

Section IV

Technical Specification

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ATTACHMENT

- Attachment-A Technical Schedules
- Attachment-B Bid Drawings

Section IV TECHNICAL SPECIFICATION

1. PLANT DESCRIPTION

The 4th thermal power plant is composed of eight (8) boilers and six (6) turbines/generators. All of the super-heater outlet steam pipes of the boilers are connected to the main steam header, from which steam is led to each turbine.

On the other hand, feed water to the boilers are led from feed water main header. (See attached drawings MON-K-0-12 and --13) Boilers are of indoor with pulverized coal firing, radiant, non-reheat, natural circulation type and their main features are as follows:

(Boilers)

Maximum continuous evaporation	420 t/h
Steam pressure at super-heater outlet	140 kgf/cm ²
Steam temperature at super-heater outlet	560 °C

(Turbine)

Nominal output	80MW(#1,5,6), 100MW(#2,3,4)
Inlet steam pressure	130 kgf/cm ²
Inlet steam temperature	555 °C

(Generators)

Rated capacity	125,000 kVA
Power factor	0.8 (lagging)
Rated voltage	10,500 V
Rated current	6,875 A
Rated frequency	50 Hz

The layout of the power plant is shown in Drawing No. MON-K-0-11.

The boilers and turbines are supervised and controlled from the central control room (CCR). The CCR is divided into two (2) rooms; one for #1, 2, 3, 4 boiler and #1, 2, 3 turbine, the other for #5, 6, 7, 8 boiler and #5, 6 turbine. All the generators including excitation systems are supervised and controlled from each local panel and/or from the electrical central control room (ECCR). (Refer attached drawings No. MON-K-0-10, MON-K-0-11)

2. SCOPE OF THE GOODS AND SERVICES

2.1 General

In General, scope of Works of Package-2 is rehabilitation and upgrading of existing analog module type control system, and also control system and instrumentation for the conversion to the direct firing system. However some existing equipment including instrument will be remained so that modification of existing system shall also be included.

The Works to be performed rehabilitation and upgrading of existing analog module type control system, comprises the design, manufacture, shop test, marine and inland transportation to the Site designated by the Purchaser, the supervision work for the erection work at the Site, the commissioning works, the trial run under operation of boiler, and other necessary Services.

Scope of the Works shall include:

- Upgrading of boiler control system
- Plant simulator for upgrading of boiler control system
- Uninterruptible power supply system for upgrading of boiler control system
- Rehabilitation of instrumentation for boiler control system
- Rehabilitation of steam and water sampling system
- Designing and Manufacturing
- Transportation
- Supervision, Commissioning, Trial run and Training

2.2 Scope of the Works

The Works to be supplied and performed by the Supplier under this Contract shall be referred to Clause 12 to 16. Whereas the Goods is specified in Clause 12, and the Services is specified in Clause 13 to 16.

The Supplier shall:

- (1) Perform the visual inspection at the Site for the design (modification work, interface with the existing equipment, etc.) before design of the Goods.

- (2) Co-operate with the Purchaser to ensure proper matching of design, manufacture, supply and trial run, including start-up, shut-down and emergency conditions.
- (3) Co-operate with the Purchaser in formulating procedures for handling and maintenance of the Goods.
- (4) Facilitate witness of the Purchaser.
- (5) Co-operate with the Package-1 Supplier and the Package-5 Contractor.

The Services to be provided by the Supplier shall include, among others, the provision of supervisory services by experts in the number and qualification adequate for the successful erection work. The Supplier shall be responsible for the safety, protection and security of the experts and other personnel dispatched to the Site by him.

3. TIME SCHEDULE, KEY DATES AND PERIOD

3.1 Implementation Schedule

The completion of the Rehabilitation Project is reckoned from the effective date of the Contract up to the Provisional Acceptance of the Works, "Implementing Schedule" drawing No.MON-K-0-01 is attached.

The supplier shall submit his proposal for the detailed schedule together with his Bid. The schedule shall include the following items :

- effective date of the contract
- design and engineering
- manufacturing
- transportation
- removal of existing equipment and civil work
- erection and installation
- test and commissioning
- trial run
- date of provisional acceptance

3.2 Key Dates and Periods

The following are considered contractual key dates and periods in the execution of the Rehabilitation Project.

3.2.1 Effective Date of Contract

The effective Date of Contract is the Contract signed date.

3.2.2 Delivery Dates of the Goods at the Site

The Supplier shall deliver and unload all the Goods at the Site or the specified place by the Purchaser, by the date not later than :

Delivery 1(1st Unit)	:	Thirteen (13) months after the effective date of the Contract
Delivery 2(2nd Unit)	:	Nineteen (19) months after the effective date of the Contract
Delivery 3(3rd Unit)	:	Twenty-five (25) months after the effective date of the Contract
Delivery 4(4th Unit)	:	Thirty-one (31) months after the effective date of the Contract

The Supplier shall submit his proposal for the above delivery date filling in the Technical Schedules. (From is attached Attachment - A)

3.2.3 Date of Completion of Erection Work

All the Goods shall be assembled, installed, connected and made ready for starting the commissioning, by an erection Contractor of Package-5 under supervision of the Supplier.

3.2.4 Commissioning

The Supplier shall execute the commissioning for all the Goods to be supplied under this Contract.

Upon the notice of the Supplier, the Purchaser shall give the certificate of completion of the commissioning for each unit.

The details of the commissioning shall be referred to Clause 13.

3.2.5 Trial Run

Upon the completion certificate of the commissioning the Supplier shall start the Trial Run under support of the Purchaser.

The Trial Run shall be continued for not less than five (5) days.

For farther details of the Trail Run shall be referred in the Clause 14.

3.2.6 Date of Provisional Acceptance for all Work

Upon completion of the Trial Run for each Unit the Purchaser shall issue the Provisional Acceptance Certificate.

3.2.7 Warranty

The Supplier shall warrant the Works to the Purchaser for a period of twenty-four (24) months starting from the date of the issuance of the Provisional Acceptance Certificate for 1st and 2nd Unit/ eighteen (18) months starting from the date of the issuance of the Provisional Acceptance Certificate for 3rd Unit/ twelve (12) months starting from the date of the issuance of the Provisional Acceptance Certificate for 4th Unit.

The Supplier shall be responsible for making any defect in or damage to any part of the Goods which may appear or occur during the Warranty Period and which arises from any defective materials, design, workmanship, transportation, or commissioning.

The Supplier shall make good the defect or damage as soon as practicable and at his own cost.

The Supplier shall also refer to this Bidding Document of Section II, Clause 13 "Warranty".

4. LIQUIDATED DAMAGE

In the event the Supplier fail to complete the delivery of the Goods and documents/drawings within the contracted time period, such failure shall be a default under the Contract, the Supplier shall be liable for payment to the Purchaser as liquidated damage and not be way of penalties.

The liquidated damages shall be in the amount of one-tenth of one percent (0.1%) per day of one-fourth (1/4) of the total Contract Price except those specified in the following Table.

The total amount of liquidated damage under this Clause shall be limited to a maximum ten percent (10%) of the total Contract Price:

Portion of the Goods and Documents	Liquidated Damages
Each delivery of the Goods	0.1% of 1/4 of the total Contract Price/per day
Each delivery of the materials needed during the civil work periods	100,000 J. Yen per day
Submission of drawings and informations necessary for the foundation work of the Goods	100,000 J. Yen per day
Submission of operation manuals	100,000 J. Yen per day
Submission of maintenance manuals	100,000 J. Yen per day
Each period from the date of commencement of the commissioning up to the date of Provisional Acceptance	0.1% of 1/4 of the total Contract Price/per day

5. DATA, DRAWINGS AND DOCUMENTS

5.1 Drawings Attached to the Bidding Document

5.1.1 Purchaser's Drawings

- (1) Purchaser's Drawings attached to the Bidding Document.

The drawings contained in the Bidding Document shall be utilized for bidding purposes only. They are not considered as necessarily defining the design of the Goods to be furnished, but are merely illustrative to show the general layout of the equipment, except where limiting or mandatory dimensions and elevations are indicated.

The Works shall be executed in accordance with the detailed design drawings prepared by the Supplier.

- (2) Copyright

Copyright for drawings of existing equipment shall remain to the Purchaser.

5.1.2 Proposal Drawings, Documents and Technical Schedules

The Supplier shall submit the Technical Schedules fully completed together with documents and drawings specified in this Bidding Document and other documents, which the Supplier deems useful to better evaluate his Bid.

5.2 Supplier's Drawings, Documents, Data and Instructions

5.2.1 General

The Supplier shall submit to the Purchaser for approval or reference, drawings, plans, erection manuals, calculations, codes and standards, copies of all documents necessary for implementing the Works in accordance with the provisions of the Contract Document. The sequence of submission shall be such that information is available for review or approval of each drawing or document when it is received.

The scope of these submittals shall include, but not be limited to those specified and shall be sufficiently comprehensive to fully establish that all parts and procedures to be used in

performing the Works comply with the objectives of the Contract. The Purchaser will have the right to require the Supplier to submit such additional information as may reasonably be required.

The Supplier shall, within one (1) month after the effective date of the Contract, prepare and submit to the Purchaser for approval a schedule of documents which he proposes to submit in accordance with the requirements of Clause 5.2.4 below and the other clause of this Bidding Document, together with the dates on which he proposes to submit such drawings and documents.

