Engineers Specification

Provide a sea water cooled resistive load bank for permanent, on-board installation as a component of the power generating system. The load bank shall incorporate an integrated control process management system capable of monitoring the vessel's load condition and supplement the vessel's load, as the load drops below an acceptable level.

The load bank operation shall be set in the automatic mode position.
Except as otherwise indicated, the load bank and ancillary components shall be of types, sizes, characteristics, and ratings indicated, which comply with manufacturer's standard design, materials, components, and construction in accordance with published product information, and as required for complete installation.

1. Manufacturers

The load bank shall be supplied by a manufacturer with proven experience in the marine industry. Bids shall include the necessary information, brochures etc, to ensure that the manufacturer meets the criteria. The load bank shall be a marine designed system specifically designed to cater for marine on-board conditions. Customised non-proven systems or prototypes shall not be acceptable and must comply fully with the requirements of this specification. The load bank shall be SEPHCO type LSMC or approved equivalent

2. Sequencing and Scheduling

1. Schedule delivery of load bank equipment, which permits ready access for large equipment components to their designated installation spaces.
2. Co-ordinate the location for equipment.
3. Co-ordinate with other plumbing and electrical work to facilitate the necessary piping and cabling, as necessary to interface with the installation of the load bank with other work**.**

3. Load Bank Rating

(a) Capacity:	XXXkW
(b) Voltage:	XXX V X phase
(c) Frequency:	XX Hz
(d) Ambient Temperature:	15° to 120° F
(e) Duty Cycle:	Continuous

A. Load Bank Design

1. The load bank shall be completely self contained, free standing complete with circulation pump. The load bank vessel shall be constructed from composite materials, resistant to salt water, incorporating immersion proof resistive elements and monitoring safety devises. A separate NEMA 3R control panel shall house contactors for each load group, load group circuit breakers, load bank protection devises, main load bus, auxiliary terminals and the unit controller.
The load bank shall be designed for compatibility with the marine environment. Pump, fittings and control devices shall be suitable for exposure to salt water.

Circulation of seawater sourced from the sea chest, shall be the means to cool the resistors. Flow rate shall be to the manufacture's specification and limited to 40°c (104°F) temperature rise. The load bank resistors, shall be able to withstand continued operation in salt water.

2. All external securing devises such as screws, nuts and bolts shall be of #316 stainless steel.
3. Valves, and associated pipework and fittings shall be 90/10 copper nickel.
4. Inlet and discharge connections shall be flexible, reinforced, Silicone type Hump couplings.

B. Enclosure

The load bank control enclosure shall be constructed from zinc coated steel, have a fully opening hinged door to provide full and clear access to all resistor connections and switch gear. The enclosure shall have, a full gutter surround, fitted with a neoprene rubber, wire reinforced type gasket. Hardware such as locks and hinges shall be brass chrome plated or stainless steel. Paint finish shall be two-pack polyurethane primer, finished with two coats of two-pack polyurethane marine grade Snow White enamel.

C. Load Resistors

The load resistors shall be totally immersion proof type, Nema 6, resistant to heated salt water. The resistors shall be fully sealed SEPHCO type NIC, mineral insulated and tested to 2.5 kV. Resistor to resistor contact or to adjacent parts shall not impede the performance or cause failure to the resistor. Resistor values shall be accurate to 2.5% of rated value and shall not reduce in value by more than 2.5% at full operating temperature.

1. Each resistor shall be fixed in location by a copper nickel bulkhead fitting sealed by gasket. Resistors shall be fully supported along their length.
2. Each resistor shall be electrically grounded and removable without dismantling adjacent resistors.
3. Resistor terminals shall be fully accessible and segregated from the switchgear. Each resistor shall be easily removable and withdrawable from the load bank vessel as an assembly.
4. Resistor design and rating shall ensure a life span of one year under normal operating conditions.

D. Circuit Protection

(1)Each resistor shall be grounded to the main control enclosure.
Resistor groups shall be evenly balanced over 3 phases, terminated and switched by a contactor.
Each load group shall be protected by a three-pole circuit breaker.
Fuses shall not be used.

(2) Contactors for each load group shall be sized to match the breaker capacity and rated for 50°(120° F) operation.

(3) Wiring to resistors shall be by flexible multi-stranded copper cable rated to 110°(230° F).

(4) Heavy bus connections shall not be used to terminate the resistors.
Main terminal studs shall be provided directly onto the copper bus.
(5) The pump shall be protected by a thermal overload and circuit breaker.
The cooling pump shall have monitoring and trip devises, such as a flow and pressure switch.
(6) The coolant and element resistors shall be monitored by high limit re-settable thermostats, monitored by the load bank's control system.

