TENDER SPECIFICATION OF MARINE DG (400 KW) WITH MCAM SENSOR FACILITY OF BNS KHALID BIN WALID

1. **Name of the Equipment**. Marine DG (400 KW) With MCAM Sensor Facility.

2. **Purpose**. The purpose of this Procurement is to replace the 04 (Four) existing Marine AC Diesel Generators (415V, 3 Phase, 50Hz, 400KW) with control systems with new items. This also involves required modifications in the Main Switchboards (MSB) to accommodate the switchgears, digital and analogue meters and panels of new diesel generators, required integration with onboard Machinery Control and Monitoring (MCAM) system, and minor update of MCAM system.

3.	**Quantity**	:	04 (Four) complete sets.
4.	**Type**	:	Marine Type.
5.	**Brand**	:	Caterpillar, Cummins, MTU, Wartsila and Everllence SE (MAN Diesel) (To be mentioned).
6.	**Model**	:	To be mentioned.
7.	**Country of Origin**.	:	USA, UK, Germany and Finland (Country to be mentioned).
8.	**Manufacturing Country**	:	USA, UK, Germany and Finland (Country to be mentioned).
9.	**Year of Manufacturing**	:	2026 or later.
10.	**Manufacturer (Assembler)**	:	Name and full address with e-mail of manufacturer (assembler) is to be mentioned.
11.	**Supplier/ Principal/ Bidder**	:	Name and full address with e-mail of Supplier/ Principal is to be mentioned.
12.	**Local Agent**	:	Name and full address with e-mail of Local Agent is to be mentioned.

13. **Standard**. The Marine AC Generator set and associated accessories, items supplied under the scope of the supply are to be designed, constructed / manufactured as per internationally recognized standards. The generator is to be tested by a marine surveyor after the production and the **Unit/ Product Certificate** (separate from Type Approval Certificate) for this product in English are to be provided by the supplier during delivery.

14. **Qualification of Bidder**. The bidder is to be authorized by OEM/ OEM authorized agent/dealer of the generator for the supply of the items as per this tender. Authorization certificate in this respect is to be submitted with the offer. In case of offer from OEM authorized agent/dealer, certification of documents regarding such authorization/ agency ship/ dealership of OEM to the authorized agent/dealer is also to be provided.

15. **Scope of Supply**. The scope of supply shall include the following (but not limited to):

a. 04 X Complete Marine Diesel Generator set including Local Control Panel (LCP) and EPCC/ Remote Control Panel, and associated systems and accessories for immediate operation (as per Para 17 to 24).

b. Main Switchboards Modification (as per Para 25).

c. MCAM System Sensor Facilities Update in coordination with Init, Denmark (Previous Name: Logimatic, Denmark, OEM of KBW's MCAM System) (as per Para 26).

d. Interfacing/ Integration with MCAM System in coordination with Init, Denmark (as per Para 27).

e. Necessary power cable and control cable, and cable between CCS, Main Switchboards, LCP, Remote Control Panel, Engine room and Auxiliary Machine room (AMR) (as per Para 28).

f. Software and Firmware (as per Para 29).

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g. Factory Acceptance Test (FAT) (as per Para 30).

h. Training (as per Para 31).

j. Documentation and Certification (As per Para 32 and 33).

k. Installation, Supervision, Setting to Work (STW) and Commissioning (as per Para 34).

l. Test/Trial and Acceptance (as per Para 35).

m. Spares (as per Para 39).

n. Optional Items (As per Para 40)

16. **Operating Environment of Generator Sets**.

a. **Ambient Condition**. The Generator sets and associated accessories and items are to be designed to operate in the following ambient condition:

Air temperature	5^0C to 55^0 C.
Sea Water (SW) temperature	5^0C to 32^0 C.
Relative humidity	Up to 95 % Non-condensing.
Salinity	Up to 34 gm/ltr.
Quality of Sea Water (SW)	High Mud (Suspended solids in SW 2000 ppm) content SW in Coastal Areas.

b. **Maximum Allowable Inclinations**. The Generator set and associated accessories and items shall be able to run when the ship (on which they will be installed) is subjected to following rolling/ pitching:

(1) Roll : $\pm 30^0$.
(2) Pitch : $\pm 10^0$.

17. **General Particulars of Marine Diesel Generator Sets**.

Description of the Diesel Generator		
1.	Complete Generator Set	a. Country of Origin and Manufacture: USA, UK, Germany and Finland (Country to be mentioned)
		b. Brand (Manufacturer/ Assembler): Caterpillar, Cummins, MTU, Wartsila and Everllence SE (MAN Diesel) (To be mentioned)
		c. Model: To be mentioned
		d. Type: Marine
		e. Power Ratings: 390 – 420KW (Prime Rated Power (PRP))
		f. Ingress Protection: IP 23 or better
		g. Overall dimension of the Generator set (prime mover and alternator combined): (1) Length: To be mentioned (2) Breadth: To be mentioned (3) Height: To be mentioned (4) Weight: To be mentioned (5) HP fuel line Diameter: To be mentioned (6) Other dimensions of the offered Generator sets are to be mentioned **Note**: Existing Generator dimension is L x B x H (3290 x 1400 x 2015) mm and weight without water and fuel is 4930 Kg. The new marine diesel generator sets shall be within, and as close as practicable to the size and weight limits of the existing unit in order to ensure compatibility with all associated systems and maintain overall weight and stability requirement. The existing inner diameter of the HP fuel line is 28 mm. The proposed system is to match the existing setup.
2.	Prime Mover	a. Type: Marine.
		b. Brand: Caterpillar, Scania, MTU, Wartsila , Everllence SE (MAN Diesel), Perkins and Cummins (To be mentioned)
		c. Model: To be mentioned
		d. Country of Origin and Manufacture: USA, UK, Finland,

