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**TECHNICAL JOB  
SPECIFICATION**

**700/4**

**REVISION 0**

**DATE 05/04/2011**

## **HIGH PRESSURE (HP) TRANSMISSION SYSTEMS**

### **ELECTRICAL ENGINEERING DOCUMENTS**

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**QUALITY ASSURANCE PAGE**

**CHANGES LOG**

**REVISIONS LOG**

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**REFERENCE DOCUMENTS**

ELOT EN 60027  
[Letter Symbols to be used in Electrical Technology]

ELOT EN 60617  
[Graphical Symbols for Diagrams]

IEC 60050  
[International Electromechanical Vocabulary]

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## **1.0 SCOPE**

This Specification outlines data and information to be included in the engineering documentation produced by Contractors and Vendors/Manufacturers.

Extent of data, information and documentation to be prepared, will be mutually agreed among the parties for each specific project.

## **2.0 GENERAL**

All information shall be expressed or shown using terms, definitions, letter symbols and graphical symbols as standardized by **ELOT EN 60027, ELOT EN 60617 and IEC 60050**.

A summary of terms and symbols is given in **para 24.0 and 25.0**.

## **3.0 CLASSIFICATION OF HAZARDOUS LOCATIONS**

It shall be represented by drawings showing on the plot plan the plan view and, where required, the elevation of the extension of hazardous areas for each class and division (zone) of hazardous locations.

The same drawings shall show one of the following information:

- a) The individual sources of hazard giving the different area classifications and the zone contour.
- b) The envelope of the area where the sources of hazard giving the same area classification are supposed to be located.

Special care shall be taken in indicating the opening (building doors and windows or openings in general). If special provisions are taken to permit a certain classification by means of walls, barriers, ventilation, exhaust ducts etc., they shall also be shown on the drawings.

## **4.0 ONE LINE DIAGRAMS FOR D.C. AND AC. POWER CIRCUITS INCLUDING METERING AND PROTECTIVE RELAYING**

The diagrams shall include the following information: Major equipment ratings indicated below:

- a. Generators: voltage: power output - power factor - subtransient and transient impedance in per unit - frequency - efficiency.
- b. Power Transformers: power - ratio - voltages - vector group - hour number - taps impedance in per unit - neutral connection (isolated or earthed).
- c. Circuit Breakers: Rated current-interrupting current and half wave current-making capacity (peak value).
- d. Busses: Rated current-half wave current-short time thermal current (1s)- phase rotation- reference hour number L1, L2, L3 phases. Neutral-earth.
- e. Arresters: Rated voltage.
- f. Neutral Earthing Devices: Current limit and time.

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g. Cables: Rated current, cross section area type, and number of conductors.

Quantity, ratios and connections of current and potential transformers, vector group and phase rotation and hour number, where necessary.

Relays code number and quantity of elements.

Dotted lines to associate the major protective relays to the primary circuit devices, which they operate, using arrows at the devices concerned. (This last information may be shown on separate drawings).

Symmetrical (half cycle and interrupting) short circuit levels on which design is based.

Identification and rated power of individual loads connected to each switchgear, motor control center, turnaround power center, local sub-panel etc.

Expected power demand on each bus (maximum and normal operating).

Main breakers shall be specified if draw-out type or fixed type, type of interrupting method (air, oil, vacuum etc.).

## **5.0**

### **ONE LINE DIAGRAM FOR INSTRUMENT POWER SUPPLIES**

It shall be based on the instrumentation load computation and related busses voltage and maximum loads (active and apparent power in the A.C. circuits).

The one line diagram shall include the following information:

- Major equipment rating indicated below:
- Battery Charger: voltage-power output.
- Batteries: voltage-capacity.
- Inverters: voltage-power output, power factor.
- D.C. Stabilizer: voltage-power output, percent stabilization.
- A.C. Stabilizer: voltage-power output, percent stabilizing power factor.
- Relays and Devices: code, number-quantity.
- On Load Switches: rated current-symmetrical short circuit current, making current (peak value).
- Meters: Volt meters-ammeters, wattmeters, varmeters, frequency meters (quantity-scale).
- Fuses: Rated current-quantity.
- Dotted lines shall be used to associate protective relays with related operated equipment.
- Symmetrical short circuit voltage on which design is based shall be shown on each bus.
- Quantity of conductors on each bus or line.

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## **6.0 EQUIPMENT SPECIFICATIONS AND MATERIAL REQUISITIONS**

Manufacturer/Vendor shall prepare for each type of equipment the relevant material requisition (MR), with all information regarding item identification, required changes-reference documents and, standards ratings and technical characteristics. Manufacturer/Vendor's documents reference, supply system, site conditions, terminals and connection cables characteristics, special requirements.

The Material Requisition and Manufacturer/Vendor's documents (drawing, calculations, certificates etc.) must be approved by the Owner before placing Purchase Order for the equipment.

Specifications attached to Material Requisition shall give design criteria for the above mentioned equipment according to the Job Specification issued for the Contract.