The schedule of documents and document lists summarizing all existing and proposed drawings and documents of items intended for submission to the Purchaser shall be updated monthly to show the status of the drawings and documents submitted and any additional proposed drawings. These updated lists shall be submitted to the Purchaser by seventh (7th) day of the every month.

Any manufacturing, test and transportation of the Goods prior to the approval of drawings pertinent thereto shall be at the Supplier's risk. The Supplier shall be responsible for any extra cost that may arise in consequence to such risks.

When submitting drawings for approval, including drawings prepared by a sub-supplier (if any), the Supplier shall certify that the Supplier has fully examined such drawings and that the drawings comply with the requirements of the Contract.

The Supplier shall be responsible for any discrepancies, errors, or omissions in the drawings, documents and data supplied by him whether these have been approved by the Purchaser or not.

The Purchaser shall have the right to require the Supplier to make any changes to the drawings, documents and data which may be necessary, in the opinion of the Purchaser, to make the Works conform to the intent of the Contract.

All revisions of drawings shall be clearly described in the revision column and be indicated on the drawing by means of a triangle bearing the revision number.

All drawings, documents, data and information to be submitted shall be in English language and be drawn using the metric system of measurements. Refer to Clause 7 (2).

Every drawing shall carry a title block with the Contract Number and a space shall be made in the title block for incorporating the Project Drawing Number.

The first lines of the title block shall read:

Rehabilitation Project of the 4th Power Plant in ULAANBAATAR, MONGOLIA (PHASE-II)

CONTRACT NO. _____

Where applicable, drawings shall show a graphic scale key plan and north arrow. Lettering, notes and title block shall be in English language. Dates on drawings shall be spelled out (e.g. 28 Dec. 2002).

5.2.2 Processing Drawings for Approval

Prior to fabrication of the Goods at the factory or to the award of order to the Sub-Suppliers, the Supplier shall submit to the Purchaser seven (7) copies of printed drawings and documents for approval, with a mark or stamp "FOR APPROVAL". All the others shall be submitted as "FOR INFORMATION".

The Approval procedure shall in principle be treated in accordance with following procedure.

- (1) The Purchaser will review the submitted drawings and documents within fifteen (15) days after receipt. The Supplier shall confirm the receipt date of submitted drawings and documents. It is noted that even for "FOR INFORMATION", the Purchaser treat it as "FOR APPROVAL" and send comment.
- (2) After the drawing and documents are approved or reviewed by the Purchaser, the Purchaser will send his comments to the Supplier by a facsimile discriminating with marks "APPROVED", "APPROVED WITH NOTES", "NOT APPROVED" or "FOR INFORMATION".
In case that the Supplier has not received any comments from the Purchaser after twenty (20) days after submission, the Supplier shall be deemed that submitted drawing and documents are "Approved".
- (3) The drawings and documents "FOR INFORMATION" with the comments of the Purchaser are deemed to be "for Approval".
- (4) The drawings and documents with the mark "APPROVED", "APPROVED WITH NOTES" will authorize the Supplier to proceed the Works if the Supplier completely

accept the Purchaser's comments. Any design or manufacturing done before approval of the drawings shall be at the Supplier's own risk.

- (5) The drawings and documents marked with "NOT APPROVED" shall be revised by the Supplier and resubmitted for the approval to the Purchaser.
- (6) In any case, the Purchaser will not return the Supplier's drawings or documents. Initially supplied drawings and documents shall have the revision number "Rev.0". Subsequent revisions shall be numbered as Rev.1, Rev.2 until approval. All revisions shall be clearly described in the revision column and indicated on the drawings with Rev number in framed by triangle.

5.2.3 As-Built Drawings

- (1) Revision and/or modification made to the Goods during erection work and commissioning periods shall be correctly and completely reflected into all the concerned drawings and documents as the "AS-BUILT" drawing by the Supplier.
- (2) Record Drawings
Prior to the Provisional Acceptance of the Works for the final Unit, the Supplier shall submit to the Purchaser five (5) prints and two(2) CD-ROM of all duly checked and approved "AS-BUILT" drawings.

5.2.4 Submission of Drawings, Documents and Data

The Supplier shall prepare and submit to the Purchaser for approval or reference, drawings and technical data/documents including but not limited to the following:

- (1) Codes and Standards

The Supplier shall, within one (1) month after the effective date of the Contract, submit for approval by the Purchaser a list of the Codes and Standards which shall govern the design, manufacture, construction, erection, test, commissioning and trial run of all the related Works under this Contract.

Each one (1) copy of the applied code or standard shall be supplied to the Purchaser.

- (2) General Arrangement Plans for Machinery and Equipment.

The Supplier shall supply layouts, arrangement and location of the Goods including the outline dimensions and sizes of the Goods.

The Supplier shall, within two (2) months after the effective date of the Contract, submit for approval the above.

(3) Drawings, Documents and Specifications of Control System and Instrumentation for Approval

The data, drawings and documents to be submitted by the Supplier for approval as listed below:

- (a) Design specifications of modulating and binary control systems such as DCS system cabinet, control drives and their related instruments.
 - (b) Control, measurement and protection schematic including interface diagrams.
 - (c) List of interface between local and CCR including control drives, transmitters and cables.
 - (d) Detailed schematic connection diagrams, control wiring diagrams, detailed terminal wiring diagrams and terminal lists for measurement and control system.
 - (e) Detailed single line and control wiring diagrams for power supply, schemes at points of consumption of electric power.
 - (f) Elementary and control wiring diagrams for motor operated valves from CCR.
 - (g) Dimension drawings and mounting drawings for all instruments control valves and control drives.
 - (h) Drawings showing the design of linkages between dampers and drives.
 - (i) Arrangement drawing of the central control room (CCR).
 - (j) Surface arrangement drawings for control desks.
 - (k) Surface arrangement drawings for instrument panels.
 - (l) Dimensional drawings for all panels and desks.
 - (m) Operation and maintenance manuals for all instruments, controllers, control drives, control valves, sampling racks and all other equipment included in the scope of Supply.
 - (n) Spare parts list.
-

- (o) Testing procedure of trial run.
 - (p) Training program for the Purchaser.
- (4) Drawings, Documents and Specifications for Control system and Instrumentation for Reference use.
- (a) Weight of each main components of the boiler control systems.
 - (b) Final specification and data sheets for all Goods (equipment, controllers, control drives and protection devices covered by this Specification).
 - (c) Final specification and data sheets.
 - (d) List of special tools for maintenance.
 - (e) Power Utility consumption of each unit including plant simulator - kW consumed

(5) Progress Report

(a) Monthly Reports

The Supplier shall submit to the Purchaser and the representative of the Purchaser (such as engineers if required) by tenth (10th) day of every month, a written detailed progress report, in an approved form, indicating the stage reached and anticipated completion dates for the design, ordering, procurement, manufacture, and testing of the components up to the completion date of transportation of the Goods. The report is to be forwarded promptly so that on receipt by the Purchaser the information is not unduly out of date.

Further the Supplier shall submit the progress report during site test and commissioning period in the same manner as above.

(b) Weekly Meeting

All Parties concerned to this Contract shall have a weekly meeting every week after commencement of erection work at the Site and make the minutes of meeting.

(6) Instructions for Erection Works

The erection work will be undertaken by an Erection Contractor under supervision of the Supplier. The Supplier shall provide the instructions for the erection work of the Goods supplied by this Contract. The preliminary instructions for the erection work shall be submitted not later than three (3) months after the effective date of the Contract, and the following items shall be included at least and other necessary information shall be included:

- Outline of erection procedures
- Equipment and instrument list
- Layout of equipment
- Dimensions and weight of equipment
- Approximate cable length
- Preliminary wiring diagrams
- Recommended erection schedule
- Other necessary information

The final erection instructions shall be submitted three (3) months before the commencement of the erection work and the following items shall be included at least:

- Erection procedures
- Layout of all Goods
- Dismantling procedure of the existing equipment and foundation
- Detailed equipment & instrument list
- Outline drawings of all equipment
- Civil work drawings for foundation of equipment
- P & I diagrams
- Piping drawings
- Cable wiring diagrams
- Cable tray and/or conduit drawings
- Special erection tools and machines to be recommended
- Other necessary information

(7) Test Procedures and Reports

The Supplier shall submit to the Purchaser comprehensive test procedures/ programs two (2) months prior to the start of the actual tests of the Goods.

The procedures shall include the following items, but not limited to:

- Description on the test activities
- Test circuit diagram including test instrumentation
- Time schedule
- Evaluation criteria for the test results
- Form of test record

The Supplier shall submit reports or test results upon completion of the tests carried out in accordance with the Bidding Document including those in the manufacturer's works.

(8) Operation Manuals

The boiler operation manual shall be prepared and submitted under the cooperation of the Suppliers of Package-1 and Package-2 on the basis of existing boiler operation manual provided the Purchaser.

Two (2) sets of draft of the manuals shall be submitted for review of the Purchaser within seventeen (17) months after the effective date of the Contract.

Each Ten (10) sets of the completed manuals in English and Mongolia shall be submitted by the Suppliers of Package-1 and Package-2 within twenty-seven (27) months after the effective date of the Contract.