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		Sweden and Germany (To be mentioned)
		e. Year of Manufacture: 2026 or later
		f. Aspiration: Turbo-charged and Heat-Exchanger.
		g. Prime Rated Power (PRP) as per ISO 8528-1: To be mentioned
		h. Overload Rating: 110% of PRP 01 (one) hour in every 12 hours
		j. Minimum allowable continuous load: 120kW or 25% whichever is lower
		k. Number of Cylinders and arrangement: To be mentioned
		l. Bore and Stroke: To be mentioned.
		m. Compression Ratio: To be mentioned.
		n. Combustion: Direct Fuel Injection (To be mentioned).
		p. RPM: 1500 (To be mentioned).
		q. Specific Fuel and Lube Oil Consumption (in Liters/kWh): To be mentioned.
		r. Combustion air requirement: To be mentioned (May commensurate with existing air supply system arrangement and air pressure).
		s. Governor: Electronic (Details to be mentioned)
		t. Turbo Charger (Maker): To be mentioned.
		u. Fuel oil to be used: High speed Diesel (HSD) (Sulphur content less than 500 PPM).
		v. Lube oil to be used: SAE-40/SRD-40.
		w. Lube oil priming pump: The required power supply for lub oil priming pump is to be mentioned. The existing supply of the ship is 24V DC.
		x. Starting System: Electrical Starting system. (1) Battery Quantity: To be mentioned for each Genset. (2) Battery Capacity (**each**): 12V, 200AH or more (Must be compatible with Genset). (3) Brand and Model: To be mentioned (Must be of a renowned Brand).
		y. Dynamo: **Each** generator shall have dynamo for charging the starting system battery (Details to be mentioned).
		z. **Local Control Panel**: One local control panel for **each** generator shall be of marine standard and flexibly mounted on the generator sets to meet the required inclination conditions. The supplier shall provide all necessary arrangement so that the generator can be started from this panel. **Each** panel shall also be equipped with the following digital and analog meters, gauges and facilities (but not limited to): (1) **Display Facility for**. (a) RPM. (b) Hour count. (2) **Gauges**. (a) Lube oil pressure gauge. (b) Seawater pressure gauge. (c) Lube oil temperature gauge. (d) Fresh water temperature gauge. (e) Exhaust temperature gauges. (f) Lube oil filter differential pressure gauge. (g) Fuel filter differential pressure gauge. (3) **Safety Devices**. (a) Low lube oil pressure alarm (audio and visual). (b) High cooling water temperature shutdown device with audio and visual alarm.

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		(c) High lube oil temperature alarm (audio and visual). (d) Low lube oil pressure shut down device with audio and visual alarm. (e) Prime Mover over speed alarm and auto shut down device/over speed trip gear (with manual resets). (4) Each LCP must comprise a local operation switch for selection of local or remote control. With the local operation switch, main switchboard control as well as remote control can every time be disabled and overridden, except for the EMERGENCY STOP.
3.	Alternator	a. Type: Marine.
		b. Excitation System: Self excited (To be mentioned).
		c. Brand: Leroy Somer, Stamford and Mecc Alte (To be mentioned)
		c. Model: To be mentioned.
		d. Country of Origin and Manufacture: USA, UK and EU Countries (Country to be mentioned)
		e. Year of Manufacture: 2026 or later.
		f. Classification Standard: To be mentioned.
		g. Number of Poles: 4 Poles.
		h. Maximum Continuous Rating (MCR): Sufficient to cater for operational load plus 10% reserve.
		j. Overload rating: 110% for 1 hour.
		k. Power Factor: 0.8 lagging.
		l. Rated Terminal Voltage: 415V AC.
		m. Frequency: 50Hz.
		n. No of Phases: 3 (three) Phase.
		p. Output: 400KW minimum (To be mentioned).
		q. RPM: 1500.
		r. Field type: Brushless revolving (field type).
		s. Rotor: Dynamically balanced.
		t. Stator: Double layer concentric winding.
		u. Connection: 3 Phase, star connected, neutral un-earthed.
		v. Excitation: AREP (Auxiliary Winding Regulation Excitation Permanent) or better.
		w. Ventilation: Self air ventilated.
		x. Insulation class: H.
		y. Maximum Temperature rise: H/125°C.
		z. Enclosure: To be mentioned.
		aa. Number of Bearing: Single bearing.
		ab. Anti-condensation heaters shall be incorporated (existing DG space heater supply 115V AC).
		ac. Winding Temperature: Winding temperature sensor and safety device shall be incorporated.
		ad. The alternator voltage variation at the rated power factor shall be maintained within ±1%.
		ae. Protection: Normal overload and single phasing protection.
4.	Control Power Supply	The required power supply for control system is to be mentioned. The existing supply of ship is 24V DC.
5.	Parallel Operation and Low Load operation	a. The offered generator sets shall have the arrangement to run in continuous parallel condition with automatic load sharing.
		b. The generator sets shall be capable of continuous operation at loads as low as 120 kW or 25%, whichever is lower.
		c. It shall be capable to synchronize both in automatic and manual mode. In this case, the existing manual synchronization facilities may be reused.
6.	AVR	a. Type: Digital.
		b. Brand and Model: Details to be mentioned.
		c. Country of Origin and Manufacturer: To be mentioned.
		d. Year of Manufacture: 2026 or later.
		e. Manufacturer: To be mentioned.
		f. Voltage Regulation Accuracy: ±0.25% or better.
		g. Regulation Features:

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		(1) Voltage Equalization (2) Droop Management (3) Cross Current compensation (4) LAM (Load Acceptance Module) (5) Negative Field Forcing
		h. Communication and Settings: Software configuration (PC tool).
		j. AVR shall have facility for remote voltage adjust potentiometer in main switchboard.
7.	Loading Condition	The Generator sets and AVRs must be highly responsive. However, the generator sets shall meet the following transient condition as per MIL-STD 1399: **Voltage**. a. Voltage transient tolerance: Within ±16% (To be mentioned). b. Voltage transient recovery time: Max 2 sec (To be mentioned). **Frequency**. a. Frequency transient tolerance: Within ±5.5% (To be mentioned). b. Frequency transient recovery time: Max 2 sec (To be mentioned). The above transient Conditions must be maintained under following load change: a. Load increases from 0% to 25%, 25% to 50%, 50% to 75%, 75% to 100%. b. Load Changes from 100 to 0%. c. Sudden addition of largest 3-phase induction motor available onboard ship while generator running at 50% load. The Ship largest motor is of 75 KW (AC Motor). **Note:** Graphs showing various characteristics and response of transient voltage and frequency variation for each generator are to be submitted with the FAT Report.
8.	CCS/ Electric Plant Control Console (EPCC)	a. Existing analogue and digital meters, indicators, synchroscopes, selection switches, cables and any other device (except generator set controllers) available at EPCC for control and monitoring may be reused for smooth operation and functionality of new generator sets. However, if any new items are required, it shall be provided by the Supplier. Actual requirement of items required is to be assessed during site visit. List of items required for EPCC are to be quoted separately. b. All the necessary mechanical modification (panel preparation for fixing items, painting and etc) are Supplier responsibility. Necessary mechanical and electrical line diagram and drawing of EPCC are to be provided with the offer. **Note**: Existing EPCC is described in Paragraph 18c. Supplier shall ensure the existing configuration and capability, if not increased.
9.	Generator Set Controller	a. Type: Marine.
		b. Brand and Model: To be mentioned.
		c. Year of Manufacture: 2026 or later.
		d. Country of Origin and Manufacture: To be mentioned.
		e. Manufacturer: To be mentioned.
		f. Year of Manufacture: 2026 or later.
		g. Classification Standard: Marine.
		h. Trip of Unessential Loads: Yes (to be mentioned).

