	Bar	℃	mm	℃	℃	℃	℃	℃	℃	mm	Bar	℃	Bar	℃	%	℃	Bar	℃	℃	Bar	℃	t/h	Bar	Bar	℃	℃	Bar	Bar	℃	℃	Bar	
RATED	>0.98	43-49		65	65	65	65	65	65	450	140	<54	3		98		0.85	<52	<52	0.1-0.2	45-50	30										
01:00	2.24	45	258	50	50	50	55	57	57	468	138	54					.82	45	44	.21	41	27	1.23	0.44	33	42	–	0.47	33	42	32	
02:00	2.22	45	257	50	50	50	55	57	57	468	138	54					.82	45	44	.22	40	27	1.22	0.44	33	42	–	0.47	33	42	32	
03:00	2.23	45	257	50	50	50	55	57	57	468	138	54					.82	45	45	.21	41	27	1.22	0.44	33	43	–	0.47	33	43	32	
04:00	2.21	44	258	50	50	50	55	57	57	468	138	54					.82	45	44	.21	41	27	1.22	0.44	33	43	–	0.47	33	43	32	
05:00	2.18	44	258	50	50	50	54	57	57	468	138	54					.81	44	44	.21	40	27	1.21	0.44	33	43	–	0.46	33	43	32	
06:00	2.22	44	257	50	50	50	54	57	57	468	138	54					.81	44	44	.22	40	27	1.23	0.44	33	43	–	0.46	33	43	32	
07:00	2.21	44	257	50	50	50	54	57	57	468	138	54					.81	44	44	.21	40	27	1.22	0.44	33	43	–	0.47	33	43	32	
08:00	2.24	44	257	50	49	50	54	57	56	468	138	53					.82	44	44	.21	40	27	1.24	0.44	33	42	–	0.47	33	43	32	
09:00	2.24	44	257	50	50	50	55	57	56	468	138	54					.81	45	45	.21	40	27	1.23	0.44	33	42	–	0.47	33	43	32	
10:00	2.25	44	257	50	50	50	55	57	57	469	138	54					.81	45	45	.22	40	27	1.24	0.44	33	43	–	0.47	33	43	32	
11:00	2.23	44	257	49	49	49	54	57	56	468	138	55					.81	45	45	.22	40	27	1.31	0.45	33	42	–	0.48	33	42	32	
12:00	2.22	44	257	50	50	50	55	57	57	468	138	55					.81	45	45	.21	40	27	1.25	0.44	33	42	–	0.47	33	42	32	
13:00	2.23	45	258	50	50	50	55	57	57	468	138	56					.81	45	46	.21	40	27	1.24	0.44	33	42	–	0.47	33	43	32	
14:00	2.24	45	258	50	50	50	55	57	57	468	138	56					.81	45	46	.21	40	27	1.24	0.44	33	42	–	0.47	33	43	32	
15:00	2.25	45	257	51	51	51	56	58	57	468	138	56					.81	46	46	.21	41	27	1.25	0.44	34	43	–	0.47	34	43	32	
16:00	2.27	45	257	51	51	51	55	58	57	468	139	55	–	–	–	–	.82	45	45	.22	41	27	1.24	0.44	34	43	–	0.47	34	43	32	
17:00	2.23	45	257	51	50	51	55	58	57	468	139	55	–	–	–	–	.82	45	45	.21	41	27	1.25	0.44	34	43	–	0.47	34	43	32	
18:00	2.21	45	258	51	50	51	55	58	57	468	138	55	–	–	–	–	.82	45	45	.22	41	27	1.24	0.44	34	43	–	0.47	34	43	32	
19:00	2.19	45	257	50	50	51	55	58	57	468	138	56					.80	45	45	.22	41	27	1.24	0.44	34	43	–	0.47	34	43	32	
20:00	2.2	45	257	51	50	51	55	58	57	468	138	56					.81	45	46	.22	41	27	1.25	0.44	34	44	–	0.47	34	44	32	
21:00	2.21	45	258	51	51	51	55	58	57	468	138	56					.80	45	46	.21	41	27	1.24	0.44	34	44	–	0.47	34	44	32	
22:00	2.19	45	257	51	51	51	55	58	57	468	138	56					.80	45	46	.22	41	27	1.25	0.44	34	44	–	0.47	34	44	32	
23:00	2.20	45	257	50	50	50	55	57	57	468	138	55					.81	45	45	.22	41	27	1.36	0.46	34	43	–	0.48	34	42	32	
24:00	2.20	45	257	50	50	50	55	57	57	468	138	55					.81	45	45	.21	41	27	1.24	0.44	34	43	–	0.47	34	44	32	

