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TECHNICAL JOB
SPECIFICATION

760/1

REVISION 1

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**HIGH PRESSURE (HP) TRANSMISSION
SYSTEMS
&
LNG PLANT**

**ELECTRICAL SUPPLIES FOR
INSTRUMENTATION**

QUALITY ASSURANCE PAGE

CHANGES LOG :

- New Referenced Documents added
- Para 2.1 modified
- Para 8.3 modified

REVISIONS LOG

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REFERENCED DOCUMENTS

ELOT EN 60896-11

[Stationery Lead-Acid Batteries, Part 11: Vented types – General Requirements and Methods of Test]

ELOT EN 60896-21

[Stationery Lead-Acid Batteries, Part 21: Valve Regulated types – Methods of Rest]

ELOT EN 60896-22

[Stationery Lead-Acid Batteries, Part 22: Valve Regulated Types – Requirements]

ELOT EN 60950-1

[Information Technology Equipment – Safety, Part 1 : General Requirements]

ELOT EN 62040-1-1

[Uninterruptible Power Systems (UPS). General and Safety Requirements for UPS used in Operator Access Areas]

ELOT EN 62040-2

[Uninterruptible Power Systems (UPS). Electromagnetic Compatibility (EMC) Requirements. Class RS]

ELOT EN 62040-3

[Uninterruptible Power Systems (UPS), Performance Requirements and Test Methods]

ELOT EN ISO 9001

[Quality management systems - Requirements]

EU DIRECTIVES

LVD 2006/95/EC

[Harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits]

EMC 2004/108/EC

[Approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC EMC]

1.0 SCOPE

This Specification describes a continuous duty three-phase, solid state, transistorised Uninterruptible Power System (UPS). The UPS shall utilise a true "online" topology with a microprocessor based, pulse width modulation (PWM) inverter. It covers the requirements governing the design of systems and equipments for instrumentation supply.

The present specifications contain minimum requirements and Vendors must complete the offer strictly in accordance therewith, either confirming the data contained in these specifications or filling in the spaces provided where requirements are not met.

Any derogations from or exceptions to the minimum requirements must appear in the offer. Where no exceptions are shown, the requirements of the present specifications shall be considered as accepted.

2.0 GENERAL

This specification is appropriate for use in conjunction with the Material Requisition.

Unless otherwise specified in the Material Requisition and the Technical Description, requirements given in this specification shall govern.

Should conflict exist between requirements of the specification and those of the Material Requisition and the Technical Description, the latter shall govern: in case of doubt, Vendor shall apply to Contractor.

Any deviation shall be listed by Vendor in his bid, with explanation of reasons and advantages of suggested alternative solution.

2.1 1 EU LEGISLATION & STANDARDS

All equipment shall be designed, manufactured and tested in accordance with Codes and Standards issued by **CENELEC**, and the Recommendations issued by **IEC**.

The most important European Standards relevant to this specification are:

ELOT EN 60896-11

[Stationery Lead-Acid Batteries, Part 11: Vented types – General Requirements and Methods of Test]

ELOT EN 60896-21

[Stationery Lead-Acid Batteries, Part 21: Valve Regulated types – Methods of Rest]

ELOT EN 60896-22

[Stationery Lead-Acid Batteries, Part 22: Valve Regulated Types – Requirements]

ELOT EN 60950-1

[Information Technology Equipment – Safety, Part 1 : General Requirements]

ELOT EN 62040-1-1 Uninterruptible Power Systems (UPS). General and Safety

Requirements for UPS used in Operator Access Areas

ELOT EN 62040-2 Uninterruptible Power Systems (UPS). Electromagnetic Compatibility (EMC) Requirements. Class RS

ELOT EN 62040-3 Uninterruptible Power Systems (UPS). Performance Requirements and Test Methods

ELOT EN ISO 9001 Quality management systems - Requirements

All apparatus shall bear the CE mark, together with:

- The Certification of Conformity to **EMC Directives (2004/108/EC)** repealing Directive 89/336/EEC).
 - The Certification of Conformity to **Low Voltage Directive (2006/95/EC)**.
- Any other applicable EU Directive.

In the event of conflict of laws, it is agreed that the most restrictive law, regulation or standard will apply.

3.0 ENGINEERING DOCUMENTATION

Vendor shall furnish (but not limited to) the following documentation:

One line diagrams covering all equipment up to and including distribution panels with metering, relaying and protective devices shown.