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		j. Protective Functions with Alarm (but not limited to): (1) Overcurrent: 120% of I_N in 10 sec. (2) Phase failure: Same trip as undervoltage/ underfrequency. (3) Overload: 120 % of P_N in 10 sec. (4) Reverse power: -10% of P_N in 5 sec. (5) Busbar Overvoltage: 120% of U_N in 1 sec. (6) Busbar Undervoltage: 75% of U_N in 1 sec. (7) Busbar Overfrequency: 110% of f_N in 20 sec. (8) Busbar Underfrequency: 90% of f_N in 10 sec.
		k. Priority Settings: Possible (To be mentioned).
		l. Communication and Configuration Tool: Software configuration tool is to be provided (Details to be mentioned).
10.	Power Management System (PMS)	Shall have following functions but not limited to: a. Automatic start of a generator set following black-out. b. Load dependent start/stop of with adjustable reserve load. c. Safety stop (secondary) of generator in case of critical condition, and automatic start of next D/G (in AUTO mode). d. Safety Shutdown from LCP (low lube oil pressure, high cooling water temperature, or overspeed). e. Overspeed from LCP. f. Automatic start of new generator (in AUTO) and delayed stop of D/G in case of pre-alarm for critical operation (pre-alarm of low lube oil pressure and high fresh water temp). g. Control of generator cool down time (for normal stop of generator). h. Generator monitoring and alarm (common alarm to MCAM). j. Generator start-up sequence. k. Voltage, current and frequency monitoring with alarm. l. Automatic synchronizing and parallel operation. m. Symmetrical load share between engaged generators. n. Deloading of generators before disengaging from the main switchboard. p. Automatic synchronizing of bus tie breaker and coupling of two bus bar section independent of the number of running diesel generator sets on each bus bar side. q. Combat Function (manual selection): all generators (in AUTO) engaged. r. No Generator Stop (manual selection): Running generators are to remain engaged even load decreases. s. Generator protection with breaker trip and/or alarm for the following criteria: (1) overcurrent (2) phase failure (3) phase current asymmetry (4) overload (5) over voltage (6) under voltage (7) reverse power (8) over frequency

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		(9) under frequency t. Automatic trip of unessential consumers. u. Bus tie breaker protection with breaker trip and/or alarm for the overcurrent. v. Integrated system self-monitoring for communication failures, wire break of critical inputs and sensor failures. **Note**: Existing PMS is described in Paragraph 18. Supplier shall ensure the existing configuration and capability, if not increased.
11.	Mode of Operations (not limited to)	a. Automatic mode of individual generators: Fully automatic power management controlled by the Generator Set Controller. b. Semi Automatic mode of individual generators: Operator manual control of generator start/stop and breaker open/close (with auto synchronization) from OWS (MCAM Operator Console) and/or EPCC operator panel. c. Diagnosis mode of individual generators (diesel engine diagnostic mode): Operator manual control of generator speed d. Manual control of both generators and Bus Tie Breaker: Manual main switchboard control of generators start/stop and manual synchronizing. e. Local control of individual generators: Generator start/stop from LCP.
12.	Coupling	The Alternator is to be flanged to the Prime Mover (Engine) through SAE standard, bell housing via flexible coupling. The flexible coupling will be according to the final Torsional Vibration Calculation (TVC). The details shall be mentioned
13.	Base Frame	The Generator sets are to be elastically mounted on a base frame to be rigidly fixed to the generator seating. Lifting eyes are to be provided for lifting the complete Generator sets as a whole, and also the Prime Mover and the Alternator separately. The supplier is to supply standard shock and anti vibration mountings along with holding-down bolts.
14.	Time between Overhauls	To be mentioned.

18. **Existing PMS**.

a. The PMS is realized with generator set controller (Deif PPM3 equipment), and operates as a standalone system in relation to MCAM. 06 (six) PPM3 units are installed in Main Switchboard-1 (MSB1) and Main Switchboard-2 (MSB2), one for each generator and one for each bus tie. In addition, remote operator panels for the four generators are installed in the EPCC console, where each remote panel is connected to the associated PPM3 unit in MSB with CANBUS. The PPM3 units in MSB are directly connected to the generator LCP and the Air Circuit Breakers (ACB) for monitoring and control. All functionality and operator facilities are available in the PPM3 system and are independent of the state of the MCAM system. The MCAM operator workstations includes mimic with remote control features of the Deif PMS.

b. The data connection between MCAM and PPM3 is via serial MODBUS. The MCAM system comprises 06 (six) PMCS cabinets, but only the two units involved in PMS. PMCS 1 controls the MSB 1 equipment and PMCS 5 controls the MSB2 equipment. The MCAM operator facilities consist of two workstations in the CCS console and one workstation on bridge. All three workstations have identical capabilities. The MCAM components communicate over a fiber ring. The PPM3 units are able to control the power plant in combined MSB mode via a redundant CANBUS connection between MSB1 and MSB2. The PPM3 units can operate independently of the other units, so in any failure situations it is possible to operate the MSBs in split mode with automatic PMS.

c. The CCS / EPCC is divided in three panel section plates; Overhead Section Plate 1 for Indications, Vertical Section Plate 2 for Indications and Operation (with power generation and distribution plant mimic) and Horizontal/Section Plate 3 for Indications and Operation. Both analogue and digital indicators are provided on the EPCC console to inform the operator about the electrical plant operation conditions. Arrangement of panels and

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components on the console plates is mirror imaged for both bus bar mains. Arrangement of components on the individual panels is the same for all diesel generator sets to prevent operator errors. The overhead and vertical panel plates contain the power plant mimic panel with both synchroscope units and necessary selection switches for manual synchronization. The horizontal panel provides dedicated control facilities as well as the operator panels for the PMS.