## **7.0 SCHEMATIC DIAGRAMS**

Schematic diagrams and the related connection and interconnecting diagrams shall be supplied to serve construction purposes, trouble shooting and maintenance requirements.

Manufacturer/Vendor's drawings shall be used to the maximum practicable extent.

## **8.0 CONNECTION AND INTERCONNECTING DIAGRAMS**

Interconnecting diagrams shall show the devices identification, terminal strip reference, terminal numbers and designation that appear on the schematic diagrams.

Similar procedures must be followed by Manufacturer/Vendors for what concerns internal connection inside the equipment and panels.

Internal wiring shall be numbered and ferrule only when specifically required by Owner.

## **9.0 LOAD DATA LIST AND LOAD COMPUTATION FOR DIFFERENT PLANT CONDITIONS. INCLUDING D.C. LOADS AND INSTRUMENT LOADS**

Tabulation shall be prepared containing at least the following information:

- Item reference.
- Service.
- Nameplate rating (kW or KVA).
- Design load.
- Normal operating load active.
- Normal operating load reactive or apparent (only if essential for design purposes).
- Maximum demand load.
- Usage factor.

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For each bus the following information shall be listed (in a separate tabulation):

- Average 24 h load (active)
- Average 24 h load (apparent)
- Maximum 1 h load kW (active)
- Maximum 1 h load KVA (apparent)
- Average 24 h power factor.

**10.0**      **SHORT CIRCUIT CALCULATION (MAXIMUM AND MINIMUM VALUES) INCLUDING MOTOR CONTRIBUTION TO SHORT CIRCUIT**

Manufacturer/Vendor shall prepare computations sheets and impedance diagrams, before starting any action related to Material Requisition releasing for electrical machinery and main equipment.

**11.0**      **VOLTAGE PROFILE CALCULATION FOR STEADY STATE AND FOR RE-ACCELERATION**

Manufacturer/Vendor shall prepare the load flow study with the calculation of voltage drops on each bus and user or group of users.

**12.0**      **CABLE SCHEDULE**

A cable schedule shall be prepared for each cable with at least the following information:

- Item reference (identification).
- User data including starting time of motors (if higher than 5s), short circuit clearing time, voltage drop (normal and starting), rated voltage.
- Cable length.
- Type of cable.
- Cross sectional area.
- Maximum conductor temperature (normal and short circuit).

The item reference shall include in synthetic alphanumeric notation the following information:

- User identification and type of power user, such as lighting, control, communication, voltage level or category (ELV, LV, MV, HV).

**13.0**      **TABULAR FORMS FOR RELAY DATA**

For each bus or group of busses (substation or panel) a table shall be prepared showing for all relays the following information:

- Panel of bus item number.
- Relay symbol.
- Service.
- CT or PT ratio.
- Setting range of time.



- Setting range of current or voltage.
- Diagram of time versus current (or versus other quantity).

**14.0**      **RELAY CO-ORDINATION STUDY WITH REPRESENTATION OF DECREMENT EFFECTS**

It shall be prepared the impedance diagram for each section of the electrical plant to which the relays are related showing the protective devices and the relays. The profile of any relay shall be plotted on a logarithmic scale diagram in order to show, for the various ranges of short circuit current, the selectivity and steps of time regarding that particular part of circuit.

**15.0**      **UNDERGROUND CABLE LAYOUTS**

The underground drawing to be used shall be the most up to date which is available (UG drawings shall be in general common with other UG utilities like water, sewers, civil etc.)

The following information shall be shown:

- Direct buried cables.
- Underground cables lay in conduit or ducts banks (e.g. road crossing).
- Underground cables changing in direction (up or down).
- Underground cable leaving the ground.

For cables in conduit, it shall be shown conduit size, and user cable, identification:

- Typical sections for underground cables crossing roads in duct banks.
- Typical sections for concrete holes dimensions and ducts distances etc.

Typical details for cables leaving the ground and connection to final electrical equipment.

**16.0**      **ABOVEGROUND CABLE LAYOUT**

For aboveground cables (AG) the drawings (plot plans and elevation drawings) shall show the following information:

- Cable trays type, location and dimensions.
- Cables in conduit or conduits banks, giving conduit type and size in inches.
- Details according to contractor's standards.

For the cables it shall be still valid the data required in **para 15:**

- Earth and protection conductors, earthing bus bars related to AC cable installation.

**17.0**      **LIGHTING LAYOUTS AND WIRING DIAGRAMS**

Layout plans shall include the following information:

- Lighting intensity assigned to each area.
- Type of lighting source e.g. incandescent, fluorescent, mercury vapor etc.
- Special purpose lighting fixtures.
- Lighting receptacles.

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- Lighting panels.
- Quantity, location and type of lighting fixtures.
- Type of installation.
- Any information about feeding cables and protections.
- Reference cable of circuits to be associated to the panel outlets.
- Local switches inside buildings.

**18.0****SUBSTATION LAYOUTS**

Substation layouts shall include main electrical equipment, interconnecting means with special care for bus ducts, duct bank, trenches and building auxiliary equipment like exhaust fans, louvers, grounding pits, service entrances and battery limits.