NIGHT SHIFT "A" 21:00 TO 07:00 — ATT: DPT: A.M DM

MORNING SHIFT "B" 07:00 TO 14:00 — ATT: DPT: A.M DM

EVENING SHIFT "C" 14:00 TO 21:00 — ATT: DPT: A.M DM

ADD MANAGER (O)-V PLANT MANAGER-V

CENTRAL POWER GENERATION COMPANY LIMITED, (GENCO-II), 747MW CCPP, TPS, GUDDU

DATE: 09-07-2022

LOG SHEET FOR GENERATOR STEAM TURBINE UNIT # 16

DAY:- Saturday

TIME	GENERATOR PARAMETERS									HYDROGEN			GENERATOR RTD				BEARING VIB:					
	ACTIVE POWER	REACTIVE POWER	POWER FACTOR	FIELD CURRENT	FIELD VOLTAGE	STATOR CURRENT	STATOR VOLTAGE	FREQ:	FIELD TEMP:	H2 PRESS:	H2 PURITY CELL-1	H2 PURITY CELL-2	GEN: STATOR CW TEMP:		HOT GAS	COLD GAS	#1	#2	#3	#4	#5	#6
UNIT	MW	MVAR	PF	ADC	VDC	A	KV	Hz	°C	Bar	%		INLET °C	OUTLET °C	°C	°C	um	um	um	um	um	um
RATING	261		0.9	2456	317	9509	20	50		3	>98		<50	<70	<65	≤50						
01:00	202	-25	-0.98	1361	156	6084	19.9	50.5	41	2.87	-	-	41	51	64	42	6	-	-	70	34	14
02:00	208	-26	-0.98	1367	158	6237	19.9	50.2	41	2.85	-	-	41	51	64	42	8	-	-	68	30	14
03:00	208	-22	-0.99	1392	160	6211	19.9	50.0	41	2.83	-	-	41	51	64	42	7	-	-	68	27	14
04:00	211	-18	-0.99	1427	162	6310	19.9	49.8	42	2.81	-	-	41	51	64	43	7	-	-	67	27	15
05:00	211	-05	-0.99	1460	169	6235	19.9	49.9	42	3.0	-	-	40	51	63	43	8	-	-	66	27	14
06:00	210	-19	-0.99	1414	160	6262	19.9	50.1	41	2.98	-	-	40	51	63	43	8	-	-	69	31	14
07:00	210	-22	-0.99	1395	159	6218	19.9	50.5	41	2.96	-	-	40	51	63	42	7	-	-	70	34	14
08:00	210	-16	-0.99	1410	160	6225	19.9	50.4	41	2.94	-	-	40	51	63	42	8	-	-	68	31	13
09:00	210	-20	-0.99	1410	161	6213	19.9	50.2	41	2.92	-	-	40	51	63	42	8	-	-	69	33	13
10:00	210	-15	-0.99	1424	164	6261	19.9	50.3	42	2.90	-	-	41	51	63	42	8	-	-	70	32	14
11:00	195	-18	-0.99	1371	157	5902	19.9	50.0	40	2.88	-	-	40	49	63	41	6	-	-	70	32	14
12:00	195	-10	-0.99	1379	158	5729	19.9	50.2	41	2.86	-	-	40	50	63	42	7	-	-	68	29	13
13:00	195	5	1.00	1441	164	5891	19.9	50.1	42	2.86	-	-	40	50	63	42	7	-	-	68	29	14
14:00	210	13	0.99	1518	175	6199	19.9	50.3	43	2.85	-	-	41	51	64	43	6	-	-	69	30	14
15:00	195	-3	-1.0	1446	167	5847	19.9	50.4	43	2.83	-	-	41	51	64	43	7	-	-	69	31	15
16:00	195	-19	-0.99	1329	152	5803	19.9	50.4	42	2.81	-	-	41	50	64	43	6	-	-	70	33	14
17:00	195	-38	-0.97	1285	147	5891	19.9	50.1	41	2.79	-	-	41	50	64	43	7	-	-	68	30	14
18:00	195	-31	-0.97	1310	151	5922	19.9	49.9	41	2.78	-	-	41	50	64	43	8	-	-	66	26	14
19:00	195	-42	-0.97	1273	146	5974	19.9	50.4	40	3.0	-	-	41	51	64	43	6	-	-	68	32	14
20:00	210	-25	-0.97	1386	159	6338	19.9	49.9	42	2.99	-	-	41	51	64	43	6	-	-	65	27	14
21:00	210	-29	-0.98	1377	158	6377	19.9	50.1	42	2.97	-	-	41	52	64	43	8	-	-	66	29	14
22:00	210	-24	-0.98	1399	160	6325	19.9	50.2	42	2.95	-	-	41	52	64	43	8	-	-	67	31	14
23:00	210	-21	-0.99	1410	162	6340	19.9	50.2	42	2.93	-	-	41	52	64	42	8			68	29	14
24:00	210	-26	-0.98	1374	157	6333	19.9	50.4	42	2.91	-	-	41	52	64	42	7			65	25	14