(9) Maintenance Manuals

The Supplier shall submit maintenance manuals for all the Goods supplied in this Contract.

Two (2) sets of draft of the manuals shall be submitted for review of the Purchaser within nineteen (19) months after the effective date of the Contract.

Each ten (10) sets of the completed manuals in English and Mongolia shall be submitted within twenty-seven (27) months after the effective of the Contract.

For each equipment supplied under this Contract, the following shall be developed:

- Procedure covering preventive maintenance of the specific detail of equipment.
- Detailed dismantling and assembling procedures
- Checks and tests prior to returning to the equipment to service.

- Detailed assembly drawings and illustrations including parts lists and numbers for replacement ordering.
- Setting and running clearances and tolerances.
- Cleaning and preservation procedures.
- A preventative maintenance schedule for all the Goods.
- A lubrication schedule showing requirements and specifications for all the Goods.
- Printed circuit board schematics and module schematics.
- Detailed drawings and method of use of special maintenance tools.
- List of recommended spare parts and list of consumables
- Troubleshooting guide.
- Trade name or standard name of materials (lube oil, welding rod and wearing metal) that are available in Mongolia to those supplied under this Contract.

6. PATENTS, TRADE MARKS

- (1) The Goods may bear patent numbers, trade marks or trade names in English of each one of the suppliers thereof.
Nothing contained herein shall be construed as transferring any patent or trademark rights or copyrights in such Goods, and all such rights are hereby expressly reserved to the true and lawful owners thereof. No copyright for drawings and documents of the Project in any case can be transferred to the Purchaser.
- (2) The Supplier shall defend the Purchaser and hold harmless the Purchaser from patent liability or claim of patent infringement of any nature or kind, including costs and expenses for, or on account of, any patent or unpatented invention made or used in such Goods, including the costs and expenses of litigation, if any.

7. APPLICABLE STANDARD AND UNITS OF MEASUREMENT

(1) Applicable standard

Unless otherwise specified in the Specification, all the Goods shall conform to the latest edition to one of the following codes and standards or equivalent.

(a) Japanese standards

JIS	-	Japan Industrial Standards
JEC	-	Standards of the Japanese Electro-technical Committee
JEM	-	Standards of Japan Electrical Manufacturer's Association
JCS	-	Japanese Cable Maker's Association Standards

(b) U.S.A. standards

ASME	-	American Standards of Mechanical Engineers
ANSI	-	American National Standard Institute
ASTM	-	American Society for Testing and Goods
ISA	-	Instrument Society of America
MSS	-	Manufacturers Standardization Society of the Valve and Fitting Industry
NEMA	-	National Electrical Manufacturers Association
NFPA	-	National Fire Protection Association
IEEE	-	Institute of Electrical and Electronics Engineers
OSHA	-	Occupational, Safety and Health Act
NEC	-	National Electric Code
UL	-	Underwriters Laboratories

(c) International standards

ISO	-	International Organization for Standardization
IEC	-	International Electro-Technical Commission

(2) Units of measurement

Weights and measures shall be given in the metric system and the following symbols shall be used for the drawings and documents submitted by the Supplier.

mm	:	Millimetre
cm	:	Centimeter
m	:	Metre
km	:	Kilometer
cm ²	:	square centimetre
cm ³	:	cubic centimetre
kg	:	Kilogram
kgf	:	kilogram force
kgf/cm ²	:	kilogram force per square centimeter
t	:	metric ton (1,000 kilogram)
sec.	:	Second
m/s	:	metre per second
A	:	Ampere
V	:	Volt
kV	:	Kilovolt
kVA	:	kilovolt-ampere
MVA	:	megavolt-ampere
kW	:	Kilowatt
MW	:	Megawatt
MWH	:	Megawatt-hour
N-m	:	Newton-meter
ppm	:	Parts per million
Micro-S	:	Micro-Siemens
°C	:	degree Celsius
rpm	:	Revolution per minute
Hz	:	Hertz
g/kW-h	:	gram per kilowatt-hour
kcal/kg	:	Kilocalorie per kilogram
%	:	per cent

8. SHIPPING INSTRUCTION

(1) Packing

All the Goods shall be packed and then containerized along all the routes to Mongolia, unless otherwise specified.

The Supplier shall take suitable precaution for the packing of the Goods to ensure safe handling during the transportation up to the Site.

The packing shall be sufficiently strong to avoid loss or damage and adequately sealed for cold weather condition so that each item will be kept serviceable at least sixty (60) days after the arrival thereof at the Site.

Precaution shall be taken to protect shafts and journals where they rest on wooden or other supports likely to contain moisture. At such points, wrapping impregnated with anti-rust composition, to avoid chafing and indentation due to movement which is likely to occur in transport, shall be used and be suitable for at least ninety (90) days.

Woodwool shall be avoided as far as possible. Straw packing shall be prohibited.

Wooden boxes for export packing shall fulfill the requirements of JIS-Z-1402, 1403 and 1405 or equivalent.

All stencil marks on the outside of casings shall be either of waterproof materials or protected by shellac or varnish to prevent erasure in transport.

Where practicable, all indoor items damageable moisture such as instruments and panels, machine components, etc., shall be covered in polyethylene sheet, sealed at the joints and the enclosure provided internally with an appropriate desiccant. In addition, for the Goods of less durability to low temperature shall be fully insulated.

All items of the Goods shall be clearly marked for easy identification on the packing. The container shall each contain a list of packages included in it on the outside, and shall bear an identification mark relating them to the appropriate shipping documents.

All packages shall be clearly marked on the outside to show where the weight is concentrated and the correct position of the slings.

If the Supplier ships dangerous goods as defined in the International Maritime Organization (IMO) code, he shall pack them in accordance with the authorized rules issued by the organization of the Supplier's country or equal to "Rules for the Carriage and Storage of Dangerous Goods in Ships" issued by the Ministry of Transportation of

Japan and shall submit the following documents two (2) weeks prior to cargos becoming available for shipment, with one (1) copy to the Purchaser.

- (a) Advance notice of dangerous goods to the Port Authority (4 copies)
- (b) Declaration of dangerous goods to a shipping company (4 copies)

Any items not stipulated herein shall be according to the Supplier's Standard of export packing for cold weather condition.

(2) Packing List and Container Stuffing List

Each container shall have a copy of packing list for the packages contained which shall be covered in a waterproof envelope and be placed outside of the container. The packing list shall give all information on the package, such as package number, packing appearance, net weight, gross weight, dimension, measurement, name of the Site (4th Thermal Power Plant, Ulaanbaatar, Mongolia) and description of Goods which is contained in each package.

In case that the containers having serial numbers of packages are contained, the master packing list shall be placed inside the container which has the lowest package number.

The Supplier shall submit for each delivery the Container Stuffing List indicating the numbers of packages in each container.

(3) Marking

- (a) Each package shall be clearly marked on two (2) sides in black with a stencil and water proof ink or oil paints by means of block letters not less than 30 mm high as follows:

The marking for each package shall be of Supplier's standard.

CONSIGNEE : The 4th Power Plant in Ulaanbaatar, Mongolia
PROJECT : Rehabilitation project of the 4th Power Plant (Phase-II)
LOAN NO. : JBIC Loan MON -P6
DESCRIPTION OF CONTENTS :
PORT OF SHIPMENT :
NET WEIGHT : (kg)
GROSS WEIGHT : (kg)
DIMENSION : (L) x (W) x (H) (cm)
PACKAGE SERIAL NO. :
SUPPLIER :

These marks shall be protected against weather by clear water-resistance varnish.

- (b) Bags, bundles, other packages and loose pieces, which cannot practically be marked as aforesaid, shall have two metal labels securely fastened thereto by wire, and each label shall be stamped or printed with the above markings.

9. SHIPMENT, INLAND TRANSPORTATION AND STORAGE

- (1) The Supplier shall, on his responsibility and at his own cost, ship, transport and unload all the Goods to the Site.
 - (2) The Supplier shall, on his responsibility and his cost, send the documents specified in Section II, Clause 9 to the Purchaser upon shipment one (1) week before arrival of the Goods.
 - (3) The Supplier shall notify the Purchaser of the following information by fax upon shipment.
 - (a) Loan agreement (with JBIC) Number and Project Name.
 - (b) Items Shipped.
 - (c) Name of Company Responsible for all Transport.
 - (d) Number of Packages and Containers Shipped.
 - (e) Name of Ship and Train Number for the place at the border.
 - (f) Name of Shipping Company and its Agent in Mongolia and other country if any.
 - (g) Bill of Lading Number.
 - (h) Port of loading in the country of the Supplier and Expected Date of Arrival in China or Russia.
 - (i) Date of Shipment in the country of the Supplier and in China or Russia.
 - (j) Expected Date and Place of Arrival at the Border and Ulaanbaatar.
 - (k) Total Gross Weight and Measurement of Each Container Shipped.
 - (4) The Supplier shall be responsible for customs clearance of all Goods supplied under the Contract. The Supplier shall submit to the Purchaser six (6) copies of bills of lading of the Goods immediately after the customs clearance.
 - (5) The Supplier shall observe all regulations which limit loads on wharves, rails, and roads over which the Goods will be transported. The handling and storage of any Goods supplied under the Contract during transportation thereof shall be at the risk of the Supplier and without responsibility to the Purchaser.
-

(6) Inspection of the Goods

- (a) Upon arrival of the Goods, the Supplier unpack, check and inspect them for verification of losse, shortage and/or damage, at the presence of the Purchaser.
- (b) The Purchaser and Supplier shall sign the checklist to be prepared by the Supplier.
- (c) If losse, shortage or damage of any Goods is found in the packages, the Supplier shall forthwith supply a substitute of the Goods on his account to the checklist thus mutually signed.

