Health, Safety and Environment
Proficiency at deepwater projects
Best-in-class safety performance

Crane Vessel SDP-2 **TITAN 2** IMO # 8129656

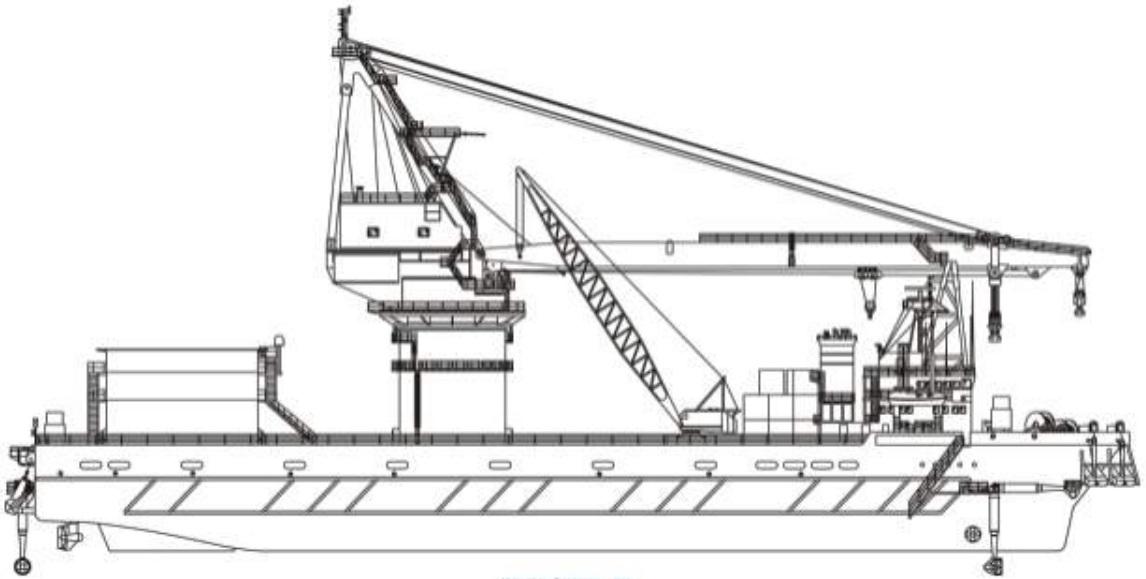
INTRODUCTION

TURKU REPAIR YARD LTD

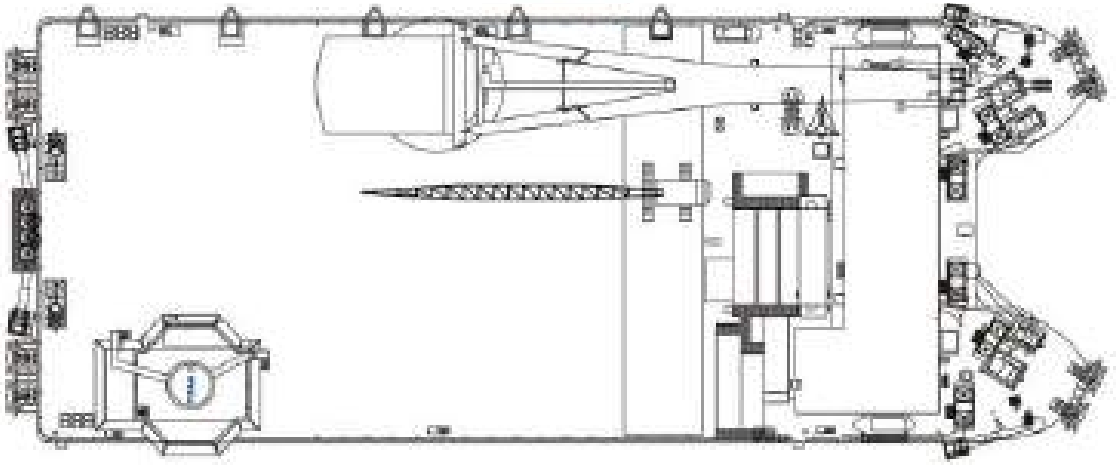
- The *Titan 2* is a Catamaran Heavy Lift Crane vessel, it has been working in Mexican Gulf since 1994. It was constructed in 1985 in WARTSILA Oyj, Finland (Hull # 1278). In 1999 it's crane was upgraded from 600 to 800 ton. In 2002 the Vessel was upgraded at the Bollinger facility in Calcasieu, Louisiana. The old propulsion control system was upgraded by DP system; eight swing-down azimuth thrusters were added. Between 2002 and 2010, the vessel changed class from DNV to double-class — Russian «KM AUT 2 special purpose crane ship-catamaran» & ABS «A1, AMS, ACC, DPS-2». The Port of Registry is Chernomorsk, Ukraine.

VESSEL DESCRIPTION

- This vessel is a 19,813 gross ton, 139,3m LOA by 54 m wide, twin hull vessel with a hull draft of 4 m. Lift capacity 800 t . Its propulsion and steering is provided by two electric motor driven azimuth thrusters 2,278 hp, two electric motor driven bow tunnel thrusters 536 hp and eight engine driven swing down azimuth thrusters 1,045 hp. The *Titan-2* has a single main 660V switchboard fed by three 1850 kW diesel generators, a Kongsberg SDP-2.1 DP system with five position references and a Kongsberg NorControl propulsion alarm system.



PROFILE



VESSEL PARTICULARS

GENERAL	
Length (overall)	456.76 ft (139.30 m)
Width	178.0 ft (54.30 m)
Depth	42.65 ft (13 m)
Classification	KM AUT 2 special purpose crane ship-catamaran / A1, AMS, ACC, DPS-2
Year of Built	1985
Registry (Flag)	Ukraine
Operating Draft (min/max)	11.9 ft (3.63 m) /13.16 ft (4.01 m)
Tonnage (gross / net)	19,813 gross / 5,944 net
Max Deck Load	Project Specific
Free Deck Area (length x width)	24,920 sq ft (2,316 m^2)
Accommodations	102/330 people
Hospital Beds	2
Transit Speed (econ / max)	7/9 knots max
Helicopter Max Rating	12,000 lbs
Helicopter Refueling Capacity	N/A
Helideck Dimensions	49 ft (14.94 m) x 49 ft (14.94 m)
NAVIGATION	
GPS - GP-70 MK2; GPS - DPS 100	
Furuno Radar - FR-2825; Furuno Radar - Fr-2120	

VESSEL PARTICULARS

MACHINERY	
Main Engines	(3) 1,850 kW @ 750 rpm
No. of Generators	6
Main Power	(3) 1,850 kW
Auxiliary Power	(2) 320 kW, (1) 100 kW
No. of Compressors	3
Total Output	(67Nm³/h)
Water Makers	Sea Recovery, "ATLAS" Denmark
Total Capacity	1,250 USG/h (4,731.25 L/h)
Sewage Treatment Plant	RF-4000-M,ENVIRO VAC INC. ORCA II A-36 , Rauma Repola , UnexBio 60
Total Capacity	1,479.5 USG/d (5,600 L/d)
Oil Filtering Equipment	Coffin World Water System, ULTRA-SEP US 3000MD (15 ppm)
Total Capacity	792.6 USG/h (3000 L/h)
BUNKER CAPACITY	
Fuel	208.407 USG (670,500MT)
Fresh Water	79,286.657 USG (300,100 MT)
Potable Water	32,179.656 USG (121,800 MT)
Lube Oil	6,076 USG (21,390 MT)
Ballast Water	1,236,723.9 USG (4,681,000 L)