Material requisitions of all equipment including all technical data. Operation and maintenance manual furnished by the Vendor of equipment.

Coordination study demonstrating the selectivity of circuit protective devices throughout the system.

Current limiting effects of components (if any) and battery internal resistance shall be considered in the study.

4.0 LOAD CLASSIFICATION

Classification of A.C. instrument power loads shall be based on the tolerable time of transfer (1) between normal and stand by supplies as follows:

Tolerable Transfer Time (s)	Class
0,005	A
0,2	B
Over 0,2 -10	C
Transfer to standby not required	Non classified (2)

Classification of D.C. instrument power loads shall be by specifying the tolerable outage time (1) for each one individually. Particular attention shall be given to devices involved in shut down operation.

- 1) Tolerable transfer and outage times are the longest supply interruption which will not have a significant effect on process or equipment operation.
- 2) Non-classified are those which are non-essential during general power outages and whose loss may also be tolerated during infrequent maintenance and repair of their power supply.

5.0 SUPPLY TO DC INSTRUMENT LOADS

Control and shutdown systems shall be supplied from separate sources, as shown in **Figure 1** (if required).

A backup supply shall be provided for all supplies, such that each D.C. bus has two 100% sized D.C. supplies connected in parallel.

A common backup supply is acceptable, if all of the following conditions are met:

- a) Voltages of all normal supplies are equal.
- b) All normal supplies and the backup supply have output voltage stabilization of the same precision and adjustability. The backup supply output voltage is to be adjusted for no load when all normal supplies are maintaining voltage.
- c) Backup supply size equals at least the size of the largest normal supply backed up.

Voltage stabilization shall be provided to maintain voltage within tolerable limits of the loads served, considering battery voltage variable from fast and/or equalizing charge voltage down to end-of-discharge voltage at design load.

Earth detector shall be provided for each load bus.

6.0 SUPPLY TO AC INSTRUMENT LOADS

A.C. loads shall be fed from supplies as shown in Figure 2. It is acceptable to have separate stabilizing section for each distribution section.

Voltage stabilization shall be provided in the normal and alternative supplies, to maintain voltage within tolerable limits of the loads served, taking into account the calculated variation of A.C. source voltages and voltage drop variations due to load changes.

Transfer switches at distribution panels for class A and B loads shall operate immediately upon drop of voltage below lower tolerable limit. Transfer initiation of automatic switches for Class C loads shall be delayed to be selective with relaying and transfers in the main power system.

By-pass switches shall be provided for all automatic transfer switches and shall be 3 positions with make- before break contacts.

7.0 SUPPLY TO NON-CLASSIFIED LOADS

Non-classified loads may be fed radially, with neither standby supply nor battery backup.

Radial supply shall include voltage stabilization of frequency stabilization or both, if the main power supply stability is inadequate for the loads.

8.0 EQUIPMENT

8.1 DESIGN SPECIFICATIONS

The Uninterruptible Power System (UPS) shall include the following functional units:

Rectifier / battery charger.

Inverter.
Maintenance bypass switch.
Static changeover switch.
Batteries.

8.2 RECTIFIER / BATTERY CHARGER

The rectifier / battery charger shall be designed and made according to the following specifications:

- Input load circuit breaker with auxiliary indicator contact.
- Battery circuit breaker with auxiliary indicator contact.
- Fully controlled six (6) or twelve-pulse (12) plus filters thyristor bridge.
- Battery circuit filter to limit current ripple to batteries to 0.05 C-i₀ or better.
- Testing and control circuit which, in addition to normal functions, shall:
 - * Control the walk in/soft start function in a minimum time of 10 seconds.
 - * Check the battery circuit (battery fault).
 - * Test the battery by automatically performing a partial battery discharge at weekly intervals or at user's request. The test will be performed by both a voltage testing method and through an algorithm that checks the battery discharge curve.
 - * Adjust battery float voltage as a function of ambient temperature (correction factor's typical value -0.11 % per °C).
 - * Stop the rectifier when output voltage is too high and can damage the batteries (max value allowed 2.4 V/cell).
 - * Calculate the remaining autonomy time of the battery during discharge.

8.3 1 BATTERIES

The batteries shall be:

- Ni-Cd open / sealed type with an operating life of approximately 20 years. ---
- Lead acid sealed type with an operating life of 5-10 years.