CENTRAL POWER GENERATION COMPANY LIMITED,
GENCO-II, 747 MW CCPP T.P.S GUDDU

DATE 9-07-022

BOILER (HRSG) LOG SHEET # 1 OF GAS TURBINE UNIT # 14

DAY Saturday

TIME	HP Main Steam			IP Main Steam			LP Main Steam			Reheat Steam			Reheat Inlet		HP Drum		IP Drum		LP Drum		HP Feed Water			IP Feed Water			LP Feed Water		
	Flow	Pres:	Temp	Flow	Pres:	Temp	Flow	Pres:	Temp	Flow	Pres:	Temp	Pres:	Temp	Pres:	Water Level	Pres:	Water Level	Pres:	Water Level	Flow	Pres:	Temp	Flow	Pres:	Temp	Flow	Pres:	Temp
UNIT	t/h	Bar	°C	t/h	Bar	°C	t/h	Bar	°C	t/h	Bar	°C	Bar	°C	Bar	mm	Bar	mm	Bar	mm	t/h	Bar	°C	t/h	Bar	°C	t/h	Bar	°C
RATED																													
01:00	274	112	560	–	25	307	–	3.5	320	234	21	558	–	–	116	-85	24	-85	3.5	-78	233	149	151	42	48	226	320	26	113
02:00	281	114	560	"	25	308	"	3.7	321	240	22	557	"	"	118	-90	24	-85	3.7	-78	244	147	151	42	48	227	320	24	114
03:00	281	114	560	"	25	308	"	3.7	321	240	22	557	"	"	118	-94	24	-86	3.7	-75	242	145	153	42	47	227	327	24	114
04:00	283	115	560	"	25	311	"	3.8	322	244	22	555	"	"	119	-91	25	-80	3.8	-79	242	145	154	44	47	227	333	24	115
05:00	284	115	560	"	25	309	"	3.8	323	244	22	557	"	"	119	-93	25	-85	3.9	-86	248	141	154	43	46	227	334	23	115
06:00	280	115	560	"	25	309	"	3.7	321	242	22	558	"	"	119	-84	24	-79	3.7	-82	242	145	153	41	47	227	329	24	114
07:00	281	115	560	"	25	308	"	3.7	321	243	22	559	"	"	119	-90	24	-85	3.7	-80	240	146	153	41	47	228	332	24	114
08:00	277	115	560	–	25	304	–	3.6	319	242	22	560	–	–	119	-90	25	-85	3.6	-78	237	148	152	42	48	227	327	25	113
09:00	279	114	560	–	25	304	–	3.6	319	240	22	560	–	–	118	-88	25	-88	3.6	-79	237	146	152	41	47	227	325	24	113
10:00	283	115	560	–	25	307	–	3.6	319	244	22	558	–	–	120	-85	25	-80	3.6	-82	245	145	152	40	48	228	330	24	114
11:00	265	109	560	–	23	302	–	3.2	316	228	21	558	–	–	113	-87	23	-99	3.3	-102	233	148	149	42	48	225	314	24	110
12:00	265	109	560	–	23	302	–	3.3	318	225	22	559	–	–	113	-87	23	-98	3.3	-114	234	147	148	43	49	226	315	24	110
13:00	284	116	560	–	25	308	–	3.9	316	242	22	557	–	–	120	-96	25	-103	4.0	-113	245	144	155	46	47	230	345	22	116
14:00	275	110	560	–	24	312	–	3.6	318	228	21	556	–	–	115	-104	23	-95	3.6	-104	240	147	153	44	48	226	337	23	113
15:00	275	109	560	–	23	308	–	3.6	315	226	21	556	–	–	112	-90	23	-87	3.7	-102	232	147	153	42	48	225	323	24	112
16:00	265	108	560	–	23	306	–	3.6	315	225	21	556	–	–	112	-85	23	-80	3.8	-94	228	148	153	41	48	225	218	24	112
17:00	264	108	560	–	23	305	–	3.7	312	224	21	557	–	–	112	-93	23	-78	3.7	-90	229	149	153	40	48	225	303	24	111
18:00	264	108	560	–	23	306	–	3.7	312	225	21	558	–	–	112	-90	23	-85	3.7	-102	230	147	153	40	48	225	310	24	112
19:00	264	108	560	–	23	306	–	3.6	313	225	21	558	–	–	112	-91	23	-90	3.7	-103	228	145	152	41	47	225	310	23	112
20:00	286	116	560	–	25	307	–	4.1	319	245	23	557	–	–	121	-85	25	-102	4.1	-126	250	144	155	44	48	230	340	22	117
21:00	285	116	560	–	25	307	–	4.1	322	242	22	558	–	–	120	-80	25	-97	4.1	-104	246	143	156	45	47	229	337	23	116
22:00	285	116	560	"	25	308	"	4.0	322	244	22	558	0	0	120	-89	25	-85	4.1	-98	245	143	155	45	47	229	333	23	116
23:00	285	116	560	–	25	309	–	4.0	323	243	23	558	–	–	120	-88	25	-91	4.1	-97	246	144	155	45	47	229	334	23	116
24:00	284	116	560	"	25	309	–	4.0	323	242	23	556	–	–	120	-85	25	-91	4.1	-90	246	144	155	45	47	229	334	23	116