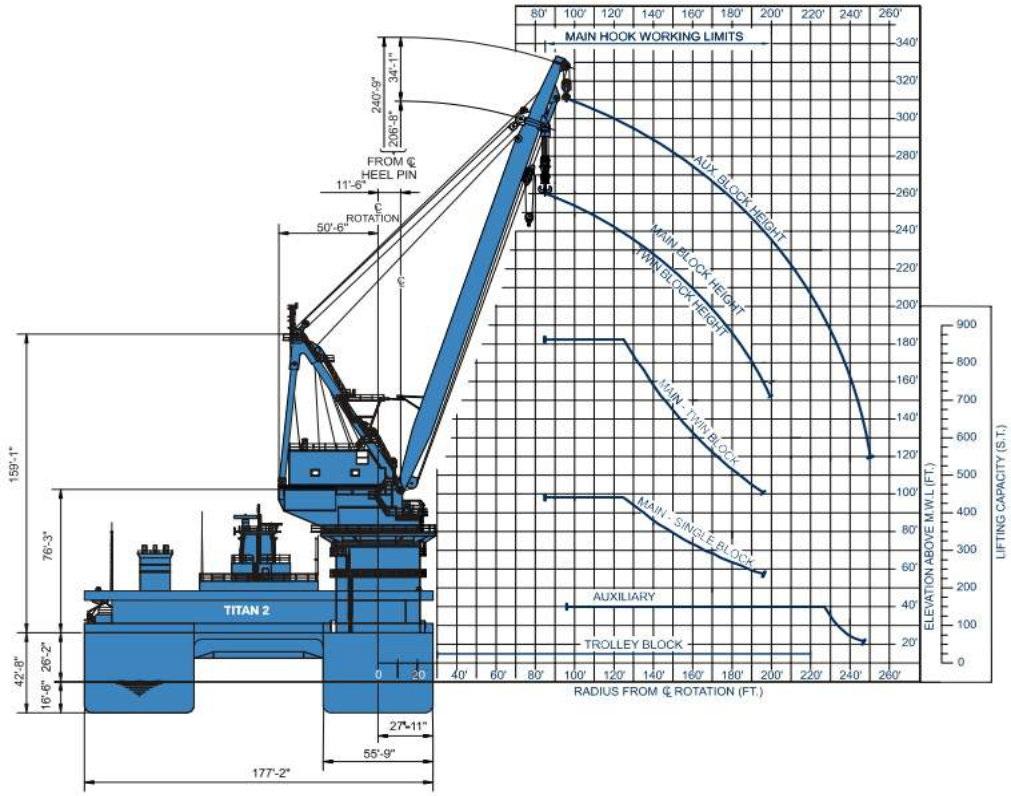
VESSEL PARTICULARS

- **MOORING EQUIPMENT**
- No. of Anchors; Weight — (2); 20,000 lb (11000 kg)
- Make, type — Delta Flipper
- No. of Winches — (2) Electric
- Make, type — Rauma Repola, mw750 ES
- Wire (length/diameter) — 4,921 ft (1,500 m) /3inch
- **AUTOMATISATION SYSTEM**
- Dynamic Positioning System — Kongsberg SDP-21
- Independent Joystick System — Kongsberg SJS-01
- Propulsion Control Systems — Rolls-Royce and Thrustmaster
- Vessel Management Systems — Kongsberg NorControl monitoring and alarm system
- Machinery Control and Alarm System — SACO
- **DYNAMIC POSITIONING**
- DP Class — DPS-2
- DP System — Kongsberg SDP 21

Thrusters	2	8	2
Type	Z-Drive Full Azimuth	Outdrive Full Azimuth	Bow (Tunnel Mount)
Power	2,278 hp	1,045 hp	536 hp
Total DP Power			13,988 hp

VESSEL PARTICULARS

- **MAIN CRANE**
- Derrick
- Make, Model Gusto/Kone
- Type KU163P (Electric) Revolving Gantry
- Boom Length
- Main 206.67 ft
- Auxiliary 240.75 ft
- Whip Travel type trolley
- Capacity
- Main Revolving N/A
- Main Fixed 881.85 s. tons @ 124.67 ft (800 MT@ 38 m)
- Auxiliary 165.35 s. tons @ 193.57 ft (150 MT @ 59 m)
- Whip 22 s. tons @ 220 ft (20 MT @ 67.06 m)



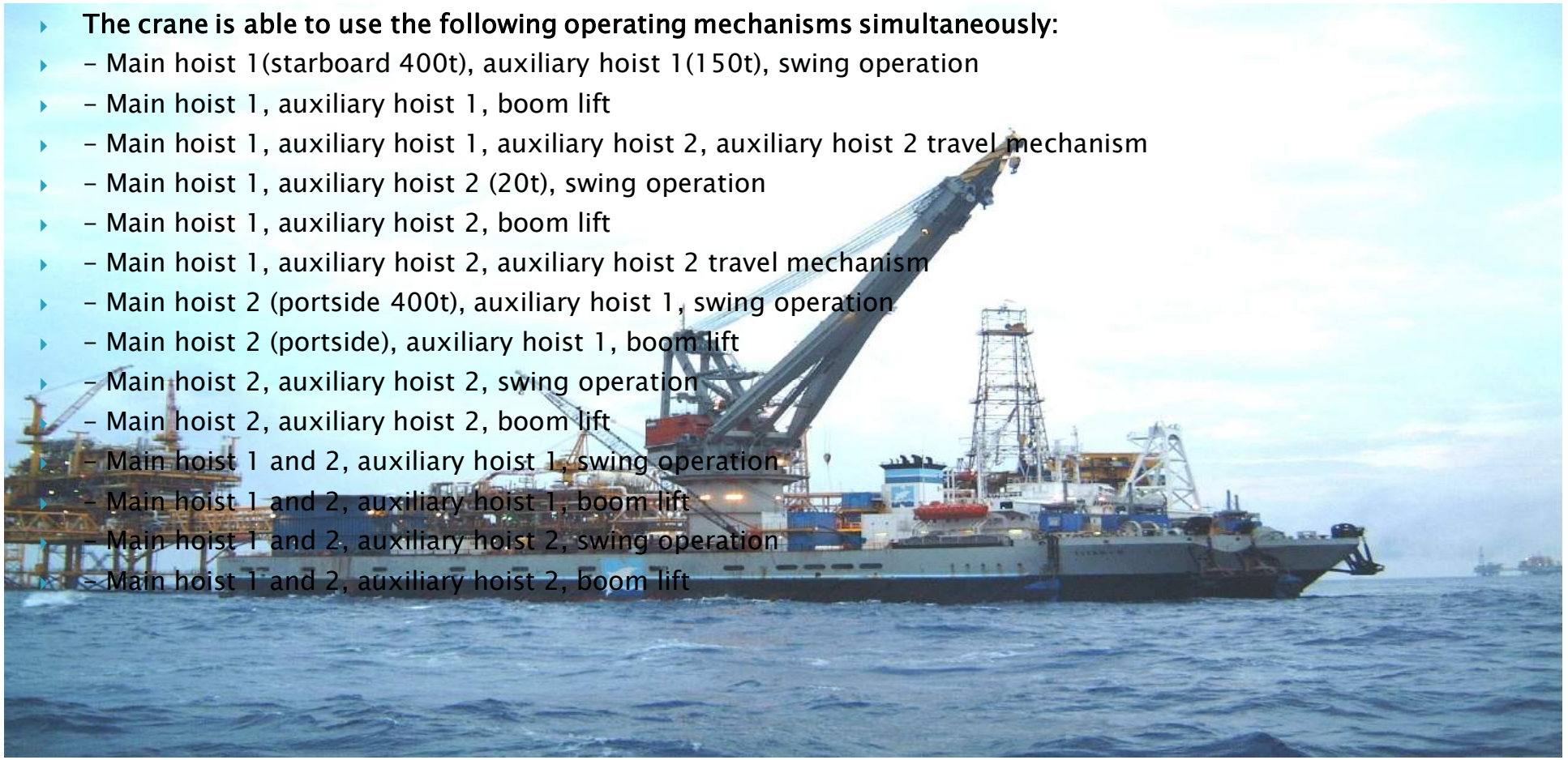
HOOK RADIUS vs. LIFTING CAPACITY & HOOK HEIGHT