(7) Storage and Keeping of the Goods

The Purchaser shall supply indoor/outdoor storage area and the bridge crane free of charge. The Supplier shall be responsible for handling, keeping the Goods in the warehouse and handing over the Goods to the erection Contractor under control of the Purchaser.

According to the erection schedule, the erection Contractor will give a notice prior to receiving the Goods from the Supplier. List of the Goods handed over to the erection Contractor should be provided by the Supplier to the Purchaser.

10. NAME PLATE AND CAUTION PLATE

Name plates of instrument, control desk and instrument panel shall be indicative with English language. However, Caution plates shall be Indicative with Mongolian language by Cyrillic alphabet.

Such Mongolian language shall be translated by the Supplier on Supplier's account.

11. TECHNICAL REQUIREMENT

11.1 General

The Technical Requirement in the CLAUSE 11 defines the minimum functional and technical requirements for the Control and Instrumentation

11.1.1 Requirement of the Goods

(1) Quality

(a) All Goods to be used for the Project shall be new, unused, factory approved free of any defect in quality and workmanship, and of first-class commercial quality in strength, reliability and other necessary features.

Any defect and imperfection will not be acceptable.

(b) The Goods shall be designed, manufactured, erected and tested according to the most recent relevant standards (codes). All Goods (materials, equipment, calculation sheets, drawings, quality and class, methods of inspection, constructional peculiarities and parts) specified in the "Scope of the Goods" shall comply in every respect with the applicable standard (see Clause 8). Especially in cases a particular code specified in the Clause 13 shall be conformed.

(c) Site conditions specified herein shall be considered in the selection of the Goods. As the minimum/maximum mean temperature would be assumed minus 30°C /plus 30°C , valves, pipes and so on installed equipment shall be subject to even minus 40°C during short hours in winter. Especially, grease, oil and sealing Goods for them shall function in such cold period.

(2) Spare Parts and Consumables

(a) Supplier shall supply spare parts and consumables necessary for three (3) years operation of the Goods. Whereas the duration of one (1) year operation should be regarded as eight thousand (8,000) hours.

(b) The Bidder shall specify scope of supply in accordance with Clause 12.17.

- (c) List of spare parts and list of consumables shall be provided in the Technical Schedules of the Bid. (Attachment-A :Technical Shedules) Unit price of each spare part shall be provided in the Price Schedules.

(3) Power supply

The supplier shall comply with following erectric characteristics.

(a) AC source

- Voltage : 6,000V, 380V, Three (3) phase or 220V, Single phase, 50Hz
- Voltage fluctuation : - 5%, + 10%
- Frequency fluctuation : \pm 5%

(b) DC source

- Voltage : 220V

(4) Site conditions

The 4th Thermal Power Plant is located approximately ten (10) kilometers west of the center of Ulaanbaatar, Mongolia.

The supplier shall comply with following Meteorological Condition in Ulaanbaatar

- | | |
|------------------------------|------------------------------|
| (a) Temperature (mean) | Maximum : +30°C |
| | Minimum : -30°C |
| (b) Relative humidity (mean) | Maximum : 90 % |
| | Minimum : 30 % |
| (c) Monthly precipitation | Maximum : 80 mm |
| | Minimum : 2 mm |
| (d) Elevation | 1,350 meters above sea level |

(5) Environment Conditions

Field devices shall be designed for the following condition:

(a) Temperature (mean): -20°C - 80°C

(b) Relative humidity (mean): 5 % - 85%

Control components shall be housed in free standing cabinets and must be able to withstand the following conditions:

(a) Temperature (mean): 0°C - 70°C

(b) Relative humidity (mean): 5 % - 95%

Control room equipment shall be designed for the following conditions:

(a) Temperature (mean): 4°C - 40°C

(b) Relative humidity (mean): 40 % - 80%

(6) Goods and Services Supplied by the other Supplier

Following Suppliers/Contractor shall co-operate with each other in Implementation of this Rehabilitation Project.

Package-1 Supplier : Conversion of firing system for boiler No.5 to No.8

Package-2 Supplier : Rehabilitation of C&I for boiler No.5 to No.8

Package-3 Supplier : Rehabilitation of boiler tubes for boiler No.5 to No.8

Package-4 Supplier : Replacement of exciter for generator No.1 to No.4

Package-5 Contractor : Erection work for the Goods supplied by Package-1 to Package-4

11.1.2 General Condition for Rehabilitation

The Supplier shall investigate the site conditions before design of the Work.

Followings are the basic conditions for design of the Work.

- (1) Electric power source for control and instrument is;
- | | |
|-----------------------------|--|
| AC 6,000V, 3 ϕ , 50 Hz | (for large capacity motor drive) |
| AC 220V, 1 ϕ , 50 Hz | (for control) |
| AC 380V, 3 ϕ , 50 Hz | (for motor drive including for the control valves, the control drives for damper and vane) |
| DC 110 V | (for alarm circuit) |
| DC 220 V | (for interlock) |

(These voltage rating shall be confirmed by the Supplier after the site survey and during progress of design)

11.2 Boiler Control System

11.2.1 General

The Supplier shall supply DCS control system for boiler control. Brief summary of general equipment requirement is;

- Distributed Architecture
- Scalability
- Non Obsolescence
- Reliability and Availability

(1) Distributed Architecture

The DCS control system shall support a decentralized, hierarchical structure that is capable of being physically distributed to all DCS location. The system shall permit data acquisition and control functions to be performed at various area locations while providing the capability to monitor and control the distributed functions from a MMI's display. The DCS control system shall be flexible enough that it can be configured to a wide range of process control applications at the loop and component level without changes to the hardware.

(2) Scalability

The DCS control system shall be capable of everything from single loop control to elaborate large complicated designs encompassing hundreds of I/O points. Commonality of hardware, configuration and communications strategies is critical to minimize spare parts and training.

(3) Non Obsolescence

The DCS supplier shall be committed to designing process control and information systems such that future enhancements to hardware and software will not obsolete existing systems in the field. It is also a requirement that existing systems can be retrofitted with enhancements without replacement of existing operator interface hardware or process control equipment. Supplier shall describe in the Technical Schedules, the number of times it has obsoleted its major control system over the last fifteen years.

(4) Reliability and Availability

The DCS control system shall incorporate 1:1 redundant multi-function controllers for execution of process control functions and 1:1 redundant communication modules for interfacing to the plant data highway. Redundant controllers and communication modules shall operate in a hot standby mode. The transfer to the standby controllers or communication modules shall be automatic and bumpless.

In addition, the plant communication data highway and the controllers to I/O communication highways shall be fully redundant with both paths continually active. No single point of failure may cause complete loss of process control.

The I/O processor modules shall be capable of primary / hot-stand-by back-up configurations. This is to provide I/O processor redundancy for critical I/O areas.

The DCS power supply system shall be equipped with input connections for uninterrupted supply system (UPS). The DCS power supplies shall be rack mounted or modular and shall be capable of at least 2N redundancy. The power feeds to all control and I/O processors shall be fully redundant.

The system, as a whole, shall be designed to eliminate single points of possible failure. The failure of one component will not cause the entire system to fail. In order to maximize system availability, the controllers, I/O processors, communication modules, and power supplies must be capable of being replaced on line (i.e., under power) without the need for output holders or other manual devices.

11.2.2 Boiler Control Function

Boiler control system shall have following control functions;

- Modulating control
- Sequencing control
- Boiler inter-lock
- Data acquisition

11.3 DSC Systems

DCS system shall consist of;

- Man-Machine-Interfaces
- Data Highway
- System Enclosures to mount;
 Bus Interfaces
 Controllers
 I/O processors
 Power Supply system
- Maintenance Tools for Man-Machine-Interfaces
- Maintenance Tools for Controllers and I/O processors
- Plant Simulator

See attached drawing MON-K-2-02 "Typical DCS System Layout" .

11.3.1 System Enclosures and DCS Components

(1) System Enclosures

The Supplier shall supply Supplier's standard system enclosure to mount various and necessary control components such as controllers and I/O processors. The thickness of the enclosure plates shall be desired to be 3.2 mm.

Enclosure shall equip draft circulation enough to hold enclosure inside temperature with filters to prevent penetration of any kind of dust.

The Supplier shall submit dimensional drawing and typical component layout drawing in the Technical Schedule.

(2) Bus Interfaces

Interfaces between data highway and controllers shall be provided thru 1:1 redundancy.

(3) DCS Controllers

The DCS controller shall have multi-function control processing with I/O processors and shall be mounted in enclosure. All control functions specified in the Clause 11.2.2 shall be executed by one type of controller.

The DCS controller shall be of Fault Tolerant Design philosophy. The fault tolerant system shall consist of backup controllers that are identical to the primary controllers.

Fail over to the backup controller shall be automatic and provide for the continuation of full automatic control without operator intervention.

