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TECHNICAL JOB
SPECIFICATION

721/2

REVISION 1

DATE 01/11/2011

LNG PLANT
ELECTRICAL SUBSTATIONS

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QUALITY ASSURANCE PAGE

CHANGES LOG

- para 9.0

REVISIONS LOG

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REFERENCE DOCUMENTS

DESFA Job Spec. No. 700/5
[General Electrical works]

DESFA Job Spec. No. 740/1
[Outdoor Lighting]

ELOT EN 61547
[Equipment for general lighting purposes - EMC immunity requirements]

ELOT EN 60950-1
[Information Technology Equipment – Safety, Part 1 : General Requirements]

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1.0 SCOPE

This Specification covers the requirements for substation layout. Outdoor substation (protected aisle outdoor construction) and outdoor switchyards are not in this Specification. Only substation building have been considered.

2.0 GENERAL

A substation is defined as an assembly of low voltage and/or medium metal-clad switchgear or control centre supplied directly by feeders or by adjacent step-down transformers.

Indoor substation is a substation in which the indoor metal-clad equipment are within a field constructed substation building.

Building construction shall be as outlined in the specifications issued by Civil section.

3.0 DOCUMENTATION

Substation equipment layout drawing, showing equipment position, dimensions, clearances, cable entry, installation details and aisles shall be prepared by Contractor.

4.0 LOCATION AND PROTECTION

Substation building and outdoor facilities (transformers, earthing resistors etc.) shall preferably be located in a non-hazardous location; location in class 1 division 2 areas may be considered only for substations to be located adjacent to the process unit for which the non hazardous space availability is not enough.

Depending on the location, the substations considered are:

4.1 NATURALLY NON-HAZARDOUS SUBSTATION BUILDING

This substation to be located only at a non-hazardous area, it shall be designed with a positive pressure system in order to prevent the entrance of sand or dust.

A single pressurizing system is accepted. A time delayed alarm for the building pressure loss shall be provided. For all off-site substations where contamination is not considered to be a problem, normal ventilation in lieu of pressurization shall be investigated and offered to the client as an alternative.

4.2 SPECIAL NON-HAZARDOUS SUBSTATION BUILDING

This substation to be located only in class 1 division 2 areas, shall be designed with a positive pressure system in accordance with the requirements listed in the Electrical Specification **DESFA Job Spec. No. 700/5 para 9.2.3.**

Two ventilating fan motors with explosion proof enclosure shall be provided.

The minimum maintained overpressure shall be 5 mm water gauge.

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A time delayed alarm for the building pressure loss shall be provided.

5.0 SUBSTATION DESIGN

The substation shall include the building and the transformer yard. All switchboards are located in the building (M.V. switchgears, L.V. power centre, motor control centre, turnaround power centre, auxiliary switchboards, D.C. panel etc).

Battery of accumulators shall be located in the substation building and in a separate room.

The fenced outdoor transformer yard shall include step-down transformers, neutral earthing resistors and the disconnecting board for tapped feeder distribution, if any.

Small transformers for lighting and/or auxiliary service distribution may be located indoor (substation building) or outdoor (transformer yard) depending on economic convenience.

6.0 SUBSTATION BUILDING DESIGN

The substation building shall be elevated above grade. The clearance shall be at least 1500 mm from finished grade to the lowest part of underside of the building operating floor (switchboards floor) supporting structure.

Substation building shall not have windows and shall be provided with one equipment door (double door) and one personnel door preferably located on the opposite sides.

Doors shall be metallic, provided with quick opening locks (panic bolts) and with gasket to prevent the entrance of sand or dust.

The equipment door shall be suitable sized to accommodate the largest assembled unit of equipment; standard size doors with removable panels above may be provided.

Substation building floor shall be levelled and have a smooth finish.

Channel inserts shall be provided for the erection of switchboards and equipment and shall be installed level with substation finished floor.

Reinforcing steel bars of concrete structure as well as metallic structure doors and fence frames, shall have provision for earthing connection.

6.1 SUBSTATION BUILDING LAYOUT

Common operating aisle is preferred for switchgear, control centre, turnaround power centre and auxiliary switchboard.