CRANE PARTICULARS

CRANE "KONE-800"	
MAIN HOIST NO. 1 AND NO. 2 (2 ×400 T)	
Hoisting capacity at boom outreached parallel to sea surface	2×400 t at 38 m
Minimum outreach at zero trim and list	Approx. 26 m
Hoisting height at 38 m outreach	75 m + 29 m
Speed of hoisting at 400 t load	0…3 m/min
Speed of hoisting at 60 t load	0…12 m/min
AUXILIARY HOIST NO. 1 (150 T)	
Hoisting capacity at boom outreached parallel to sea surface	150 t at 69 m
Minimum outreach at zero trim and list	Approx. 30 m
Hoisting height at 69 m outreach	60 m + 45 m
Speed of hoisting at 150 t load	0…6 m/min
Speed of hoisting at 20 t load	0…30 m/min
AUXILIARY HOIST NO. 2 (20 T)	
Hoisting capacity at boom outreached parallel to sea surface	20 t at 67 m
Minimum outreach at zero trim and list	Approx. 9 m
Hoisting height at 41 m outreach	75 m + 29 m
Speed of hoisting at 20 t load	0…30 m/min
Speed of shifting at 20 t load	0…30 m/min

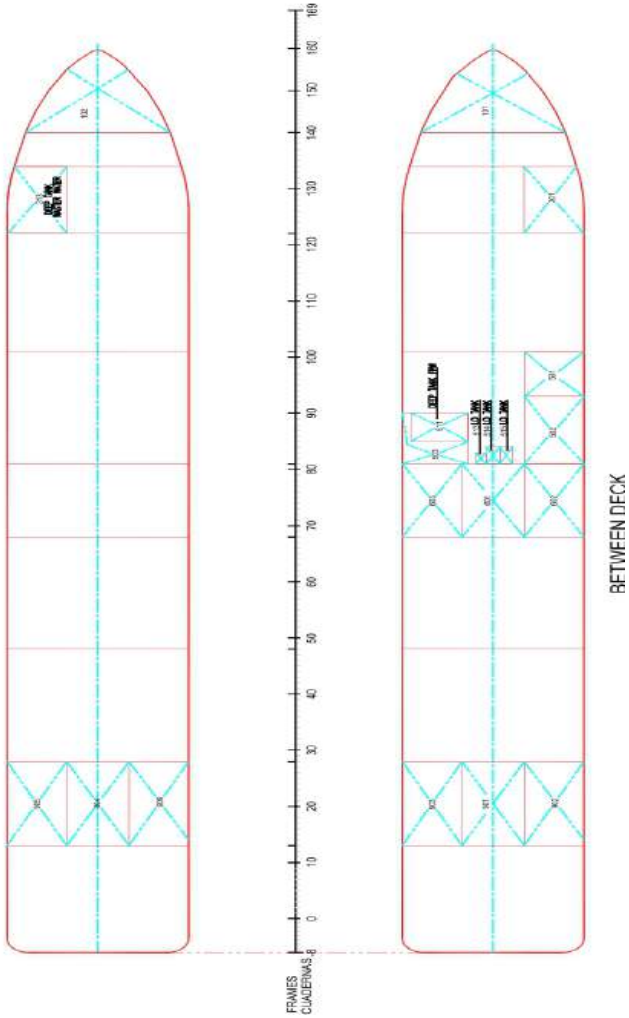
CRANE OPERATING

- **The crane is able to use the following operating mechanisms simultaneously:**
- – Main hoist 1(starboard 400t), auxiliary hoist 1(150t), swing operation
- – Main hoist 1, auxiliary hoist 1, boom lift
- – Main hoist 1, auxiliary hoist 1, auxiliary hoist 2, auxiliary hoist 2 travel mechanism
- – Main hoist 1, auxiliary hoist 2 (20t), swing operation
- – Main hoist 1, auxiliary hoist 2, boom lift
- – Main hoist 1, auxiliary hoist 2, auxiliary hoist 2 travel mechanism
- – Main hoist 2 (portside 400t), auxiliary hoist 1, swing operation
- – Main hoist 2 (portside), auxiliary hoist 1, boom lift
- – Main hoist 2, auxiliary hoist 2, swing operation
- – Main hoist 2, auxiliary hoist 2, boom lift
- – Main hoist 1 and 2, auxiliary hoist 1, swing operation
- – Main hoist 1 and 2, auxiliary hoist 1, boom lift
- – Main hoist 1 and 2, auxiliary hoist 2, swing operation
- – Main hoist 1 and 2, auxiliary hoist 2, boom lift



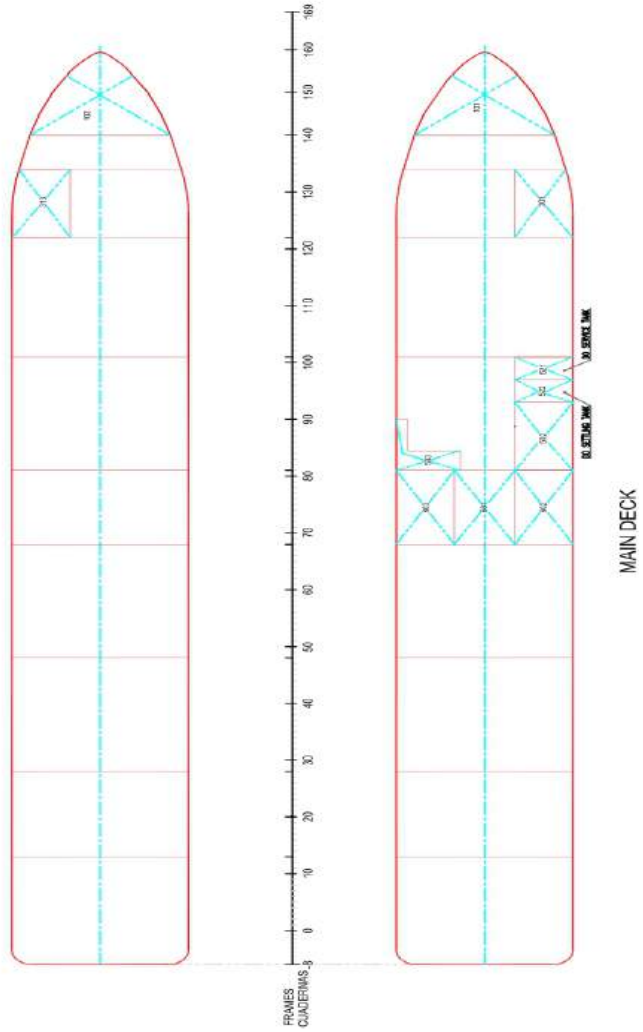
SHIP STORAGE

- Fresh water tank
- #503
- #511
- Sewage water tank
- #313
- Bilge water tank
- #408
- Boiler water water
- #303