The primary controller must be replaceable on line without using an output holder or other manual output devices. Transfer back to the primary controller shall require operator intervention via a standard display that provides a means for safely transferring automatic control back to the primary. The standard display shall provide complete status information in each controller.

Power up self-checks shall be self-initiating when power is applied to the control processor, and shall perform sequential tests on the various control processor function elements. Red and green LED indicators at the front of the control processor shall reflect the successful (or unsuccessful) completion of the power up self checks.

(4) I/O Handling

The I/O modules shall be able to support process signal from various types of sensors and contact devices without requiring external or auxiliary signal conditioning devices.

I/O modules shall be front accessible and be replaceable without removing any field wiring.

The supplier shall provide enough I/O modules to include analog I/O, digital I/O, Inputs of RTD, T/C, Pulse and remote I/O. The spare points per each different type of I/O modules shall be 20% of the actual-to-be-used point quantities.

(5) Power Supply System

The power supply system shall be designed to operate on 220 VAC, 50 HZ

The power supplies shall provide 24 VDC power for control and I/O functions through 1:1 redundancy. If the primary power supply fails, the redundant power supply will be able to meet the total power demand for the enclosure. Failed power supplies shall be able to be removed without removing power from the system or affecting control. The status of the power supplies shall be indicated by LED. The power system shall also provide status indication to the operator via the data highway to the MMI.

11.3.2 Control Function of Controllers

The control systems shall be designed to have functions that the combustion control can be operated automatically under boiler load down to a half of MCR evaporation and also shall be operated automatically from start-up to full load for furnace pressure and feedwater control.

Main input and output for the boiler are indicated in the Drawing MON-K-2-05 "Vital I/O points for the boiler modulating control". Detailed control functions such as P.I.D action, function generation, timing generation etc. shall be applied in addition to this fundamental I/O diagrams in order to get précised control action.

The Controllers of one type shall execute all control and monitoring functions required for boiler controls as described below;

(1) Combustion Control

A combustion control system shall be supplied to maintain Super-heater outlet pressure at set point value and also safe and efficient combustion by modulating fuel and air flow.

The system shall be suitable for the flow control of pulverized coal (PC), heavy oil and combustion air.

PC shall be fed from four (4) pulverized directly to the burners through PC pipes. Three (3) PC pipes are branched from each pulverized exit, so that twelve (12) PC pipes are connected to twelve (12) burners arranged with each four (4) corners of three (3) levels. (See attached drawing MON-K-0-07 "Connect of Pulverized Coal Pipes from Pulverizers to Burners".)

Combustion air (secondary air) shall be fed by one (1) forced draft fan (FDF) of centrifugal type controlled by inlet vane. The control system shall maintain the super-heater outlet steam pressure by controlling the PC flow to the burners by means of boiler master signal. (See attached drawing MON-K-2-09 "Flow Diagram for Combustion Air and Flue Gas".)

The boiler master signal is introduced to both of coal feeders and pulverizer inlet flue gas dampers. Fuel/air ratio shall be adjusted by flue gas O₂ signals which are measured at two (2) point, on both sides of economizer inlet gas duct, and averaged for the control signal.

Cross limiting fuel/air control shall be provided for safe boiler operation

The control system shall prevent a reduction in combustion air flow below the absolute safe minimum limit or the safe minimum limit corresponding to the prevailing fuel input.

Temperature correction for air flow, both of pressure and temperature correction for steam flow shall be provided. When furnace brightness comes to dim and after certain seconds, heavy oil burners shall be put into firing automatically. Existing two (2) furnace brightness detector shall be utilized for this purpose (remote signal indicators with contacts shall be newly supplied and installed).

Adjustment of calorific value of coal shall be provided.

(2) Furnace Pressure Control

The control and protection system for furnace pressure shall ensure that safe and proper combustion exist for all operating and fault conditions.

Feed forward signal from airflow control or suitable measures shall be adopted for quick and precise control.

One (1) induced draft fan of axial flow type with static vane control is served for this purpose, within the non-dangerous condition.

(3) Steam Temperature Control

The boiler have three (3) stage steam temperature control as shown in drawing MON-K-2-06, namely, start-up control, first stage control and second stage control. All of these controls shall be done by water spray injection to the live steam. Each of these three (3) control systems has two (2) spray control valves per boiler.

The start-up steam temperature control shall be made in remote manual operation and the remainder shall be automatic.

Injection water for start-up control system is taken from feed water main pipe and used only during the boiler start-up period. In this injection water system, differential pressure across the temperature control valves is very high. Injection water for the other control systems, first stage and second stage, are produced by de-super-heater condenser, in which condenses saturated steam taken from the drum. Because of such design of de-super-heater spray, differential pressure across the temperature control valves is low. Relationship between drum pressure and each spray point pressure is shown in drawing MON-K-2-07.

(4) Feed Water Control

An automatic control system shall be provided and shall give the appropriate rate of supply of feed water to the boiler to meet the prevailing steam demand over the full range, whilst maintaining the drum level at the desired setting point. During the severe conditions of boiler load change, the transient deviation from normal water level shall remain within the non-dangerous condition. Because the feed water is taken from feed water main, the pressure drop across the main control valve at the rating condition shall be as large as 30 kg/cm² pressure. Automatic sequential changeover from the main feed water control valve to the auxiliary control valve and vice versa shall be provided.

Changeover of 3-elements and single element control shall be arranged for the start-up feed water control valve.

Drum level measurement shall be compensated automatically for variation in drum pressure. Feed water flow shall be corrected by temperature.

(5) Boiler Load Distribution Control

Signal from the Boiler load distribution control system supplied on Phase-I Project, shall be boiler demand signal for respective boiler load setting in combustion control.

In the existing boiler load distribution control system, the output signals to each boiler are produced by a control strategy that control function of constant steam pressure at the common header and feedforward signal of total steam flow of No.1 boiler to No.8 boiler are combined for load distribution to each boiler.

(6) Primary Flue Gas Temperature Control

Drying of wet coal for pulverizers is made by flue gas. Hot gas is extruded from the furnace upper portion and tempered by cold gas from the Gas recirculation fan (GRF) in order to obtain suitable temperature. Set point of this gas temperature is manually changed according to the raw coal moisture.

There are two temperature control systems for one boiler. (See attached drawing MON-K-2-09 "Flow Diagram for combustion air and flue gas".)

(7) Pulverizer Temperature Control

Pulverizer outlet pulverized coal (PC) flow is measured and controlled by pulverizer inlet tempering gas damper. Diagram for (6) primary flue gas temperature control, (7) pulverized Temperature control indicated in the Drawing MON-K-2-08 "Typical Instrumentation around the pulverizers." If the Package-1 supplier is different from Phase-I project, Phase-II configuration shall be well considered by the Supplier.

Design and manufacturing schedules shall be submitted in the Technical Schedule and shall be consulted with the Purchaser at the Contract stage.

(8) Boiler Inter-lock Sequence

Inter-lock sequence for boiler trip circuit shall be carried out by DCS controller. Existing boiler inter-lock sequence is indicated in Dwg.MON-K-2-12 "Boiler Plant Inter-Lock Diagram" The Supplier shall carefully review exiting boiler inter-lock scheme and describe most reliable inter-lock scheme in the Technical Schedules.

As one of the boiler inter-lock functions, light-off shall be initiated when furnace brightness is down to less than 30% and it continues in a few seconds. Ignition of the burners is made from adjacent coal burner flame. The heavy oil burners are of steam atomizing and fixed (non-retractable) gun type. Atomizing steam shall be fed to the burner continuously in order to cool down of the gun. The inter-lock logic shall have function only for sequential on-off of heavy oil inlet valves and purge steam valves.

(9) Boiler Auxiliary Operating Sequence

Sequencing logic for the auxiliary machinery and equipment shall be implemented by DCS Controller. Sequencing logic shall be programmed by functional blocks.

Inter-lock logic for two sets out of four heavy oil burners per one boiler (eight burners for four boilers in total) shall be provided to be kicked by furnace brightness detector signal.

(10) Data Acquisition

The Supplier shall provide sufficient amount of I/O modules enough for monitoring state and status of boiler process data in the various displays on the monitors of MMI.

11.3.3 Plant Data Highway

The redundant plant data highway shall be a unidirectional, high speed serial data highway shared by all DCS nodes. The central data highway shall support up to 250 nodes (connections), but not limited to.

The data highway shall consist of a redundant pair of coaxial or twinaxial cables that will permit the communication system to operate at a speed of 10 MHz with distances between nodes of up to 4,000 meters.

11.3.4 DCS Maintenance Tool

The Supplier shall supply personal computer based or supplier's standard maintenance tools which will allow the Purchaser to operate standard DOS and Windows applications on the same machine as the DCS supplier's configuration and utility software.

The Maintenance Tool will be used for on-line system configuration, control tuning, and system debugging. The computing unit of the maintenance tool shall utilize, at a minimum, a Pentium IV microprocessor with a 1.4 GHZ internal clock speed. A minimum of 30 Gbytes of disk storage space and 256 Mbytes of RAM shall be provided. In addition, a 1.44 Mbyte floppy disk drive shall be provided. A CD-R drive shall also be provided. The maintenance tool shall provide at least two (2) serial and one (1) parallel communication ports. The maintenance tool shall have real time connection to the DCS. A 21 inch SXGA monitor with a minimum 1280 x 1024 pixel resolution shall also be provided.