E. Cooling Pump

The cooling system shall consist of a pump, directly driven by a NEMA 3R rated motor. The pump shall be self-priming type and constructed from zinc-free marine bronze, bronze impeller, with a Duplex stainless steel shaft. Pump operation shall be such that the pump runs automatically when activation of the load bank occurs and continues to operate for a period of five minutes after any load shutdown and reactivated again for the five minute period after a power loss.

F. Load Bank Controller

The load bank shall include a dedicated load management process controller, field programmable, which provides all the necessary software to monitor and load automatically, the on-board power generating system.
The controller shall include the following features:-

a. Monitoring of the load bank cooling pump interlock systems, such as thermostats, flow switches, pressure switches and pump motor thermal overload devises**.**
b. Communication and 12 volt power supply to a remote control panel.
b. Monitoring of the on-board electrical load by current transformers located on the main bus.
c. Provision to monitor and load single or multiple generator operation.
d. Field programmable, generator percentage load setting, system voltage, generator capacities and CT values.
e. Delay-on adjustment, load response time adjustment.
f. Cooling pump automatic start-up.
g. Cooling pump automatic shutdown and cool-down period..
h. Display running hours
Response to any load change condition by supplement the vessel's load with a load value equal to drop in load.
i. Soft start load sequence on initial start.
j. Remote load dump input.
k. Message display of load bank fault condition and diagnostics.
l. Automatic load dump on fault condition.
m. USB connection for PC optional interface.
n. RS485 MODBUS interface.

G. Load Bank Control Operation

The load bank shall be equipped with an automatic control processor, which shall be on line during the running of the on-board power generating system.
In automatic mode, the controller shall monitor the vessel's load when initialised by a remote signal, and respond accordingly by supplementing the load.

(2) The control processor shall feature EEPROM memory for system back-up of operation parameters during any momentary power loss. Operating parameters such as generator ratings, CT ratios, time delays and percentage load setting shall be stored in the EEPROM memory.
Adjustment to the percentage load setting and time delays shall be accessible at any time.
The controller shall be capable of controlling single or multiple generator operations and any sequential running of the generators.

(3) The controller shall calculate the exact load required to supplement and maintain correct loading onto the power source, corresponding with the controller's setting.
The controller shall actuate one or a combination of load steps from the load bank to precisely stabilise the engine-generator.
The switching operation of load shall be non-linear, so as to provide smooth operation, whilst minimising load contactor switching. The controller shall include solid state contactor drives for fast reliable operation of the load bank contactors.
The controller shall instantly remove loads should a sudden increase in power source load occurs or threaten an engine generator overload, typically when side thrusters are activated.

(4) Upon recovery of the power source load, the controller shall shed loads from the load bank and continue to run the cooling pump for a period of five minutes.

(5) The remote control panel, specified as an option, shall be the means to control the load bank in a manual mode.
Manual operation shall only be possible when the remote enable/disable signal is in the disable position.

(6) When the manual operation is in progress, the remote control panel shall be made inoperative in the event that the enable/disable signal is enabled. The condition shall initiate a load dump and a load bank cool-down mode. The system shall automatically reset to the auto mode and monitor the generator load accordingly.

H. Delivery, Storage and Handling

Deliver load bank to site for receipt by installing contractor.

1. Inspect delivered load bank, at site together with installing contractor, to ensure that there is no damage to the unit.
2. Any equipment found damaged at time of inspection, shall be removed by Vendor from site and replaced with new.
3. Deliver load bank and components properly packaged and mounted on pallets or skids to facilitate handling by installing contractor. Utilize factory fabricated

type containers or wrapping for load bank to protect unit from damage.
4. If storage is required, store units in original packaging and protect from weather.
5. Handle load bank carefully to prevent physical damage to equipment and components. Remove packaging, including opening of crates and containers at site, avoiding any actions, which would damage the equipment, prior to inspection of equipment with installing contractor.

I. Field Quality Control
1. Prior to energizing of circuitry check all accessible connections to manufacturer's torque tightening specifications.
2. Prior to energizing of load bank, check with ground resistance tester phase-to-ground insulation resistance levels to ensure requirements are fulfilled.
3. Ensure strict compliance with the manufacturer’s installation instructions

J. Adjusting and Cleaning
1. Check operating positions of valves on discharge and supply lines.
2. Touch-up scratched or marred surfaces to match original finishes

K. Demonstration
After wire and cable hook-ups, energize load bank and demonstrate operation in accordance with the design requirements. Where necessary, correct malfunction and reset to demonstrate compliance.