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IMO generator replacement

Mechanical, Electrical and Public Health Services Design Specification

Spec210

12th May 2017

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Contents

1.0 General Description

This specification details the works required for the installation of a new generator at International Maritime Organization building.
The works shall comprise the supply of materials, delivery to site, off-loading, storing, transporting about the works, installation drawings, installing, testing, commissioning, performance testing, and setting to work, full co-ordination with other Contractors, builders work drawings, 'as installed' drawings and manuals, planned maintenance documentation, training personnel and carrying out tender obligations during the Defects Liability Period.
The whole of the Works shall be carried out in accordance with the following: -

a) British Standard 7671 requirements for Electrical Installation (Institute of Electrical Engineering Wiring regulations) Including current amendments and guidance notes.
b) The regulations and requirements of the local Electricity Authority.
c) The factories Act 1961
d) The Health and Safety Executive
e) Memorandum of Guidance on the Electricity at Work Regulations 1989
f) British and European Standard Specification and Codes of Practice as applicable
g) Local Authority Bye-Laws
h) Troup Bywaters + Anders References Specification Y Clauses.
i) The execution of the work shall be subject to the approval and entire satisfaction of the Engineer and Project Manager.

The Contractor shall take responsibility for finalising the design and information as detailed within the Design – TB+A to provide Matrix and associated tender specifications, schedules and drawings. Develop this information including but not limited to engineering load calculations, sizing information, final plant selections, coordination of the installation works with the structural and architectural designs to form a complete construction set of information and operation and maintenance information for complete operational systems as detailed within this documentation.

Drawings issued for tender are provided for guidance only. The Installer shall produce his own production and co-ordinated layouts for all areas in satisfaction of the design intent set out in the tender documents.

The MEP Contractor shall be responsible for the production design and co-ordination drawings, and for selecting all plant and equipment, and the like for compliance with the performance objectives set out in this specification.

The MEP Contractor shall adopt the data included as the performance requirement upon which the coordinated design shall be based.

Where no such value can be determined the CIBSE minimum requirement/recommendation or industry Custom and Practice, whoever results in the higher specification, shall be taken as the basis of design.

1.2 Performance Criteria

INFORMATION TO BE PROVIDED BY THE CONTRACTOR IN CONNECTION WITH ELEMENTS UNDER HIS DESIGN AND INSTALLATION. THE DETAILS CONTAINED IN THIS SECTION OUTLINE THE CONTRACTOR DESIGN SUBMISSIONS, PROGRAMMES, METHOD STATEMENTS AND TECHNICAL PROPOSALS AS WELL AS INSTALLATION AND CO-ORDINATION DRAWINGS THAT WILL BE REQUIRED FROM THE SUCCESSFUL CONTRACTOR PROGRESSING THROUGH THE WORK – NOT DURING THE TENDER PERIOD

The Contractor shall include with his Tender a method statement, in particular the following are to be provided as appropriate:

a) Full details and descriptions of all proprietary products, and suppliers and Sub-Installers upon which the Tender are based.
b) Programme, setting out drawings etc. that will be submitted to the Employer's Representative for review and comment.
c) Schedule of lead-in times for all materials and goods that have long delivery periods.
d) Schedule of spares to be provided.
e) Management and Supervision Proposals.
f) All other drawings, details, samples, documents and/or information which are reasonably necessary to explain and/or amplify the requirements of the Tender or to enable the Installer to execute and complete the works.
g) Such further information as reasonably may be required by the Employer's Representative in verifying the full detail of the MEP Sub-Contractor Proposals.

1.3 Objectives

The MEP Sub-Contractor shall complete the coordinated design and detail the works to meet the Main Contractors/ Engineers and Employer's Representative's requirements including this Specification, the Architectural and Structural drawings and all other criteria which are relevant.

1.4 Design Calculations, Installation & Working Drawings

The MEP Sub-Contractor shall submit fully detailed, logically and neatly laid out calculations which shall comprise but shall not be limited to the following:

- Terminal equipment, grille and diffuser selection
- Plant and equipment selections including proposal for alternative equal & approved manufacturers.
- Verification/proving of duct pressure drops for fan
- Protection co-ordination (including calculation of prospective short circuit)
- Earthing arrangements
- Verification of tray and trunking sizing and support design
- Protective and equipotential conductor sizing calculations

Working drawings shall comprise, but shall not be limited to the following:

Co-ordinated plant layouts and sections	1:20
Wiring layouts	1:50
Schematic diagrams of all Services and Controls	NTS

The tender shall be based upon the manufacturers named in the equipment schedules and drawings. The tenderer will be asked to confirm this as part of the tender submission. The Contractor is also invited to submit an alternative tender price for using alternative manufacturers.

V10 LV Generation

2030 STANDBY GENERATOR INSTALLATION

This section of the Specification relates to the detailed requirements for the mains failure generator installation comprising the supply, delivery, installation, testing and commissioning of the complete system required for the full and correct working of the generator installation.
The works shall be carried out in accordance with the current edition of BS 7671, British Standard Codes of Practice and in accordance with the requirements of the general specification for the Mechanical and Electrical Building Services installation.
The generator shall be located in the basemen at International Maritime Organization building in London.

The Contractor scope of works shall include but it is not limited to the following works: -

Enabling works

+ Removal and disposal of existing generator.
+ Removal and disposal of the existing control panel
+ Drain down, clean and store the existing fuel tank.
+ Removal of existing flue and making good of hole in concrete slab and partition.
+ Removal and disposal of the existing ductwork, attenuators, and extractor fan.
+ Relocation of existing lighting and fire alarms detectors.

New works

+ Delivery and positioning of the equipment, including any necessary dismantling and re-assembling, Craneage, Road closures, etc.
+ Supply and installation of all equipment so as to make the system fully operational.
+ Supply and installation of fuel oil day and connection to existing bulk oil storage tank including all pipework, pumps, isolation valves, wiring, etc.
+ Supply and installation of lubricating oil replenishment tank and pipework.
+ Supply and installation of the complete ventilation system for engine aspiration and cooling, complete with supply fan, acoustic attenuation, ducting, external inlet and outlet louvres.
+ Supply and installation of flues including silencers, catalytic converter, flexible connections, drains, etc.
+ Re installation of the existing fuel tank
+ Full load testing on site
+ Allowance for temporary load bank and LV cables for connection to generator for testing and commissioning.
+ Provision of working drawings.
+ Testing, commissioning and demonstration to the Engineer at the factory and upon completion.
+ Submission of attenuator and silencer selections with supporting calculations.
+ Provision of as installed drawings and O&M Manuals.