The battery shall be housed in a separate air-conditioned room and shall be protected by fuses located on each pole and through an appropriate circuit breaker.

In order to protect batteries from damage due to deep discharge (discharge with light load), the inverter stop voltage shall automatically vary as a function of discharge time, as specified in the table below (for lead acid type batteries):

<u>Discharge Time</u>	<u>End of Discharge Voltage</u>
Discharge up to 1 hour	End of Discharge Voltage > 1.80 V / cell
Discharge up to 2 hours	End of Discharge Voltage > 1.75 V / cell
Discharge up to 4 hours	End of Discharge Voltage > 1.68 V / cell
Discharge up to 10 hours	End of Discharge Voltage > 1.65 V / cell

For Ni-Cd type batteries the discharge voltage shall be 1.05 V / cell.

To maximise battery-operating life, the float voltage shall be automatically adjusted as a function of the ambient temperature.

Batteries, in the event of total failure of the main power source, shall guarantee the supply of nominal UPS output power for a minimum autonomy of 8 hours or for the time specified in the Technical Description (whichever is greater).

8.4 INVERTERS

The inverter shall be designed according to the following specifications:

- Transistorised switching circuit (pulse width modulation, PWM) capable of converting direct current voltage from rectifier or batteries into alternating current voltage.
- Class H three-phase transformer.

- Sized output filter to create an output voltage sinusoidal envelope.
- Sizing of neutral circuit for a current of at least 1.7 times the phase current. –
- Testing and control circuit which, in addition to normal functions, shall:
 - * Stop the inverter when the voltage is too low as a function of the discharge time, as specified in para 8.3.
 - * Automatically adjust the output power in accordance with ambient temperature.

8.5 MAINTENANCE BYPASS SWITCH

The UPS shall be equipped with a system of bypass switches capable of transferring the load to the reserve supply without interruption so as to enable the UPS to be switched off and isolated for maintenance operations.

8.6 STATIC CHANGEOVER SWITCH

The static switch assembly shall be designed and made according to the following specifications:

Two static switches, each consisting of a pair of thyristors connected in antiparallel in each inverter output and reserve supply output phase.

Reserve and by-pass (standard) load circuit breaker with auxiliary indicator contact.

Output load circuit breaker with auxiliary indicator contact.

Microprocessor controlled logic shall:

- * Automatically transfer load to reserve line without interrupting the power supply in the event of overload, over temperature, out-of-tolerance dc voltage or inverter fault conditions

- * Automatically transfer load to reserve line with a delay of 20 ms if the reserve and the inverter are not synchronised, in the event of overload, over temperature, out-of-tolerance DC voltage or inverter fault conditions

- * Automatically re-transfer the load from the reserve line to the inverter line, without interrupting the power supply, when normal load conditions are restored.

8.7 AC VOLTAGE STABILIZER

Voltage stabilizer shall be of the constant voltage type (saturated - core and capacitor) or step voltage regulator (TCUL), or induction voltage regulator type. They shall automatically regulate the output voltage without interrupting the load. Step regulators shall be continuous type without breaks between taps. Performance characteristics shall be as follows for 0-100% load and expected power factor range, for input voltage variations of $\pm 10\%$ and for expected ambient temperature extremes.

-Voltage: 230V or 400V $\pm 2\%$ with input frequency stability within ± 1 Hz. -
Wave shape: with less than 5% of total harmonic distortion.

-Transient: maximum voltage variation shall not exceed $\pm 10\%$ after sudden application or removal of full load. Recovery time to steady state shall be within 1,0 second.

9.0 OPERATING MODES

This section describes the different operating modes of the Uninterruptible Power System.

9.1 NORMAL OPERATING MODE

The supply of the loads connected to the Uninterruptible Power System (UPS) shall always be supplied by the inverter which shall be supplied by the primary line through the rectifier/battery charger.

The rectifier shall also provide the power necessary to keep the battery in the fully charged condition.

The inverter shall be synchronised with the reserve line so that the load can be transferred from the inverter to the reserve supply on account of an overload or inverter stop without any interruption in the power supply to the load.

9.2 INVERTER STOP OR OVERLOAD

In the event of an inverter stop (whether manual or caused by a UPS protection), the load shall be automatically transferred to the reserve supply without interruption.

Similarly, when a temporary overload downstream of the UPS occurs, the load shall be automatically transferred to the reserve supply without interruption and then returned to the inverter when the overload condition ceases.