19. **Fuel Oil System**. Fuel oil system shall consist of the followings but not limited to:

Ser	Description		Remarks
a.	Prime Mover driven fuel oil feed pump including a Ready Use (RU) tank mounted on or beside the prime mover. If the existing feed pump and RU tank is suitable for the offered generator sets, then these are not to be included in the offer.	:	To be mentioned.
b.	Duplex type fuel filter with changeover valve. Filter elements are to be replaceable during operation.	:	To be mentioned.
c.	Pressure regulating valve.	:	To be mentioned.
d.	Leak oil fuel system.	:	To be mentioned.
e.	Flame proof hose lines for fuel pipe work to and from Prime Mover.	:	To be mentioned.
f.	Details of arrangement including those for pumps and fittings to be specified.	:	To be mentioned.
g.	The fuel system of the new generator sets shall be commensurate with, and fully compatible with, the existing diesel fuel system onboard. The design shall ensure proper interfacing with all associated components and piping arrangements. In case any interfacing or modifications are required, they shall be carried out by the supplier. Existing conditions and installation requirements are to be confirmed by a pre-bid site-survey.		

20. **Lubricating Oil System**. The lube oil system shall consist of the followings:

Ser	Description		Remarks
a.	Prime Mover driven lube oil pump (gear type) with relief valve on pump discharge.	:	To be mentioned.
b.	LO priming Pump.	:	To be mentioned.
c.	Lub oil pump for extracting oil from wet sump.	:	To be mentioned.
d.	Duplex type lube oil filter with cartridges. Filter cartridges are to be changeable during running.	:	To be mentioned.
e.	Pressure gauges.	:	To be mentioned.
f.	Flexible connections/ hoses.	:	To be mentioned.
g.	Details arrangement including pumps and fittings are to be specified.	:	To be mentioned.
h.	The lubricating oil system of the new generator sets shall be compatible with the existing lubricating oil arrangement. The system shall be designed to match the existing configuration as closely as practicable. In case any interfacing or modifications are required, they shall be carried out by the supplier. Existing conditions and installation requirements are to be confirmed by a pre-bid site-survey.		

21. **Cooling Water System**. Prime Mover internal cooling is to be done by fresh water. Fresh water-cooling is to be done by seawater. Seawater is muddy in the harbor, where the ships will usually be berthed and operated. The Prime Mover cooling water system shall include the following:

Ser	Description		Remarks
a.	Engine driven self-priming seawater and fresh water circulating pumps with discharge pressure gauges. (Water pumps with rubber impellers will not be acceptable).	:	Impeller material is to be mentioned.
b.	Any type of fresh water cooler, external to the Prime Mover.	:	To be mentioned.
c.	Fresh water and seawater pressure gauges.	:	To be mentioned.
d.	Galvanized steel fresh water pipe external to the Prime Mover with flexible pipe connection.	:	To be mentioned.
e.	The cooling water system of the new generator sets shall be designed to match and integrate with the existing cooling water arrangement as closely as practicable. The system shall ensure full compatibility with current piping, flow rates, heat exchanger capacity, and connection points. In case any interfacing or modifications are required, they shall be carried out by the supplier. Existing conditions and installation requirements are to be confirmed by a pre-bid site-survey.		

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22. **Exhaust System**. The existing exhaust system is attached as enclosure may be used for the new Generator sets. The exhaust system of the offered Generator sets shall match with the existing exhaust system of the ship from Generator outlet to ships outlet through funnel. If cannot be matched, exhaust pipes from Generator outlet to ship's outlet will have to be supplied by the supplier. However, following may be included in the exhaust system:

Ser	Description		Remarks
a.	Combined exhaust temperature gauge for both bank.	:	To be mentioned.
b.	Stainless steel expansion bellows with flange between the Turbo charger/Engine exhaust manifold outlet and the main exhaust pipe.	:	To be mentioned.
c.	Exhaust silencers.	:	To be mentioned.
d.	The exhaust system of the new generator sets shall be designed to align with the existing exhaust arrangement as closely as practicable, ensuring compatibility with current piping, back pressure limits, supporting structures, and outlet configuration. In case any interfacing or modifications are required, they shall be carried out by the supplier. Existing conditions and installation requirements are to be confirmed by a pre-bid site-survey.		

23. **Safety Devices**. Following safety devices are to be provided for the Generator:

Ser	Description		Remarks
a.	Low lube oil pressure alarm - audio and visual.	:	To be mentioned.
b.	High cooling water temperature shutdown device with audio and visual alarm.	:	To be mentioned.
c.	High lube oil temperature alarm - audio and visual.	:	To be mentioned.
d.	Low lube oil pressure shutdown device with audio visual alarm.	:	To be mentioned.
e.	Prime Mover over speed alarm and auto shut down device/ over speed trip gear (with manual resets).	:	To be mentioned.
f.	Manual emergency shut off device.	:	To be mentioned.
g.	Reverse power protection system.	:	To be mentioned.
h.	Over current protection system.	:	To be mentioned.
j.	Over voltage/under voltage protection system.	:	To be mentioned.
k.	Over speed protection system.	:	To be mentioned.

24. **Shutdown System**. Shutdown system shall include the following:

Ser	Description		Remarks
a.	Normal shutdown.	:	To be mentioned.
b.	Local/emergency shutdown (push button to be protected with removable/ open able cover).	:	To be mentioned.

25. **Main Switchboards Modification**.

a. Two MSBs are placed in CCS and Engine Room-2. Generator-1 and 2 are connected to MSB1 and Generator-3 and 4 are connected to MSB2. Each MSB is composed of 02 x Generator (Alternator) Panel, 01 x Bus-Tie and Synchronization Panel and 02 x 415V AC Feeder Panel. Necessary modification in generator panels and Bus-Tie and Synchronization panels are to be done by the Supplier.

b. Existing circuit breaker, switchgears, meters, indication lights, selection switches, synchroscope, Watt-hour meter, buzzer, cables and any other device available at switchboard for control and monitoring may be reused for smooth operation and functionality of new generator sets. However, if any new items are required, shall be supplied by the Supplier. Actual requirement of items required is to be assessed during site visit. List of items required for Main Switchboard modification are to be quoted separately.

c. Modification of MSBs shall not degrade capability and functionality of the existing main switchboards. All the necessary mechanical modification (panel preparation for fixing items, painting and etc.) are Supplier responsibility. Necessary mechanical and electrical diagram and drawing of Main Switchboard modification are to be provided with the offer.

d. Actual requirement of Air Circuit Breaker (ACB) is to be assessed by the supplier on site visit. If required, ACBs of appropriate ratings (ratings to be mentioned) are to be supplied.