The DCS supplier shall provide an interactive graphics-editing program that allows DCS logic and configuration drawings to be created. The package shall use a graphically oriented, objects based approach to process design, which allows the user to link control algorithms together to configure the control strategy and to create the drawings that will be the control strategy documentation. The actual drawings shall be used to create and compile, and download the control program configurations into the control controller. The DCS utility software must also include a "verification" feature that will ensure accurate documentation by comparing configuration drawings against the actual process configuration executing in the multi-function controllers.

11.3.5 Man-Machine-Interface (MMI) System

(1) General

The MMI shall provide an interface to the process and support monitoring and control through graphic or text displays. These displays effectively communicate equipment status and process state. Dynamic state and static data graphic elements shall be combined on any display.

Any display shall be operator friendly to be accessed.

MMI must not support a fixed hierarchy but must be fully configurable to suit individual processes and applications. The operator shall be able to define logical connections between displays.

MMI shall not execute control algorithms.

Loss of MMI or data highway shall not cause loss of boiler control.

Mouse manipulation will be the main operator interface to the MMI and the boiler process.

(2) Displays

Dynamic data displays on the CRT shall be updated on a real time basis and callable via a mouse. The time required for a new display shall be less than two seconds. The displays shall be capable of displaying text and graphic symbols of different colors and sizes. Graphic symbols representing equipment or processes shall have dynamically changing colors depending upon operational status. For reference, a typical requirement (not limited to) for displays of each MMI:

- 30,000 tags or points
- 8 Windows
- 200 tags or values per display
- 1,500 displays or graphics
- 1,000 event logs
- 16 Sequence of Events Logs
- 80 Sequence of Events Reports
- 300 logs (total of trend, trip and snapshot)
- 20 Trends, operator assignable, collected at two second intervals.
- 2,000 Trends, collected at 15 or 60 second intervals.

The display system must be capable of "Next Page" and "Previous Page" scrolling and recalling a previously marked display or the previously displayed screen. Graphic displays can be accessible by entering a display name, tag name, tag index number or by clicking any alarm point in the alarm list display.

Alarm lists on the windows of existing instrument panel is indicated in Table TS-2-01 for reference.

The Purchaser shall confirm an alarm management on the display after the Contract. Fundamental requirement is to cover,

- (a) Different alarm group assignment of over 40 total groups
 - (b) Capability of operator's recognizing at least eight (8) alarm priority levels
 - (c) Display of alarm summary
 - (d) Printing events such as alarms, operator actions and tag state changes with time stamps to include month, day of the week, hour, minutes, and second
 - (e) Assignable alarm comment messages to suggest operator action
 - (f) Alarm summary display shall provide the operator with the following data for each tag that is in alarm;
 - Tag name of the point in alarm (minimum 14 alphanumeric characters)
 - Tag description of points in alarm (minimum 32 alphanumeric characters)
 - Alarm description (High, Low, Deviations, etc.)
 - Alarm priority level with different color
 - Alarm comment message (minimum of 32 alphanumeric characters)
 - Time and date of alarm
 - Time and date of acknowledgment
 - Time and date of return to normal
- (3) MMI Computing Unit

The computing unit of MMI shall be either Supplier's standard or customized personal computer and shall utilize, at a minimum, a Pentium IV microprocessor with a 1.4 GHZ internal clock speed. A minimum of 30 Gbytes of disk storage space and 256 Mbytes of RAM shall be provided. In addition, a 1.44 Mbyte floppy disk drive shall be provided. A CD-R drive shall also be provided. The computing unit shall provide at least two (2) serial and one (1) parallel communication ports. The MMI computing unit shall have real time connection to the DCS thru plant data highway.

When one of two (2) sets of identical MMI computing units per each boiler and boiler simulator has a fault, the other MMI shall support both CRTs.

Either of two (2) sets of MMI computing units shall support one (1) set of 50 inches Visual Display Unit (VDU) installed vertical panel on boiler basis and boiler simulator.

A 21-inch SXGA monitor (CRT) with a minimum 1280 x 1024 pixel resolution shall also be provided.

A 50 inches SXGA monitor (VDU) of MMI with, at least, 1280 x 1024 pixel resolution shall be provided. The display of VDU shall be derived from either monitor of two (2) MMIs thru operator mouse-to-display selection. The lamp for display source shall have life time of 5,000 hours or longer.

One (1) set of dot printer and one set of A4 size color printer shall be provided on boiler basis and boiler simulator.

Table TS-2-01
List of Existing Alarm Windows

No.	Alarm Window Indication	No.	Alarm Window Indication
1	MILL-A COAL FEEDER MOTOR STOP	38	STEAM TEMP. ABNORAML
2	MILL-A COAL FLOW STOP	39	BOILER TRIP
3	MILL-B COAL FLOW STOP	40	HEAVY OIL TEMP. LOW
4	MILL DRAFT LOW	41	HEVY OIL TEMP. LOW
5	BOTH PGF STOP	42	BOILER BLOW VALVE OPEN
6	BOTH MILL OUT TEMP HIGH	43	BOILER LOAD LOW
7	FLAME DETECTOR LOW (FLAME UNSTABLE)	44	IDF, FDF LUB. OIL STOP
8	FLAME DETECTOR VERY LOW (FIRE TRIP)	45	IDF, DFD LUB. OIL STAND-BY
9	MILL-B COAL FEEDER STOP	46	STEAM TEMP. LOW
10	MILL-A OVERLOAD	47	HO AUTO-START INTERLOCK CUT
11	MILL-B OVERLOAD	48	BOILER INTER-LOCK No. 1 GROUP STOP
12	(Blank)	49	H. O. PRESSURE LOW
13	IDF, FDF, PGF BEARING TEMP. ABNORMAL	50	DRUM LEVEL CHANGE
14		51	STEAM PRESSURE HIGH
15		52	CCR CONDITION ABNORMAL
16	(Blank)	53	STEAM TEMP. SYSTEM AT START-UP ABNORMAL
17	PC BUNKER LEVEL HIGH	54	STEAM TEP. HIGH
18	MILL-A MOTOR ABNORMAL	55	MILL-A INTERLOCK OFF
19	MILL-B MOTOR ABNORMAL	56	BOILER INTERLOCK No.2 GROUP STOP
20	MILL-A/B OUTLET TEMP. ABNORMAL	57	HEAVY OIL HEATING STEAM PRESS. LOW
21	MILL-A/B OUTLET TEMP. HIGH	58	
22	ASH DISPOSAL SYSTEM ABNORMAL	59	MIAN STEAM PRESSURE LOW
23	PC PIPE CLOGGING	60	ELECTRIC SOURCE FOR CONTROL
24	HEVY OIL LIT OFF	61	H.O. SHUT-OFF VALVE POWER LOSS
25	PC BUNKER LEVEL LOW	62	MAIN STEAM TEMPERATURE LOW
26	MILL-A CONTROL CIRCUIT ABNORMAL	63	MILL-B INTER-LOCK OFF
27	MILL-B CONTROL CIRUCIT ABNORMAL	64	HO ATOMIZING STEAM PRESS LOW
28	BEARING TEMP. HIGH		
29	PGR, IDF, FDF MOTOR BEARING TEMP. HIGH		
30	LOWER BUNER PC STOP		
31	MIDDLE BUNER PC STOP		
32	UPPER BURNER PC STOP		
33	PO ₄ INJECTION PUMP TRIP		
34	DRUM LEVEL ABNORMAL		
35	TEAM PRESSURE ABNORMAL		
36	IDF STOP		
37	FDF STOP		

This list shows indication of alarm windows for one boiler

(4) MMI Maintenance Tool

The Supplier shall supply one (1) set of Supplier's standard MMI maintenance tool common for all MMI computing units connected thru plant data highway.

The Supplier's standard computing unit of MMI maintenance tool shall be provided with an interactive graphics editing program that allows graphic and text-combined graphic display to be created.

A 21 inch SXGA monitor (CRT) with a minimum 1280 x 1024 pixel resolution shall also be provided.

One (1) set of dot printer and one (1) set of A4 size color printer shall be provided on boiler basis and boiler simulator.

11.3.6 Plant Simulator System

The Supplier shall supply a plant simulator system as a part of the total DCS system. The simulator system shall function as an operator training tool, a maintenance training tool, and as a process control development tool.

The simulator system shall also be used to test the actual control logic prior to startup.

(1) System Requirements

The simulator system shall use the same control logic program and equipment of the actual boiler control system as those used in the actual process. The system shall include:

- DCS system cabinet(s) to include plant simulation and instruction model
- Data highway to be connected directly or thru a gateway to the actual plant data highway
- DCS maintenance tool additionally to include instructor operation function
- MMI equipment
- Operator desk
- Instrument panel
- Instructor's desk

(2) Simulator Functional Requirements

The actual process control logic shall be downloaded, unmodified, into the simulation controllers.

(3) Simulation Controllers and Instructor's Console

The simulation controllers, when functioning as the instructor's console, shall permit an instructor to set up and conduct operator training. The instructor shall be able to select specific functions to activate, depending on the particular type of training being conducted. The functions shall include:

- Boiler start/stop simulation
- Recall and restore the simulation starting conditions
- Save existing or create new starting conditions
- Ability to institute process malfunctions for operator response

- Trainee Monitoring, which will permit the instructor to evaluate the trainee's performance to instructor-initiated conditions

11.3.7 Uninterruptible Power Supply System

Uninterruptible power supply system (UPS) shall be supplied for continuous supply of stable and high quality AC power for DCS system except for control drives (these shall be connected to the house service line) and other instruments which will be affected by power failure or momentary voltage drop and also DC power for alarm circuit. When utility power is not available, the inverter shall convert DC power from storage battery to AC power.