This capability shall permit the inclusion of loads whose inrush current is greater than the supply capacity of the inverter, provided always that the reserve supply is within accepted limits.

In the event of an overload with an unsuitable supply, the Uninterruptible Power System shall not transfer the load and shall continue to supply it from the inverter for a period of time dependent upon the extent of the overload and the characteristics of the UPS.

These no-normal operating conditions shall be alarmed to the user.

9.3 EMERGENCY (mains failure)

Upon failure or reduction of the primary AC source, the load shall be supplied by the battery through the inverter.

During this stage, power shall be drawn from the battery whose charge will be reduced.

Visible and audible signal shall alert the user to this operating state.
The remaining autonomy time shall be calculated by a diagnostic algorithm.

9.4 RESTORATION OF PRIMARY AC SOURCE

Upon return of the primary AC source to within tolerance limits, the Uninterruptible Power System shall start operating in normal mode again.

Even if the battery is completely discharged, the rectifier/charger shall automatically restart, "walk in" and gradually assume both the inverter and battery recharge loads.

10.0 CONTROLS, MEASUREMENTS, SIGNALS AND ALARMS

The Uninterruptible Power System shall be controlled by a microprocessor and shall be provided with an at least 40 character (2 line) display unit to display signals, measurements, alarms and operating modes as described below.

10.1 CONTROLS

The UPS shall be provided with the following controls:

Inverter start.

inverter stop (to avoid switching off accidentally, while simultaneously allowing prompt action to be taken in the event of an emergency, the button must be held down for 2 seconds).

Audible alarm cancel.

10.2 MEASUREMENTS

Vendor shall fill-in the following table to confirm that the following measurements are provided:

a) Rectifier / Batteries

Battery current while charging	.....
Battery current while discharging	.....
Rectifier/battery voltage	.....
Battery cubicle temperature	.....

b) Inverter/Reserve

Frequency
Voltage
Current
Overload

c) Output/Load

Frequency	.....
Voltage	.....
Current	.....
Applied load percentage	.....
Crest factor	.....

10.3 SIGNALS AND ALARMS

Vendor shall fill-in the following table to confirm that the following signals shall be provided:

Phase sequence fault	.....
Battery fault	.....
Imminent shutdown due to battery at end of discharge	.....
Inverter blocked	.....
Overload	.....
Load on reserve	.....
Reserve supply fault	.....
Reserve voltage high	.....
Bypass switch closed	.....
Battery temperature alarm	.....
Insufficient ventilation	.....

The following signals shall be made available at terminal board through a potential free contact:

System normal (summary alarm)	.....
Inverter fault	.....
Load on reserve	.....
Primary supply failure	.....
Imminent shutdown due to end of battery autonomy	.....

The UPS shall also:

Upon mains failure, display on the display unit the remaining battery autonomy, which shall be a function of battery state and charge (discharge curve, degradation, operating temperature, etc).

Keep a record of all events preceding and following a fault.

Display simple, clear instructions to step the user through work procedures.

Permit the addition of a second serial RS232 board for simultaneous and independent use of local and remote monitoring.

Be able to support graphic measurement and signaling software. Be

able to interface with a network monitoring system using SNMP.

Be able to provide a telemonitoring function (see **para 10.4**).

The terminal board shall also include an input terminal capable of stopping the inverter, stopping the rectifier/battery charger and inhibiting the static switches (E.P.O.).

10.4 TELEMONITORING

This section defines the possibilities of the system for remote monitoring and control either from the Control room and optional from a long distance (several kilometers) via software and/or modem.

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Remote alarm unit. A separately mounted alarm panel shall be available and shall include the following: System normal, Mains failure, LED test, UPS alarm, Load on reserve, Alarm mute, imminent shutdown, Inverter fault, ON/OFF switch

An interface kit shall be available to communicate diagnostic information to a non dedicated PC up to 30 meters away from the UPS. This shall include a software package with a menu screen, which shows the exact state of the UPS.

Another software package is aimed at the end user and will allow the monitoring and control of the UPS via modem, using a commercial telephone line. Communication with the UPS will be bi-directional so that at any moment the end user may initiate an on line connection to the UPS and gain access to the units parameters and measurements. The monitoring station will be notified of any anomalous functioning of a UPS connected to the monitoring station.