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26. **MCAM System Sensor Facilities Update**.

a. Country of Origin (MCAM) : Denmark

b. Country of Manufacture (MCAM) : Denmark

c. Supplier will carry out following works as part of MCAM update. Necessary hardware, software, tools and accessories are also to be provided for the said works by the Supplier. The scope of update is as follows (but not limited to):

(1) Updating firmware of existing PLCs.
(2) Upgradation of network switches with newer version including firmware.
(3) Upgradation of MCAM PCs including Operating System (OS).
(4) Updating SCADA software platforms of MCAM system.
(5) Changing I/O devices of Operating Stations (MCAM PC).
(6) Changing indicator lamps in CCS and Bridge consoles.
(7) Mimic diagram update according to the new generators' features.
(8) Any other work to integrate Generator sets with the MCAM system.

27. **Interfacing/ Integration with MCAM System**. Necessary interfacing and integration are to be done with MCAM system via PMCS with generator set controllers by the Supplier. The supplied controller shall have the provision of integration. All necessary hardware, software, tools, accessories and other items required for the said interfacing are to be supplied by the Supplier. Existing functionality of PMCS and MCAM system must be maintained or improved after the said interfacing. **Third party contract with OEM of MCAM System (Init, Denmark) is the responsibility of the Supplier.**

28. **Cables**. The supplier is to provide necessary high quality Power and Control cables for Generator sets (as per IEC 60092-352, IEC 60092-350 standard and marine type) to connect with the LCPs, PMCS, EPCC and Main Switchboards. Actual requirement of cable is to be assessed by the supplier on site visit and to be submitted with the offer **(if existing power supply cable from generator to switchboard are useable, then separate power supply cable is not to be quoted)**. Details of various cable specification and unit price (per meter) is to be quoted separately.

29. **Software and Firmware**. All necessary software, firmware and program of Generator set controller, Engine speed controller, AVR, MCAM System PLCs and other control system are to be provided. Method (step-by-step procedure), tools and items required for loading the software and firmware are also to be provided.

30. **Factory Acceptance Test (FAT)**.

a. FAT will be carried out by a team of 03 (Three) BN members for 05 (five) working days at OEM premises (Detail address shall be mentioned). Both way air fare, accommodation and food for the FAT team will be borne by BN. All types of movement/ transportation (air/sea/road) of the team within the manufacturer's country, reception and arrangement for entry into the country/ concerned area for the FAT are to be arranged by the Supplier. The supplier shall inform BN about the date of FAT (schedule) and FAT criteria at least 08 (eight) weeks prior to the date of FAT. FAT procedure shall be forwarded to the buyer 06 (six) weeks prior to the date of commencement of the FAT to the concerned directorate for approval of BN. Serial number of Prime Mover and Alternator are to be provided along with the FAT procedure. The cost of FAT in this respect is to be quoted in the offer.

b. On return from the country of OEM, the FAT team will submit the report to concerned Directorate at Naval Headquarters. Naval Headquarters will, in turn, forward final decision along with FAT report, basing on which DGDP will render clearance for shipment of stores to the supplier concerned. The supplier will not make shipment of any item of the contract without clearance from DGDP.

c. During FAT, tests will be carried out to fulfill the required condition mentioned in technical specification of the offered system. Various tests for checking performance are to be carried out and recorded. After FAT, a joint test report will be prepared and signed by both the seller and buyer's representative.

d. The FAT criteria is to be submitted in details including the following:

(1) **Generator Load Tests**. Generators load test will be carried out to fulfill the required condition mentioned at Para 17 (7). Recording of voltage, frequency, transient voltage and frequency variation and recovery time will be made to ascertain the specified condition.

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(2) **Prime-Mover Test**. Factory Test Reports of prime mover are to be provided.

(3) **Tests of Alarm and Safety Devices**. Various test for checking temperature, pressure, fuel oil consumption etc. with recording of alarm and shutdown steps are to be carried out.

(4) **Test Report**. Test reports are to be prepared in English which will include all test results and other relevant information. Test report is to be submitted to BN before shipment.

31. **Training**.

a. The Supplier is to send one qualified OEM Engineer who will provide onboard operation and maintenance training in Bangladesh to BN personnel for 01 (One) week after test, trial and commissioning. Emphasis is to be given on operation, maintenance, faultfinding and troubleshooting of Prime Mover, Governor, Alternator, AVR, Engine and Generator set Controller including software/ firmware installation procedure, Control Circuit and the updated MCAM system etc. Cost of airfare (to and from Bangladesh), accommodation, food and internal transportation (to and from work site and hotel) of the OEM Engineer is to be borne by the Supplier.

c. On completion of successful training, each trainee shall be given with a completion certificate mentioning their level expertise.

d. The mode of instruction shall be English. All documents shall be written in English, and training aids and materials (both hard copy and soft copy) shall be provided by the Supplier. Duration of training shall be approximately for 40 hours a week (not exceeding 08 hours per day) considering 05 working days per week.

e. Detail plan and course content shall be formulated and forwarded to BN for approval at least 02 (two) months prior commencement of training. Cost of training is to be quoted separately.

32. **Documentation**. 01 (one) set of brochure/ booklet, line diagram, paralleling arrangement circuit diagram, technical information, etc. of the offered Generator sets (Prime Mover, Alternator, AVR, Governor, etc.) shall be provided with the quotation for evaluation and assessment. The brochure shall contain characteristics/ performance curves, behavior when various loads are added or taken-off in addition to other behaviors of the Generator sets. Following documents and manuals in English (both soft and printed copies, 02 printed copies each) are to be provided free of cost at the time of item delivery:

a. Drawings and instructions manual for installation of the Generator sets.

b. Drawings and instructions manual for Main Switchboard modification and EPCC Panel.

c. Electrical wiring diagrams and faultfinding flow charts of the alternator, main switchboards, EPCC Panel and LCPs.

d. Drawing and diagrams of Power Management System (PMS).

e. Instruction and operation manual of the prime mover.

f. Maintenance manual and workshop level repair manual of the prime mover.

g. Parts catalogue of the prime mover, alternator and LCP.

h. Instruction and operation manual of the alternator.

j. Maintenance manual and workshop level repair manual of the alternator.

k. Instruction and maintenance manual and circuit diagram of the Generator Set Controller, AVR and Electronic Governor.

l. Software/ firmware/ program loading and extraction procedure (in details).

m. Record of change including drawings and the circuit diagram of the updated MCAM system.

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Note: Maintenance manual must contain circuit diagram, design block diagram, data flow, maintenance schedule, overhaul time, faultfinding flow chart, mechanical diagram, spares list and etc. which will be necessary to troubleshoot and repair.