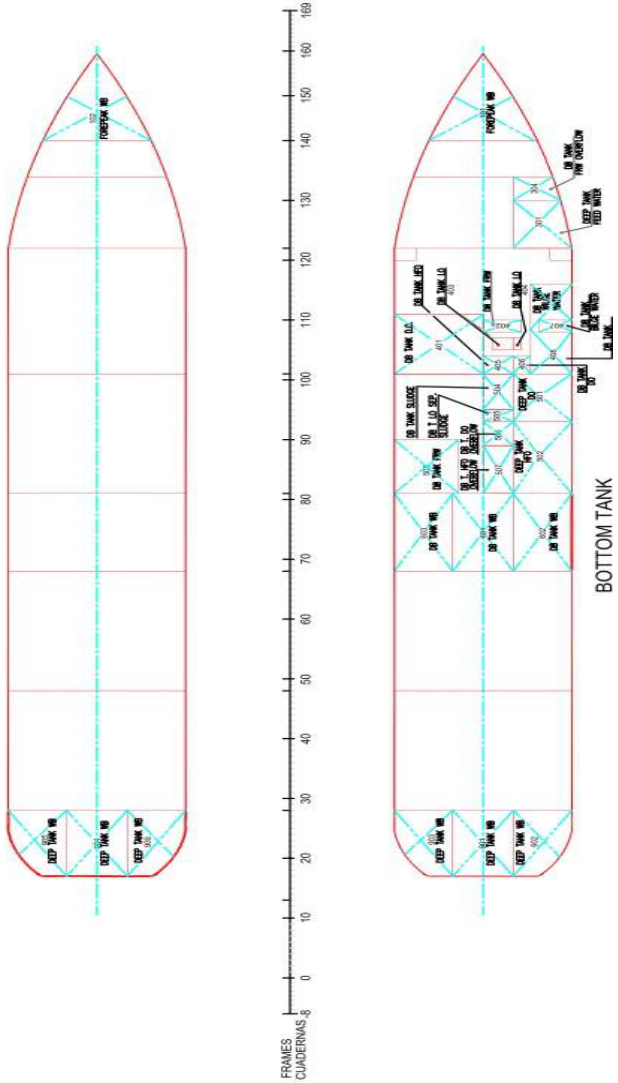
SHIP STORAGE

- Fuel oil tank
- #502
- #523
- #524
- Diesel oil tank
- #401
- #501
- #521
- #522
- Lube oil tank
- #513
- #514
- #515



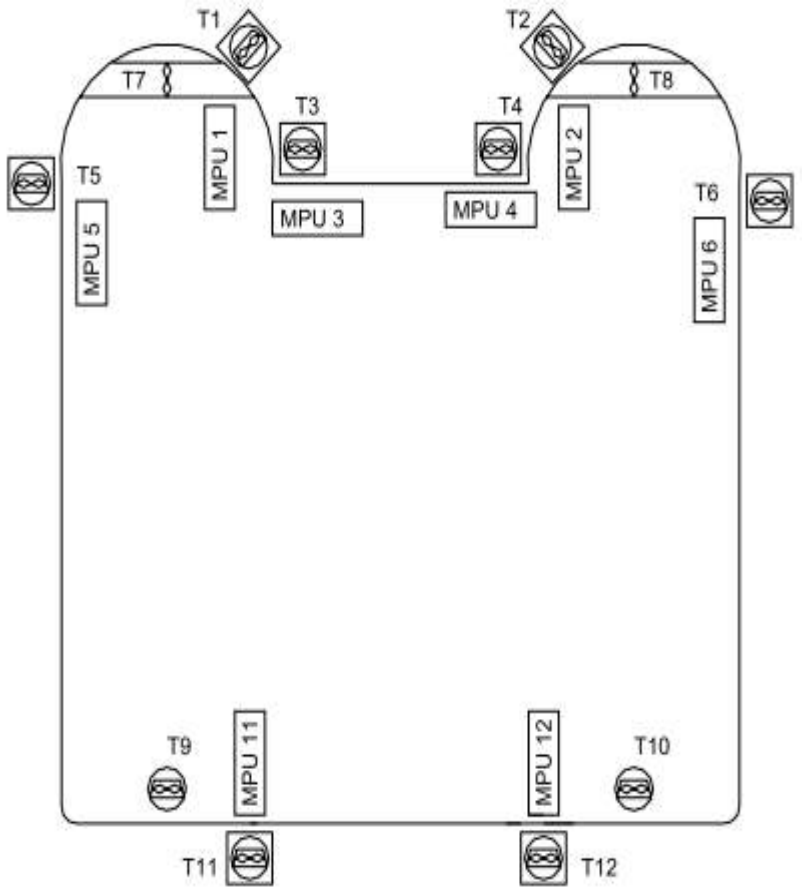
SHIP STORAGE

- Ballast tank
- #101-Fore peak
- #102-Fore peak
- #601
- #602
- #603
- #901
- #902
- #903
- #904
- #905
- #906



