**Section 6 - Employer’s Requirements**

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**ABBREVIATIONS**

|  |  |  |
| --- | --- | --- |
| ADB | - | Asian Development Bank |
| AVR | - | Automatic Voltage Regulator |
| BS | - | British Standard |
| BSEN | - | British Standard Euro Norm |
| CB | - | Circuit Breaker |
| DGU | - | Diesel Generator Unit |
| DIN | - | Deutsches Institut für Normung |
| DO | - | Diesel Oil |
| ELS | - | Emergency Lighting System |
| HV | - | High Voltage (­ 36 kV) |
| HVAC | - | Heating, Ventilation & Air-Conditioning |
| ISO | - | International Standardisation Organisation |
| I&C | - | Instrumentation and Control |
| KKS | - | :Kraftwerk Kennzeichnungs-System (= Designation System for Power Plants) |
| LV | - | Low Voltage (< 1 kV) |
| MV | - | Medium Voltage (­1 kV < 36 kV) |
| P&I | - | Piping and Instrumentation |
| SCADA | - | Supervisory control and data acquisition |
| SIS | - | Swedish Standard |
| SLD | - | Single Line Diagram |
| SWG | - | Switch Gear |
| TOC | - | Taking Over Certificate |
| UPS | - | Uninterrupted Power Supply |

# General Technical Requirements

# General Information

## Location of Power Plant Area

The area on which the new generator to be installed under this Contract is located within the existing Male’ Power Station. The available space at site is very restricted and the new generator has to be fitted into the limited area. The lay-out drawings included in the Tender Documents are marked “As-Built”, but do not necessarily represent reliably the situation at site. The Tenderer shall therefore consider these drawings as indicative only without guarantee for individual measurements.

Storage facilities at site and the surrounding area as well as in the port are extremely limited, hence material supply has to be strictly co-ordinated with the installation progress.

## Physical Data

|  |  |
| --- | --- |
| Climatic conditions | Tropical maritime / coastal |
| Altitude above sea level (LLWL) | 1.2 m |
| Atmosphere | Highly saline, corrosive and dusty |
| Average annual rainfall | 2000 mm |
| Maximum daily rainfall | 200 mm |
| Average rain days / year | 153 |
| Absolute highest temperature | 36°C |
| Mean maximum temperature | 34°C |
| Absolute lowest temperature | 17°C |
| Mean minimum temperature | 25°C |
| Maximum sea water temperature | 30°C |
| Normal sea water temperature | ~ 28 to 29 °C |
| Design wind speed | 160 km/h |
| Isokeraunic level | 40 thunder days per year |
| Earth quake risk | Design shall consider earth quake zone 1 |

## Technical Standards and Regulations

Unless specified otherwise in the Tender Documents, the design, material, equipment, execution and testing of the Works under this Contract shall conform to the latest editions of the Standards and Codes.

Prior to the submission of any design, calculations and/or drawings for approval, the Contractor shall provide the Employer with one (1) set (official, complete, unabridged and in English language) of the Standards and Codes applied for the detailed design and execution of the Works.

The unit system to be used throughout the project works shall be that of the S.I. system as far as this is applicable. Deviations may be allowed for workshop drawings, subject to the prior approval by Employer.

## Quality Control / Quality Assurance

### Quality Control and Quality Assurance System

The Contractor shall be responsible to meet the Employer’s minimum requirements for a Quality Control and Quality Assurance System or Procedure.

### Quality System

1. The Contractor shall implement a Quality System that complies with ISO 9001:2000 or any other similar internationally recognized Quality Management System Standard or Specification that is acceptable to the Employer.
2. If any part of the Contract is sub-contracted, the Sub-Contractor(s) shall also implement a Quality System that complies with ISO 9001:2000 or any other similar internationally recognized Quality Management System Standard or Specification that is acceptable to the Employer, as appropriate for the sub-contracted work.
3. The Contractor shall remain ultimately responsible for the Quality of all plant and equipment to be supplied and all Works to be performed under the Contract, including the Sub-Contractor(s)’.
4. The Standard to be selected shall cover all work activities from tendering and contract award to completion of the Contract, such as contract management, design and engineering, material procurement, provision of goods and services, construction, planning and scheduling, progress measurement, reporting, ‘as-built’ documentation etc.
5. It is preferred that the Contractor and/or its Sub-Contractor(s) have a Third Party Registration of their Quality System. The registration shall be from any Accredited Certifying Body (for example BSI, BV, DNV, Lloyds, ABC, TUV, etc.) who is themselves accredited by a National Accreditation Authority to assess Quality Systems.
6. Where a Contractor and /or its Sub-Contractor(s) do not have Third Party Registration, they shall demonstrate that they have a Quality System that complies with ISO 9001:2000.

### Quality Documents to be submitted with Tender

1. The required QC/QA Documents to be submitted along with the Contactor’s Tender shall be used by the Employer to evaluate the Contractor’s capability to deliver a quality product and/or services that will satisfy the Contract requirements.
2. As a minimum the following shall be submitted along with the Tender:
3. If the Contractor has Third Party Registration, a valid copy of ISO 9001: 2000 Certificate.
4. If the Contractor is not certified to ISO 9001:2000, the Contractor shall submit evidence that an acceptable internationally recognized Quality Management System Standard or Specification coherent with the Contract scope of work is in operation. This requirement can be fulfilled by submitting any of the following:

* Copies of System and Compliance Audit Report with satisfactory result prepared for another similar contract or project.
* A copy of Baseline Systems Audit Report on the Contractor’s Quality System by an accredited Certifying Body who carried out an Audit against ISO 9001:2000.

### Quality Documents to be submitted after Contract Award

1. In the event of a successful Tender by the Contractor, a project specific Project Quality Plan (PQP) shall be prepared and submitted for the Employer’s review and comments. The PQP shall then be submitted to the Employer’s QC/QA Department for approval.
2. Upon acceptance and approval of the PQP all documents specified or listed therein shall be collated or developed and submitted for acceptance and approval in the same manner as the PQP, i.e. review by Employer and approval by the Employer. The same manner shall apply to Sub-Contractor(s)’ quality and work documents.
3. The PQP document shall form part of the Contract. The PQP shall be the basis for the implementation of the Project Quality Management System and shall be applied throughout the duration of the Contract.
4. It is the sole responsibility of the Contractor that the PQP and all other documents specified or listed therein shall be developed, accepted, and approved to its final form within the time schedule stipulated by the Contract. The approval or rejection of these documents shall not be construed as a liability in the part of the Employer. No Works shall commence prior to approval of these documents specified or listed therein unless explicitly permitted by the Employer in writing.
5. The Project Quality Plan shall consist of, but not be limited to:
   1. Index;
   2. Revision status, together with the control mechanism and a Distribution List. Distribution shall be as per the Contract, but shall include the Head of the Employer’s QC/QA Department;
   3. Details of Contractor’s procedures for preparing, reviewing, revising and re-issuing the Project Quality Plan during the Contract;
   4. Detailed description of all Quality related aspects, as applicable, of the Scope of Work of the Contract;
   5. Identification of all main work activities and sub-activities to be controlled by the PQP;
   6. Identification of activities that will be carried out by the Sub-Contractor(s), including details of Sub-Contractor(s)’ Quality System, and how it will be monitored and controlled by the Contractor;
   7. Organizational structure specific to the Contract identifying job title, functions, and responsibilities of management and staff;
   8. A list of applicable Procedures, Work Instructions, Inspection and Test Plans, etc. The list itself shall be considered as Controlled Document.

As a minimum this shall include:

1. List of Corporate Quality Systems Manuals, Work Procedures, Method Statements, etc. that shall be used on the Contract;
2. List of Contract specific Work Procedures, Work Instructions, and Method Statements etc., by Sub-Contractor(s) for assigned work activities;
3. List of forms and formats with unique numbers that will be used in Contractor’s Quality Management System;
4. List of applicable Quality Control Plan and/or Inspection and Test Plans to be used in the project.
   1. Audit Execution Plan which shall include:
5. Audit Plan and procedure on conduct of audits;
6. Internal Audit Schedule;
7. External Audit Schedule of Sub-Contractor(s).
   1. Where the services of a Third Party Certification is required by the Contract, this section of the Project Quality Plan shall Include details of the Third Party Certification Authority and of the services that they will provide.
8. All documents, procedures, method statements, inspection and test plans, quality control plans, etc. that are listed in the approved Project Quality Plan shall be prepared by the Contractor and submitted to the Employer. These documents, if required, shall be subject to changes, revisions, amendments to during the progress of Works.
9. The approval of revised document shall be as per original procedure. The Contractor shall take necessary action to change as well all related document/s that are affected by the change of revision on any document e.g. Project Quality Plan.
10. Other procedures, method statements, test plans, etc. that are not listed in the approved Project Quality plan but found to be required during the execution of works shall be prepared by the Contractor as advised by the Employer. The control and approval of which shall be in accordance with the normal procedure.
11. The Contractor shall be responsible for any discrepancies, errors or omissions in the documents supplied by him, whether such documents have been approved or not.

### Quality Management during the Contract

1. General and specific quality matters shall be reported by the Contractor in the Contract Weekly/Monthly Reports. Example of these quality matters are results of tests and inspections carried out on site, analysis of non-conformance and corrective actions, areas of concern or weakness identified in the Quality System.
2. The Contractor shall nominate a Management Representative who shall have defined responsibility for the implemented Quality System, in accordance with Clause 5.5.2 of ISO 9001:2000 and as laid out in the PQP.