2031 NEW GENERATOR INSTALLATION

1. General

The Contractor shall supply and install 1 x Model TGC_AV-700 or similar approved automatic mains failure diesel powered generating set comprising 1No. unitary operation 700kVA. 630Kva PRIME power

rating, continuously rated at 0.8 p.f. lagging, 400Volts, 50Hz, 1500 RPM complete with fuel tanks, exhausts, air intake and discharge louvres, acoustic attenuation, external enclosure etc.

The set shall be continuously rated with 10% overload capacity available for a period of one hour in any 12-hr period.

The generator shall be capable of accepting an initial load step of 50% of the rated load when running at normal operating temperatures.

The deviation of the waveform of the voltage output from a pure sine wave shall not exceed the limits specified in BS 4999.

2. Engine

The set will utilise a Volvo TAD 1643 GE diesel engine or similar approved.

The engine shall be designed for satisfactory operation on fuel oil complying with BS 2869 Class A Category 3 - with a minimum 60% load acceptance and lubrication oil complying with BS 1905.

The engine shall be supplied with:

+ Medium duty air filter to BS 1701
+ Standard engine manufacturer lubricating and fuel oil filters comprising spin on throw away cartridges
+ Switches for low oil pressure, high water temperature and engine overspeed
+ Engine driven water pump with thermostatic missing bypass valve
+ Fuel pump shutdown solenoid, energised to run.
+ Standard engine manufacturers lubricating oil sump, with drain plug and valve.
+ Thermostatically controlled jacket water heater and local isolator.
+ 24v DC starter motor, powered by a set of Lead Acid batteries, sized for 4 x 10 seconds start attempts at 15 degrees Celsius
+ Electronic Engine Governing Class A1

The engine shall be fitted with a close control electronic speed governor of a Class A type and shall comply with the maximum change of speed, percentages and recovery times set out in BS5514 Part 4, class A1/ISO 8528 Class G2

The following instruments shall be provided on a set mounted instrument panel.

1. A lubricating oil gauge.
2. A water thermometer.
3. Lubricating oil thermometers on the outlet from the engine when a lubricating oil cooler is fitted.

The set shall be complete with rubber anti vibration mountings to provide a minimum vibration isolation of 95% and prevent noise transmission via the structure.

The sets shall be equipped with “set mounted” daily service oil tank with maximum storage capacity available.

3. ALTERNATOR

A single bearing alternator shall be coupled to the engine through a solid coupling and a two bearing alternator direct through a suitable flexible coupling which shall be capable of accommodating any slight misalignment between the engine and alternator.

The alternator shall be capable of delivering the required KW’s taking into consideration the typical details of loads detailed under section 4, below, within limits of the specified ambient conditions, the

specified continuous output at rated voltage and frequency, plus 10% overload for one hour in any period of twelve hours.

Alternator shall be provided with steady state voltage regulation within +/- 1.5% from no load to full load at any power factor between 0.8 lagging and unity by means of a solid state voltage control unit and inclusive speed variation of 4.5%.

Line and neutral terminal boxes shall be fitted to opposite sides of the machine and six ends of the stator winding shall each be brought out to their respective line and neutral terminal boxes. The three neutral ends shall be star-connected in the terminal box and blank plates shall be provided for both terminal boxes.

Where the alternator is brushless, it shall be self-exciting, self-regulating, fan ventilated screened and drip proof to IP23 with Class H insulation.

Thermistors shall be supplied and installed in the alternator windings which will shut down the engine upon reaching an unacceptable level of overheating.

Single bearing brushless alternator shall comply with BS5000 Part 40- BS4999 and shall be provided with Radio Suppression Equipment to VS EN 55014.

4. Details of Load

The Contractors attention is drawn to the following which will affect the sizing of the alternator and selection of the engine.

The Contractor shall confirm generator set including alternator selections in the Tender offer.

The alternator shall be capable of operating within the range of plus or minus 1% of the nominal voltage according to the setting of the automatic voltage regulator from no load to 10% overload between unity and 0.8 power factor lagging.

The alternator shall be capable of withstanding a short circuit for three seconds when under the control of the automatic voltage regulator.

The system shall be capable of supporting the maintained switch panel which supplies the following:

No.	Rating (A)	Reference	L1 Max (A)	L2 Max (A)	L3 Max (A)
1	400	Spare - Empty – No MCCB	N/A	N/A	N/A
2	400	Spare - Empty – No MCCB	N/A	N/A	N/A
3	400	Spare - Empty – No MCCB	N/A	N/A	N/A
4	400	Spare - Empty – No MCCB	N/A	N/A	N/A
5	400	Spare - Empty – No MCCB	N/A	N/A	N/A
6	400	Spare - Empty – No MCCB	N/A	N/A	N/A
7	160	Ninth Floor Lift L2 Fireman's Core B	40.66	45.61	42.46
8	250	Basement Hydraulic Lift L8 Core A	19.66	24.23	36.36
9	100	Ninth Floor Lift Distribution Board	75.48	69.14	71.21
10	100	Spare - Empty – No MCCB	N/A	N/A	N/A
11	100	Seventh Floor Lift L1 Core A	14.84	24.09	36.14
12	100	Basement DB MSBL1/P1 & MSBTP1	25.42	24.3	36.13
13	100	Ninth Floor Lift L7 Core C	11.91	24.07	36.21

14	100	Ninth Floor Lift L6 Core C	12.71	23.93	36.18
15	100	Basement Distribution Board MBBTP2	12.1	24.1	36.01
16	200	Spare - Empty – No MCCB	N/A	N/A	N/A
17	200	Spare - Empty – No MCCB	N/A	N/A	N/A
18	250	UPS Changeover Switch	78.6	103.3	86.3
19	100	Spare – Meter and MCCB	N/A	N/A	N/A
20	100	Basement DB MBBTP1	24.67	23.91	42.2
21	100	DB1/SERV/G	46.71	46.89	52.12
22	100	DB3/SERV/G	40.99	41.12	36.19
23	100	Incident Room 1st Floor	15.32	24.06	36.24
24	100	Emergency Auditorium Lighting	11.99	23.91	36.16
		Maximum total load recorded:	*431.06*	*522.66*	*619.91*

5. Mounting

The generator set shall be mounted as a whole on a heavy duty fabricated welded steel base frame. The bedplate itself shall be carried on anti-vibration mountings of bonded rubber of Christie and Grey or equal manufacture. Vibration isolation shall be 95%

The bedplate shall be sufficiently flexible as to allow a suitable engine oil drain tray to be placed beneath the engine.

All connections to the set shall be sufficiently flexible as to allow the anti-vibration mountings to operate correctly.

The body shall be manufactured from high quality Zintec Sheet steel with panels having a double return to give rigidity.

The doors shall be constructed with a solid external face, infilled with 75mm thick acoustic quality high-density non hydroscopic mineral wool, and an internal face of perforated pre galvanised sheet.