ARRANGEMENT OF PROPULSION SYSTEMS

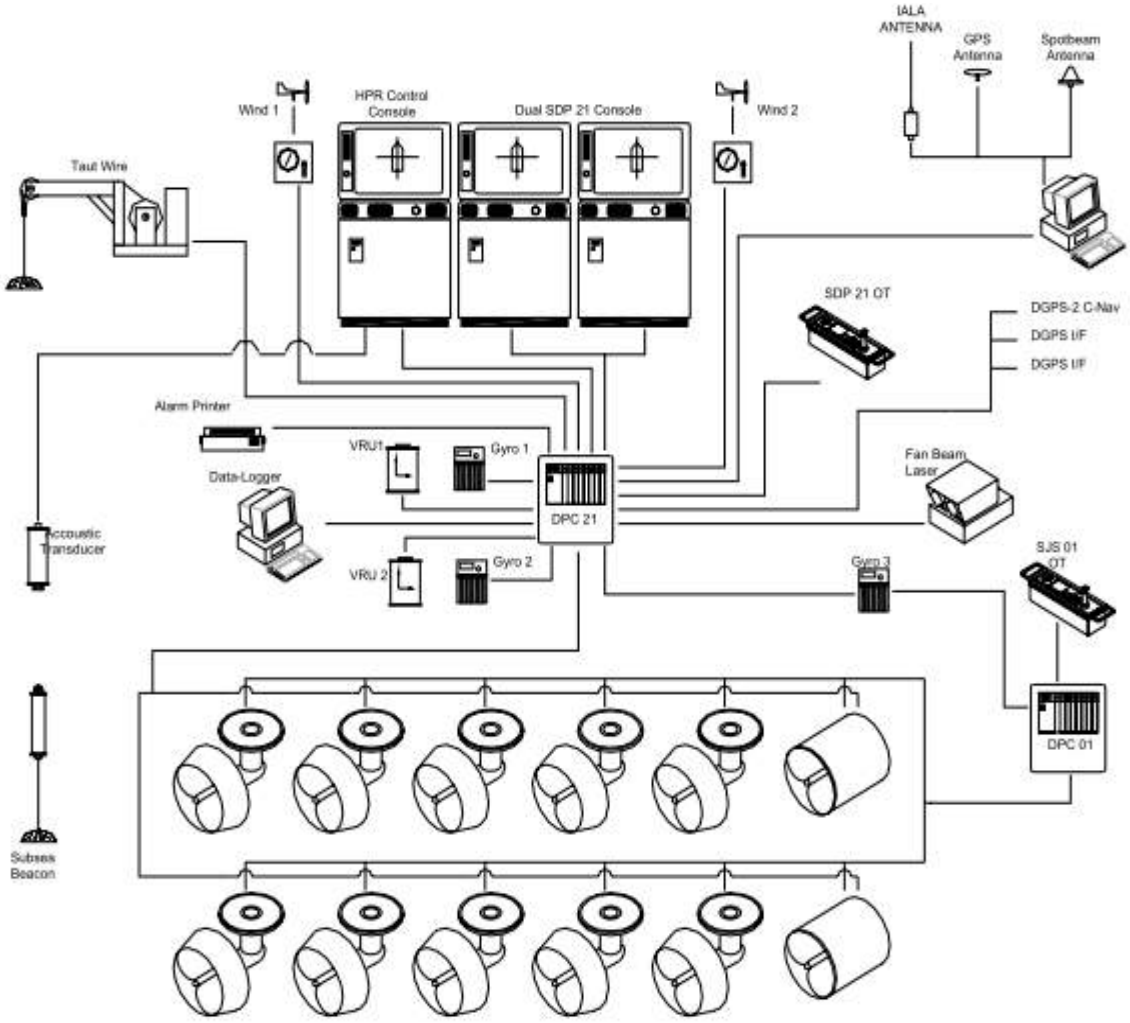
- The location of the twelve thrusters that provide the Titan II's propulsion and steering. Tunnel thrusters T7 & T8 and main propulsion azimuth thrusters T9 & T10 are original ship equipment. During transit, only T9 & T10 are used. Usually thrusters T1-6, 9-12 are used during DP operation but the bow tunnels can be added if required. The vessel has no rudders and the thrusters provide all steering.
- Tunnel thrusters T7 and T8 are each driven by a constant speed induction motor. The power and direction of their thrust is controlled by hydraulically varying the propeller blade pitch.
- Main propulsion azimuth thrusters T9 and T10 have fixed pitch. The power of their thrust is controlled by changing the speed of the SCR-driven DC motor that rotates each propeller. The azimuth direction of thrust is changed using hydraulic motors.
- Swing-down azimuth thrusters T1-6, 11 & 12 have fixed pitch and their propeller speed, azimuth rotation and raising/lowering are all hydraulically driven. An engine driven hydraulic power unit supplies the pressure for each thruster.



DP CONTROL SYSTEM

KONGSBERG

- **Dynamic Positioning System**
- The Titan II uses a dual redundant Kongsberg SDP-21 dynamic positioning control system . The system consists of two SDP-OS operator consoles, the DPC-21 control cabinet, separate DP/IJS/manual control mode switches for each thruster, an independent joystick system (IJS), two UPS, seven system references and 5 position references.



MAJOR EQUIPMENT

- **MAIN ENGINE** 3 units
- Type: WARTSILA VASA 6R32
- Built in: Finland, 1983
- Factory Numbers: 2722, 2723, 2724
- Output: 1850 kW (2510 hp) each, 750 RPM
- Total hours 80174/79268/79016
- Since last overhaul 13298/12005/16016

MAJOR EQUIPMENT

- **MAIN GENERATORS** 3 units
- Type: Stromberg HSPOL 12/854, 660 V, 2345 kVA, 750 RPM, slide bearings,
- Built in: Finland, 1984
- Factory Number: № 4535397, № 4535398, № 4535399
- Output: 1850 kW

MAJOR EQUIPMENT

STROMBERG

- **PROPULSION ELECTRIC MOTORS** 2 units
- Type: Stromberg GTCUL 100/324, 800 V,1700kW,2305hp 0-1000 RPM
- Factory Numbers: № 45-35807, № 45-35808.
- Built in: Finland, 1984
- Output: 1700 kW
- **PROPELLER AND STEERING COLUMN** 2 units
- Type: AQUAMASTER «US 1602/4500»
- Built: Finland, Hollming Oyj, 1984
- Factory Nos. 10/84 and 11/84
- Total hours 58601/68732
- Since last overhaul 5560/11139

Rolls-Royce

Hollming

MAJOR EQUIPMENT

- **BOW THRUSTERS** 2 units
- Type: KAMEWA 1650/400 kW/AS-CP
- Output: 400 kW
- **BOW THRUSTER ELECTRIC MOTORS** 2 units
- STROMBERG, Finland, factory Nos.4335708, 4335709, built in 1984, type HXUR 808H2, 400 kW, 660 V, 420 A, 50 Hz, 1488 RPM , ball bearings 6324 C4 / 6322 C3, dimensions L=1690, W=940, H=1000 mm, weight 2700 kg.

Rolls-Royce

STROMBERG

MAJOR EQUIPMENT

- OUTDRIVE FULL AZIMUTH THRUSTERS 8 UNITS
- MANUFACTURED "THRUSTMASTER" TEXAS
- Type: OD 1000
- Driving Engine: CATERPILLAR CAT 3500B
- Hydraulic pump : REXROTH LA4V501000H010T-302
- Output: 1045 hp/746 kW

MAJOR EQUIPMENT

- EMERGENCY GENERATOR
- **Emergency Diesel**
- Model ADGF,
- Made in Russia, 1983. 100 kW, 1500 RPM

Emergency Generator

- Model MSSF 94-4, Made in Russia, 1983. 100 kW, 400V / 190A

MAJOR EQUIPMENT

- STARTING AIR COMPRESSOR 3 units
- STRUCTOR OY. YTLSINKI, Norway, 1984. Type «SPERRE» HL-2/77. SPERE MERK VESTED A/S 6057 Ellingsoy. 380 V / 15 A, 7.2 kW, 1445 RPM, 25 Nm^3/hour, 30 bar

SPERRE

MAJOR EQUIPMENT

- **FIRE PUMP** 2 units
- IRON A/S COPENHAGEN, 1984. Type QVK-6/300. 660 V, 75 kW, 2970 RPM, 160 m3/h, 10 bar. Factory № 43.533/1, 43.534/2

ironpump world class water pumps

MAJOR EQUIPMENT

- **EMERGENCY FIRE PUMP**
- IRON A/S COPENHAGEN, 1984. Type CHV-3-65/170. Factory № 43.547380 V, 21 kW, 2900 RPM, 40 m^3/h, 9 bar
- **BALLAST PUMP** 2 units
- WARTSILA TURKU, 1984. Type CV 200/300. Factory № 9888, 9887 c/with vacuum add-ons.
- 660 V, 52 kW, 1470 RPM, 400 m^3/h, 2.5 bar

ironpump world class water pumps

WÄRTSILÄ

MAJOR EQUIPMENT

- **AUXILIARY STEAM BOILER** 2 units
- Manufacturer: "RAUMA REPOLA", Finland
- Built in: 1983
- Type: UNEX BH-4000-13
- Factory Nos.: 5183, 5184
- Dimensions: L = 3600 mm, ∅ = 3000 mm
- Heating surface: 105 m^2
- Steam pressure: P_{WORK} = 12 bar
- Steam output: 4000 kg/hour
- Steam capacity: 2 m^3
- Design steam temperature: 195°C
- Fire-chamber t°: 285°C