11.0 UPS TECHNICAL DATA TO BE FILLED BY VENDOR

11.1 INPUT CHARACTERISTICS

Parameter	Unit of Measure	Specification data	Supplier's data
Nominal voltage	(V)	400V 3-phase	.....
Voltage tolerance	(%)	±15	.....
Nominal frequency	(Hz)	50	.....
Tolerance on frequency	(%)	±5	.....
Input power factor @ 400V		>0.83	.....
Total harmonic distortion (THDi) @ full load	(%)		

11.2 INVERTER OUTPUT CHARACTERISTICS

Parameter	Unit of Measure	Specification data	Supplier's data
Nominal voltage	(V)	400V 3-phase+N	
Nominal frequency	(Hz)	50	
Nominal power @ 40°C Automatic adjustment of nominal output power as a function temperature	(kVA)	See M.R. @25°C= 110% @35°C= 105% @40°C= 100%	
Output voltage stability in steady-state condition for input within permitted limits and load variations from 0 to 100% (%)	(%)		±1
Stability in dynamic conditions for 100% load step variations	(%)		±5
Recovery time at 2% of nominal steady-state values	(ms)		<20
Load crest factor Without derating			3:1
Output voltage distortion with 100% linear load	(%)		< 3%
Output voltage distortion with 100% non-linear load and crest factor 3:1	(%)		< 5
Voltage stability for 100% unbalanced loads (0,0,100%)	(%)		±3
Output frequency stability in synchro with mains	(%)		±0.75
Output frequency with internal oscillator	(%)		±0.05

Parameter	Unit of Measure	Specification data	Supplier's data
Frequency slew rate	(Hz/sec)	<1	.....
Permitted overload :			
-for 10 minutes	(%)	125%	....
-for 1 minute	(%)	150%	....

11.3 CHARACTERISTICS OF ELECTRONIC STATIC CHANGEOVER SWITCH

Parameter	Unit of Measure	Specification data	Supplier's data
Nominal voltage	(V)	400V 3-phase	
Tolerance on voltage	(%)	±10	
Nominal frequency	(Hz)	50	
Tolerance on frequency	(%)	±0.75	
Permitted overload:			
-for 10 minutes	(%)	125%	.
- for 60 seconds	(%)	150%	.
- for 600 milliseconds	(%)	700%	.
-for 100 milliseconds	(%)	1000%	..

11.4 UPS CHARACTERISTICS

Parameter	Unit of Measure	Specification data	Supplier's data
Noise level measured @ 1 meter and @ 100% load according to ISO 3746	(dBA)		.....
Performance at 50% load	(%)		.....
Performance at 100% load	(%)		.....

Color of cubicles RAL7035 .

The constructional and functional characteristics of UPS must be in line with state of the art technology in this field; in particular:

- They must be equipped with test points.
- Instruments and indicators must make maintenance and troubleshooting on the equipment quick and easy.

The UPS will be guaranteed for one year during which time the Supplier will provide technical assistance. The supply of spare parts will be guaranteed for 10 years.

12.0 TESTING

12.1 SHOP TESTS

Each instrument power supply system including voltage stabilizer and transfer switches shall be submitted to a shop test as follows:

Full load heat run for 48 hours with determination of efficiency and losses.
Transient voltage responses with step load changes up to 100% load.

Output short circuit test to establish ability of equipment to clear down stream faults. This test should also be used to prove the coordination between the two protective devices immediately down-stream of the inverter.

Measurement of total transfer time including failure detection period.
Check of voltage and current wave shapes.

12.2 WITNESS TESTS

If the instrument power supply equipment is to be inspected, shop tests shall be witnessed by the Owner's representative. Supply system as shown in **Figures 1 and 2** have to be always witnessed.

13.0 MISCELLANEOUS

This section defines details of services, activities and means necessary to complete the supply of the Uninterruptible Power System.

13.1 DOCUMENTATION

All technical documents issued by the Supplier, in particular the user handbook and the installation, maintenance and troubleshooting guides must be in the English language.

13.2 SPARE PARTS

The Supplier shall include in the offer a list of recommended spare parts for at least two and/or five years.

13.3 PACKAGING

The Supplier shall ensure that all equipment is suitably packaged.