6. Cooling System

The generator is to be supplied with a temperate duty radiator complete with engine driven pusher fan and personnel guards and rated for an ambient temperature of 40 degrees Celsius~~. The engine is fitted with an electrically powered heater(s) to improve quick starting in an emergency power requirement.~~

Acoustic louvres and attenuators shall be supplied and installed by the Contractor to both air intake and discharge louvres.

Noise specs:

+ 70 db(A) @ 1mtr Outside
+ 75db(A) @ 1 mtr Inside

7. Starting Battery

The battery shall be either 12 or 24 Volts and capable of withstanding the loads imposed upon it by its specified duties. It should be of the lead acid type and shall be of sufficient capacity for four starts in succession once in an eight-hour period. Auxiliary circuits connected to the battery shall be protected by the fuses.

8. Starting Battery Charger

The electrical supply for the battery charger shall be supplied from either the generator auxiliaries distribution board or from the set when it is in service. An alternative quick charge rate controller shall be provided. The charger shall be fitted with an ammeter to measure the charge and discharge current excluding the starter motor current.

The trickle charger shall be of the fully automatic thyristor controller type with a printed circuit board to control the thyristor's operation to limit the output.

The battery charger shall be located adjacent to the battery set.

9. Indication, Instrumentation and Control

The generator is to have a set mounted control panel. It is to be a Deepsea 7310 unit or similar approved. It will be suitable for locally starting and stopping the set in accordance with the operating philosophy of the existing units, the main control element will be located within the additional section supplied for our previously installed. Control panels shall be connected to the Building management System in order to monitor the parameters detailed in section 10.

Signals shall be taken from the control panel in the Basement Plant room. Contractor shall verify that the existing Cat 5e Cable LSOH 4 pair 24 AWC can be used. Head end graphics to be created for the monitoring of the generator.
Existing BMS operation system: SIEMENS Desigo Insight v 6.2. with PXC controllers.

Under no circumstances shall the standby generator be permitted to parallel with the mains supply.

Switches

Plant control switch (off/run/auto)
Voltmeter selector switch (phase to neutral/phase to phase)
Battery charger control switch (normal/off/boost)
Emergency Power Off

Instrumentation

Voltmeter 3" scale moving iron flush square. (0-500 Volts)
Four ammeters 3" scale moving iron flush square
Frequency meter scaled 46/54Hz. 3" scale flush square
Wattmeter 3" scale suitable for 3 phase, 4 wire, unbalanced loading
Power factor meter 3" scale flush square
Battery charging ammeter 2" scale
Bulk and daily service fuel tank level indication calibrated in litres
Hours run indicator
Battery volt meter

Indication

Fail to start indicator lamp
Low oil pressure shutdown lamp
High oil temperature shutdown lamp
High water temperature shutdown warning lamp
Overspeed shutdown warning lamp
Overcurrent trip lamp
High frequency/speed shutdown warning lamp

A lamp test switch with blue indicator lamp shall be provided for testing of all the indicator lamps.

Controls

Lamp test push button
Alarm mute push button
Fault reset push button
Delay to start timer 0.5 to 30 second adjustable period (set 0.5)
Solid state overspeed detection board
Solid state over frequency detection board
Necessary current transformers for instrumentation
HRC auxiliary fuses
24V alarm horn

Lock-Out

The set shall stop and lock-out to prevent further starting when: -

- If it fails to start when the electric starter motor has been in operation for 3 No. 10 second starts.
- The lubricating oil pressure falls to a value at which it would be unsafe to continue running the engine.
- The cylinder head temperature exceeds a safe minimum at which it would be unsafe to continue running the engine.
- The underspeed trip has operated.
- Over current relay has tripped.
- Earth fault has tripped.
- Operation of the fire valve.
- Emergency Power Off has been activated.

Control panel shall be supplied with anti-condensation, heater and thermostat.

Fault Indication

Each lock-out shall be indicated by an amber alarm on the panel, together with an indication of the fault causing the shut-down.

10. Automatic Voltage Regulator & Remote Alarm Panel/BMS Interfaces

AVR

The automatic voltage regulator shall be of a type which shall maintain its adjustment for long periods without attention. The voltage shall be maintained within +/- 1% of the rated voltage at any load from no load to 10% over load, from unity to 0.8 lagging power factor under all ambient conditions.

Remote Alarm Panel/ BMS Interfaces

Remote indication of the status of the generator sets shall be provided by a remote alarm panel. The status for each set shall be monitored by the existing BMS system as follows:

Generator "On Line"	When generator is "on line" the signal shall be derived from the main switchboard generator circuit breaker when in "Closed" position.
Generator "Tripped/Locked Out"	This signal shall "OPEN" the main switchboard generator circuit breaker.
Generator Fault	A common alarm also indicating that one of the following has operated:-
Generator Battery	An alarm instigated by the battery voltage falling below the normal operational level.
Generator 1 Battery or Battery Charger Failure	Volt free Contact
Generator High/Low Fuel Tank	An alarm instigated by the bulk service tank level falling below or rising above a preset low or high level limit. This signal shall be provided via level switches.
Generator High/Low Lubricating	An alarm instigated by the oil tank level falling below or rising above a preset low or high level limit. This signal shall be provided by generator manufacture.

Existing BMS systems is SIEMENS Desigo Insight V 6.1. Generator control panel shall be connected for monitoring purposes with the BMS system via the existing control panel CP08 in plant room 3 Basement Level. This panel is provided with PXC50.D.

Contractor shall supply and install new SIEMENS PXC50.D automation station for the generator monitoring and all the wiring required for to take the signal from the Generator Control panel to the CP08.

All wiring shall be labelled and the modules identified.

Existing extractor fan is connected to the existing BMS system and the signals AIRFLOW and FAULT are taking back to the CP01 located in the basement Plant Room.
Contractor shall disconnect and removed from CP01 the generator fan monitoring and integrate these signal into the new PXC 50.D installed in CP08.

Head end graphics shall be upgraded to display the generator monitoring system in one dedicated window.

10. Silencers

Silencers for high temperature applications (e.g. diesel) shall have casing manufactured from a suitable gauge steel, with adequate precaution taken to cater for expansion and thermal shock. The internal elements shall be packed with an inert, rot and vermin proof, non-hygroscopic and non-combustible mineral fibre acoustic medium of at least 96Kg/m^3 density, and faced with a layer of mineral fibre cloth behind the perforated metal facing. For very high temperature, steel wool or equivalent material may be used as the acoustic medium.

Insulation thickness to provide maximum surface temperature to comply with Health & Safety requirement.

The outer casings of the silencers shall be constructed from a suitably heavy gauge steel with the seams and joints contiguously welded. Acoustic elements within the silencer shall be designed and constructed with due allowance of differential expansion and thermal shock.

Silencers shall also be fitted with suitable flanges and drain plugs and shall be manufactured and finished with due allowance made for the operating temperatures and environmental conditions.