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MAJOR EQUIPMENT

- AIR-CONDITIONERS 2 units
- «STAL»
- Type U6D, capacity 420000 KCal/hour, 1485 RPM, 380V / 280A.
- Serial No. 101324
- Manufacturer «STAL», Sweden, 1984.
- Condenser type KTM-12.
- Refrigerating medium R22
- «SABROE»
- Type SMC-112L, 1500 RPM,
- Serial No. 110.089
- Drive type — coupling
- Control — UNISAB II Control- and regulating system.
- Sweden, 1997.
- Refrigerating medium R22

MAJOR EQUIPMENT

- **WATER MAKERS** 4 units
- «ATLAS» Denmark, 1984. Type «AFGU» № S-51, Factory №№ 9344, 9345
- Output: 30 m^3 per 24 hour
- «SEA RECOVERY»
- Type: Model SCR Tasman SEA
- Factory Number: TS79MB7563907057,VVCH3863805007
- Output: 60 m^3 per 24 hour

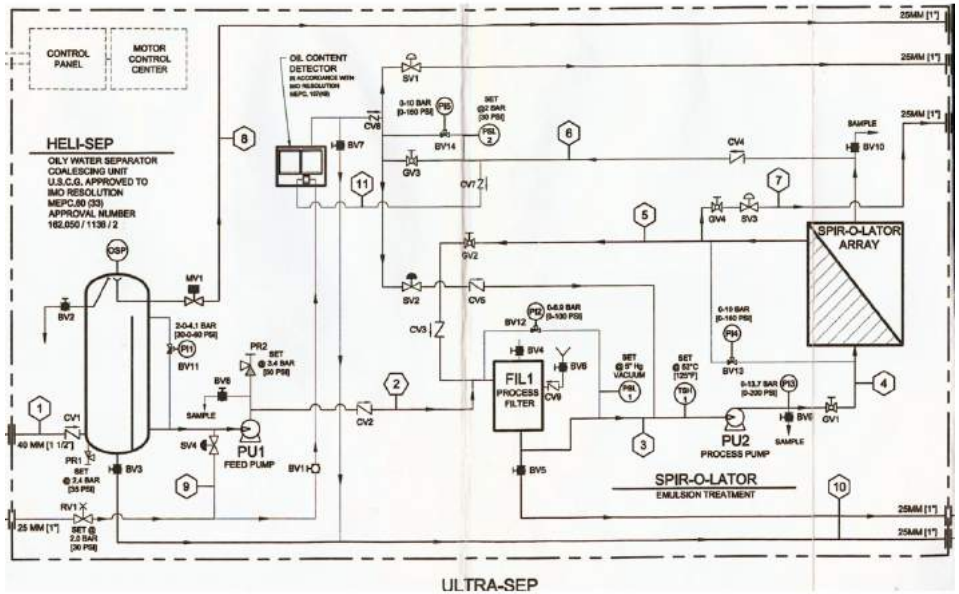
- **DOUBLE-DRUM ANCHOR WINCHES** 4 units
- Type: MW 750 E-S

MAJOR EQUIPMENT

- MAJOR SWITCHBOARDS
- 660V / 2500A “Square D” 3 units
- 660V / 2000A “Merlin Gerin” 3 units
- 380V / 1250A “Merlin Gerin” 2 units
- 660V / 1000A “Merlin Gerin” 2 units
- 380V / 630A “Merlin Gerin” 2 units
- 380V / 640A “Merlin Gerin” 3 units
- 660V / 600A “Merlin Gerin” 6 units

MAJOR EQUIPMENT

- OILY WATER SEPARATOR
- **ULTRA-SEP** . Model US 3000-MD Measured oil content of effluent is less than 15 ppm.
- Factory Number: 47294