M. Amin HDM

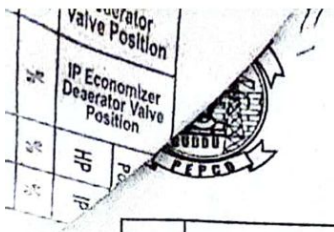
CENTRAL POWER GENERATION COMPANY LIMITED,
GENCO-II, 747 MW CCPP T.P.S GUDDU

TIME	HP Economizer Temp:		IP Economizer Temp:		Feed Water Heater Temp:		HP De-Super Heater			IP De-Super Heater			Smoke Temp				Smoke Pressure		Wall Temp		Recirculation Pump # 1		Recirculation Pump # 2		Recirculation Valve Position	Recirculation Valve Position	IP Drum Deaerator Valve Position	IP Economizer Deaerator Valve Position	CBD Valve Position	
	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Flow	Front Temp:	After Temp:	Flow	Front Temp:	After Temp:	Inlet H	outlet H	HP Evap:	IP Evap:	Inlet	Outlet	Hp Super heater	Re-heater	Current	Outlet Pres:	Current	Outlet Pres:					HP	IP
UNIT	°C	°C	°C	°C	°C	°C	t/h	°C	°C	t/h	°C	°C	°C	°C	°C	°C	mba	mba	°C	°C	A	Bar	A	Bar	%	%	%	%	%	%
01:00	151	319	149	226	104	133	16	518	460	8	532	496	642	109	327	250	22	1.5	—	—	—	—	205	34	—	63	.	.	20	30
02:00	153	320	150	227	104	136	14	516	464	7	532	497	640	110	328	252	24	1.6	0/0/0	0/0/0	.	.	200	34	.	62	.	.	20	30
03:00	153	320	150	227	104	136	14	516	464	7	532	497	640	110	328	252	24	1.6	0/0/0	0/0/0	.	.	198	33	.	62	.	.	20	30
04:00	154	321	151	227	104	136	13	515	464	7	528	496	636	111	330	254	25	1.7	.	.	.	.	196	33	.	62	.	.	20	30
05:00	154	320	151	227	104	137	12	515	469	7	530	498	637	110	329	253	25	1.7	.	.	.	.	193	32	.	62	.	.	20	30
06:00	153	320	150	227	104	137	13	516	465	7	530	498	639	110	328	252	24	1.6	.	.	.	.	197	33	.	62	.	.	20	30
07:00	153	320	150	228	104	137	13	516	466	7	530	498	641	109	328	252	22	1.5	.	.	.	.	200	33	.	62	.	.	10	10
08:00	152	320	150	228	103	136	14	518	466	7	533	499	642	109	328	251	21	1.4	—	—	—	—	200	33		61	—	-	10	10
09:00	152	320	149	227	103	137	13	516	467	7	533	498	643	108	328	251	23	1.5	—	—	-	-	199	33	—	61	—		5	10
10:00	152	320	149	229	103	137	13	518	467	7	530	497	640	108	328	252	24	1.7	—	-	—	—	190	33	—	61	—	—	0	0
11:00	149	317	146	225	103	131	16	520	455	8	535	497	642	107	324	247	19	1.2	—	—	—	—	203	33	—	61	—	—	—	-
12:00	149	317	148	227	103	131	16	518	454	8	535	497	642	108	324	247	20	1.2	-	-	—	—	201	32	-	61	—	-	—	-
13:00	149	317	147	226	103	132	16	521	453	8	534	498	640	107	325	246	20	1.2	-	—	—	-	199	33	—	61	—	-	—	
14:00	155	324	153	230	104	136	13	517	466	8	530	495	638	111	331	253	25	1.8	—	—	—	—	198	33	—	63	—	-	—	-
15:00	153	317	150	226	102	131	15	514	455	8	531	492	641	108	328	248	19	1.2	-	—	—	-	200	33	-	62	—	-	—	-
16:00	153	317	150	226	102	131	15	516	455	8	530	480	640	107	325	248	19	1.2	—	—	—	—	200	33	-	62	-	-	-	-
17:00	153	317	150	225	106	134	16	519	454	8	533	493	641	109	324	248	19	1.3	—	—	—	—	205	33	—	62	-	—	—	—
18:00	153	316	150	225	105	133	16	519	455	8	534	494	642	109	323	248	19	1.3	-	—	—	—	203	33	-	61	—	—	-	-
19:00	152	317	150	225	105	132	15	520	458	8	535	495	643	109	324	248	19	1.3	—	-	-	-	197	32	-	61	—	-	-	-
20:00	156	321	153	230	107	138	13	517	469	8	532	497	639	112	329	254	25	1.7	-	—	—	—	196	31	—	63	—	—	—	-
21:00	156	321	153	228	104	139	13	517	471	8	532	497	639	111	329	253	25	1.6	—	-	—	-	194	32	-	61	—	—	—	-
22:00	155	321	153	229	104	138	13	516	469	8	531	497	640	111	329	253	25	1.8	0/0	10	.	.	196	32	.	61	.	.	.	.
23:00	155	321	153	228	104	138	13	516	468	8	531	497	640	111	325	253	25	1.8	-	-	-	—	196	32	—	61				
24:00	155	321	151	228	104	138	13	516	468	8	531	497	640	111	329	253	25	1.8					196	32	—	61				