Silencers shall be delivered to site with blocked ends to prevent ingress of rubble, etc., during installation, and to reduce the risk of damage. The direction of air flow through the silencer shall be clearly marked on the casing.

11. Exhaust Flue

The generator manufacturer shall supply and install mild steel exhaust flue with the necessary insulation material for safe installation in the generator plant room suspended from the soffit and terminating above the plantroom.

Where the exhaust flue is exposed, the exhaust pipe shall be fitted with a 0.4mm thick, type 304 bright annealed, corrosion resistant stainless steel or other suitable material to BS 1449 Part 2 1983 outer wall, in lieu of the above. The flue shall be caged where exposed and accessible.
Flue shall be terminated with appropriate cowl to prevent the straight discharge of the fumes into the basement courtyard or pedestrian zone.

RVT silicon sealant shall be applied to the top edge of the channel band and groove in the outer casing.

Flexible connections shall be fitted between the engine manifold and exhaust pipe system.

Where necessary, expansion bellows shall be fitted. Expansion bellows shall be low pressure rating suitable for corrosive atmosphere and temperatures up to 1000^{o}C, or corrugated bellows type construction with internal sleeves and should be manufactured from type 316 corrosion resistant stainless steel to BS 1449: Part 2: 1983 installed without cold draw, designed to accommodate pressure to 1500mm w.g.

For flue ducts flexible reinforced fabric type compensators shall be used and shall be suitable for the operating temperature and conditions stated above, with internal sleeves as necessary.

Adequate silencers shall be incorporated into the exhaust system to limit noise level external to the plantroom to the levels detailed on Tender drawing. (Note cost options). The silencers shall be located in the plantroom.

The exhaust piping shall be installed clear of all structural elements to prevent heat transfer and possible combustion and supported so that no vibration is transmitted to the building structure.

Where personnel or combustion hazards exist, the exhaust system shall be insulated with 50mm thick mineral wool mattress to a nominal density of 90 kg/m^3 and suitable for temperatures up to 950^{o}C. Insulation thickness to provide maximum surface temperature to comply with Health and Safety requirements. The mineral wool shall be encased in hammer clad overall.

12. First Fills

The engine shall come complete with the first fills of lubricating oil and anti-freeze.

The bulk storage tank and daily service tanks shall also come complete with the first fill of fuel oil.

The Contractor shall include for all lubricating oil and fuel for testing and commissioning.

13. System Configuration

Operation of the generator set shall be fully automatic with the provision of overriding by hand control. On receipt of an appropriate signal the standby set shall start automatically and accept load within 10 seconds.

Phase failure and undervoltage will be detected within the intake switchboard.

On restoration of the mains supply: -

(i) The generator shall run for 15 minutes and supply the load (until the mains is restored and stable).
(ii) The remote auto change-over switch located within the main low voltage switchboard shall change over to mains upon completion of the 15-minute cycle.
(iii) Leaving the generator running on no-load for a further 10 minutes (approximately) completing the cooling cycle.

14. Controls Wiring, Fuses and Earthing

All control wiring shall be terminated with pressure crimped lugs or eyes suitable for PVC insulated wiring. The terminations and respective terminals shall be coded, clearly marked with numbers or letters and shown on the circuit diagram on both ends of the cables.

Fuses shall comply with BS 88, category of duty AC46, fusing factor Class Q1. A spare fuse cartridge for each pole shall be mounted inside the control cubicle. MCCB's shall not be used.

All metalwork generating set housing electrical equipment shall be bonded to a brass earthing terminal of not less than BS 3692 ISO bolt M10 size situated in an easily accessible position on the baseplate.

The set shall be supplied with an 1000A, (4) pole MCCB mounted adjacent to the generator set within the container and will be connected to the alternator via suitably rated flexible load cables.

15. Painting

Panels shall be manufactured from Zinc Coated sheet steel with an internal face pre-galvanised perforated sheet which shall be wiped down with Panel wipe or similar to remove oil or grease.

A coat zinc phosphate primer shall be applied to give good anti corrosive properties, including good humidity resistance.

The finish colour shall be supplied in BS4800 and will be confirmed.

All ferrous metalwork to be painted is first to be shot-blasted to removal all scale and oxide where necessary, degreased where necessary and then immediately treated with etching prime. Undercoat and finishing coats shall be sprayed and shall be applied at the manufacturer's works.

All exhaust silencers, exhaust pipes, flanges, clips and fixings shall be sprayed with metallic aluminium paint in accordance with BS 2569 Part 2 Process "D".

Lubricating oil, fuel oil and starting air pipework and electrical services shall be identified with 100mm wide colour bands complying with BS 1710 Table 1, superimposed on the ground colour adjacent to flanges, valves, junctions and terminations.

16. Ducting and ventilation equipment.

All associated electrical services shall be stripped back to source and to a safe point of isolation. The existing electrical cabling shall be tested and verified to determine its suitability for retention and use with the new fan. However, allowance should be made for a new electrical supply

All duct work from the existing supply and extract shall be stripped. The duct work shall be removed.

The contractor shall supply and install a new centrifugal supply fan Flatkwood or similar approved able to deliver in combination with the generator internal fan:

Total air cooling required for generator: Flow - 13m^3/s and Static Pressure – 500 Pa

Fresh air supply for the system shall be drawn from the wall openings inside the generator through the acoustic enclosure.

Vitiated air and heat generated will be removed via ductwork connecting to a louvered panel mounted in the party wall to the builders' work discharge chamber.

The supply fan is intended for operation when the generator is running and is monitored from Control panel CP01.

Duty and installation shall be coordinated and confirmed before placing order due to the room space restrictions.

Fan shall comply with EU regulation 327/2001 and fully compliance with the Ecodesign Directive 2009/125/EC. Efficiency class IE3 o IE2 + Frequency converter. Fans minimum efficiency Stage 2.

Supply ductwork in accordance with classification in DW/144 Table 1.
Prior to final commissioning, in addition to a visual assessment of the internal surfaces, undertake Preferred Vacuum Test (PVT) to establish dust accumulation level is within the acceptable level for the cleanliness quality class listed in Table 2, (A.4) in TR/19.

Provision of 2 no attenuators to reduce fan noise level so the total rating for the installation does not exceed the values specified in section 6.

17. Testing and Commissioning

The generator manufacturer shall include in the Tender for testing of the generator at full load inclusive of inductive loads **at their works** in the presence of the Services Engineer and Clients representatives.

Final acceptance tests (including inductive load banks which are provided under this supplier remit) shall also be carried out after erection on Site.

All tests shall be carried out in accordance with the requirements laid down in BS 6499 BS 2613 and Clause No. 1935.

Following completion of all tests, two copies of the test results shall be issued.

The generator manufacturer shall furnish for Engineers comment a test programme generally on the basis of the following.

The generator set and the complete system, shall be tested on site with resistive and inductive load banks.