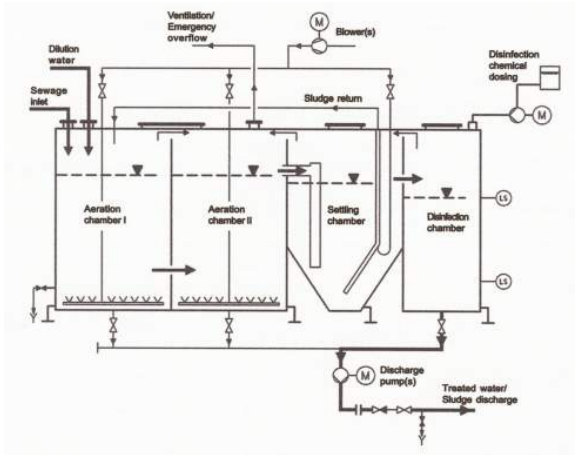


ULTRA-SEP

Compass Water Solutions

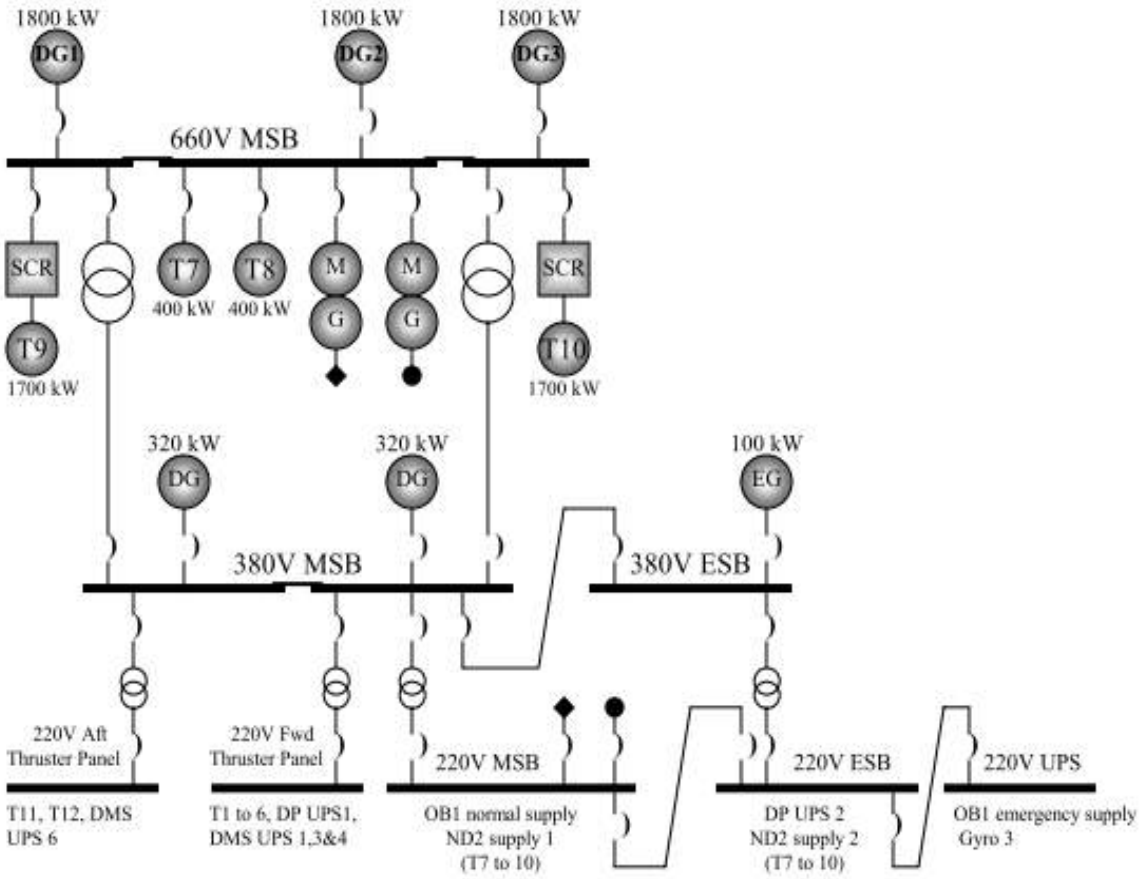
MAJOR EQUIPMENT

- SANITARY WATER SYSTEM
- **Biological sewage treatment units** 3 units
- Type: UNEX BIO 80, Rauma Repola
- Factory Number: 1131
- Finland, 1981. 5.6 – 9.6 m^3 per day
- Type: RED FOX RF-4000-M
- ENVIRO VAC INC. ORCA II A-36
- Factory Number: 4130,2108
- Output: 7,5 & 15 m/c per d.



ELECTRIC POWER SUPPLY SYSTEM

- Electrical One – Line Diagram



ELECTRIC POWER SUPPLY SYSTEM

660V System

The three 660V, 50Hz generators are the normal source of electrical power on the vessel. They feed the 660V main switchboard bus. In an emergency, the main switchboard can be split into three buses by manually removing the two bus links but the switchboard is normally operated as a single bus. This bus distributes power to the two bow tunnel thruster motors, the SCR and main hydraulic pump for each main propulsion thruster, the SCRs for the crane and winches, the two transformers supplying the 380V main switchboard and the two motor-generator sets supplying power to the 220V main switchboard.

Except for protective relays, all generator and switchboard functions are manual. Each diesel engine's speed is controlled by a UG-8 actuator/governor but it can be manually adjusted from the switchboard. All synchronization must be performed manually using these adjustment switches. The generators are self-exciting and their voltage regulators are powered from the generator voltage. A switch can be used to adjust each generator's voltage. The generators run in droop but the voltage and speed control allow adjustment of load sharing. Most of the generator control functions associated with a particular generator are supplied from that generator's power with the exception of 24V coils used for remote engine start. If this 24V battery system fails, the generators can still be started locally. The generators are air started and cannot be started or run long without the services supplied from the 380V main switchboard. In a blackout, the 380V auxiliary generators would have to be started to supply services before the main generators could be started.

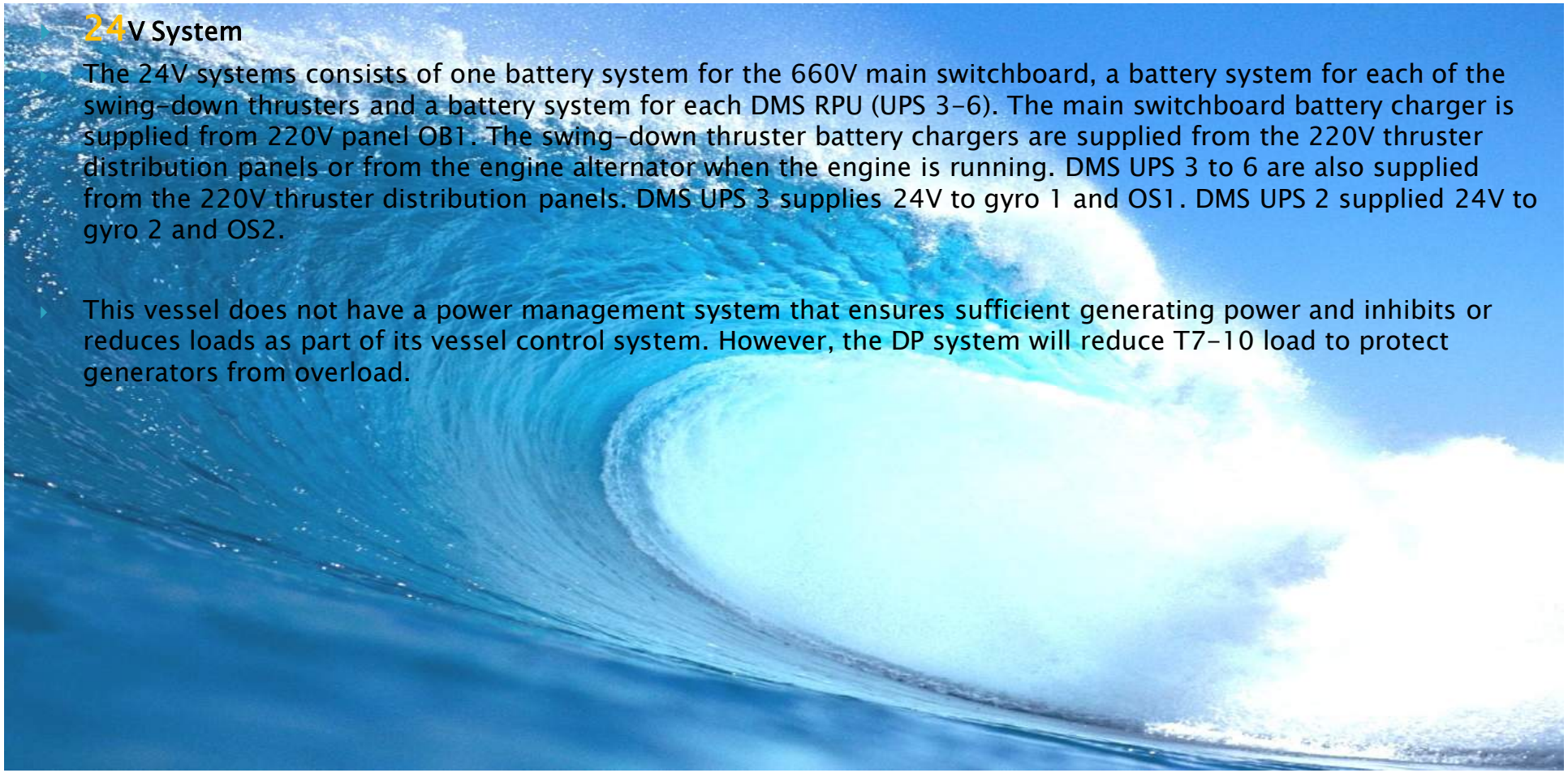
ELECTRIC POWER SUPPLY SYSTEM

- **380V Systems**
- The 380V system consists of a main and an emergency switchboard. The main 380V switchboard is normally supplied from the 660V switchboard, via one of two transformers, but can be supplied from two auxiliary 400V generators. The breakers for the two transformers are interlocked. The 380V main switchboard normally operates as a single bus but, in an emergency, a bus link could be manually removed to split the switchboard into two buses. It supplies power to the Tautwire, the HiPAP hoist motor, the transformers supplying the 220V Thruster Panels, the bow tunnel pitch pumps, the main propulsion azimuth lubrication and standby hydraulic pumps, the ship's fuel oil pumps, all cooling water pumps, the main engine prelube pump, the ER fans and most other 380V loads. It can supply 220V main switchboard via a transformer. With the exception of protective relays, all functions are manual.
- The 380V emergency switchboard is normally supplied from the 380V main switchboard. If this supply fails, its breaker will open and the emergency generator start and restore power. The 380V emergency switchboard supplies the 220V emergency switchboard and the emergency compressor.