13.4 COMMISSIONING

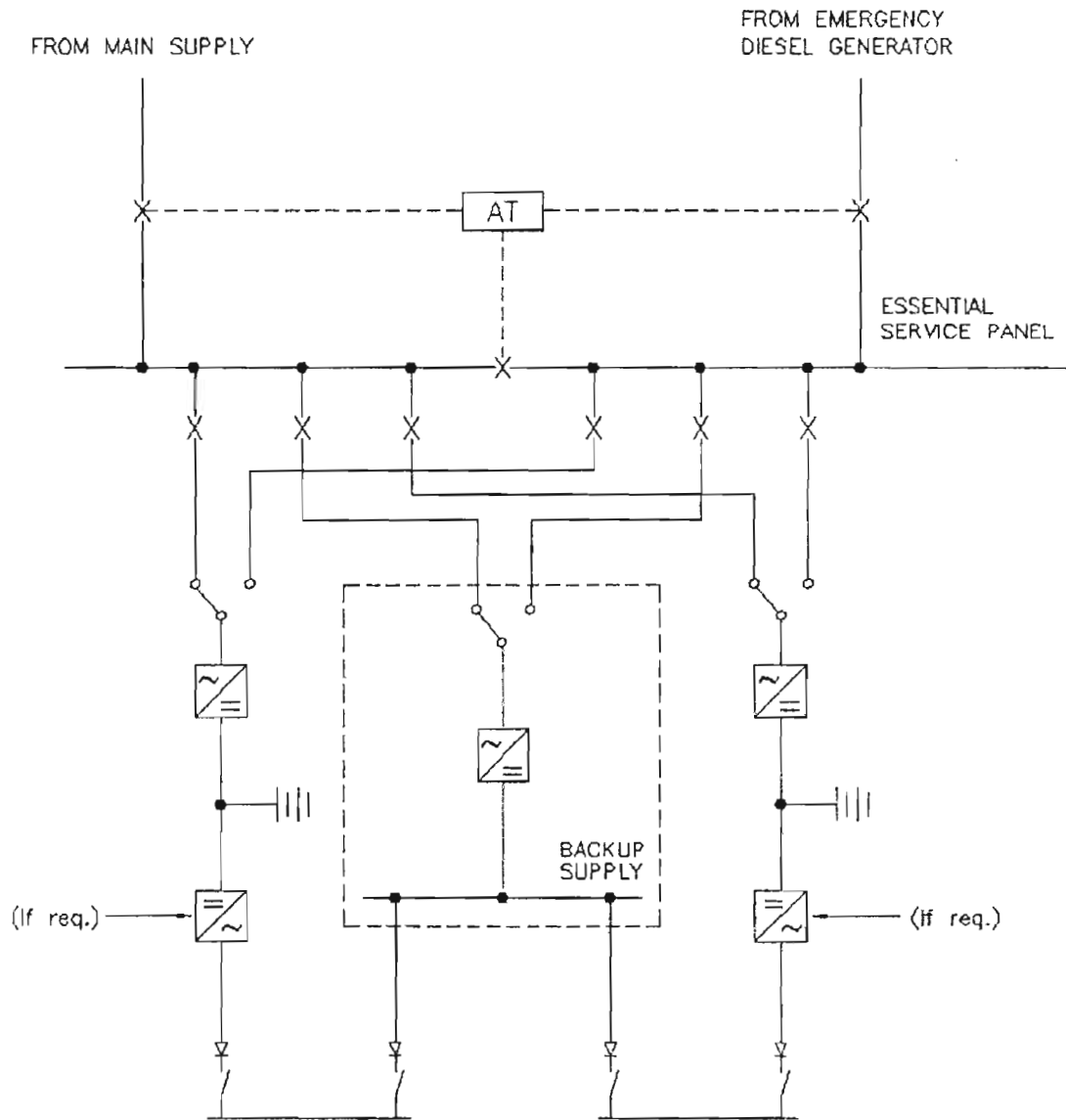
Commissioning costs shall be payable by the Supplier who shall be responsible for the work done and the personnel involved.