The system shall be tested for:-

i) 4-hrs at full rated load.

ii) 1 hour at 10% overload
iii) Half hour of 75% full load.
iv) Half hour of 50% full load.

The generator manufacturer shall provide fuel for testing and commissioning of the generator installation.

Alternator and exciter maximum winding temperatures and hot winding resistances shall be recorded immediately after the six-hour full rated load trial and the set shall be shut down for the minimum time necessary for the recording of these results.

Determination of frequency and voltage regulation under the following instantaneous load changes shall be noted:-

a) No load to maximum acceptable load.
b) Full rated load to no load.
c) No load to full load to no load, in steps of 25% of full load.
d) No load to 35% rated KVA at low power factor.

The ambient temperature in the plantroom and outside temperature shall be recorded throughout.

Operation of all protective circuits and devices together with verification of the settings of relative sensors shall be carried out.

The sound levels at the point of air intake/discharge.

Check of phase-to-phase and phase-to-neutral wave form by oscillogram.

Calculation of alternator efficiency by summation of losses.

Temporary load tank location to be installed in the car park basement level. Exact location to be confirmed and agreed before works.
Proper overcurrent protection must be provided for all load-bank feeders.
Contractor shall allow for the provision of fans to avoid overheating.

18. Handbook Spares and Tools

The generator manufacturer shall provide three copies of an operating and maintenance instruction handbook, including a schematic circuit diagram showing connections; schedule of components incorporated in the control, switching and part numbers catalogue, etc. instrumentation cubicle, and drawings of the generator set and control cubicle showing overall dimensions and fixings.

The generator manufacturer shall provide a schedule of spares and tools required for the maintenance of the engines and a list of tools included in the tender.

19. Access & Delivery

The generator manufacture shall survey the premises to ascertain the restrictions with respect to the plant delivery and include for all the costs.

The generator manufacturer shall also include for the delivery of the equipment in a “manageable sizes and weights” and assembling on the premises as necessary.

20. Working Drawings

Tender drawings, when produced will be General Arrangement drawings showing the design intent.

In addition to the specification requirements, the generator manufacturers attention is drawn to the following:-

a) The generator manufacturer shall include for the survey of the premises within 5 working days following the receipt of the instruction for the works and submit the drawings showing the full construction details for approval by the Engineer within 3 weeks of the receipt of instruction for the works.
b) The production of the remainder of the details shall be in accordance with the Client's programme requirements.

The generator manufacturer shall provide three copies of an operating and maintenance instruction handbook, including a schematic circuit diagram showing connections; schedule of components incorporated in the control, switching and instrumentation cubicle, and drawings of the generator set and control cubicle showing overall dimensions and fixings.

The generator manufacturer shall provide a schedule of spares and tools required for the maintenance of the engines and a list of tools including in the tender.

21. Fuel System

Day Tank

The generator manufacturers shall include for the removal, cleaning and storage of the existing fuel tank installed in the plant room.

The existing tank shall be re-installed and recommissioned as part of the scope of the works.

Generator set shall be provided with an integral bunded 24hour fuel tank with a minimum capacity of 1000 litre.

The generator manufacturers shall include for controlling valves including fire valves in the flow pipework.

The low and high level fuel alarms shall generate an alarm lamp and an audible alarm on the generator control panel.

The generator manufacturers shall provide a hydrostatic contents gauge on the front face of the tank to indicate the contents of the day run tank.

Pipework and fittings shall be manufactured from mild steel 'heavy grade' in accordance with BS 1387 and shall be welded throughout.

For clarity on fuel tank arrangements see drawings

22. Lubrication Oil

The generator manufacturer shall include for the supply and installation of a lubricating oil storage tank including pipework, low and high level switches and wiring to indicator lights on the control panel for each generator to maintain the generator in continuous operation for a minimum of 48-hrs in the event of a mains failure.

23. Enclosure

The generator and associated control panels shall be located in an acoustic enclosure mounted within the basement of International Maritime Organization.

The enclosure shall be supplied by the generator manufacturer as an integral part of the system or shall be constructed on site. The construction of the enclosure shall generally be in accordance with the enclosure specification and shall be finished as the remaining items of plant of a colour to be agreed with the Client.

24. External Enclosures

The Contractor shall supply all construction requirements, anti-vibration fixings, attenuation, louvre details, supply fan for ventilation, heating and electrical provisions of the enclosure.

The enclosure shall comprise of a heavy gauge, fully welded mild steel base frame. The base frame shall be hot dip galvanised to BS 729. A mild steel box section superstructure shall be fitted to the base frame. The superstructure shall be fully painted with one coast of primer and two coats of acrylic gloss. The complete structure shall be designed to accommodate the full operating load of the installed equipment (both point loads and uniformly distributed loads) and shall include for all anti-vibration requirements.

Steel floor plates shall be fixed to the base frame and painted one coat primer and two coats non-slip floor paint. All joints shall be mastic sealed to provide a watertight deck. Foil faced Celotex insulation board shall be fixed to the underside of the floor to prevent condensation. Walkways shall be fitted with non-slip rubber mats.

The walls and roof of the enclosure shall be clad with composite insulated building panels. The panels shall comprise of an external pre-coated steel sheet finished with a Plasticol coating. The insulation core shall be CFC free urethane foam. The internal liner shall be pre-coated embossed steel. Inner and outer facings shall have Class 1 surface spread of flame to BS 476: Part 7:1987 and are Class O, as identified by Building Regulations and shall be LPCB approved.

Expected performance life of wall and roof panels shall be 25 years.

The Contractor shall include for a 3 phase 100Amp TPN MCB Distribution Board which will serve the ancillary systems provided by the Contractor, including; external lighting, internal lighting, emergency lighting, small power 30mA 13Amp socket outlets and a fire detection and alarm system including a lanyard wire fusible shut-down system.

The Distribution Board shall be supplied by a 4 core XLPE LSF SWA LSF cable provided from the Client's existing power distribution

V90 Electrical Installation

100.000 SYSTEM DETAILS

100.010 SYSTEM DESCRIPTION
Electrical Performance Specification.
The Contractor shall carry out the following:

1. New Wiring to the Generator Installation

a) Install 2x4Core 240mm² XLPE/LSF/CU/LSF + 2x 1Core 240mm2 LSF CU CPC cables from the existing switchboard to serve the new generator control panel.
b) Ensure the generator neutral point is earth bonded at the generator set.

100.020 DESIGN PARAMETERS
To the standards indicated within this specification.

100.040 SYSTEM DRAWINGS
Refer to drawing register.

200.000 GENERAL LIGHTING AND POWER

200.010 REGULATIONS:
Comply with:
- Requirements for electrical installations (the IEE Wiring Regulations) BS 7671
  - Including Amendment 2 (excluding paragraph 514).