### QC/QA and Verification Personnel

1. The Contractor shall assign sufficient Quality Control /Assurance Personnel to the Contract to ensure that the Quality Management System, Quality Assurance and Quality Control are effectively established, implemented and maintained throughout the Contract.
2. The Contractor shall assign a QA Employer at the construction site. There shall be sufficient inspection personnel to cover all disciplines, work, and activities, and all Sub-Contractor(s)’ work and off site facilities.
3. The QA Employer shall report to the QA Manager, and the QC Inspectors to the QA Employer. The duties and responsibilities of QA Employer and QC Inspectors shall be established and documented in the PQP.

### Records

1. Records are “Documents stating results achieved or providing evidence of activities performed” as defined by ISO 9000:2000. These shall be properly controlled and maintained throughout the duration of the Contact. It can be any written account of facts obtained from an observation or an event, a chart, a completed form or any document which furnishes objective evidence of activities performed or results achieved.
2. A documented procedure shall be established by the Contractor and its Sub- Contractor(s) to define the controls required for the identification, storage, protection, retrieval, retention time, and disposition of records.

### Quality Auditing

1. The Contractor shall plan and carry out Internal Audits of their Quality System and External Audits of their Sub-Contractor(s) on a regular basis throughout the Contract period.
2. Compliance audit shall be carried out at least once per month on all ongoing activities.
3. The Audit shall be conducted in accordance with the Contractor’s written procedure which shall be reviewed by the Employer and approved by the Employer. The Audit Execution Plan or Procedure shall be written, executed and included in the PQP using the guidance of ISO 19011 series.
4. An Audit Schedule shall be prepared and included in the Project Quality Plan.
5. The Employer shall be included on the distribution list for all Contractor’s Internal and External Audit Notifications and shall be invited to participate in audits. The Employer reserves the right to choose whether or not to attend the audit.
6. Qualifications of Contractor’s External and Internal Auditors shall be established in the Audit Plan.
7. The Audit Procedure or Audit Execution Plan shall specify the contents of an

Audit Report, which shall include as a minimum:

a) List of Corrective Action Request (CAR), if any, stating clearly details of non-conformance found, preventive actions to be taken and date of Completion of Corrective Action;

b) Log of CAR’s showing Follow up and Close out status.

1. The Contractor shall maintain a summary log of all Corrective Action Requests raised during Internal and External Audit.

### Control of Non-Conforming Product

1. A documented procedure shall be established by the Contractor to ensure that product(s) (goods or services) that do not conform to requirements stipulated in the Contract is identified and controlled to prevent its unintended use or delivery.
2. Non-conformities shall be recorded in a Non-conformance report (NCR) together with their disposition. A log of all NCR’s raised shall be maintained and included in the Regular Reports.
3. Disposition of non-conformities reported shall be proposed by the Contractor, and shall be reviewed and approved by the Employer.
4. The documented procedure to control non-conforming product(s) (goods or services) shall be a controlled document and shall form part of the PQP.
5. When non-conforming product(s) or service(s) are corrected this shall be re- verified by the Employer to determine conformity to Contract requirements.

### Corrective Action

1. A documented procedure shall be established by the Contractor to identify and plan actions so that non-conformities reported do not recur.
2. The procedure shall define the requirements for non-conformity review, determination of root causes for the non-conformity, evaluation of the need for actions to ensure that non-conformities do not recur, determination and implementation of action needed, records of action taken and review of the corrective action taken.
3. The defined corrective action shall be focused on eliminating causes of nonconformity recorded.

### Preventive Action

1. A documented procedure shall be established by the Contractor to identify and plan actions to eliminate the cause of potential non-conformities and to prevent their occurrence.
2. The procedure shall define the requirements for determination of potential non- conformity and their causes, evaluation of the need for actions to prevent occurrence of non-conformities, determination and implementation of action needed, record of results of action taken and review of the preventive action.

### Inspection, Measuring, and Test Equipment

1. The Contractor shall supply all inspection, measuring, and test equipment required for inspection and testing. The equipment shall be calibrated at the start of the Contract and re-calibrated as required by the Manufacturer, Contract specification(s), international codes and standard or job conditions.
2. Calibration records shall be available for review by the Employer and shall be kept and maintained by Contractor at construction site/work location.
3. Contractor shall ensure proper and adequate handling, preservation, and storage condition such that the accuracy and fitness for use are maintained.
4. The Contractor shall establish and maintain documented procedures to control, calibrate, and maintain inspection, measuring, and test equipment in accordance with the relevant clause of ISO 9001:2000.

### Third Party Certification

1. Where Third Party Certification is specified in the Contract, the Contractor shall use the services of an internationally recognized Third Party Certification Authority or Society.
2. The approval or acceptance of this Third Party Certification Authority or Society shall be to the sole discretion of the Employer.

## Technical Documents and Drawings

The Contractor shall prepare and furnish to the Employer all documents, which are required for the execution of the Works and for their operation and maintenance after successful commissioning.

### General

This section specifies the general scope and gives a definition of the documents which, together with those listed in the Conditions of Contract, shall be delivered by the Contractor to the Employer within the periods, and in the number and quality as specified in the General and Particular Conditions of Contract.

The Employer reserves the right to request from the Contractor additional documents as may be required for proper understanding and definition of constructional, operational, co-ordination or other matters.

The Contractor shall coordinate with his Sub-Contractors in the exchange of drawings, dimensions, data and all other information required to ensure proper execution of the work. All documents to be supplied shall be submitted in time so that any comment and change requested by the Employer can be taken into account before starting of the manufacture in the workshop and/or erection or installation at site.

In case the Contractor fails to submit such documents, he shall be held responsible for the execution of any subsequent changes requested by the Employer and the resulting additional cost and/or delay. The Contractor shall not be released of his responsibility and guarantee after drawings and computations have been approved by the Employer.

The preparation of drawings, computations or other technical documents shall not be sublet by the Contractor without the written authorisation of the Employer. In such a case the Contractor has full responsibility as if they were done by himself.

On drawings, catalogue sheets or pamphlets of standard equipment submitted to the Employer, the applicable types, paragraphs, data, etc., shall either be marked distinctively or the non-applicable parts be crossed out. Documents not marked in such a manner will not be accepted and approved by the Employer.

If required for proper understanding of the documents, additional descriptions/ explanations shall be given on these documents or on separate sheets. All symbols, marks, abbreviations, etc., appearing on any document shall clearly be explained by a legend on the same document or on an attached sheet.

Each device appearing on any document (drawing, diagram, list, etc.) shall clearly be designated. The abbreviation mark used for an individual device shall be identical throughout the complete documentation so as to avoid confusions. All documents shall have a uniform title-block as agreed by the Employer, irrespective of the origin of the document, provided with an approved identification number.

### Distribution of Documents and Drawings

All documents, correspondence, drawings etc. shall be distributed as shown in the following list and within the terms indicated in the relevant Sub-Clauses:

|  |  |  |  |
| --- | --- | --- | --- |
| ***Documents*** |  | ***To the***  ***EMPLOYER*** | |
|  | ***Head***  ***Office*** | | ***Site***  ***Office*** |
| Set of Contract Documents | 4 |  | 1 |
| Correspondence | 1 |  | 1 |
| Documents for approval | 1 |  | 2 |
| Approved documents | 1 |  | 1 |
| Documents for information | 1 |  | 1 |
| Document submission schedule | 1 |  | 1 |
| Detailed implementation time schedule | 2 |  | 1 |
| Monthly project progress reports | 2 |  | 1 |
| Insurance certificates | 2 |  | - |
| Receiving cum Damage Report | 1 |  | 1 |
| Codes and Standards | 1 |  | - |
| Quality Assurance Program | 1 |  | 1 |
| Health, Safety, Environment (HSE) Regulations | 1 |  | 1 |
| Site test procedures for approval | 1 |  | 1 |
| Approved site test procedures | 1 |  | 1 |
| Site test reports | 3 |  | 1 |
| Performance test schedule for approval | 1 |  | 1 |
| Approved performance test schedule | 1 |  | 1 |
| Performance test procedure for approval | 1 |  | 1 |
| Approved performance test procedure | 1 |  | 1 |
| Performance test reports | 3 |  | 1 |
| Workshop test program | 1 |  | 1 |
| Workshop test reports and certificates | 3 |  | 1 |
| Preliminary as-built drawings | - |  | 1 |
| Final as-built drawings | 5 |  | - |
| Final as- built drawings in AutoCAD format and as PDF files on CD-Rom | 5 |  | - |
| Preliminary O&M manuals for approval | 1 |  | 1 |
| Approved final O&M manuals | 5 |  | - |
| Monthly project progress reports | 3 |  | 1 |
| Project completion report | 3 |  | 1 |
| Progress photos | 1 |  | 1 |
| Progress photos on CD-Rom | 1 |  | - |
| Completion photos | 2 |  | 1 |
| Completion photos on CD-Rom | 1 |  | - |
| Payment invoices | 2 |  | - |
| Final list of spare parts | 5 |  | - |
| Final list of tools | 5 | | - |
| Final list of lubricants | 5 | | - |
| Cash flow schedule | 2 | | - |

### Document Submittal Schedule

The Contractor shall submit within the period stipulated in the tender document Submission Schedule for all drawings, calculations, which are subject to approval.