If this layout is adopted, the operating side of different equipment shall be preferably aligned; to allow this alignment, the front and back clearance may be increased where necessary.

Space for 30% future additional breakers on switchboards shall be provided.

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The clearances specified below shall be kept, they are to be considered as minimum distances from the nearest obstruction and shall also be increased as necessary to meet manufacturer's recommendations.

- Operating aisle (between switchgear and other equipment) 1500 mm
- General operating aisle 1200 mm
- Behind switchgear 750 mm
- Between equipment ends or between equipment 750 mm ends and wall
- Vertical from equipment to the lowest part of ceiling 500 mm

A separate room shall be provided to locate the battery of accumulators.

Battery shall be mounted on rack against the wall. Operating space shall be provided depending on battery type and/or manufacturer's recommendation.

6.2 LIFTING DEVICES AND FACILITIES

Lifting devices are required for supporting and transporting the following equipment:

- Circuit breakers in low and medium voltage switchgears. A separate lifting device is not required for circuit breakers provided with a self rolling device from switchgear to substation floor and vice versa.
- Controller in medium voltage motor control centre.

Lifting devices shall have rubber wheels and shall be designed to make possible the support of breakers during the removal and return to switchgears.

A platform to facilitate the loading and unloading of equipment shall be provided outside the substation building at the equipment entry door.

In order to facilitate the rolling of equipment to/from substation, the platform shall be installed at the same substation floor level.

The platform may be made of steel sheet supported by a separate steel structure, or of concrete slab obtained as the extension of substation floor slab.

Both types of platforms shall be provided with removable handrail.

7.0 TRANSFORMER YARD

Power transformers shall be located in such way so as to minimize the length and bends of secondary connections.

Transformers, neutral earthing resistors and disconnecting board if any, shall be installed on concrete pads. The top of concrete pads shall be at least 150 mm high from finished grade. The area around the concrete pads (generally extended up to the perimeter fence), shall be filled with 40 to 50 mm gravel stone of enough depth to accommodate the oil quantity of the largest unit. The gravel shall be retained by a concrete curb 200 mm wide and, at least, 150 mm high.

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Transformer fire wall shall not be provided for transformer unless required by local codes. If provided, fire walls shall extend 150 mm above the top of transformer and 600 mm beyond in both directions lengthwise. Fire wall shall be either block or suitable construction as dictated by the local availability of materials.

A chain link fence at least 2.4 m high shall be provided around the transformer yard.

Removable fence section shall be provided where required for equipment removal.

Two personnel gates shall be provided and located at the opposite side of transformer yard.

7.1 TRANSFORMER YARD CLEARANCES

The below specified clearances shall be kept, they are to be considered as minimum distances from the nearest obstruction and shall be increased as necessary to meet manufacturer's recommendations.

- From transformer to building wall 750 mm
- Between transformers 900 mm
- Around neutral earthing resistors (on 3 sides at least) 900 mm
- From transformer to fence 900 mm
- From transformer to fire wall (if any) 600 mm

8.0 CABLE ENTRY

The space below substation floor (from grade to substation floor) shall be used as cable distribution room.

Cable from the underground conduit system shall enter underground into substation cable room passing through walls in sleeves or slots.

Cable from underground conduit system shall enter underground into substation room passing through walls. The conduit shall extend at least 250 mm above cable room grade. The concrete envelope of conduits shall extend at least 150 mm above cable room grade. The space around the cable(s) at the point where they leave the conduit, shall be sealed to prevent the entrance of dust, insect and moisture. Spare conduits shall be provided with plugs.

Cable shall enter to equipment from the bottom passing through the floor in sleeves or slots. The space around the cable at the point where they pass through the floor shall be sealed to prevent the entrance of sand, dust, insect and moisture and to prevent also the leakage of pressurizing air, if existing.

Continuous cable trays or cable racks shall be provided inside the cable room for the cable distribution from underground cable (direct buried and/or underground conduit system) to the switchboards through the floor. Suitable fire stops shall be provided at substation cable entry and along cable trays or racks in order to avoid flame propagation through cables to switchboard (refer **DESFA Job Spec. No. 700/5**).