Capacity of the UPS shall be 1.5 times of total power consumption required for control and instrument for one boiler unit. Storage battery shall have the capacity to operate controls and instruments for 15 minutes.

Power supply for the UPS is 220VAC, single phase and output shall be 220VAC, single phase and 110VAC.

The Supplier shall state, in the Technical Schedule, power consumption for the control and instrument system, capacity of UPS, required storage battery capacity in ampere-hour unit and dimensions of the UPS.

11.3.8 Control Desks and Panels

(1) General

Arrangement of existing CCR is shown in Dwg.No.MON-K-2-01. In this drawing, control desks, instrument panels, terminal cubicles and relay racks for the boiler plants, shall be replaced with new panels, desks and cubicles. Those for the turbine plants shall be remained as they are.

Arrangement of the new instrument panels and control desks shall be fabricated in accordance with Dwg.No.MON-K-2-01. The space of removed terminal cubicles and relay racks is used for the new terminal cubicles and uninterruptible power supply system (UPS). Predicted arrangement of the control room shall be attached in the Technical Schedules.

Eyebolts or suitable lifting tackles shall be fitted to the panels and desks for carry them into the CCR from window, if they are too big to be brought in through building stairway.

(2) Control Desks

Two (2) sets of the MMI computing units with CRT, minimum pushbuttons such as one (1) set of boiler trip button and three (3) sets of PCV on-off/auto-manual buttons, shall be arranged on the one control desk with a frontage of 1640 mm each.

Keyboard shall be mounted inside of drawer placed at the frontage of the desk.

Sectional dimensions of existing desk are shown in Dwg.No.MON-K-2-15.

In this drawing, dimensions with asterisk (*) shall be kept for new desk but other dimensions shall depend on the Supplier's design.

Surface arrangement of the desks shall be so designed as to enable operator for easy access to operate boiler. Construction of the desk shall be for easy maintenance. Doors and removable covers, if necessary, shall be equipped at suitable places. Thickness of the plate to construct the desk shall be not less than 3.2 mm and suitable ribbing shall be arranged.

Painting color shall be equal to the existing color.

The Desks shall equip draft circulation enough to hold desk inside temperature at ambient temperature with filter to prevent penetration of any kind of dusts.

Dimensions and arrangement drawings shall be attached in the Technical Schedules.

(3) Instrument Panels

Arrangement of instruments on the existing instrument panels is shown in Dwg. No.MON-K-2-14.

50 inches VDU screens shall be installed at the upper portion of the panel.

VDU accessories shall be installed inside of the instrument panel.

4 sets of vertical indicators (drum level left and right, furnace brightness left and right) shall be mounted on the instrument panel. Indicator shall be of single point vertical scale type and the scale size shall be 150 mm or bigger for operator to read the indicating value from the control desk. The Supplier is requested to locate these indicators to be well matched with 50" display.

Conventional alarm annunciator is not required to be installed.

(Refer to attached drawing No.MON-K-2-02)

The instrument panels shall be of closed cubicle type with backside door. Frontage width of each instrument panel shall be 1,200 mm

Construction of the panels shall be easy for maintenance. Thickness of plates to construct the panel shall be not less than 3.2 mm and suitable ribbing shall be added. Painting color shall be equal to the existing.

Dimensions and surface arrangement of the panels shall be attached in the Technical Schedule.

Anchor bolts shall be supplied with the desks or prior to their delivery. The shipping schedule should be consulted with the Purchaser.

Type and size of the anchor bolts shall be matched to the floor structure of the CCR.

11.4 Instrumentation

11.4.1 General

Sufficient instrumentation including thermo-elements, chemical analyzers, gas analyzers, furnace brightness detectors and transmitters shall be provided to meet the boiler operation.

11.4.2 Control Drives

Control drives of existing system were manufactured in ex-USSR. Existing control drives shall be replaced to the new ones, and their power supply switchgears (contactors) shall be also replaced with new contactless type. All of the control drives supplied with their own actuating motors, driven by 380 VAC, 3 ϕ power supply. The control drives for newly added control system such as pulverizer temperature, shall be supplied with also contactless type power supply switchgears. The contactless (solid state) contactors shall be located near the associated control drives. Contactless contactors shall be water and dust proof type and installed in local switch boxes. The control drives shall be equipped with hand wheel for local manual operation and position feed back transmitter suitable for associated control system.

11.4.3 Control Valves

All of the control valves supplied with their own actuating motors, driven by 380 VAC, 3 ϕ power supply. Contactless contactors shall be water and dust proof type and installed in local switch boxes. The control valves shall be equipped with hand wheel for local manual operation and position feed back transmitter suitable for associated control system.

Valve connections to the pipe shall be of butt welding. Details of their welding bevel should be confirmed by the Purchaser.

The design of the control valve shall mostly comply with the requirements that the valves are able to reproduce a characteristic curve of flow vs stem stroke and that the usable range extend down to a low percentage of maximum flow. Inner valve and seat ring shall resist erosion and the method of resistance to erosion shall be submitted in the Technical Schedule.

The design condition for main feed water control valve is:

Inlet water pressure	180 kg/cm ²
Outlet pressure	164 kg/cm ²
Fluid temperature	135 °C
Flow quantity	465 m ³ /h
Connecting pipe	275 A (325 mmOD)

The design condition for primary and secondary spray control valve is:

Inlet water pressure	160 kg/cm ²
Outlet pressure (primary spray)	153.8 kg/cm ²
Outlet pressure (secondary spray)	142.8 kg/cm ²
Fluid temperature	364 °C
Flow quantity	6.2 m ³ /h (each)
Connecting pipe size (inside)	20 A (28 mmOD)

11.4.4 Transmitters

All existing transmitters shall be replaced with the new transmitters and additional transmitters for newly installed direct firing systems shall be included in this Scope.

Measuring conditions shall be confirmed with the Purchaser prior to the design of the transmitters.

Vital measuring points for the control system shall be measured by duplicated transmitters and selective circuit in boiler control system shall be included. The Supplier shall indicate in the Technical Schedules what selective method shall be taken.

- (1) All electronic transmitters shall be of smart type, suitable for peer to peer (4-20mA) connection with portable transmitter calibrator, All transmitters shall have a calibrated accuracy of less than +/-0.1 percent of span or better. The accuracy shall include the effects of linearity, hysteresis, repeatability and dead band. All transmitters shall have a temperature coefficient of 1.0 percent or less per 55°C.
- (2) Independent and noninteracting external zero and span adjustments shall be provided.

- (3) All parts of transmitter in contact with the process fluid shall be constructed of materials suitable for the application and the pressure and temperature conditions encountered.
- (4) Transmitters shall be provided with suitable hardware for mounting on a pipe.
- (5) Transmitters used for measuring differential pressure, flow and level shall be furnished with a pressembled stainless steel 3-way valve manifold suitable for mounting directly on the transmitter.
- (6) All transmitters shall be designed to prevent the process medium from contacting the electronics or from entering the wiring conduit, if the measuring element should fail.
- (7) Transmitters shall be designed with plug in circuit boards.
- (8) Transmitters shall function adequately for at least 150 percent of maximum operating pressure. Transmitters shall be capable of withstanding this pressure without damaging the sensing element and without affecting the calibration and performance.
- (9) The Supplier shall provide complete set of portable transmitter calibration kit.

11.4.5 Thermocouples and Thermo-Resistances

Temperature measurement shall be made by either thermocouple or thermo-resistance whichever suit for the measuring condition. Length and outside diameter of the measuring element shall be fully fit for the thermo-well in order to have good response. Extension nipples shall be supplied, if necessary.

Existing thermo-wells shall be diverted for new measuring system as far as possible. If the existing wells do not suitable for reuse, the Supplier shall supply adequate thermo-wells and their bosses (or connecting flanges for air and gas measurement).

Type of thermocouple shall be suitable for measuring temperature range and ungrounded type shall be selected.

Thermocouple shall be of stainless sheathed mineral or glass insulated type and preferably double element type, if applicable.

Thermocouples for measuring the super-heater element and other boiler metal supervisory purposes shall be supplied with adequate welding pad.

11.4.6 Furnace Brightness Detector

Furnace brightness detector shall be suitable to measure magnitude of brightness of inside furnace and will be used for boiler safety guard system (Boiler Interlock System defined in the Document here). According to the detector signal level, Boiler Interlock System will act

- (1) At low signal level, light off heavy oil burners to assist stable combustion
- (2) At very low signal level, initiate Boiler Trip

It shall be photo cell type detector with signal converter to transmit 4 to 20mA signal to the CCR (boiler inter-lock and indicator at the instrument panel). The Supplier shall select and supply photocell applicable for this service at the supplier responsibility and cost. One detector shall have multi photo cells in parallel circuit to increase high reliability and availability. The detector shall be designed to protect against fly ashes.