### Design, Drawings and Calculations

#### General

The Contractor shall commence his design work immediately after contract award. During the preliminary stage of the Contractor's design work, he shall submit to the Employer in advance drawings and documents for information and general review, as a basis for initial design meetings. As soon as the quality, completeness, and conformity with the Employer’s Requirements have reached a satisfactory level, the Contractor shall issue the drawings and documents for approval, priority being given to the drawings and calculations necessary for civil engineering works in order to prevent any delays in the execution of the Works.

All designs and drawings to be submitted for approval as well as the “as-built” drawings shall be prepared in the latest AutoCAD format or with an AutoCAD compatible programme. The necessary software shall be made available to Employer.

All drawings shall be plotted to scale in the metric system and marked accordingly.

Drawing sizes shall be DIN A4, A3, A2, Al and not larger than A0. Sections and details of parts of the work shall be shown on the same drawing of the work to which they relate. All notes necessary for the proper understanding and execution of the work shown on a drawing shall be printed on the said drawing.

All drawings shall have a drawing title block, serial number, issue record and scale subject to the approval by Employer. All drawings prepared by Sub-contractors/Sub-suppliers shall be in accordance with this provision.

All design calculations shall be provided in checkable form. Hand-written calculations are not acceptable.

Drawings to be supplied by Sub-contractors/Sub-suppliers shall be checked thoroughly by the Contractor with special regard to materials, measurements, sizing of components, compatibility, and other details to satisfy himself that they conform to the requirements and the intent of the technical specifications, and the Contractor shall place thereon the date of his approval. Drawings found to be inaccurate or otherwise in error shall be returned to the Sub-contractor for correction before submitting the same to the Employer.

#### Arrangement Drawings/ Dimension Drawings

All arrangement drawings shall be drawn according to scale. The General Arrangement Drawings shall show the physical arrangement of equipment (machines, tanks, switchgears, control panels, etc.), civil constructions (buildings, rooms, foundations, ducts, etc.) and reserved areas (for pipes, cables, lines, etc.) in relation to each other and to agreed coordinates and boundaries. Such drawings shall be prepared for the whole plant and for each building (building, hall, room, ducts and trenches, etc.).

The Arrangement or Layout Drawings of electrical and instrumentation and control equipment shall indicate the location of all apparatus wherever used, i.e. in or on machines, control boards, switchboards, cubicles, panels, etc. The apparatus shall be denominated with the same standardised abbreviations as used in all other documents.

The Dimension or Outline Drawing shall show all elements and the main dimensions of individual construction units where necessary with plan, section, side and top views. If reasonably possible such dimensions can be shown on Arrangement Drawings.

#### Installation Drawings

The mechanical, electrical and I&C Installation Drawings shall provide detailed information on the disposition of the various items of a system (e.g. compressors, pumps, valves, lighting fixtures, socket outlets, connection boxes, transmitters, actuators, loudspeakers, telephones etc.) and of the piping, cabling and wiring comprised in the installation or assembly. They shall be based on dimension drawings of buildings, areas, rooms, cubicles, etc. containing the equipment.

#### Submission of Documents and Drawings

The Contractor shall prepare all necessary principal and detail drawings etc., giving full and complete information to enable the Employer to properly consider the design of the work. Drawings and documents that require approval by the Employer shall be submitted to the Employer on the dates stipulated.

Drawings shall be submitted without delay in the order in which they are required for ordering of materials and/or manufacture of equipment and/or installation at site.

All drawings prepared or supplied by the Contractor shall be marked with the title of the work, certified by the Contractor and Sub-contractor respectively, and shall be transmitted to the Employer in as many copies as specified in Sub-Clause 2.5.2. Each transmission of drawings shall be accompanied by a document transmittal sheet stating the numbers and titles thereof. The format of the document transmittal sheet shall have received prior approval by Employer.

The Contractor shall submit, in accordance with his program approved by the Employer, schedules of plant assembly drawings, major assemblies and plant layout drawings, civil and building work drawings, schematic and flow diagrams, wiring diagrams, complete with mechanical and electrical services, together with such detailed drawings as may be necessary for the Employer to review the design. The sequence of submission of all drawings shall be such that all information or data are available for checking each drawing when it is received.

#### As-built Drawings

All drawings, which require modifications as a result of construction and erection work and/or operational experience, shall be constantly updated on site by the Contractor and re-issued marked “as-built”. All revised details shall be fully described on each working drawing and shall be clearly marked by an enclosing indication marking.

During the commissioning period the updated drawings shall be checked by the Contractor and certified by the Employer’s / Employer’s representative. These updated drawings are the basis for the “as-built drawings".

Final drawings of the Work as completed, i.e. the "As-built Drawings", shall be prepared by the Contractor and forwarded to the Employer in as many copies as specified hereinbefore. These drawings shall be in sufficient detail to enable the Employer to maintain, dismantle, reassemble, and adjust all parts of the work.

All drawings incorporated in the O & M manuals as well as all key drawings, i.e. general arrangement drawings, system diagrams, flow diagrams, single line diagrams, control diagrams, etc. shall in addition to the original dimension be supplied in a reduced DIN A3 or DIN A4 size.

Upon taking over, and prior to issuance of the TOC, the Contractor shall furnish the Employer’s site office with one set of “as–built” single line diagrams, flow diagrams, and P&I diagrams, mounted on boards with an acrylic facing suitably framed.

### Document Approval Procedure

#### General

As far as Contractor’s specifications, drawings, design calculations, data sheets, etc. for the Works are concerned, they are subject to approval by Employer. Any manufacture or construction carried out prior to such approval will be at the Contractor’s own risk and expense.

The Contractor shall allow not less than the period prescribed in the General Conditions of Contract for the review and approval of documents - fully compliant with the Employer’s Requirements - by the Employer. This period will start on the receipt of the submittals in both the Employer’s / Employer’s head office and local site office.

The Employer is entitled to reject documents if they are not orderly prepared, obviously not checked by the Contractor (if documents are prepared by Sub-contractors), or not properly declared.

#### Submission for Approval

All documents submitted for approval shall be accompanied by a transmittal letter, listing the said documents. The transmittal letters shall be serially numbered, the relevant number to be entered on each submitted document.

Every copy of a document sent for approval shall be clearly marked "For Approval" in a visible place. The Employer may, however, decide to mark such document “Not Subject to Approval” if deemed necessary.

Documents for which no approval is required shall clearly be marked "For Information Only" in a visible place. The Employer may however treat such document as sent for approval, if deemed necessary.

Documents prepared by Sub-contractors shall bear a stamp from the Contractor and the name and signature of his responsible Employer certifying that the documents have been checked by him. Sub-contractor's Documents without the Contractor’s certification mark may be rejected and returned to the Contractor.

When submitting documents, whether for approval or for information only, the Contractor is obliged to indicate plainly and unmistakably any deviation from the Employer’s Requirements and to ask the Employer explicitly for approval of such deviation. Failure to do so does not release the Contractor from his obligations of strict compliance with the Employer’s Requirements even if the documents submitted by the Contractor were approved by the Employer.

Any major deviation from the Employer’s Requirements proposed by the Contractor and approved by Employer shall be subject to the General Conditions of Contract.

#### Categories of Approval

As far as documents submitted for approval are concerned, the Employer will notify the CONTRACTOR by returning one copy marked with one of the following notations:

1. "Approved"
2. "Approved Except as Noted"
3. "Not Approved"
4. "For Information Only".

These notifications shall be interpreted as follows:

Notification (1) "Approved" authorises the Contractor to commence or to proceed with the work in compliance with his contractual obligation.

Notification (2) "Approved Except as Noted" constitutes an approval in principle, however, with reservations marked by the Employer on the document itself or noted in a separate comments sheet. Notification (2) authorises the Contractor to proceed with the work, however, subject to all corrections noted on the document or on a comments sheet, and after he has made sure that the work at this stage is in full compliance with the Employer’s Requirements.

Notification (3) “Not Approved” indicates that the document has been rejected and needs to be revised owing to the reasons stated by the Employer. Notification (3) does not authorise the Contractor to proceed with the work as per the submitted document.

Notification (4) “For Information Only” denotes that no approval is required and that the documents are considered for information only. Although such documents are not subject to the Employer's approval, the Employer may raise objections to or make comments on them that shall be taken into consideration by the Contractor.

#### Revision of Documents

If a document has been modified or revised in accordance with the annotations of the Employer, it shall bear a revision index together with the date of revision, and an indication of the changes clearly stated and circled on the relevant document and marked with the revision index.

After correction, the document shall be resubmitted by the Contractor to the Employer for approval within 21 days from receiving the document.

The Contractor shall not proceed with any site activities unless the respective “Approved” and/or “Approved Except as Noted” drawings are available on the Site.

The Employer's approval of the Contractor's and/or Sub-contractor's drawings shall not relieve the Contractor from his responsibility for errors or omissions, which may exist, even though work is done in accordance with such approved drawings. If such errors or omissions are discovered later, they shall be corrected and the work shall be made good by the Contractor at his own expense, irrespective of any approval by the Employer.

The dates whenever drawings and other documents were submitted to the Employer, approved by the Employer, revised by the Contractor and re-submitted to the Employer, and finally distributed by the Contractor shall be entered by the Contractor in schedules for every type of document (drawings, calculations, specifications, motor lists, etc.). These document submittal schedules shall continuously be up dated by the Contractor and submitted to the Employer as and when requested.

### Operation and Maintenance Instruction Manuals

#### Draft O & M Instructions

The Contractor shall prepare and submit preliminary draft operation and maintenance instructions for all important plant and equipment to the Employer for their comments and approval at least eight (8) weeks prior to the programmed start of pre- commissioning tests. The manuals shall be in sufficient detail to allow the Employer to supervise the commissioning work,

The approved preliminary instruction manuals as above shall be submitted to Employer in required number of copies for use during pre-commissioning and commissioning works, and to serve as training material for the Employer's personnel.