06.05

NIGHT SHIFT "A" 21:00 TO 07:00 | MORNING SHIFT "B" 07:00 TO 14:00 | EVENING SHIFT "C" 14:00 TO 21:00

CamScanner



CENTRAL POWER GENERATION COMPANY LIMITED,
GENCO-II, 747 MW CCPP T.P.S GUDDU

DATE 9-07-022

BOILER (HRSG) LOG SHEET # 1 OF GAS TURBINE UNIT # 15

DAY Saturday

TIME	HP Main Steam			IP Main Steam			LP Main Steam			Reheat Steam			Reheat Inlet		HP Drum		IP Drum		LP Drum		HP Feed Water			IP Feed Water			LP Feed Water		
	Flow	Pres:	Temp	Flow	Pres:	Temp	Flow	Pres:	Temp	Flow	Pres:	Temp	Pres:	Temp	Pres:	Water Level	Pres:	Water Level	Pres:	Water Level	Flow	Pres:	Temp	Flow	Pres:	Temp	Flow	Pres:	Temp
UNIT	t/h	Bar	°C	t/h	Bar	°C	t/h	Bar	°C	t/h	Bar	°C	Bar	°C	Bar	mm	Bar	mm	Bar	mm	t/h	Bar	°C	t/h	Bar	°C	t/h	Bar	°C
RATED																													
01:00	273	112	555	—	24	315	—	3.2	319	215	22	560	22	345	115	-10	23	-85	3.2	-85	—	143	148	46	50	225	348	25	105
02:00	277	113	556	"	24	316	"	3.3	319	220	22	560	22	345	117	-50	24	-79	3.3	-79	0to10	140	149	44	49	227	340	25	105
03:00	277	113	556	"	24	316	"	3.3	319	220	22	560	22	345	117	-50	24	-78	3.3	75	"	140	149	41	49	227	333	25	105
04:00	281	115	556	"	25	317	"	3.5	321	222	22	558	23	344	119	-100	24	-83	3.5	-78	"	141	151	47	48	228	329	24	106
05:00	281	115	556	"	25	317	"	3.5	321	224	22	559	23	345	119	-106	24	-84	3.5	-83	"	138	151	46	48	227	356	24	107
06:00	280	114	555	"	25	317	"	3.5	320	222	22	559	23	344	118	-65	24	-84	3.5	-88	"	141	151	48	48	227	362	24	107
07:00	280	114	555	"	25	317	"	3.5	320	222	22	560	23	345	118	-79	24	-85	3.5	-82	"	140	151	47	49	226	345	24	107
08:00	282	114	555	—	24	316	—	35	320	220	22	560	23	346	118	-67	24	-96	34	-91	—	140	151	60	48	226	380	24	108
09:00	280	114	556	—	25	317	—	34	321	219	22	560	23	347	118	-110	24	-88	35	-92	—	141	150	49	48	227	351	25	107