33. **Certificate**. Following certificates are to be provided by the supplier of the Generator sets and associated equipment/ accessories:

a. Certificates by OEMs of alternator, prime mover and the complete genset mentioning respective country of manufacture.
b. Manufacturer's Authorization Certificate with the offer.
c. Assurance letter of assistance from Init, Denmark with the offer.
d. FAT Certificate (in English) are to be provided at the time of item delivery.
e. Necessary Unit/ Product Certification as per Paragraph 13.
f. Quality assurance certificates for the Generator sets and their associated equipment and instruments in regard to its manufacturer and performance is to be provided at the time of items delivery.

34. **Installation, Supervision, STW and Commissioning.**

a. The new generator sets shall be installed at the existing location, maintaining dimensions as close as practicable to the current unit to preserve system accessibility. The arrangement of the new generator sets shall permit direct integration with existing fuel, lubricating oil, air intake, and exhaust systems without major modification. In case any modifications are required, that shall be carried out by the Supplier without any additional cost. Adequate clearance shall be ensured for safe operation, monitoring, and maintenance.

b. Modification of main switchboards and EPCC Panels shall be done at the existing location within same dimensions. Adequate clearance shall be ensured for safe operation, monitoring, and maintenance.

c. MCAM system sensor facilities update work shall not affect the existing capability and functionality of the existing MCAM system. Physical upgradation shall be done at the existing location within same dimensions.

d. The Supplier shall supervise the complete removal of the existing generator sets, cables (if necessary) and LCPs from the ship, without damaging any equipment or existing design factors of the ship. BN will provide necessary manpower/ workforce, relevant assistance and facilities for the said removal work. The Supplier is to bear the complete responsibility of the damage and provide the rectification of that damage at their expense occurred (if any) of any equipment/system of BN ship while installation/ interfacing work.

e. All panels, cabinets, racks and junction boxes shall be made of chromium plating or similar and painted sea water resistant aluminum to prevent corrosion.

f. Qualified OEM Engineers shall be employed for the installation, STW and commissioning. Welding, cutting and lifting assistance for installation shall be provided by BN under the direct supervision of OEM Engineer. All other works shall be done by the Supplier. All types of expenses related with both-way airfare (to and from Bangladesh (installation site)), food, accommodation and internal travel of the OEM engineer during installation shall be borne by the Supplier.

g. All tools, installation materials, cables, cable gland, and other necessary items required for the installation and interfacing works shall be provided by the Supplier. The Supplier shall ensure the watertight integrity of the compartments on completion of the installation work.

35. **Test, Trial & Acceptance**.

a. The OEM Engineer shall ensure satisfactory tests, trial and functioning of the generator sets after all necessary modification in main switchboards and EPCC Panel, and integration/ interfacing with MCAM system (with assistance of MCAM OEM). All instruments and consumables for Harbour Acceptance Test (HAT), Sea Acceptance Test (SAT) and acceptance shall be provided by the Supplier.

b. The OEM recommended HAT and SAT protocol/ procedures shall be forwarded to NHQ at least 06 (Six) weeks prior to the date HAT and SAT for approval of BN.

c. HAT shall be carried out at harbour on completion of successful STW and commissioning. SAT shall be carried out at sea on completion of satisfactory HAT. On completion of satisfactory Test and Trial (HAT and SAT), an acceptance certificate shall be signed by both BN and Supplier.

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36. **Labeling**. Circuit breakers, control switches, instruments, indicating light and terminal blocks etc are to be clearly labeled to identify their purposes and function.

37. **Standard Accessories.** Standard Accessories including housing materials, installation materials which are essential to install and operate the generator sets with required functionalities shall be provided (whether or not those are mentioned in the specification). 01 (One) set of filters for each generators shall also be provided for later use. A list of such items/ accessories will have to be provided inclusive of main equipment price.

38. **Site Survey**. A detailed site survey will be conducted by the Supplier right after the contract signing for installation of new generator sets, redesigning the PMS, modification of main switchboards and EPCC panels, interfacing with MCAM system, and MCAM system update for ascertaining the final design and timeline of the project. The site survey report is to be submitted to BN for final approval. The cost of transportation, accommodation, food, etc. of the visiting team will be borne by the Supplier. However, necessary security clearance, permission, and other administrative support will be given by BN.

39. **Essential Spares.** Following items are to be provided as spares:

Ser	Name of Item	Deno	Total Qty	Unit Price
1.	Lube Oil Filter	Set	08	To be mentioned
2.	Fuel Filter	Set	08	
3.	Air Filter	Set	08	
4.	Belt (all types)	Set	04	
5.	Seawater pump	No	01	
6.	Fresh Water Pump	No	01	
7.	Fuel High Pressure Line	Set	02	
8.	Fresh Water Pump Repair Kit	No	04	
9.	Sea Water Pump Repair Kit	No	04	
10.	Fresh Water Pressure Gauge	No	02	
11.	Lube oil pressure gauge (in & out).	No	01	
12.	AVR	No	01	
13.	Genset Controller	Set	01	

40. **Spares for Future Maintenance (Optional item)**. A list of necessary spares for future maintenance and cost shall be mentioned in the offer as per following list (not limited to):

Ser	Description of Spares	Reference/ Part no	Qty	Unit Price	Maintenance Schedule/ Hour
1.	Seawater pressure gauge.	No	01	To be mentioned	
2.	Lube oil temperature gauge.	No	01		
3.	Fresh water temperature gauge	No	01		
4.	Exhaust temperature gauges (Combined).	No	01		
5.	Lube oil filter differential pressure gauge.	No	01		
6.	Lub oil pressure sensor.	No	01		
7.	Cooling water pressure sensor.	No	01		
8.	Lube oil temperature sensor.	No	01		
9.	Cooling water temperature sensor.	No	01		
10.	Fuel oil pressure sensor.	No	01		

41. **Technical Support.** Technical support is to be provided to solve any maintenance and operational problem arising with the item within the warranty period. An assurance agreement in this respect is to be submitted with the offer.

42. **Warranty**.

a. Manufacturer's warranty for repair/ replacement at the Supplier's cost for the supplied items for a period of minimum 12 months after final acceptance by BN on completion of installation and necessary test/ trial onboard the ship is to be provided. The warranty shall

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cover all parts and service costs/ charges throughout the warranty period. **Certificate from OEM regarding warranty is to be provided with the offer.**

b. If for defect of any unit or sub unit of the supplied items, the Generator sets or any supplied items remain non-operational for a certain period within warranty, the warranty will be extended by the same period.

c. For warranty repair/ replacement, the supplier will collect the defective item (portable) from NSD, Chittagong/ NSSD, Dhaka (as applicable) and re-supply the same to collecting place after warranty repair or for replacement within 90 (ninety) days from the date of defect at no cost to the purchaser.