The Contractor shall revise and update the operation and maintenance instructions during commissioning as necessary and introduce all such modifications into the preliminary manuals.

#### Final O & M Manuals

The final Operation and Maintenance Manuals shall be submitted to the Employer not later than two (2) months after the issuance of the TOC.

The number of volumes/parts making one set of complete manuals and the content of each volume shall be subject to the approval by Employer. The volumes shall, in general, be grouped major equipment wise and contain the operating and maintenance instructions, relevant approved drawings, factory routine test reports, etc.

All documents shall be properly bound in book form, containing all information, description of equipment, operating procedures as well as operating forms and operator's log sheets for all mechanical and electrical plant and equipment. They shall include all detailed instructions and schedules for periodical overhauls of plant and equipment. The various instructions shall be written in a style easily intelligible for the operating and maintenance personnel, explaining for various situations what is to be done and why.

All records of workshop tests and of site acceptance tests shall be included in the instruction manuals.

The Contractor shall further prepare, assemble, and submit complete spare part lists for all equipment supplied by him or by his Sub-contractors. These lists shall be incorporated into the respective instruction manuals.

## Identification of Plant Items and Documents

### Plant Identification

The Contractor shall be responsible for ensuring that all individual plant items are identified both at Site and within the drawings according to the KKS (KRAFTWERK-KENNZEICHEN- SYSTEM = Designation System for Power Plants) tag numbering convention.

The KKS classification system (ISO proposal) is published by VGB (Technical Association of Large Power Plant Operators), KRAFTWERK TECHNIK GMBH, Verlag für Technisch- wissenschaftliche Schriften, Klinkestrasse 27 - 31, D - 45136 Essen/Germany.

### List of Plant Identification Numbers

This list shall contain the used plant identification numbers in alphanumeric order and for each of them a description (the defined equipment denomination, for example as written on the equipment label) and the location (short definition of outdoor area and level elevation, or building/room with level elevation and room number).

### Labels

All components of the plants as well as components for monitoring, controlling, indicating, announcing, acting, switching, alarming, measuring and maintenance shall be provided with labels, showing the KKS number, the name of the equipment and the control system number, if this number is different from the KKS number. The labels shall -depending on the purpose for which they are to be used - either be made of non-transparent or translucent heat-resisting synthetic resin, or stainless steel, or yellow brass.

These labels shall have a width of minimum 35 mm and a length, required for the numbering respectively name and additionally at each side a length equal to the width, where screw holes for the stainless steel screws (minimum size M3) shall be located. In case, the equipment is small relative to the label, a separate stainless steel support shall be provided and installed, holding the label in a position, which allows good reading. Labels shall be written in the contractual language. The letters and numbers shall have a minimum height of 8 mm and shall be engraved by professional means.

The proposed arrangement of the labels (material, colour, size and engravings) shall be submitted to the Employer for approval.

#### Equipment Labels and Instruction Plates

Equipment labels and instruction plates shall be written in the English language. In case of instruments, instrument switches and control switches, where the function is indicated on the dial plate of the switch escutcheon plate, no additional label may be required. The label shall be fixed close to the device in such a way that easy identification is possible. Fixing on the dial glass of instruments will not be accepted. The wording shall conform to the wording used in the relevant P&I diagrams or system drawings.

All construction units shall be identified by their plant identification number. Cubicles and similar units shall also bear this identification number on the rear side if rear access is maintained.

All equipment inside cubicles, panels, boxes, etc., shall be properly labelled with their individual item number. This number shall be the same as indicated in the pertaining documents (wiring diagrams, equipment lists, etc.).

Each separate construction unit (cubicle, panel desk, box, etc.) shall be provided with top mounted labels made of anodised aluminium with black inscriptions giving the overall designation.

#### Warning Labels

Warning labels shall be provided for all dangerous areas of the power plant. Warning labels shall be made of synthetic resin with engraved letters.

LV switchboards located outside electrical rooms shall have yellow labels, with 5 cm black letters reading "ATTENTION ... V" (indicating the service voltage).

Transformer boxes shall have red labels with 7.5 cm white letters reading "ATTENTION HIGH VOLTAGE ... kV" (indicating the service voltage).

Labels (lettering as before) shall also be fixed at door to switchgear rooms.

Battery rooms shall be provided with a white label reading "BATTERY ROOM", engraved in black.

#### Instruction Plates for an Emergency

In case of an emergency instruction plates shall help to rescue live and to prevent damages. The Contractor shall provide the plates in the contractual language (e.g. "EMERGENCY EXIT“).

#### Nameplates

Equipment (machines, transformers, etc.) nameplates shall be of stainless steel, covered with a transparent paint after printing, stamping or engraving. The name plate texts shall be in the contractual language.

### Document Identification

The Employer has implemented a standardization scheme for the identification of correspondence, minutes, reports, drawings and other documents, known as CSD (Classification System for Documentation). This system shall also be applied to all documents under this project. Further information about the CSD system will be provided to the Contractor after award of Contract.

## Painting and Corrosion Protection

### General

This specification defines the requirements for surface preparation and painting as well as the application of protective coatings for structural steel, equipment, piping, tanks, electric switchboards and panels etc. for the entire power plant.

After the Contract has been awarded, the Contractor shall submit promptly the name of the proposed coating supplier and applicator together with a painting and coating schedule and with a quality assurance program for approval.

The following standards with their latest additions are guiding this specification:

1. Swedish Standard SIS 05 59 00 / ISO 8501-1
2. DIN 30670.

The Employer shall, at all times, have access to the works in order to inspect surface preparation or application of work in progress in the workshop as well as on site.

Should any work or product be found to be defective or not in compliance with the specification, correction or replacement shall be made by the Contractor at his own cost.

The Contractor shall bear the full responsibility for the application of coatings, applied by him on surfaces, primed or painted by others.

Covers should be used where required to protect structures, equipment, insulation, and lagging. When surfaces have been stained or otherwise damaged by the painting and/or surface preparation work, the Contractor shall be responsible for thorough cleaning and/or repairing of these surfaces.

Scaffolding shall be erected, maintained, and dismantled without damage to equipment, piping, machinery, or structures.

Parts which cannot be coated and which are very sensitive to atmospheric exposure must be effectively packed for storage. The inside of equipment and machinery shall be cleaned thoroughly at works, and before transportation all holes and access openings shall be effectively sealed in order to prevent infiltration of dirt and humidity.

Treated and machined parts not to be painted shall receive a provisional corrosion protection.

Unless otherwise specifically indicated, surfaces such as stainless steel, brass, copper or any other nonferrous items, finished hardware, aluminium windows, etc. shall not be painted.

**Note:**

Structural bolts shall be galvanized or cadmium plated and painted as specified under painting systems for carbon steel surfaces.

### Protective Coatings and Paint Systems

Type and number of protective coatings for any item which requires corrosion protection on this project shall be proposed by the Contractor in order to meet the afore mentioned warranty requirement.

The hereinafter specified painting system is given as a minimum requirement in order to achieve the desired durability of the paintings.

The intention of the coating specification is to protect all parts which require corrosion protection with a prime coat which should be applied at supplier's works. Only touch up of bolts, welds, and damaged areas will be required for field priming of these items.

For parts which are not likely to be damaged during transportation, the Employer may give the approval to apply the full number of coats to these parts in the workshop.

### Galvanising

For surfaces where galvanising is specified, all galvanising shall be carried out by the hot dip process, and unless otherwise specified shall conform in all respects to BS 729 and BSEN 10143. The detailed design of members shall be in accordance with BS 4479.

### Conditions for Painting

In general, coatings shall not be applied when the temperature of the steel is below +5°C. Surface temperature must be at least 3°C above the dew point to ensure that condensation does not occur on the surface. In order to prevent condensation on the steel surface, the relative humidity must be checked continuously.

In hot climates coating materials should not be applied if the steel temperature is above

+50°C.

No coating should be executed during dust storms and rain.

If more stringent, the manufacturers' recommendations may supersede the above subject to the approval by the Employer. Special exceptions for applications at higher or lower temperatures are possible if approved by coating supplier and the Employer at Site.

### Safety Precautions

All necessary precautions shall be taken by the Contractor to protect personnel and property from hazards due to falls, injuries, toxic fumes, fires, explosion, or other harm.

All painting and corrosion protection work, including the inside of buildings and vessels, shall be performed under strict safety conditions.

The Contractor shall be responsible for adequate ventilation, protection from open flames, sparks, and excessive heat, by taking into consideration the high temperatures prevailing especially during summer. The areas where this work is performed shall be clearly marked with warning signboards.

The Contractor shall be responsible to ensure that all work to be done and all equipment used is in accordance with the local authority regulations. The Contractor also shall follow the safety regulations of the relevant local or plant safety department.

### Surface Preparation

The life of a coating system depends primarily on surface preparation. Therefore, the Contractor shall precisely follow the degree of specified surface preparation in this specification.

**Steel**

The surface preparation of this specification is governed by the Swedish Standard SIS 05 59 00, now ISO 8501-1, which identifies the following Surface Preparation Grades:

* Light blast cleaning Sa 1
* Thorough blast cleaning Sa 2
* Very thorough blast cleaning Sa 2 ½
* Blast cleaning to pure metal Sa 3

The abrasives used for blast cleaning shall be grit, shot, or graded flit and shall be such that they will produce an average anchor pattern of 25-50 microns.