10:00	281	115	556	—	25	316	—	35	324	220	22	560	23	347	118	-96	24	-90	35	-83	—	141	151	48	50	228	361	24	107
11:00	262	108	556	—	23	314	—	3.6	309	207	21	560	21	346	112	-99	23	-86	3.6	-102	—	141	152	41	48	226	316	24	104
12:00	262	108	556	—	23	314	—	36	309	207	22	559	21	346	113	-98	23	-87	3.6	-99	—	141	151	42	48	226	316	24	105
13:00	263	108	557	—	24	315	—	3.7	310	208	22	558	21	346	113	-99	23	-90	3.5	-98	—	141	152	42	49	227	315	24	104
14:00	279	115	560	—	25	317	—	34	320	221	23	558	23	347	120	-110	25	-99	34	-81	—	141	150	48	48	233	350	24	106
15:00	258	107	560	-	23	312		3.1	316	205	21	555	21	346	110	-65	22	-88	3.0	-91	-	145	147	42	49	223	323	25	102
16:00	258	107	560	-	23	312	-	3.5	316	205	21	555	21	346	110	-85	22	-90	3.5	-80		145	147	42	48	223	323	25	105
17:00	258	107	560	-	23	313	-	3.7	309	205	21	556	21	347	110	-122	23	-96	3.7	-84	-	143	152	45	49	224	318	24	105
18:00	257	107	560	-	23	313	-	3.7	300	204	21	556	21	347	110	-130	22	-95	3.7	-87	-	140	153	44	49	225	322	24	105
19:00	258	108	560	-	23	313	-	3.7	299	205	21	557	21	348	111	-128	22	-101	3.7	-89	-	144	152	47	50	224	334	24	105
20:00	280	116	560	-	25	318	-	4.1	288	222	23	558	23	349	120	-139	25	-104	4.1	-99	-	139	155	51	49	230	352	23	110
21:00	279	115	560	—	25	317	—	4.3	298	223	22	558	23	349	107	-113	25	-99	4.3	-83	—	138	157	52	48	229	341	23	111
22:00	279	115	560	"	25	317	"	3.9	292	223	22	557	23	347	119	-130	25	-98	3.9	-91	0to10	140	154	52	48	228	352	23	108
23:00	278	115	560	—	25	317	—	3.8	292	223	22	557	23	347	119	-83	25	-98	3.8	-93	—	140	154	52	48	228	363	23	109
24:00	279	115	560	-	25	317	—	3.9	292	223	22	557	23	347	118	-80	25	-95	3.7	-86	—	140	153	43	50	228	360	23	108