200.030 ARRANGEMENTS OF CIRCUITS:
Divide the installation into separately controlled circuits as described below, further subdividing where necessary to ensure compliance with BS 7671 (the IEE Regulations).
Typical Distribution board circuit charts have been provided.

200.040 INSPECTION AND TEST PROCEDURE:
Comply with BS 7671 (IEE Regulations). Provide completion certificates in accordance with BS 7671 (IEE Regulations). Provide information to fulfil BS 7671 (IEE Regulation) 711-01-02.
- Carry out site testing and inspection and provide test certificates for specialist installations. Record all results and readings. Provide copies of any test and inspection result.

Check correct operation of devices. Confirm interlocks and sequences operate correctly. Provide test equipment and consumables to complete tests and retest any failed installations following corrective measures. Check and confirm correct sequence in multiphase circuits.

200.060 IDENTIFICATION - GENERAL:
Apply identification notices in accordance with the BS 7671 (IEE Wiring Regulations) Clause 514 to all electrical cables plant and equipment.
- Phase colour
  - Red, Yellow, Blue.
  - Brown, Black, Grey.

Fix using materials compatible with the notices and fixing surface.
- Obtain approval prior to manufacture of all notices.
- Provide sample for approval.

Apply identification markers in accordance with the BS 7671 (IEE Wiring Regulations), Clause 514 to all conductor termination points.
- Phase marking
  - R, Y, B.
  - L1, L2, L3.

200.070 LABELS
Label all electrical plant and equipment using safety sign 8.A.0044 of BS 5499-5, where voltages above ELV exist.

- Materials
  - Engraved thermosetting plastic laminate.
- Colour
  - Background white
  - Lettering black
- Fixing
  - Screwed into tapped hole size
  - Bolted through complete with washer nut and locking device, size
  - Adhesive

200.090 SCHEMATIC DIAGRAMS:
Provide a purpose made schematic diagram permanently fixed showing the connections of the equipment and plant.

200.110 CABLE IDENTIFICATION:
Provide all cables, other than final sub-circuit wiring with labels fixed at each end of cable, ensure labels show reference number of cable.

200.130CABLE SHEATH IDENTIFICATION - EXTERNAL:
Identify cable sheaths for various services in accordance with NJUG 7.

200.140 FIXING TO BUILDING FABRIC - PREPARATION:
Mark-out using manufacturer's drawings and templates and fix all items.
Ensure structure and fixings are suitable for items to be fixed. Use largest size of fixing permitted by diameter of hole in item to be fixed. Comply with BS 3974 for fixings.
Provide all assistance to enable any item to be built in by others.

200.150 PLUGS AND SCREWS:
Use plugs of material, size and length, in accordance with the manufacturer's instructions. Use screws to BS 1210. Generally use sherardized steel screws. In damp or exposed situations use brass screws.

200.160 FIXING - WORKMANSHIP:
Drill holes squarely. Use drills of correct size and type. Do not flame-cut holes in metalwork. Comply with manufacturer's instructions for all fixings. Avoid fixing through reinforcement. Do not fix to unsound material.

200.170 FIXING TO THE STRUCTURE:

- Obtain approval to:-
  - Cut holes in the structure.
  - Weld to structural steelwork.

200.180 OFF-SITE PAINTING AND ANTI-CORROSION TREATMENTS - GENERAL REQUIREMENTS:
Protect all equipment and ancillaries against corrosion. Protect ferrous metals with coatings at works. Provide all items for decorative finishing primed to suit base material and finish.

200.190 PAINT MATERIALS:
Apply paints in accordance with manufacturer's instructions and to BS 6150.

300.000 CONDUIT AND TRUNKING, LV CABLES AND WIRING - MATERIALS

300.010 STEEL CONDUIT AND FITTINGS:

- Standard
  - BS EN 50086-2-1.
- Ends
  - Threaded.
- Size in accordance with BS 7671 (IEE regulations).
- Fittings
  - Use adaptable boxes of 100mm x 100mm x 38 mm minimum size.
  - Use couplers and externally screwed brass bushes to connect conduit to loop-in circular conduit boxes.
- Protection class/finish
  - Class 4 hot dipped galvanized.
  - Installation
    Use maximum practical lengths to minimise number of joints. Form bends by machine and remove burrs from cut ends.
    Use bends and/or junction boxes at changes of direction. Do not use elbows or tees of any sort without approval.
    Fix securely with boxes fixed independently of conduit.
    Tightly screw all joints to ensure electrical continuity, with no thread showing. Use expansion couplings where conduit crosses movement joints in structure.

300.030 STEEL SURFACE TRUNKING:

- Type
  - Standard cable trunking.
- Standard
  - BS 4678-1.
  - BS EN 50085 pt 1
- Size in accordance with BS 7671 (IEE regulations).
- Fittings
  - PVC covers.
  - Hanger brackets.
  - Fire barriers.
- Protection class
  - Class 1.
- Finish
  - Zinc coated to BS EN 10142 or BS EN 10143 and BS EN 10147.
- Installation
  Use proprietary units to form junctions and changes of direction wherever possible.
  Use mechanical fastenings/fixings; do not weld.
  Fit a copper link at each joint to ensure electrical continuity.
  Fit grommets, bushes or liners to holes through which cables pass.

300.090 FIRE STOPPING OF TRUNKING/DUCTING:
Where trunking or ducting pass through fire resisting floors, ceilings, cavity barriers, etc., seal internally with

- proprietary intumescent material.

300.100 FLEXIBLE CORDS:

- BASEC certified.
- Standard
  - Sheathed 300/500V 90oC to BS 6500

300.110 INSULATED CABLES:
- BASEC certified.
- Type
  - Copper conductors.
  - Single core.
  - Multi-core 4 core XLPE /SWA LSF
  - Armoured.
  - Unarmoured.
  - Sheathed.
    - LSF.
- Standard
  - General purpose 450/750V to BS 6004.
  - Internal wiring 300/500V to BS 6004.
  - 600/1000V to BS 5467.
  - 600/1000V to BS 6724.
  - 450/750V to BS 7211.
  - Flat twin and earth to BS 7211.
  - LSOH 600/1000 to BS 7846.
- Cable glands
  - BS 6121-2.
  - BS EN 50262.
  - Type
    - Sealed inner and outer sheath.
    - Complete with earthing lug.
    - Electrical bond for metallic sheath.
- Fire performance to BS 5839-1
  - Standard.

300.180 PERFORATED CABLE TRAY:
Support all cables throughout their length using cable tray, firmly fixed to building fabric.
Ensure cable tray allows for spacing in accordance with BS 7671 for the design current of the cable.
- Standard BS EN 61537

Type
- Return flanged.

Perforations and thickness
- Manufacturer's standard pattern and thickness.

Fittings

Use factory made fittings throughout of same material, type, pattern, finish and thickness as cable tray.