43. **Guarantee**. The Suppler shall give guarantee of continued supply the spares (from OEM) for at least 10 years at a reasonable price (not exceeding 3% per year).

44. **Price**. Price of each item of the total offer is to be shown separately (e.g. price of the main items, additional and optional items, spares, interfacing work, installation and STW, FAT, training, Warranty, Guarantee etc.) and then grand total of the foreign currency to be shown.

45. **Shipment & Delivery**.

a. The supplied items are to be delivered within 09 (Nine) months after signing the contract to the following Consignee:

The Commanding Officer Naval Stores Depot New Mooring, Chittagong, Bangladesh BIN-002349278-0503	or	Officer In Charge Naval Stores Sub Depot Dhaka Naval Unit Khilkhet Namapara,Dhaka-1229, Bangladesh

b. **Place of Delivery**: NSD, Chittagong.

c. In case of CFR/ CPT, the supplier will carry the items from sea port/ airport (as applicable) to NSD Chittagong at the cost and risk of supplier.

d. **Port of Shipment**. To be mentioned. Port of Shipment shall be from country of manufacturer or country of origin of the complete generator set.

46. **Site Visit**. The bidder shall visit the installation site (BNS KHALID BIN WALID) before submission of tender to avoid any difficulties/ confusion about the tender requirements.

47. **Validity**. The offer shall remain valid up to 30 June 2027.

48. **Lead Time**. The supplier will install and commission the items on board ship within 3 (three) months after delivery in Bangladesh. Liquidated Damage (LD) will also be applied in this respect as per DGDP rule for the delay beyond lead time.

49. **User List**. List of users of the offered Generator sets is to be mentioned with full address. The list shall provide the name of various users with respective model and brand of the system. The offered system shall be widely used by various users. The user list will be used for the assessment of the offer.

50. **Source of Supply**. Source of supply of the offered items is to be mentioned. It shall be from the country of origin or country of manufacture.

51. **Terms of Payment**. Letter of Credit will be opened for full amount of contract price in favour of the Supplier/ Principal for the complete scope of supply with the following terms of payment:

a. 80% of contract price (excluding training, FAT and installation cost) will be released after shipment of all items and on submission of necessary documents as per DGDP rules.

b. The remaining 20% of contract price (excluding training, FAT and installation cost) will be released after successful test/ trial, jointly carried out by the buyer's representative and supplier's representative and final acceptance of the Generator sets by the purchaser.

c. 100% cost of each training, FAT and installation will be released upon completion of respective activities and upon submission of each completion certificate.

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52. **Compliance Statement**. A compliance statement fulfilling all the requirement of the tender is to be submitted for evaluation of the quotations. Stating mere 'Yes or No' will not suffice and detailed evidences with description/ information, brochures/ booklet, drawing and diagram as required is to be given. An incomplete compliance statement may attribute to cancellation of the offer. If any clause of this specification does not commensurate with offered Generator set, the deviation has to be spelt out clearly.

Enclosure:

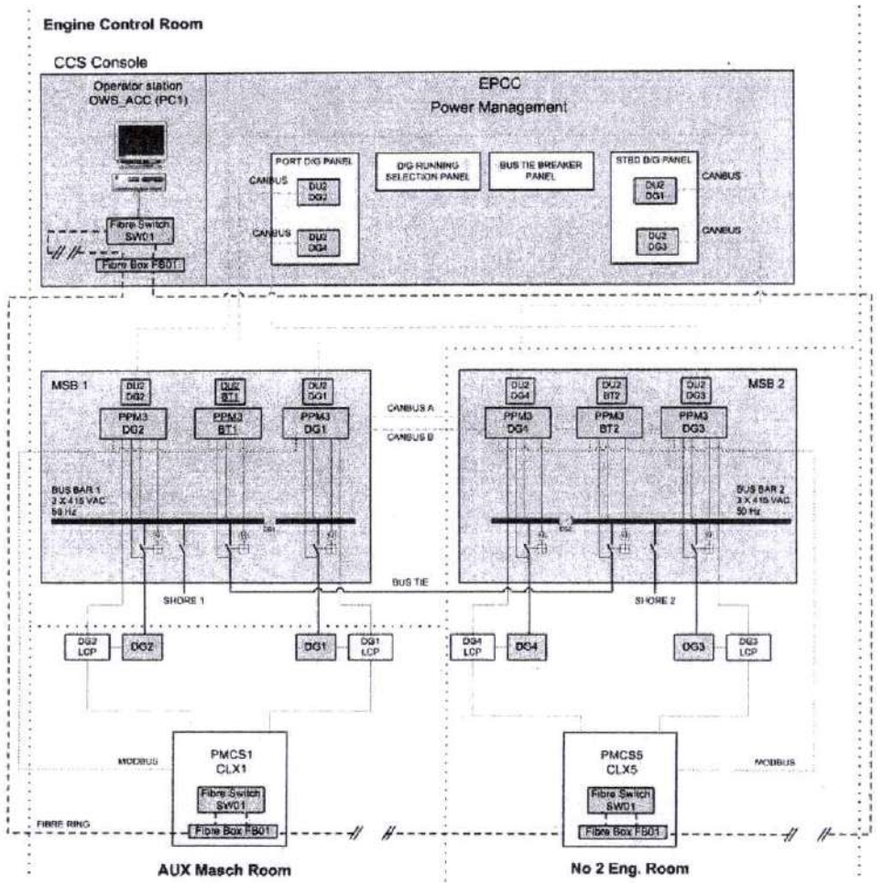
1. Power Management System of BNS KHALID BIN WALID - 02 (Two) pages.
2. MCAM System Architecture - 01 (One) page.

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Enclosure-01

POWER MANAGEMENT SYSTEM OF BNS KHALID BIN WALID

System Architecture



The power management system architecture is illustrated above. Generator DG1 and DG2 are connected to main switchboard MSB 1. Generator DG3 and DG4 are connected to main switchboard MSB 2. The two main switchboards can be operated individually (split) or connected via a bus tie with two bus tie breakers. Each MSB can be supplied from a shore connection.

The PMS is realized with Deif PPM3 equipment, and operates as a standalone system in relation to MCAM. A total of six PPM3 units are installed in MSB1 and MSB2, one for each D/G and one for each bus tie. In addition, remote operator panels for the four D/Gs are installed in the EPCC console, where each remote panel is connected to the associated PPM3 unit in MSB with CANBUS. The PPM3 units in MSB are directly connected to the D/G Local Control Panels (LCP) and the Air Circuit Breakers (ACB) for monitoring and control. All functionality and operator facilities are available in the PPM3 system and are independent of the state of the MCAM system. The MCAM operator workstations includes mimic with remote control features of the Deif PMS. The data connection between MCAM and PPM3 is via serial MODBUS.