After blast cleaning all accumulated blasting material, dust etc. must be removed, leaving a surface which is clean, dry, and free of mill scale, rust, grease and other contaminants.

The blasted steel shall be primed as specified in the specification immediately after blasting and cleaning to avoid rusting.

Before field touch up, all surfaces to be touched up, such as bolting, welding and un-primed plates shall be cleaned from all rust, scale, welding contaminants, grease, oil and other foreign matters. Damaged primer shall be removed from welded or defective areas until sound primer is encountered.

Surfaces which have been coated, but are not meeting the standards of this specification, shall be re-blasted and coated at the Contractor's cost.

Reference to other international specifications on surface preparation is made below:

**Galvanised Surfaces**

Galvanised surfaces shall be solvent cleaned to remove oil. After that the surface shall be etched or sweep blasted in accordance with manufacturer's recommendation.

Application of paint or stain should be done in accordance with manufacturer's recommendation.

### Coating Material and Application

The Contractor should use only coating materials which meet the requirement of this specification. Unless otherwise accepted, all field coats of a system must be products of one manufacturer.

The preferred application method for the specified coating systems is by airless or conventional spray equipment. Where spray equipment is required, the equipment, adjustments, and air pressure shall conform to the manufacturer's recommendation and shall be subject to approval by the Employer. Where the application by brush or roller is required due to special circumstances, the Contractor shall apply in writing, separately for the Employer’s approval.

Regarding storage of paint and coating material as well as mixing and application, the

Contractor shall follow the application instructions of the coating manufacturer.

The colours of the different coats shall differ sufficiently for control purposes.

The specified dry film thicknesses are minimum requirements. Therefore, sufficient wet film thickness per coat shall be applied to obtain the specified dry film thickness after drying or curing. The Contractor shall follow the manufacturer's instructions and shall use wet film as well as dry film thickness gauges.

Drying time between coats shall conform to the manufacturer's recommendations and shall be strictly followed.

### Inspections by Employer

Inspection by the Employer will not release the Contractor from his responsibility for the correct performance of the work and for applying strictly the approved quality control procedures.

The Contractor shall be responsible for taking liquid samples of the paint and coating materials during the construction period, and to retain these samples at the jobsite for reference in the event of coating failure. Retained samples must be kept at least until the warranty / Defects Notification Period has expired.

For quality control and inspection the following standards and instruments, which should be in a satisfactory working condition, shall be provided:

* Swedish Standard SIS 05 59 00
* Kean Tator surface comparator
* Material thermometer
* Surface temperature gauge
* Sling psychrometer
* Non destructive dry film thickness gauge
* Wet film thickness gauge
* Non destructive pinhole detector (for tank linings and immersed surfaces).

The Contractor shall be responsible for preparing a daily record of the painting work. The record shall indicate the locations and types of surfaces coated, the name of products applied, type of surface preparation and dry film thickness per coat. The record should also include information about air temperature, steel temperature, and relative humidity. The Contractor will supply the Employer with a copy of each daily record on a weekly basis.

### Colour Schedule

After award of the Contract the colour schedule for the plant shall be compiled, in accordance with the specifications, by the Contractor for approval by the Employer.

### Painting Systems

The following painting specifications (Systems) are minimum requirements for the different purposes as quoted in the head lines and/or as detailed in the first paragraph of each specification.

#### Carbon Steel Surfaces up to 100°C, Internal Exposure

Carbon steel surfaces, not insulated, indoors, such as structural steel, cranes, air-ducts, pipes, condensers, tanks and vessels' exterior surfaces, valves and fittings.

Temperatures up to 100°C:

**At Works**

|  |  |
| --- | --- |
| Surface preparation | - Blasting according to SIS 05 59 00  - Grade: Sa 2 1/2 |
| Prefabrication |  |
| Primer optional | - Depending on production flow, a weldable single pack inorganic ethyl, zinc silicate shop primer may be used  - Dry film thickness 15-25 microns  - Solids by volume min. 37% |
| Prime coat | - Single pack inorganic ethyl zinc silicate  - Dry film thickness 75 microns  - Solids by volume min. 58% |

**At Site**

|  |  |
| --- | --- |
| Pre treatment | - Thorough cleaning to remove oil, grease, dirt and any  - Other contaminants: De-rusting of all mechanical damages according to SIS 05 59 00  - Grade: Sa 3  - Touch up with 2 pack self-priming aluminium containing high build epoxy with solids by volume content of not less than 85%.  - Dry film thickness 75-100 microns |
| Finish coat | - 2 pack epoxy polyamide  - Dry film thickness 100 microns  - Solids by vol. min. 62% |

Total system minimum dry-film thickness: 175 microns.

**Note:**

When airless spray application is not possible, 2 coats of 2 pack epoxy polyamide cured finish can be applied by roller or brush to achieve specified thickness.

#### Carbon Steel Surfaces up to 100°C, External Exposure

Carbon steel surfaces not insulated, outdoors, such as structural steel, jetty structures non submerged, cranes, air-ducts, pipes, condensers, tanks and vessels' exterior surfaces, valves and fittings and other surfaces.

Temperatures up to 100°C:

**At Works**

|  |  |
| --- | --- |
| Surface preparation | - Blasting according to SIS 05 59 00  - Grade: Sa 2 1/2 |
| Prefabrication |  |
| Primer optional | - Depending on production flow, a weldable single pack inorganic ethyl, zinc silicate shop primer may be used  - Dry film thickness 15-25 microns  - Solids by volume min. 37% |
| Prime coat | - Single pack inorganic ethyl zinc silicate  - Dry film thickness 75 microns  - Solids by volume min. 58% |

**At Site**

|  |  |
| --- | --- |
| Pre treatment | - Thorough cleaning to remove oil, grease, dirt and any  - Other contaminants: De-rusting of all mechanical damages according to SIS 05 59 00  - Grade: Sa 3  - Touch up with 2 pack self-priming aluminium containing high build epoxy with solids by volume content of not less than 85%.  - Dry film thickness 75-100 microns |
| Intermediate coat | - 2 pack epoxy polyamide  - Dry film thickness 125 microns  - Solids by volume min. 60% |
| Finish coat | - 2 pack epoxy polyamide  - Dry film thickness 50 microns  - Solids by volume min. 47% |

Total system minimum dry-film thickness: 250 microns.

***Note:***

For areas where high gloss finish is required, finish coat should be a 2 pack aliphatic polyurethane 50 microns instead of epoxy, with solids by volume min. 45%.

#### Carbon Steel Surfaces up to 200°C

Carbon steel surfaces not insulated, indoors and outdoors, such as air-ducts, pipes, condensers, tanks and vessels' exterior surfaces, valves and fittings.

Temperatures 100°C up to 200°C:

**At Works**

|  |  |
| --- | --- |
| Surface preparation | - Blasting according to SIS 05 59 00  - Grade: Sa 2 1/2 |
| Prefabrication |  |
| Primer optional | - Depending on production flow, a weldable single pack inorganic ethyl, zinc silicate shop primer may be used  - Dry film thickness 15-25 microns  - Solids by volume min. 37% |
| Prime coat | - Single pack inorganic ethyl zinc silicate  - Dry film thickness 75 microns  - Solids by volume min. 58% |

**At Site**

|  |  |
| --- | --- |
| Pre treatment | - Thorough cleaning to remove oil, grease, dirt and other contaminants  - De-rusting of all mechanical damage according to SIS 055900  - Grade: Sa 3  - Touch up with single pack inorganic ethyl zinc silicate, to restore original dry film thickness |
| Intermediate coat | - 1 pack silicone acrylic  - Dry film thickness 50 microns  - Solids by volume min. 36% |
| Finish coat | - 1 pack silicone acrylic  - Dry film thickness 50 microns  - Solids by volume min. 36% |

Total system minimum dry-film thickness: 175 microns.

#### Carbon Steel Surfaces up to 450°C

Carbon steel surfaces not insulated, indoors and outdoors, such as air-ducts, pipes, condensers, tanks and vessels' exterior surfaces, valves and fittings.

Temperatures 200°C up to 450°C:

**At Works**

|  |  |
| --- | --- |
| Surface preparation | - Blasting according to SIS 05 59 00  - Grade: Sa 3 |
| Prefabrication |  |
| Primer optional | - Depending on production flow  - A weldable single pack inorganic ethyl, zinc silicate shop primer  - Dry film thickness 15-25 microns  - Solids by volume min. 37% |
| Prime coat | - Single pack inorganic ethyl zinc silicate  - Dry film thickness 75 microns  - Solids by volume min. 58% |

**At Site**

|  |  |
| --- | --- |
| Pre treatment | - Thorough cleaning to remove oil, grease, dirt and other contaminants  - De-rusting of all mechanical damage according to SIS 055900  - Grade: Sa 3  - Touch up with single pack inorganic ethyl zinc silicate, to restore original dry film thickness |
| Intermediate coat | - 1 pack silicone aluminium  - Dry film thickness 20 microns  - Solids by volume min. 49% |
| Finish coat | - 1 pack silicone aluminium  - Dry film thickness 20 microns  - Solids by volume min. 49% |

Total system minimum dry-film thickness: 115 microns.