Cable room shall preferably have open wall (at least 3 sides) with chain link fence. If not, provision shall be made for free air circulations.

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Access to cable room shall be possible from an external opening provided with fence framed door.

Cable from underground direct buried cable system leaving the ground inside the transformer yard shall be protected as specified in Electrical Specification **DESFA Job Spec. No. 700/5**.

9.0 COOLING

H.V.A.C (Heating, Ventilating, Air Conditioning)

The following should be followed for the HVAC system:

- The system will keep a positive overpressure inside the building.
- Gas detection sensors adjacent to the substation air-intake ducts shall be provided. In the event of these detectors being activated they could shut-down and close of the HVAC thus sealing the substation and preventing ingress of hazardous vapours. The same action shall also take place in the event the fire extinguish system is activated.

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Cooling design shall be as follows:

- design shall include moisture proofing and thermal insulation to prevent corrosion and to aid in limiting indoor temperature extremes. However, no means of ventilation such as louvers or roof ventilators shall be provided.
- Mechanical cooling shall be provided. Ventilating capacity shall based on limiting the indoor temperature to 35 °C but with a maximum of 10 air changes per hour in summer time, considering the heat dissipation of electrical equipment.
- A separate cooling canalization shall be provided for the battery room.
- Commercial wall-mounting cooling will be preferred, provided that they are suitable for the specified environmental condition specified in the Electrical Specification **DESFA Job Spec. No. 700/5**.

10.0 LIGHTING AND RECEPTACLES

10.1 NORMAL LIGHTING

A normal lighting shall be provided for the illumination of inside building interior, outside building and transformer yard.

Lighting intensities shall be as specified on Electrical Specification **DESFA Job Spec. No. 700/5**.

Normal lighting inside the building shall be switched manually by switches located near each door.

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Normal lighting outside the building and in the transformer yard shall be controlled automatically by the general outdoor lighting control system.

10.2 EMERGENCY LIGHTING

An emergency lighting system shall be provided inside the substation and shall provide illumination for the following equipments:

- Switchgear control, relaying and metering
- Alarm panel(s)
- Personnel doors

Additional skeleton lighting fixture shall be provided in order to have an average value of 20 lux all inside the substation.

Emergency lighting inside the substation shall be supplied from the D.C. control power battery and controlled manually by switches located at personnel doors close to the normal lighting switches.

10.3 LIGHTING FITTINGS

Lighting fitting shall be as specified in the Electrical Specification **DESFA Job Spec. No. 700/5** for what concerns the selection with regard to environment location.

For outdoor lighting refer also to Specification **DESFA Job Spec. No. 740/1**.

Lighting fittings for battery room shall be with EEx-d type of enclosure suitable for class 1 division 1, with presence of Hydrogen. Lighting switches shall be installed outside the battery room.

10.4 CONVENIENCE RECEPTACLES

At least three 16 A, 2 + 1 wire (PE), 2 + 1 pin 220 V A.C. convenience outlets shall be provided inside substation building. They shall be preferably installed on three different walls.

At least one 63 A, 3 + 1 wire (PE), 3 + 1 pin 380 V.A.C. and one 16 A, 2 + 1 wire (PE), 2 + 1 pin 220 V A.C. convenience outlets shall be provided for each transformer, within the transformer yard.

10.5 CANALIZATION

Canalization indoor and outdoor shall be as specified on the Electrical Specification **DESFA Job Spec. No.700/5**.

11.0 PROTECTION AGAINST SHOCK FOR INDIRECT CONTACT AND EARTHING

Protection against shock for indirect contact and earthing shall be in accordance with Electrical Specification **DESFA Job Spec. No. 700/5**.

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12.0 TELECOMMUNICATION AND FIRE ALARM

An intercom set connected to the intercom system between the power station control room and the substation, shall be provided in each substation.

A fire alarm push button connected to the general fire alarm system shall be provided at each substation. It shall be installed outdoor at the opposite side of transformer yard.

A suitable number of smoke and combustion gas detectors shall be provided. The smoke and combustion gas detectors shall be wired together with the fire alarm system.