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The MCAM system comprises a total of 6 PMCS cabinets, but only the two units involved in PMS is shown in the above figure. PMCS 1 controls the MSB 1 equipment and PMCS 5 controls the MSB 2 equipment. The MCAM operator facilities consist of two workstations in the CCS console and one workstation on bridge. All three workstations have identical capabilities, but only one is shown in the above figure for convenience. The MCAM components communicate over a fiber ring.

The PPM3 units are able to control the power plant in combined MSB mode via a redundant CANBUS connection between MSB1 and MSB2. The PPM3 units can operate independently of the other units, so in any failure situations it is possible to operate the MSBs in split mode with automatic PMS.

D/G MODES OF OPERATION

The system configuration comprises the following control levels that can be selected individually for each D/G:

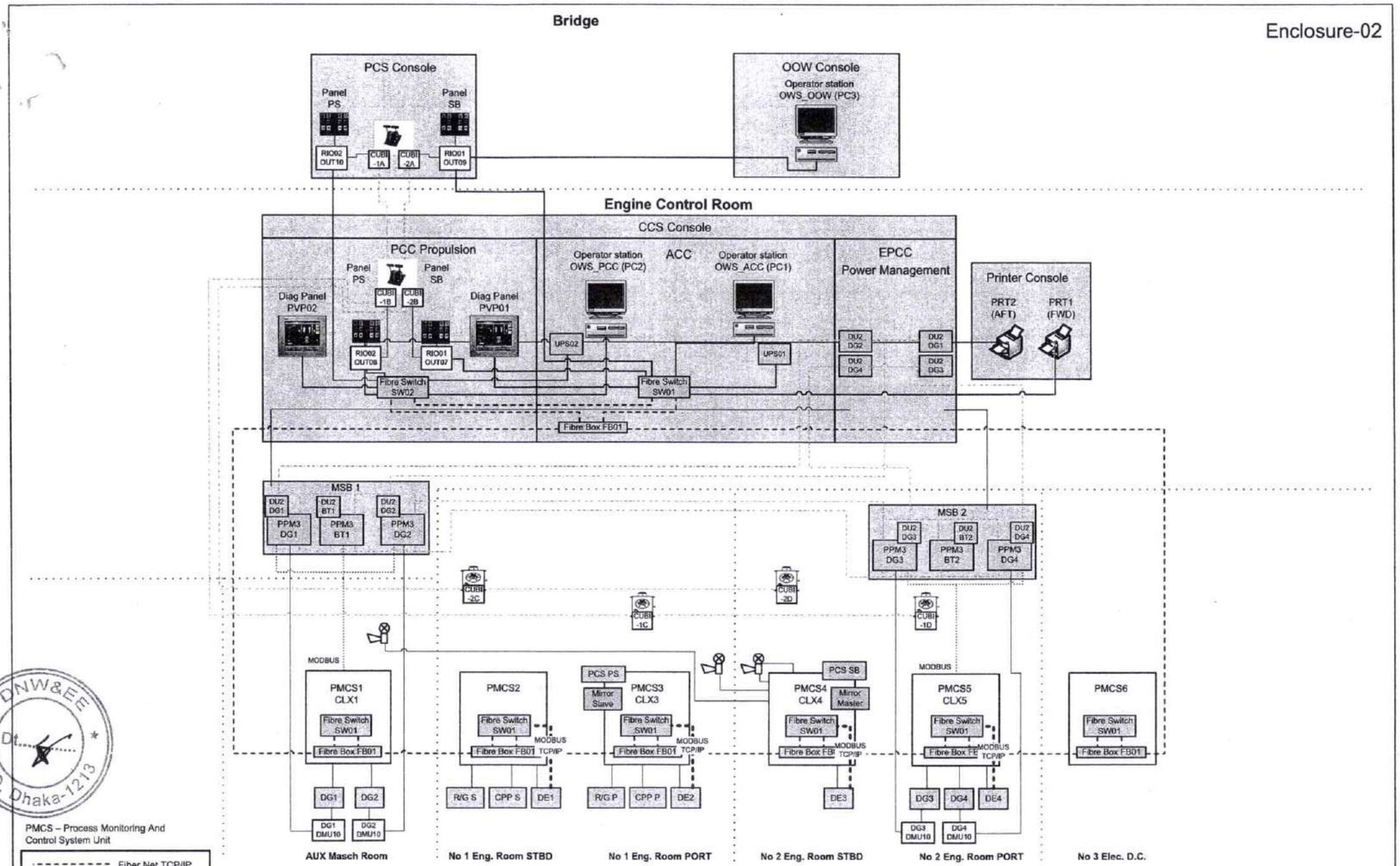
1. **AUTO mode of individual D/G:** Fully automatic power management controlled by the Deif PPM3 system. Requires the following conditions:
   a. D/G LCP to be in "REMOTE"
   b. MSB mode to be in "EPCC"
   c. PPM3 mode to be "AUTO" for appropriate D/G
   d. D/G is READY
2. **SEMI-AUTO mode of individual D/G:** Operator manual control of D/G start/stop and breaker open/close (with auto synchronization) from OWS and/or EPCC operator panel. Requires the following conditions:
   a. D/G LCP to be in "REMOTE"
   b. MSB mode to be in "EPCC"
   c. PPM3 mode to be "SEMI-AUTO" for appropriate D/G
   d. D/G is READY
3. **MSB MANUAL control of both D/Gs and Bus Tie Breaker (all three PPM3 units are in "SWBD" mode):** Manual MSB control of D/G start/stop and manual synchronizing. Requires the following conditions:
   a. D/G LCP to be in "REMOTE"
   b. MSB mode to be in "MSB"
   c. D/G is READY
4. **E/R local control of individual D/G (individual PPM3 unit is in "SWBD" mode):** D/G start/stop from LCP. Requires the following condition:
   a. D/G LCP to be in "LOCAL"
   b. D/G is READY

LCP "LOCAL" and MSB mode "MSB" has precedence over the higher level control modes.
The selection between PPM3 "AUTO" and "SEMI-AUTO" can be done either from OWS, from the PPM3 unit in the appropriate MSB section or from the remote panel in EPCC.

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Enclosure-02



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Project: BNS KHALID BIN WALID
Rev.: 07 Draw.: TSI/NJ
Scale: - Appr.: TS
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Format: A3 Date: 30.07.2015
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Page: 1/1