#### Oil Tanks - Outer Surface - t 150 °C

|  |  |  |  |
| --- | --- | --- | --- |
| Surface preparation | Blast-cleaning with suitable blasting-material up to Sa 2 1/2 in accordance with SIS 05 59 00 or DIN 55928, part 4. | | |
| Treatment | Colour | Compound | Dry film thickness micron |
| Primer | red-brown | binder: epoxide-/polyamide resin 18-22%  pigments: zinc phosphate, filler 49-53%  solvent: ≤ 32% | 100 \* |
| Intermediate Coat | white-grey | binder: epoxide-/polyamide resin 18-22%  pigments: micaceous iron oxide, filler 49-53%  solvent: ≤ 30% | 80 \* |
| Finish Coat | RAL 9001 | binder: polyacrylate/aliphatic polyisocyanate  26-32%  pigments: titandioxide, filler 27-31%  solvent: ≤ 43% | 40 \* |
| Total: |  |  | 220 |
| Remark: \* airless application | | | |

#### Oil Tanks - Inner Surface - t 70 °C

|  |  |  |  |
| --- | --- | --- | --- |
| Diesel Oil Tanks - Inner surfaces of tank roof, bottom and tank shell - 1 m high | | | |
| Surface preparation | Blast-cleaning with suitable blasting-material up to Sa 2 1/2 in accordance with SIS 05 59 00 or DIN 55928, part 4. | | |
| Treatment | Colour | Compound | Dry film thickness micron |
| Primer | grey | binder: epoxide-/polyamide resin 18-22%  pigments: zinc phosphate, filler 52-56%  solvent: ≤ 30% | 100 \* |
| Intermediate Coat | red-brown | binder: epoxide-/polyamide resin 18-22%  pigments: filler, tint pigments 51-55%  solvent: ≤ 31% | 100 \* |
| Finish Coat | grey | binder: epoxide-/polyamide resin 18-22%  pigments: filler, tint pigments 51-55%  solvent: ≤ 31% | 100 \* |
| Total: |  |  | 300 |
| Remark: \* airless application | | | |

#### Tanks, Interior Water

Tanks for industrial, de-ionised, de-mineralised, and potable water

Temperature up to 60°C, ph range: 4.5 to 9.5:

**At Site**

|  |  |
| --- | --- |
| Pre treatment | - Removal of all welding splatter. Blasting according to SIS 05 59 00.  - Grade: Sa 3 |
| Finish coats | - 3 coats of 2 pack modified phenolic epoxy  - Dry film thickness 125 microns each  - Volume solids min. 56% |

Total system minimum dry-film thickness: 375 microns.

All coatings proposed for the internal protection of potable water tanks shall be certified by an approved independent institute.

#### Carbon Steel - Water Immersion

Carbon steel surfaces, intermittently or continuously immersed in seawater, fresh water, or sewage water, such as

* sheet piling, and coastal works
* hydraulic steel structures
* interior of penstocks and manifolds
* interior of vessels and tanks

Temperature up to 60°C:

At Works

|  |  |
| --- | --- |
| Surface preparation: | - Blasting according to SIS 05 59 00  - Grade Sa 2 1/2 |
| Prime coat | - Inorganic ethyl zinc silicate  - Dry film thickness 70 microns  - Solids by volume min. 62% |

At Site

|  |  |
| --- | --- |
| Pre treatment | - Thorough cleaning to remove oil, grease, dirt and other contaminants  - De-rusting of all mechanical damage, re-blasting of welding areas according to SIS 05 59 00, Grade: Sa 2 1/2  - Touch up with inorganic ethyl zinc silicate to restore original dry film thickness |
| Intermediate coat | - 2 pack epoxy polyamide  - Dry film thickness 40 microns  - Solids by volume min. 47% |
| Finish coats | - 2 coats of 2 pack coal tar epoxy, amine cured  - Dry film thickness 150 microns per coat  - Solids by volume min. 83% |

Total system minimum dry-film thickness: 410 microns.

#### Carbon Steel Fresh Water Immersion

Carbon steel surfaces, intermittently or continuously immersed in fresh water, such as

* dam gates
* rakes
* sluice boards

Temperature up to 60°C:

At Works

|  |  |
| --- | --- |
| Surface preparation | - Blasting according to SIS 05 59 00  - Grade: Sa 2 1/2 |
| Prime coat | - Inorganic ethyl zinc silicate  - Dry film thickness 70 microns  - Solids by volume min. 62% |

At Site

|  |  |
| --- | --- |
| Surface preparation | - Thorough cleaning to remove oil, grease, dirt and other contaminants  - De-rusting of all mechanical damage, re-blasting of welding areas according to SIS 05 59 00, Grade: Sa 2 1/2  - Touch up with inorganic ethyl zinc silicate to restore original dry film thickness |
| Intermediate coat | - 2 pack epoxy polyamide  - Dry film thickness 40 microns  - Solids by volume min. 47% |
| Finish coat | - 2 coats of 2 pack coal tar epoxy, amine cured  - Dry film thickness 150 microns per coat  - Solids by volume min. 83% |

Total system minimum dry-film thickness: 410 microns.

If colour pigmented top coat system is requested, following coats should be applied after pre- treatment:

At site

|  |  |
| --- | --- |
| Intermediate coat | - 2 pack epoxy polyamide  - Dry film thickness 50 microns  - Solids by volume min. 46% |
| Finish coat | - 2 coats of 2 pack epoxy polyamide  - Dry film thickness 90 microns per coat  - Solids by volume min. 50% |

Total system minimum dry-film thickness: 300 microns.

***Note:***

Depending on paint manufacturer's recommendation, the intermediate coat may be applied at works.

#### Galvanised Surfaces

Galvanised surfaces, requiring paint finish, indoors and outdoors

Temperature up to 100°C:

|  |  |
| --- | --- |
| Pre treatment | - Thorough cleaning to remove oil, grease, dirt and any other contaminants  - To obtain min. 25 microns anchor profile sweep blast surface  - If sweep-blasting is not practicable, the surface should be etched |
| Prime coat | - 2 pack epoxy polyamide  - Dry film thickness 50 microns  - Solids by volume min. 47% |
| Finish coat | - 2 pack epoxy polyamide  - Dry film thickness 100 microns  - Solids by volume min. 62% |

Total system minimum dry-film thickness: 150 microns.

***Note:***

For areas where high gloss finish is required, the finish coat should be a 2 pack aliphatic polyurethane 50 microns instead of epoxy.

#### Buried Pipes

Buried steel pipe work, external surfaces

At Works

|  |  |
| --- | --- |
| Surface preparation | - Blasting according to SIS 05 59 00  - Grade: Sa 2 1/2 |
| Apply: | - Extruded polyethylene bandage or a sintered polyethylene coating. Thickness must comply with reinforced standard of DIN 30670 |

At Site

|  |  |
| --- | --- |
| Pre treatment | - Clean uncoated areas to remove oil, grease, weld slag, and loose dirt  - Then apply polyethylene bandage or sintered polyethylene coating to areas and joints  - Thickness should be at minimum the same as applied at works and in accordance with the Employer’s instructions |

#### Mechanical Equipment

Equipment such as pumps, motors, gearboxes, bearings, switchboards, control and relay panels, distribution boxes, transformers, turbines, generators.

|  |  |
| --- | --- |
| Pre treatment | - Blasting according to SIS 05 59 00  - Grade: Sa 2 1/2  - Degreasing, rinsing, pickling or phosphating |
| Prime coat | - 2 pack epoxy polyamide primer  - Dry film thickness 50 microns  - Solids by volume min. 47% |
| Intermediate coat | - 2 pack epoxy polyamide tie coat  - Dry film thickness 50 microns.  - Solids by volume min. 47% |
| Finish coat | - 2 pack aliphatic polyurethane  - Dry film thickness 50 microns  - Solids by volume min. 45% |

Total system minimum dry-film thickness: 150 microns.

**Note:**

Equipment supplied with manufacturer's standard coating system can be approved if the quality of the coating system meets the quality of above system. The Contractor shall submit details of the applied coating system for prior approval by Employer.

#### Steel Floors etc.

This Section applies, unless otherwise specified for galvanising, to:

* Steel floors
* Chequer plates
* Galleries
* Stairways
* Treads
* Kick steps, etc.

At Works

|  |  |
| --- | --- |
| Surface preparation | - Blasting according to SIS 05 59 00  - Grade: Sa 2 1/2 |
| Prefabrication |  |
| Primer optional | - Depending on production flow, a weldable single pack inorganic ethyl, zinc silicate shop primer may be used  - Dry film thickness 15-20 microns  - Solids by volume min. 37% |
| Prime coat | - Single pack inorganic ethyl zinc silicate  - Dry film thickness 75 microns  - Solids by volume min. 58% |

At Site

|  |  |
| --- | --- |
| Surface preparation | - Thorough cleaning to remove oil, grease, dirt and other contaminants  - De-rusting of all mechanical damage according to SIS 055900  - Grade: Sa 3  - Touch up with 2 pack self-priming aluminium containing high build epoxy with solids by volume content of not less than 85%  - Dry film thickness 75-100 microns |
| Intermediate coat: | - 2 pack epoxy polyamide  - Thickness 100 microns  - Solids by volume min. 62% |
| Finish coat | - 2 pack epoxy polyamide  - Dry film with non skid properties  - Dry film thickness 100 microns  - Solids by volume min. 62% |

Total system minimum dry-film thickness: 275 microns.

#### Bitumen Coated Items Requiring Paint Finish

**At Site**

|  |  |
| --- | --- |
| Surface preparation | - Thorough cleaning to remove oil, grease, and dirt |
| Primer | - 2 pack epoxy aluminium  - Dry film thickness 100 microns  - Solids by volume min. 85% |
| Intermediate coat | - 1 pack alkyd undercoat  - Dry film thickness 35 microns |

Total system minimum dry-film thickness: 170 microns.