M. Amin HDM

CamScanner

CENTRAL POWER GENERATION COMPANY LIMITED,
GENCO-II, 747 MW CCPP T.P.S GUDDU

TIME	HP Economizer Temp:		IP Economizer Temp:		Feed Water Heater Temp:		HP De-Super Heater			IP De-Super Heater			Smoke Temp				Smoke Pressure		Wall Temp		Recirculation Pump #1		Recirculation Pump #2		Recirculation Valve Position	Recirculation Valve Position	IP Drum Deaerator Valve Position	IP Economizer Deaerator Valve Position	CBD Valve Position	
	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Flow	Front Temp:	After Temp:	Flow	Front Temp:	After Temp:	Inlet H	outlet H	HP Evap:	IP Evap:	Inlet	Outlet	Hp Super heater	Re-heater	Current	Outlet Pres:	Current	Outlet Pres:					HP	IP
UNIT	°C	°C	°C	°C	°C	°C	t/h	°C	°C	t/h	°C	°C	°C	°C	°C	°C	mba	mba	°C	°C	A	Bar	A	Bar	%	%	%	%	%	%
01:00	148	320	145	225	99	138	18	517	433	–	535	514	641	124	325	266	21	1.4	—	—	—	—	189	35	—	20	·	·	20	80
02:00	150	322	145	227	99	141	16	517	438	8	535	514	641	125	327	268	22	1.2	0/0/0	0/0/0	·	·	189	35	·	20	·	·	20	80
03:00	150	322	146	227	99	141	16	517	438	8	533	514	641	125	327	268	22	1.2	·	·	·	·	189	35	·	20	·	·	20	80
04:00	151	324	147	228	99	143	15	513	441	8	530	512	636	128	328	272	24	1.8	·	·	·	·	184	33	·	20	·	·	20	80
05:00	151	322	148	227	99	141	15	514	443	7	531	513	637	126	328	268	24	1.6	·	·	·	·	180	33	·	20	·	·	20	80
06:00	151	323	147	227	100	142	16	514	441	8	531	512	637	126	328	269	24	1.5	·	·	·	·	187	34	·	20	·	·	20	80
07:00	151	323	147	226	100	142	15	515	443	8	532	513	638	126	328	269	24	1.6	·	·	·	·	185	34	·	20	·	·	10	50
08:00	151	322	148	227	103	141	16	514	443	8	532	513	637	126	327	266	24	1.7	—	—	—	—	186	34	—	20	—	—	10	50
09:00	150	323	147	228	103	141	16	516	441	8	534	515	641	126	327	268	23	1.4	—	—	—	—	187	34	—	20	—	—	10	30