Expansion direction foreseen for substation bulging and position assigned to future equipment shall be shown.

**19.0****COMMUNICATION LAYOUTS AND WIRING DIAGRAMS**

Layout plant shall include the following information: type of communication equipment:

- Quantity, location and type of the communication sets.
- Type of installation.
- Any information about interconnection cables.
- Main frames distribution and terminal boxes.

**20.0****FIRE ALARM LAYOUTS AND WIRING DIAGRAMS**

Layout plant shall include the following information:

- Type of fire alarm push button stations, detectors, etc.
- Quantity, location and type of the push button station and/or detectors.
- Type of installation.
- Any information about interconnection cable(s).
- Main distribution box, distribution and terminal boxes.

**21.0****EARTHING DRAWINGS AND CALCULATION OF EARTHING SYSTEM DESIGN**

Manufacturer/Vendor shall elaborate all computation of ground fault current and related cleaning time.

The earthing system drawings shall give the following information:

- Type of earthing connection including section, material, bare or insulated conductors, and bars.
- Earthing pits.
- Identification of earthed equipment using different symbols for L.V. motors, M.V. motors, power panels, lighting panels, welding receptacles etc.

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Earth fault protective relays and relay co-ordination shall be shown on general relay system co-ordination documents described in **chapter 14**.

**22.0** **LIST OF BULK MATERIAL (LIST OF MATERIAL REQUISITIONS)**

Only if special requirements are needed for safety reasons as for installation in hazardous areas or for environmental protection purposes the M/R of bulk material shall be considered as an engineering contractor responsibility.

**23.0** **OPERATING MANUAL**

The preparation of an Operating Manual is not required where the electrical system is simple and no particular difficulties on operation are envisaged being available by Manufacturers/Vendors proper documentation.

Such document is mandatory in all cases in which the extent of the network, interconnection of various systems, in plant generation, connection with the Public Utility consist a "complex system".

The Operating Manual shall include of least the following:

- Description of the normal operation of the system.
- Description of the operation of the system in the various considered contingencies.
- Simplified block diagrams of sequences of automatic and/or manual operation.

**24.0** **MEASURING UNITS**

Measuring units and letter symbols as per **ELOT EN 60027**.

International system of units SI.

**BASIC UNITS**

Length	Meter	m
Mass	Kilogram	kg
Time	Second	s
Electric Current	Ampere	A
Thermodynamic Temperature	Kelvin Degree	°K
Luminous Intensity	Candela	cd

**PREFIXES**

Factor by which the unit is multiplied	Prefix	Symbol
1 .000 .000 .000 .000 = $10^{12}$	tera	T
1 .000 .000 .000 = $10^9$	giga	G
1 .000 .000 = $10^6$	mega	M
1000 = $10^3$	kilo	K
100 = $10^2$	hecto	h
10 = $10^1$	deca	da
0,1 = $10^{-1}$	deco	d
0,01 = $10^{-2}$	centi	c
0,001 = $10^{-3}$	milli	m
0,000 001 = $10^{-6}$	micro	M
0,000 000 001 = $10^{-9}$	nano	n
0,000 000 000 001 = $10^{-12}$	pico	P

**SUPPLEMENTARY UNITS**

Plane Single	Radian	rad
Solid Angle	Steradian	sr

**DERIVED UNITS**

Superficial area	Square meter	m <sup>2</sup>
Volume	Cubicle Meter	m <sup>3</sup>
Frequency	Hertz	Hz
Density (mass density)	Kilogram per cu. meter	kg/m <sup>3</sup>
Velocity	Meter per second	m/s
Angular velocity	Radian per second	rad/s
Acceleration	Meter per second squared	m/s <sup>2</sup>
Angular acceleration	Radian per second squared	rad/s <sup>2</sup>
(*) Force	Newton	N [kg.m/s <sup>2</sup> ]
Pressure (mechanical tension)	Newton per sq. meter	N/m <sup>2</sup>
Kinematics viscosity		Cs
Dynamic viscosity		Cp
Work, energy, quantity of heat	Joule	J [N x m]
Power	Watt	W [J/s]
Quantity of electricity	Coulomb	C [A x s]
Electric tension, potential difference, electromotive force	Volt	V[W/A]
Electric field strength	Volt per meter	V/m
Electric resistance	Ohm	Ω[V/A]
Capacitance	Fared	F[Axs/V]
Magnetic flux	Weber	Wb[V x s]
Inductance	Henry	H [Vxs/A]
Magnetic flux density	Tesla	T [Wb/m <sup>2</sup> ]
Magnetic field density	Ampere per meter	A/m
Magnetomotive force	Ampere	A
Luminous flux	Lumen	lm[cd x sr]
Luminance	Candela per sq. meter	cd/m <sup>2</sup>
Illumination	Lux	lx[lm/m <sup>2</sup> ]

(\*) The unit kg. force may be used [1 kg force = 9,81 N]

## 25.0 GRAPHICAL SYMBOLS

Graphical symbols, unless otherwise specified shall be in accordance with IEC standards.