14.0 ATTACHED DOCUMENTS

1. **Figure 1**
[Supply to DC Loads]
2. **Figure 2**
[Supply to AC Loads]
3. **Figure 3**
[Symbols]

FIGURE 1

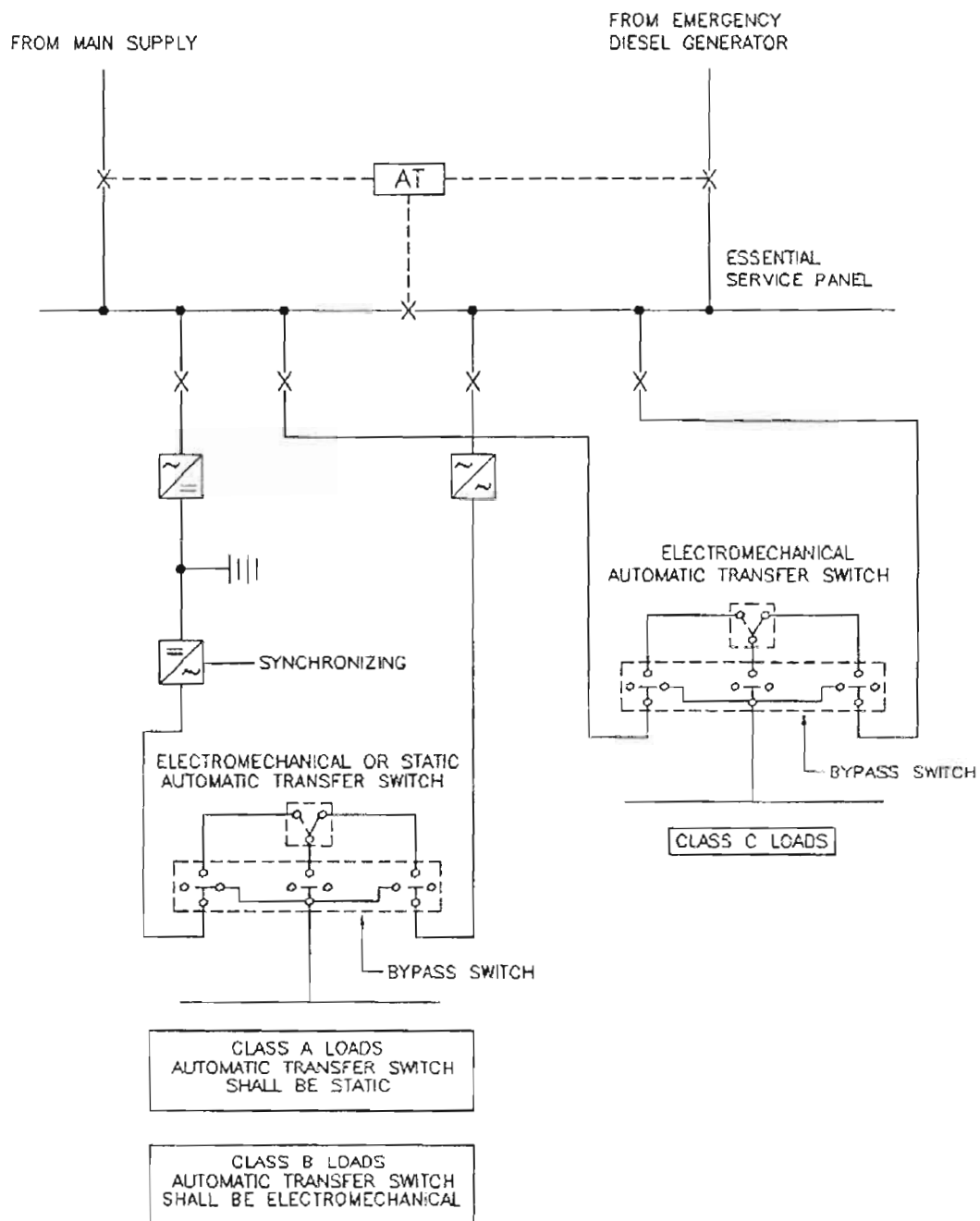
SUPPLY TO DC LOADS



NOTE : FOR SYMBOLS IDENTIFICATION SEE FIGURE 3.

FIGURE 2

SUPPLY TO AC LOADS



NOTE : FOR SYMBOLS IDENTIFICATION SEE FIGURE 3.

FIGURE 3

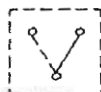
SYMBOLS



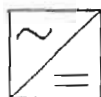
AUTOMATIC TRANSFER SCHEME



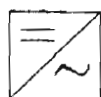
MANUAL SELLECTOR SWITCH



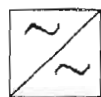
AUTOMATIC TRANSFER SWITCH



BATTERY CHARGER



INVERTER



AC VOLTAGE STABILIZER



DC VOLTAGE STABILIZER



BATTERY