300.190 CABLE CLIPS AND CLEATS:
- Standard BS EN 50368
  - Material nylon

400.000 CONDUIT AND TRUNKING, LV CABLES AND WIRING - WORKMANSHIP

400.010 INSTALLING CONDUIT IN CONCRETE:
Fix securely to reinforcement and fix boxes to formwork to prevent displacement. Depth of concrete cover not less than indicated for reinforcement.

400.020 INSTALLING TRUNKING:
Remove burrs from cut trunking ends.

400.040 APPEARANCE:
Arrange conduit and trunking, plumb where vertical, neatly parallel with other service runs and the structure.

400.050 EXPANSION AND SETTLEMENT JOINTS:
Make provision at expansion and settlement joints for movement. Use manufactured expansion couplings.

400.060 SPACING:
Install conduit, trunking and equipment clear of other services with minimum spacings:-
- to steam - 300mm, other services - 150mm and above radiators - 1000mm.

Ensure trunking and conduit is independently supported from building fabric. Obtain approval for supports.

400.070 ACCESS:
Locate covers on top or sides of trunking to allow access to wiring.

400.080 CABLE ROUTES:
- Ensure cable routes are
  - Straight, vertical or horizontal and parallel to walls.
  - In approved locations where exposed to view. Conceal cables wherever possible.
- Install
  - concealed vertical cable runs to wall switches and outlets in line with accessory.

400.090 CABLE INSTALLATION - GENERAL:
- Do not commence internal cabling until the building is enclosed and weatherproof.
- Install cables neatly and securely, adequately protected against accidental damage, adverse environmental conditions, mechanical stress and deleterious substances.
- Install cables without joints other than at equipment and terminal fittings. Do not use junction boxes without approval.
- Sleeve cables passing through masonry walls with conduit bushed at both ends.
- Do not run cables in spaces where they will be surrounded or covered by insulation.

400.100 PROTECTIVE CONDUCTORS:
Use cable conductors throughout; do not use conduit or trunking as protective conductors.

400.110 CABLE INSTALLATION - ARMOURED CABLE:
Handle and install carefully to prevent damage to sheath and armouring.
Do not install if cable and ambient temperature are, or have been for the last 24 hours, below 0^{o}C.
Fit galvanized steel guards where cables are liable to mechanical damage.
Bond armour to equipment and main earthing system.
Make moisture proof connections to apparatus using sealed glands and PVC shrouds.

400.120 CABLE INSTALLATION - PVC SHEATHED CABLES:
Do not install cables when temperature is near or below freezing.
Do not install in cavities of external walls.
Fit insulating cable glands at entries to equipment.
Terminate cable sheaths within boxes.

400.170 CABLES IN VERTICAL TRUNKING/DUCTS:
Support with pin racks or cleats at each floor level or at 5m vertical centres, whichever is less.
Provide and fix heat barriers at not more than 5m centres where fire resisting barriers are not indicated.

800.000 SPECIALIST SYSTEMS

800.240 EXISTING INSTALLATIONS EARTHING AND BONDING:
Check earth continuity conductors and loop impedance values of existing installation. Report defects and elements not in accordance with BS 7671 (IEE Regulations 16th Edition) before connecting new or modified installations to existing supply.

800.250 ELECTRICAL INSTALLATION METALWORK:
Bond together all exposed conducting parts with joints of negligible impedance. Carry out work in accordance with BS 7671 (IEE Regulations), BS 7430, Electricity Safety Quality and Continuity Supply Regulations, and Local Electricity Supply Authority Requirements.

- Comply with the requirements of BS EN 50310.

800.270 PROTECTIVE CONDUCTORS:

- Application

Provide protective and equipotential bonding conductors. Size in accordance with the BS 7671 (IEE Wiring Regulations).

- Material
  - Copper LSF to BS 7211.
  - Copper tape insulated for earth electrode
  - Metallic screwed conduits.
  - Metallic trunking.
  - Armouring or sheathing of cables.
  - Protective conductor of multi-core cable.

800.280 EARTH ELECTRODES:

- Application for generator earthing

Provide earth electrodes to BS 7430. Ensure rods meet in centres of coupling. Use high tensile steel driving studs. Protect each electrode head with purpose made concrete housing fitted with removable inspection cover. Connect tape to electrode head using heavy duty purpose made clamps.

- Rods material
  - Molecularly bonded copper clad steel
  - Rod diameter 15mm - nominal.
  - Rod length Min 2.4m
  - Electrodes interconnection
  - 25 x 3mm bare copper tape.

800.300 INSTALLATION OF EARTHING SYSTEM:
Carry out installation of earthing system in accordance with BS 7671 (IEE Regulations 16th Edition) and BS 7430. Secure bare copper tape to structure with fixing devices which avoid piercing tape and ensure 3mm (minimum) clearance of tape from structure, at 450mm maximum centres.
Locate electrodes not less than 2m distant from structure and away from all cables and metallic fences.

Extend when main cable is provided by Electrical Supply Authority, separate protective conductor from main cable armouring gland (or direct earth terminals or PME earth installed by supply Authority) to earth bar.

BS APPENDIX

BS 2950:1958	Specification. Cartridge fuse-links for telecommunication and light electrical apparatus
BS 3041-12:1981	Radio-frequency connectors. Part 12 Specification for r.f. coaxial connectors with screw coupling, unmatched (type UHF)
BS 3041-2:1977	Radio-frequency connectors. Part 2 Specification for coaxial unmatched connector
BS 3456-201:1990	Specification for safety of household and similar electrical appliances. Part 201 General requirements. Work in hand, current, partially replaced by BS EN 60335-1:1995
BS 3924:1978	Specification for pressure-sensitive adhesive tapes for electrical insulating purposes. Current but partially replaced by Parts of BS EN 60454-3
BS 3974-1:1974	Specification for pipe supports. Part 1 Pipe hangers, slider and roller type supports
BS 3974-2:1978	Specification for pipe supports. Part 2 Pipe clamps, cages, cantilevers and attachments to beams
BS 3974-3:1980	Specification for pipe supports. Part 3 Large bore, high temperature, marine and other applications
BS 4177:1992	Specification for cooker control units
BS 4533-102.1:1990	Luminaires. Particular requirements. Part 102.1 Specification for fixed general purpose luminaires
BS 4573:1970	Specification for 2-pin reversible plugs and shaver socket-outlets
BS 4660:2000	Thermoplastics ancillary fittings of nominal sizes 110 and 160 for below ground gravity drainage and sewerage. Partially replaced by BS EN 13598-1:2003
BS 4662:1970	Specification for boxes for the enclosure of electrical accessories
BS 5467:1997	Electric cables. Thermosetting insulated, armoured cables for voltages of 600/1000 V and 1900/3300 V
BS 5486-11:1989	Low-voltage switchgear and controlgear assemblies. Part 11 Specification for particular requirements of fuse boards
BS 5486-12:1989	Low-voltage switchgear and controlgear assemblies. Part 12 Specification for particular requirements of type-tested miniature circuit-breaker boards
BS 5486-13:1989	Low-voltage switchgear and controlgear assemblies. Part 13 Specification for particular requirements of consumer units. Current but obsolescent.