#### Battery Rooms etc.

Battery rooms and areas where a chemical resistant finish is required to plaster, concrete or brickwork:

At Site

|  |  |
| --- | --- |
| Surface preparation | - Thorough cleaning of surface to remove oil, grease, and dirt |
| Primer | - Water based epoxy primer  - Solids by volume min. 40% |
| Filler | - Water based epoxy filler as required to produce smoother and dense surface  - Solids by volume min. 58% |
| Intermediate coat | - Water based epoxy  - Dry film thickness 50 microns  - Solids by volume min. 50% |
| Finish | - Water based epoxy  - Dry film thickness 50 microns  - Solids by volume min. 50% |

Total system minimum dry-film thickness: 100 microns.

#### Carbon Steel Surfaces Insulated

Carbon steel surfaces insulated such as pipe, condensers, tanks, and vessels' exterior surfaces.

Temperatures up to 400°C:

At Works

|  |  |
| --- | --- |
| Surface preparation | - Blasting according to SIS 05 59 00  - Grade: Sa 2 1/2 |
| Prefabrication |  |
| Primer optional | - Depending on production flow  - A weldable single pack inorganic ethyl, zinc silicate shop primer may be used  - Dry film thickness 15-25 microns  - Solids by volume min. 37% |
| Prime coat | - Single pack inorganic zinc silicate  - Dry film thickness 75 microns  - Solids by volume min. 58% |

Total system minimum dry-film thickness: 75 microns.

### Inspection and Acceptance

The various operations during the execution of painting and of the corrosion protection works are to be performed according to the preceding provisions and are subject to intermediate inspections and a preliminary/final acceptance by the Employer. These tests are carried out in the workshop and on site; all possibilities are to be given to the Employer so that he can carry out the tests at site properly. Without the prescribed intermediate inspections at site, which should be made known by the Contractor, the final acceptance may be refused by the Employer.

Intermediate inspections are necessary for all painting systems:

* After cleaning, de-rusting or blasting, as well as when repairs become necessary: Degree of cleaning, profile of anchor pattern.
* After applying the priming coats: Random sample measurements of dry film thickness.
* Before the last final coat: measurements of dry film thickness of possibly no longer accessible surfaces, removal of faults in the coating in order to obtain a clean finish.
* Before the last top coat: Holiday and pinholes tests with the pinhole detector, if in normal operation the relevant surface is permanently immersed.
* After the last final coat of all coating systems: Performance of final total dry film thickness measurements and determination of the quality of the surface.
* Where special coats are concerned, it is sometimes necessary to constantly check the course of the weather in order to avoid being below the dew point. Tests and acceptance are to be specially specified as far as special paint and coating systems are concerned. They shall be dealt with accordingly.
* All tests are to be announced in time and have to be co-ordinated so that no interruptions in erection work arise and no waiting periods for further paint occur.
* All necessary measuring and testing apparatus is to be maintained in good condition by the Contractor during the erection time.
* All measuring results are to be entered by the Contractor on corresponding forms and lists and handed over to the Employer.
* If certificates for coating systems with special requirements are necessary, these must be submitted for acceptance.

### Warranty for Corrosion Protection

The Defects Notification Period for the complete painting and corrosion protection shall commence after the Employer's final inspection and with the issue of the verified Taking Over Certificate.

For warranty control purposes test patches shall be applied in the presence of the Contractor, Employer, and coating Supplier. Test patches have to be identified and recorded. The Employer’s approval for number, size, and location of test patches will be required. Test patches shall be the basis for clarification of responsibilities between the Contractor and coating supplier in case of defect or failure.

### Repair Procedure during Warranty Period

The entire work of painting and corrosion protection will be subject to inspections by the Employer during the warranty period and before the Performance Certificate is issued.

For defining possible failures of corrosion protection the degree of degradation and rusting of the protective coating shall be assessed in accordance with ISO Standard 4682. If the degree of corrosion is above this standard the Contractor shall be responsible for repairing and/or repainting those areas which failed.

All repairs whether touch-up or complete repainting shall be carried out in strict accordance with the repair procedures given in this Specification.

## Bolts and Nuts

All bolts, nuts, etc. shall conform to applicable Standards. Bolts or studs which are subjected to high pressure and temperature shall be of approved high tensile alloy steel with nuts of a suitable, approved material.

All bolts or studs shall be of steel suitably machined at the shank and under the bolt head. Washers shall be provided under nuts, and also under bolt heads, if required.

The aggressive environmental conditions must be considered when selecting material and surface protection. Bolts, nuts, etc. from suitable stainless steel shall be applied if submerged in highly corrosive media, or where contact with such media in case of leaks etc. can be expected. Bolts and nuts for outdoor installations, pipe installations in trenches or other applications shall be galvanised. Bolts and nuts in contact with groundwater shall be of stainless steel

Bolts and nuts either made from high temperature resistant materials or installed in enclosed parts of machines are not subject of this regulation.

## General Field Construction Regulations

### Site Regulations

The Contractor may be required to share the Site with other contractors. In this case the Employer will allocate to the contractors such areas as are required by them and as are available from time to time on the Site for construction use and storage.

The Contractor shall conduct his work at all times so as to avoid any unnecessary hindrance or interference with other contractors or with the operation of the power plant by the Employer. Where station operation will, of necessity, be affected by the Contractor's intended work, the Contractor shall give adequate notice to and shall obtain clearance from the Employer before proceeding with such work. Should interference occur, the Employer shall establish precedence and shall decide which work shall be relocated.

The Contractor, his employees, and his sub-contractors shall be subject to such rules and regulations for the conduct of the work at the Site as are stipulated in the Conditions of Contact and in the local laws and regulations. The Contractor shall be responsible for the enforcement of the Employer’s instructions regarding signs, advertisements, the prevention of fires and accidents, as well as HSE and other general regulations among his employees and his sub-contractors.

### Co-ordination at Site

Normally, co-ordination at the Site will be arranged by the Employer. In the event of more than one contractor working at the Site, the Employer shall co-ordinate the work of the contractors and with the Employer's operating staff to prevent any delay in the Works or in the completion of the project.

In all instances where his work is affected by the work of other contractors or has an effect on the work of other contractors, the Contractor shall inform the Employer about the affected work or equipment. In case of disputes between the Contractors concerned the Employer reserves the right to take the final decision.

The Contractor shall check all physical interferences, clearances, and interfaces with the work of others and submit necessary information to the Employer. The Contractor shall ask the Employer in writing for all data and information needed from other contractors for the design and execution of the work under this Contract.

The Contractor shall however be responsible for co-ordinating his work and equipment with the work and equipment of his sub-contractors involved in the project.

### Responsibility among Contractors

In areas, where more than one Contractor is involved, e.g. design and erection of piping systems, the Employer reserves the right to confer the responsibility for the overall design co-ordination to the Contractor with the main activities.

For Contract limit points in pipe systems or connections to equipment the concerned contractors shall co-ordinate their work in respect of the time schedule as well as in respect of the allowable forces and moments. The Contractor responsible for the main part shall do the stress calculation for the complete system including the small portion of the other contractors’ part. Before any welding or bolted connection will be carried out written confirmation from the Employer must be available.

### Records

The Contractor shall, at all times during the progress of the work, keep at his field office such particulars and data relative to work done and equipment installed as will permit the Employer's inspection, at a reasonable time, of such records and information as may be required.

### Operations at Site

#### Lighting and Guarding

The Contractor shall be responsible for the proper lighting, guarding and securing of all the work on site until taking over, and for the proper provision during that period of temporary roadways, footpaths and guards, as far as the same may become necessary by reason of the work, for the accommodation and protection of the Employer and occupiers of adjacent property, the public and others.

No open flares shall be used by the Contractor on site other than in the open air without special permission in writing from the Employer. Such use of open flares, with or without the permission of the Employer, shall not relieve the Contractor from full responsibility there for.

#### Protection

During erection and commissioning the Contractor shall provide all temporary scaffolding, ladders, platforms with handrails and cover plates for channels, openings etc. for proper and safe access of workmen and inspectors, and shall provide adequate protection against material falling from higher level on personnel and equipment below. In case of damage to equipment, structures, platforms etc. by other contractors, the Contractor shall estimate the cost of damage and clarify with the contractors concerned the obligation for compensation. The Employer will assist if deemed necessary.

#### Cleanliness

The Contractor shall keep clean the Site on which he stores or erects equipment and remove all waste material resulting from the work as it accumulates, to the satisfaction of the Employer. The Contractor responsible for the area as defined by the Employer has to provide an adequate number and size of containers to collect all waste material.

If the Employer is of the opinion that the Contractor's site is not being kept reasonably clean, he will give a two days' notice to the Contractor defining the areas which are considered unsatisfactory. If at the end of these two days the Site is still not reasonably clean as required, the Employer may arrange to have the Site cleaned to his satisfaction and the cost of such operation will be charged to the Contractor.

Any damage done to buildings, structures, equipment, or property belonging to the Employer shall be made good at the Contractor's expense.

#### Inductive Interference

The Employer may operate wireless communication equipment within the power station perimeter including all rooms and areas furnished with equipment under this Contract. The Contractor shall ensure that all the supplied equipment is proof against any signals emitted by this wireless communication equipment.