10:00	151	323	147	228	103	141	16	516	441	8	534	515	641	126	327	268	23	1.4	—	—	—	—	188	34	—	20	—	—	5	10
11:00	152	319	148	226	110	141	18	518	425	8	534	515	643	126	324	265	18	1.2	—	—	—	—	190	34	—	20	—	—	5	10
12:00	152	319	148	226	110	141	17	517	425	8	534	515	643	126	324	265	19	1.2	—	—	—	—	191	34	—	20	—	—	5	10
13:00	152	319	148	227	109	142	18	516	425	8	534	516	642	126	324	265	18	1.3	—	—	—	—	191	34	—	20	—	·	5	10
14:00	149	323	146	231	114	141	14	518	448	9	533	506	640	124	329	271	23	1.4	—	—	—	—	192	34	—	22	—	—	5	10
15:00	146	317	144	23	114	137	16	516	430	9	533	506	642	122	322	262	17	1.2	—	—	—	—	186	33	—	22	—	—	5	10
16:00	146	317	144	231	114	137	16	516	430	9	533	505	641	122	322	262	18	1.2					186	33		22			5	10
17:00	152	318	149	224	118	142	18	518	438	9	534	503	642	126	323	265	18	1.2	—	—	—	—	190	34	—	21	—	—	5	10
18:00	152	318	149	225	119	143	15	518	439	9	534	504	642	127	323	266	18	1.2	—	—	—	—	187	33	—	22	—	—	5	10
19:00	152	318	150	224	117	141	15	519	439	9	535	504	643	127	323	265	18	1.3	—	—	—	—	188	34	—	22	—	—	5	10
20:00	155	323	152	229	120	146	13	518	457	9	534	507	639	130	328	271	24	1.6	—	—			185	33	—	22	—	—	5	10
21:00	157	323	154	228	121	146	13	516	454	4	533	507	638	130	328	269	23	1.5	—	—			183	32	—	22	—	—	5	10
22:00	154	323	151	228	119	144	13	515	453	8	533	506	638	129	329	270	23	1.6	0/0/0		·	·	185	33	·	22	·	·	05	10
23:00	153	322	151	228	119	144	13	515	453	8	533	506	638	129	328	270	23	1.6	—	—	—	—	185	33		22			5	10
24:00	153	322	151	228	119	144	13	515	453	0	533	506	638	129	329	270	23	1.6					186	33		22			5	10

06:20

NIGHT SHIFT "A" 21:00 TO 07:00 | MORNING SHIFT "B" 07:00 TO 14:00 | EVENING SHIFT "C" 14:00 TO 21:00

ATT: A.M. | ATT: A.M. | ATT: A.M. | SHIFT INCHARGE

ANNEX-7

Name Plate of Steam Turbine Generator

NAMEPLATE DATA FOR STEAM TURBINE GENERATOR