BS 5733:1995	Specification for general requirements for electrical accessories
BS 6004:2000	Electric cables. PVC insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring
BS 6121-2:1989	Mechanical cable glands. Part 2 Specification for polymeric glands
BS 6133:1995	Code of practice for safe operation of lead-acid stationary batteries
BS 6150:1991	Code of practice for painting of buildings
BS 6290-2:1999	Lead-acid stationary cells and batteries. Part 2 Specification for the high-performance Plante positive type
BS 6290-3:1999	Lead-acid stationary cells and batteries. Part 3 Specification for the flat positive plate type
BS 6290-4:1997	Lead-acid stationary cells and batteries. Part 4 Specification for classifying valve regulated types
BS 6346:1997	Electric cables. PVC insulated, armoured cables for voltages of 600/1000 V and 1900/3300 V
BS 6500:2000	Electric cables. Flexible cords rated up to 300/500 V, for use with appliances and equipment intended for domestic, office and similar environments
BS 65:1991	Specification for vitrified clay pipes, fittings and ducts, also flexible mechanical joints for use solely with surface water pipes and fittings
BS 6724:1997	Electric cables. Thermosetting insulated, armoured cables for voltages of 600/1000 V and 1900/3300 V, having low emission of smoke and corrosive gases when affected by fire
BS 67:1987	Specification for ceiling roses
BS 7001:1988	Specification for interchangeability and safety of a standardized luminaire supporting coupler
BS 7211:1998	Electric cables. Thermosetting insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring, and having low emission of smoke and corrosive gases when affected by fire
BS 7430:1998	Code of practice for earthing
BS 7629-1:1997	Specification for 300/500 V fire resistant electric cables having low emission of smoke and corrosive gases when affected by fire. Part 1 Multicore cables
BS 7671:2001	Requirements for electrical installations. IEE Wiring Regulations. Sixteenth edition
BS 7846:2000	Electric cables. 600/1000 V armoured fire-resistant cables having thermosetting insulation and low emission of smoke and corrosive gases when affected by fire

BS 7919:2001	Electric cables. Flexible cables rated up to 450/750V, for use with appliances and equipment intended for industrial and similar environments
BS 8300:2001	Design of buildings and their approaches to meet the needs of disabled people. Code of practice
BS 88-2.2:1988	Cartridge fuses for voltages up to and including 1000 V a.c. and 1500 V d.c. Part 2.2 Specification for fuses for use by authorized persons (mainly for industrial application). Additional requirements for fuses with fuse-links for bolted connections
BS 921:1976	Specification. Rubber mats for electrical purposes
BS EN 10142:2000	Continuously hot-dip zinc coated low carbon steels strip and sheet for cold forming. Technical delivery conditions
BS EN 10143:1993	Continuously hot-dip metal coated steel sheet and strip. Tolerances on dimensions and shape
BS EN 10147:2000	Continuously hot-dip zinc coated structural steels strip and sheet. Technical delivery conditions
BS EN 295-1:1991	Vitrified clay pipes and fittings and pipe joints for drains and sewers. Part 1 Requirements
BS EN 50085-1:1999	Cable trunking and cable ducting systems for electrical installations. Part 1 General requirements
BS EN 50085-2-3:2001	Cable trunking and cable ducting systems for electrical installations. Part 2-3 Particular requirements for slotted cable trunking systems intended for installation in cabinets
BS EN 50086-2-1:1996	Specification for conduit systems for cable management. Part 2-1 Particular requirements. Rigid conduit systems
BS EN 50171:2001	Central power supply systems
BS EN 50173-1:2002	Information technology. Generic cabling systems. Part 1 General requirements and office areas
BS EN 50174-1:2001	Information technology. Cabling installation. Part 1 Specification and quality assurance
BS EN 50174-2:2001	Information technology. Cabling installation. Part 2 Installation planning and practices inside buildings
BS EN 50262:1999	Metric cable glands for electrical installations
BS EN 50310:2000	Application of equipotential bonding and earthing in buildings with information technology equipment
BS EN 50368:2003	Cable cleats for electrical installations
BS EN 60073:2002	Basic and safety principles for man-machine interface, marking and identification. Coding principles for indicators and actuators

BS EN 60146-1-1:1993 Semiconductor convertors. Part 1-1 General requirements and line commutated convertors. Specifications of basic requirements.
Partially superseded by BS EN 50328:2003

BS EN 60146-1-3:1993 Semiconductor convertors. Part 1-3 General requirements and line commutated convertors. Transformers and reactors.
Partially superseded by BS EN 50329:2003

BS EN 60146-2:2000 Semiconductor convertors. Part 2 General requirements and line commutated convertors. Self-commutated semiconductor converters including direct d.c. converters

BS EN 60335-2-80:2003 Specification for safety of household and similar electrical appliances. Part 2-80 Particular requirements for fans

BS EN 60454-1:1995 Specifications for pressure-sensitive adhesive tapes for electrical purposes. Part 1 General requirements

BS EN 60529:1992 Specification for degrees of protection provided by enclosures (IP code)

BS EN 60896-11:2003 Stationary lead-acid batteries. General requirements and methods of test. Part 11 Vented types. General requirements and methods of tests

BS EN 60896-2:1996 Stationary lead-acid batteries. General requirements and methods of test. Part 2 Valve regulated types

BS EN 60947-2:2003 Specification for low-voltage switchgear and controlgear. Part 2 Circuit-breakers

BS EN 60947-3:1999 Specification for low-voltage switchgear and controlgear. Part 3 Switches, disconnectors, switch-disconnectors and fuse-combination units

BS EN 60947-4-1:2001 Specification for low-voltage switchgear and controlgear. Part 4-1 Contactors and motor-starters. Electromechanical contactors and motor-starters

BS EN 61008-1:1995 Specification for residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs). Part 1 General rules

BS EN 61008-2-1:1995 Specification for residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs). Part 2-1 Applicability of the general rules to RCCBs functionally independent of line voltage

BS EN 61009-1:1995 Specification for residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs). Part 1 General rules

BS EN 61009-2-1:1995 Specification for residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs). Part 2-1 Applicability of the general rules to RCBOs functionally independent of line voltage

BS IEC 1008-2-2:1990 Specification for residual current operated circuit-breakers with integral

overcurrent protection for household and similar uses (RCCBs). Part 2-2 Applicability of the general rules to RCCBs functionally dependent on line voltage