### Storage Facilities

Storage facilities at site and surroundings as well as in the port are extremely limited; hence material supply has to be strictly co-ordinated with the erection progress. STELCO will arrange in coordination with the Municipality the allocation of adequate storage space in the vicinity of the power station.

### Material Transport from Storage to Erection Area

Considering the limited space at the construction site, the Contractor shall transport only that much material to the erection spot which will be used for installation within the following two days. Erection areas shall not be used to store materials.

### Dismantling of Existing Equipment

Any equipment, which within the scope of this contract requires dismantling, shall be properly identified, listed and marked prior to dismantling. Identification shall also include a brief description of its current condition and markings used for physical identification.

## Testing and Commissioning

The term "commissioning" shall mean the activities of functional testing of the completed Works after erection, i.e. upon completion of erection of the various parts and systems of the Works. The Contractor shall perform preliminary and functional (pre-commissioning) tests in order to check the proper operation of the plant and its conformity with the specification.

These tests shall demonstrate:

* the completeness of the works
* the correctness of the assembly and installation
* the safety and reliability of the works under all operating conditions:

The Contractor shall prepare and submit to the Employer for approval performance test procedures for all mechanical, electrical and I&C equipment including tests relevant methods no later than two months before commissioning is due to commence. These procedures shall list in detail the tests to be performed during commissioning. The Contractor shall provide all testing instruments and shall perform the tests set out in the procedures in the presence of the Employer.

### Test on Completion

All mechanical, electrical and I&C plant shall be inspected and tested for correct alignment, positioning, adjustment, clearances and all such items which may affect their reliable operation. The commissioning programme shall further include tests and inspections for correct connections, installation, insulation, grounding, setting of limit switches, calibration of measuring instruments and protection devices, direction of rotation of motors, etc.

With these tests the Contractor shall demonstrate to the Employer the proper performance of the entire works and their conformity with the contractual requirements.

The acceptance tests on diesel engines and generating sets shall include but not be limited to:

1. Checking the alignment of the ready assembled diesel engine and generator shaft
2. Checking all bearing clearances
3. Functional test of generator protection relays
4. Check on governor and AVR performance
5. Diesel engine acceptance tests in accordance with ISO 15550:2002
6. Diesel engine performance tests in accordance with ISO 3046
7. Diesel generating set performance tests in accordance with ISO 8528

### Unit Operation Tests

Before the plant is synchronised and any load testing may begin, permission shall be obtained from the Employer. Permission will only be given when all system operational checks have been completed to the satisfaction of the Employer.

The following tests shall be performed during Unit Operation:

1. Diesel engine speed governor and generator excitation tests for parameters in accordance to ISO-3046
2. Start-up on DO
3. Performance test of excitation system during no-load running
4. Balancing, over speed test and vibration measurement
5. Synchronisation with the grid system
6. Rated output test of the unit including temperature run
7. Over speed Tests
8. Load Acceptance Tests
9. Load Rejection Tests
10. Overload Tests
11. Control Loop Tuning
12. Other tests as specified in the Particular Requirements
13. Measurement of power consumption of essential independent auxiliaries in accordance with ISO 3046 and ISO 15550.

The Contractor shall prepare a schedule detailing the unit operation tests.

During the unit operation tests the Contractor shall demonstrate the start-up and shut-down reliability by performing at least four consecutive trouble free starts, synchronising, loading to full load, operation at full range of loads and conditions, automatic switching over from operational to stand-by auxiliaries and controlled shut-downs. All automatic devices shall function normal on each occasion. During on-line operation of the integrated systems, all equipment shall be checked for overheating, noise, vibration, and any other checks or tests specified herein or required by the manufacturer of the specific piece of equipment.

All piping systems shall be visually checked for leaks, clogged pressure gauges, interferences, excessive vibration, and other abnormal conditions.

Sensitive equipment, like heat exchangers and pumps which have no strainer during normal operation, shall be protected during startup of the system with temporary strainers. Pump suction strainers shall be checked periodically for clogging. These strainers shall be kept in service during unit operation and shall be cleaned as required to minimise pressure drop due to clogging. Whenever equipment is shut down due to strainer clogging, the strainer shall be cleaned immediately, regardless of the time of day, to assure availability of the equipment. New jointing materials shall be installed after each cleaning operation. After initial operation, when strainer fouling no longer occurs, the temporary strainers shall be removed from the piping. Spacers shall be furnished and installed where temporary cone type strainers are removed.

During this period the general running of the plant shall be monitored and the Contractor shall instruct the Employer’s operating staff in the operation of the plant. The Contractor shall prepare test protocols which have to be signed by himself and the Employer.

Immediately after the unit operation tests are complete the plant shall be shut down for inspection and adjustment.

After obtaining approval of the relevant test protocols, the Contractor shall notify the Employer in writing that the DGU is ready for the reliability test run. The starting date shall be mutually agreed upon.

### Reliability Test Run

After the Contractor has convinced himself and the Employer is satisfied, that all the unit operation tests have been completed, that the plant is complete in every respect and that all components are working properly and are ready for reliability tests, the DGU with all its ancillaries shall be required to operate at nominal output, or at reduced output, if the grid is not capable of providing the nominal load, without failure or interruption of any kind resulting from defect of plant supplied under this Contract, for a period of 21 days with a maximum of 4 hours stoppage allowed for minor adjustments. If the total stoppage time attributable to failures of the equipment supplied under the contract exceeds 4 hours the reliability test run shall start from 0 again.

During the reliability test run the Contractor will be allowed to make minor adjustments which may be necessary, provided that such adjustments do not in any way interfere with or prevent the commercial use of the plant by the Employer or result in reducing the output or decreasing the efficiency. During the reliability operation no shut-downs are permitted except those requested by the Employer and those due to perturbances which are not attributable to the tested system.

If the cumulated stopping time attributable to any failure or interruption occurring in any portion of the plant covered by this Contract due to, or arising from faulty design, materials, workmanship, but not otherwise sufficient to prevent full commercial use of the plant, exceeds 4 hours the reliability test run of 21 days shall recommence from the day one (1) after the Contractor has remedied the cause or defect.

The plant shall be operated during the tests by the Employer’s staff under the Contractor's supervision and responsibility.

### Performance and Guarantee Tests

Before the performance tests commence the Contractor may shut down the plant to clean and to make any final adjustments.

As soon as practicable after the satisfactory completion of the reliability test run, the official performance and guarantee tests shall be carried out on the plant. The Contractor shall also perform any other tests the Employer may require in order to determine that the plant is in accordance with the specification and guarantees.

All test instrumentation shall be provided by the Contractor, shall have valid calibration certificates, and shall be properly sealed.

### Measurements of Power and Fuel Consumption

All tests of the diesel generating sets shall be carried out in accordance with the latest editions of ISO 3046, ISO 8528, and ISO 15550. Test result shall be converted from site ambient conditions to site reference conditions

The generator output shall be measured at the MV switchgear by a 3 phase portable precision Wattmeter with limits of error over the effective range of not more than 0.2% of full scale value. The instrument shall be calibrated, sealed, and certified. The power consumption of the Essential Independent Auxiliaries as per ISO 3046 shall be measured by calibrated portable instruments at 50%, 75%, and 100% gen-set load.

**Continuous Net Power of Diesel Generating Set**

The continuous net power for the purpose of Bid Evaluation shall be the difference between the guaranteed output of the generating set and the rated power consumption of the declared Essential Independent Auxiliaries of the unit.

**Fuel Consumption**

The fuel consumption shall be measured by calibrated, sealed, and certified flow meters within an uninterrupted period at the following loads and intervals:

1. at 50 % load: during one hour operation, 4 readings with 15 minutes intervals,
2. at 75 % load: during one hour operation, 4 readings with 15 minutes intervals,
3. at 100 % load: during one hour operation, 4 readings with 15 minutes intervals.

The fuel consumption tests shall be made with the Diesel fuel available at the power plant.

Three fuel samples shall be taken during each test from the engine inlet, two of which shall be used to determine the net calorific value of the fuel. In case the results of the two differ more than 3%, the third sample shall be sent to a laboratory of the Employer’s choice. The method of determining the net calorific value of the fuel shall be subject to approval by the Employer.

**Lubricating Oil Consumption**

Lubricating oil consumption shall be measured by the Contractor after the reliability test run and prior to the issuance of the TOC over at least 24 hours continuous operation at minimum 80% nominal capacity. During LO consumption test the LO separator shall be stopped. The Contractor should propose the most practical method of measuring the LO consumption at site. The proposed method shall be agreed with Employer such that all parties are convinced that the results are realistic.

### Test Results and Records

The Contractor shall be responsible for recording all measurements, test results, settings, and any adjustments made during the erection and commissioning period to the complete plant covered by this Contract. Copies of all such records shall be made available to the Employer. The records shall include all relevant measurements on generating sets and other important plant equipment, like alignment data, rotor clearances, bearing wear down, settings of security devices, valve adjustments and settings, protection relay settings, and any other commissioning records including the results of the performance tests. On completion of the commissioning and performance tests the Contractor shall compile all such records and results into one bound volume for presentation to the Employer. Upon approval of the test records by the Employer, copies shall be supplied to Employer.

### Final Inspection at End of Defects Notification Period

Four weeks prior to the expiry of the Defects Notification Period the Employer will carry out a Final Inspection of all executed Works. He shall notify the Contractor of this intention. It shall be to the discretion of the Employer which part of the Works or equipment shall be subjected to the inspection and the Employer will be at liberty to open up any part of the whole of the plant for inspection of the working parts. The Contractor shall be represented during this process.