11.4.7 Steam and Water Sampling System

- (1) Boiler sampling racks

In order to keep the power plant in good condition, necessary sample of steam and water shall be taken from the plant cycle. These samples are gathered to sampling racks which shall be installed at FL + 12.0 m in the separated room from the boilers and turbines. Sampling rack shall be supplied for four (4) boilers. In addition, root valves of stainless steel made for each sampling point shall be separately supplied. Sampling points and measuring items for the samples are indicated in Table TS-2-02.

Sampling rack shall be equipped with their sample inlet valves, sample coolers, sink, manual sampling valves, pressure reducing stations, temperature indicator, cooling water inlet and outlet valves and others necessary materials required for sampling. Cabin filter shall be equipped for the sample line if it is effective for the conductivity measurement.

Necessary chemical analyzer holder shall be equipped with the sampling rack and analyzer stand for their transmitters and hydrazine, silica analyzers will be annexed to the sampling rack.

Design condition of cooling water for the sample coolers are:

5 kg/cm² and 25 °C

Sampling racks shall be installed in a cabins (supplied by the Purchaser) but spot cooler with suction filters and their power contactors for these cabins shall be supplied by the suppliers.

(2) Analyzing Instruments

(a) Conductivity Transmitter

Conductivity transmitter shall measure the solution conductivity which is taken from various points of the plant. Measured conductivity value shall be temperature-compensated automatically.

Samples shall be cooled and pressure-reduced to suit the measurement of its conductivity but detector should resist 10 kg/cm² and temperature compensation should be made up to 70°C.

Suitable measuring range shall be selected for each sampling fluid.

Flow box which inserts the electrode shall be supplied for each transmitter and shall be installed in the sampling rack. This box also included in the scope. Material of the flow boxes shall be of stainless steel, 18Cr9Ni2Mo or better. Plastic flow box shall not be acceptable.

Signals from conductivity transmitter shall be sent to the CRT display in the CCR. Number of conductivity measuring points are indicated in the Table TS-2-05. (Total points are 18)

Addition to the above, two saltwater concentration (5 to 8% NaCl) transmitters shall be supplied. Type of the detector is preferably same as the above mentioned conductivity meter type. This saltwater is used for regeneration of water softener and the detector shall be installed directly, inserted to the saltwater piping at the water treatment house (distance from measuring points to the CCR are about 350 m)

(b) pH Transmitter

pH transmitters shall measure pH values for sample solution taken from various points in the plant. The pH sensor shall be of glass electrode type with reference electrode and automatic temperature compensation and conversion shall be made, as for reference temperature, for conversion of 25°C.

Samples shall be cooled and pressure-reduced to suit for its pH measurement but pH sensor should be compensated at the temperature up to 50°C. Suitable measuring range shall be selected for each sampling fluid.

Continuous diagnosis function during operation for reference electrode and glass electrode shall be furnished.

The pH sensor shall be for easy maintenance. Cleaning method shall be indicated, KCl supply method and its interval shall be indicated in the Technical Schedules.

Measured pH values shall be sent to the CCR for CRT display and some of them shall be used for chemical dosing control.

(c) Silica Analyzer

Silica analyzer shall use photoelectric colorimetric method measured by photo cell. Measuring shall be in double range of 0 to 200 and 0 to 2,000 ppb. Short measuring cycle is essential and this figure shall be indicated in the Technical Schedule (preferably less than 8 minutes per point).

Silica analyzer shall be of full automatic measurement at analyzer stand (panel) annexed to the sampling rack. Zero calibration and span calibration shall be made automatically. The interval of color coupler shall be 7 days or longer.

Alarm conditions of the measuring system shall be indicated on the analyzer stand and their contacts shall also be equipped for sending signals to the CCR.

(d) Hydrazine Analyzer

Hydrazine analyzer shall be suitable for measure low concentrated sample water less than 5 ppm (mg/l) of N_2H_4 in the sample water.

Analyzing method shall be indicated in the Technical Schedule. Zero calibration and span calibration shall be made automatically.

Alarm conditions of the measuring system shall be indicated on the analyzer stand annexed to the sampling rack and their contacts shall also be made for sending signal to the CCR. Measured value at the analyzer shall be sent to the CCR for CRT display.

**Table TS-2-02 Sampling Racks, Sampling Points
and Their Measuring Items**

1. Boiler Sampling Rack

(Followings are for one boiler. Four (4) boiler sampling racks are needed.)

	Measuring Items	Sample Cooler	Sample Condition	Measuring Items				
				M	C	pH	Hy	Si
1.	Economizer inlet feed water	●	180k/230°C	●	●	●	●	●
2.	Drum water	●	170k/340°C	●				
3.	Cyclone drain water (L)	●	170k/340°C	●	●	●		
4.	Cyclone drain water (R)		170k/340°C	●				
5.	Saturated steam	●	170k/340°C	●				
6.	SHO. main steam	●	168k/560°C	●	●			●

Note: M:- Manual sampling.
 C:- Conductivity
 pH:- pH
 Hy:- Hydrazine
 Si:- Silica

●:- Applied to this item

11.4.8 Flue Gas Oxygen Analyzer

Each boiler shall have two (2) gas oxygen measuring points at existing economizer inlet flue duct and the two measuring values are averaged in boiler control system and used for excess air ratio control. Insertion for each detector probe shall use the existing holes with not less than 1,500 mm in length.

Calibration system shall be supplied for each boiler.

No air piping for ejector is installed near the holes.

Flue gas O₂ analyzer shall be of direct insertion zirconia's type detector with signal converter (transmitter) to transmit signal to the CRT display in the CCR. The detector shall be directly inserted to the wall of the flue. Gas extraction system shall not be accepted.

The detector shall be protected against fly ash produced from pulverized coal firing.

Both detectors and transmitters shall be of water tight. The analyzer has features of detecting faults in the zirconia's cell and the cell temperature as well as the calibration value faults. Calibration shall be done by one touch at the signal converter.

11.4.9 Cables

(1) Technical Requirement

- (a) All power and control cable shall be complying with ICEA, ASTM and IEC Standards and with the recommendation of the National Electrical Code, ANSI C1.
- (b) Conductors in vertical runs shall be supported with non-conducting material.
- (c) All terminations shall use 2-hole type lugs for cables larger than #4/0 AWG (or equivalent SI).

(2) Specification for Cables

Insulation shall be suitable for wet and dry locations, and it shall conform to Part 3, Paragraph 3.8, ICEA S.61-402. In general, low voltage cables shall be suitable for a continuous conductor temperature of 75°C. Medium voltage cables shall be suitable for a continuous conductor temperature of 90°C. Table TS-2-03 shows the minimum technical requirements for wire and cable for the power station.

Table TS-2- 03: The Minimum Technical Requirements for Wire and Cable

Voltage Class Rating	Type/No. of Cond./Material	Insulation/Jacket	Application	Minimum Size (or equivalent SI)
300V/105°C	PLTC/Single, Triad, or Multi-Pair/Copper	PVC/PVC	Instrumentation	Minimum Size (or equivalent SI)
300V/105°C	PLTC/Single or Multi-pair/ Copper	PVC/PVC	Thermocouple	#20.w #20 drain wire
300V/105°C	PLTC/Copper	PVC	75 Ohm. Coaxial Cable	#16.w #20 drain wire
300V/200°C	PLTC/Single, Triad, or Multi-pair/Copper	FEP	Instrumentation	#20, RG-59/U
300V/200°C	PLTC/Single or Multi-pair/ Copper	FEP	Thermocouple	#16.w/#18 drain wire
600V/75°C	TC/Single or Multi-conductor/ Copper	XLP/PVC	Power and Control Circuits	#12
5.15kV/90°C 7.2kV/90°C	Single or Multi-conductor/ Copper	XLPE/PVC or EPR/CPE or CSPE(133% Insulation)	Medium Voltage Power and Distribution Circuit	
Ground Wire	Single/Copper	Bare or Green Insulation	Grounding	
Static and Messenger Wire	High Strength Steel	Bare	Lightning Protection and Cable Messenger	
<p>Note) For the purpose of the isolation from noise and line surge caused by radio noise, thunderbolt, induced voltage and etc, following control cables will be used:</p> <ul style="list-style-type: none"> - compensation cable - optical cable - coaxial cable - sealed or screening cable 				

11.4.10 Terminal Panels and Terminal Boxes

(1) General

Terminal panels shall be utilized for marshaling of field cable ends.

Number of the terminal panels shall be suitable for four (4) boilers and sufficient numbers (plus 10% spare) of terminals with companion lugs shall be installed in the panel. Terminal screw shall be suitable for 0.75 mm² compression type terminal lug.

The panels shall be of dust proof construction.

Local terminal boxes with companion lugs for transmitters and temperature measurements shall be supplied as needed.

(2) Terminal Panels and Terminal Boxes for Direct Firing system

The scope of supply for instruments and cables for Direct Firing System is clarified in the attached Dwg.No.MON-K-0-14 "Supply limit for instruments and cables around the pulverizer". The Supplier of Package-1 shall supply a followings;

- (a) Local control panels (control panels which enable on-off control of motors locally and which are fitted with control switches, signal lamps, etc.)
- (b) Terminals for cable connection fitted with terminal lugs (compression type)
- (c) Terminal Panels and Terminal Boxes, which are to be, installed on the pulverizers and pulverizer auxiliary devices