ELECTRIC POWER SUPPLY SYSTEM

- **220V/230V Systems**
- The 220V systems consists of a main switchboard, an emergency switchboard, panel OB1, panel ND2, a forward thruster distribution panel, an aft thruster distribution panel, two DP UPSes and two DMS UPSes. The main 220V switchboard is normally supplied from the 660V switchboard, via the motor generator sets, but can be supplied from the 380V main switchboard, via a transformer. The 220V main switchboard supplies the normal supply to OB1, supply 1 to ND2, lights, receptacles and other small power.
- The 220V emergency switchboard is normally supplied from the 380V emergency switchboard, via one of two transformers, but it can be supplied from the 220V main switchboard. It supplies a 220V emergency UPS, the backup supply to OB1, supply 2 to ND2 and DP UPS 2. The 220V emergency UPS supplies emergency lights, gyro 3 and navigation lights panel ND1. OB1 supplies the 660V switchboard charger and ECR instrumentation. Failure of the normal supply automatically selected the backup supply. ND2 supplies power to T7-10 controllers from the selected source. It does not automatically transfer. DP UPS 2 supplies half the DP system, the HiPAP and DGPS 2.
- The forward and aft thruster distribution panels are each fed by a transformer supplied from the 380V main switchboard. The forward thruster distribution panel supplies power to thrusters T1-6's lights, fans and battery chargers. It also supplies power to DP UPS 1, DMS UPS 1 and 24V DMS UPS es 3 & 4. DP UPS 1 supplies half the DP system, the Fanbeam and DGPS 1. DMS UPS 1 supplies the NorControl thruster alarm panel in the Bridge. The aft thruster distribution panel supplies power to thrusters T11 & 12's lights, fans and battery chargers. It also supplies 24V DMS UPS 6.

ELECTRIC POWER SUPPLY SYSTEM

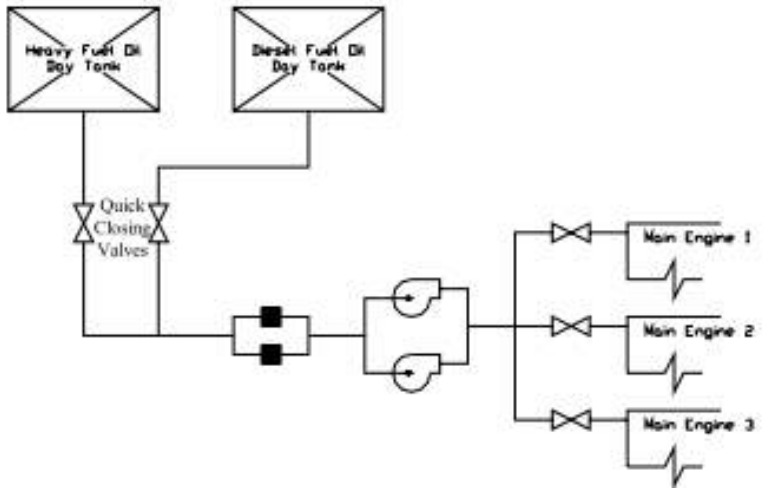


- **24V System**
- The 24V systems consists of one battery system for the 660V main switchboard, a battery system for each of the swing-down thrusters and a battery system for each DMS RPU (UPS 3-6). The main switchboard battery charger is supplied from 220V panel OB1. The swing-down thruster battery chargers are supplied from the 220V thruster distribution panels or from the engine alternator when the engine is running. DMS UPS 3 to 6 are also supplied from the 220V thruster distribution panels. DMS UPS 3 supplies 24V to gyro 1 and OS1. DMS UPS 2 supplied 24V to gyro 2 and OS2.

- This vessel does not have a power management system that ensures sufficient generating power and inhibits or reduces loads as part of its vessel control system. However, the DP system will reduce T7-10 load to protect generators from overload.

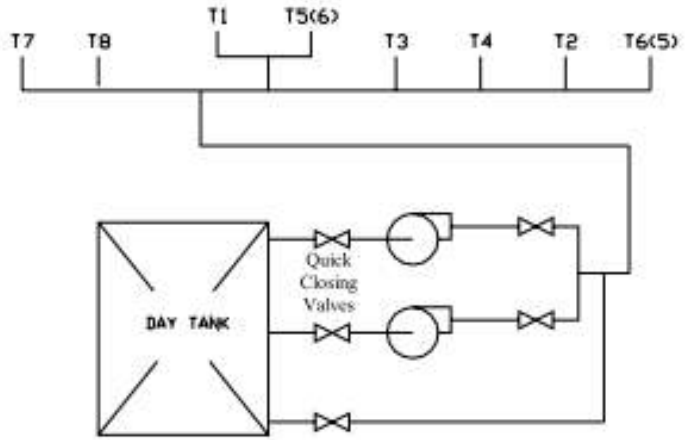
AUXILIARY SUPPORT SYSTEMS

- **Vessel Management System**
- This vessel does not have an automated vessel control system. The propulsion and some support systems are monitored by the Kongsberg NorControl alarm and monitoring system (DMS). The DMS system has a console in the Bridge and the ECR. Other ship's auxiliary systems are monitored and alarmed in the ECR. There is no remote control, integrated system.
- **Fuel Oil Distribution**
- **Main Vessel System**
- A simplified schematic of the fuel oil distribution system for the main engines . The system is comprised of two daily service tanks for heavy and light fuel oil, filters, pumps and interconnecting pipe work. The system also supplies fuel oil to the auxiliary engines and the main boilers. Additionally, the light fuel oil day tank is also the source for the hydraulic Thruster fuel distribution system.



AUXILIARY SUPPORT SYSTEMS

- The main engines are designed to run on either heavy or light marine diesel fuel but only diesel is being used currently. Fuel oil from either tank may be fed via isolation valves connecting the tanks to a central duplex filter network and then through the main fuel pumps before being fed to the main engines. The fuel pumps are equipped with additional filtering and isolation valves are fitted to each engine. The engines can run without fuel pumps if lightly loaded. Overflow returns from the engines are piped back to the respective fuel filter networks.
- **Hydraulic Thruster Fuel Distribution System**
- A simplified schematic of the fuel oil distribution system for the hydraulic thruster engines is shown in Figure 5 above. The light fuel oil day tank, part of the vessel's main fuel distribution system, supplies fuel to the 8 azimuth thruster tanks via isolation valves. The hydraulic thruster fuel oil transfer pumps are powered from the 380V section of the emergency switchboard. Each individual thruster engine fuel tank is fitted with it's own isolation valve to allow for manual filling, together with independent fuel filtering at each tank.

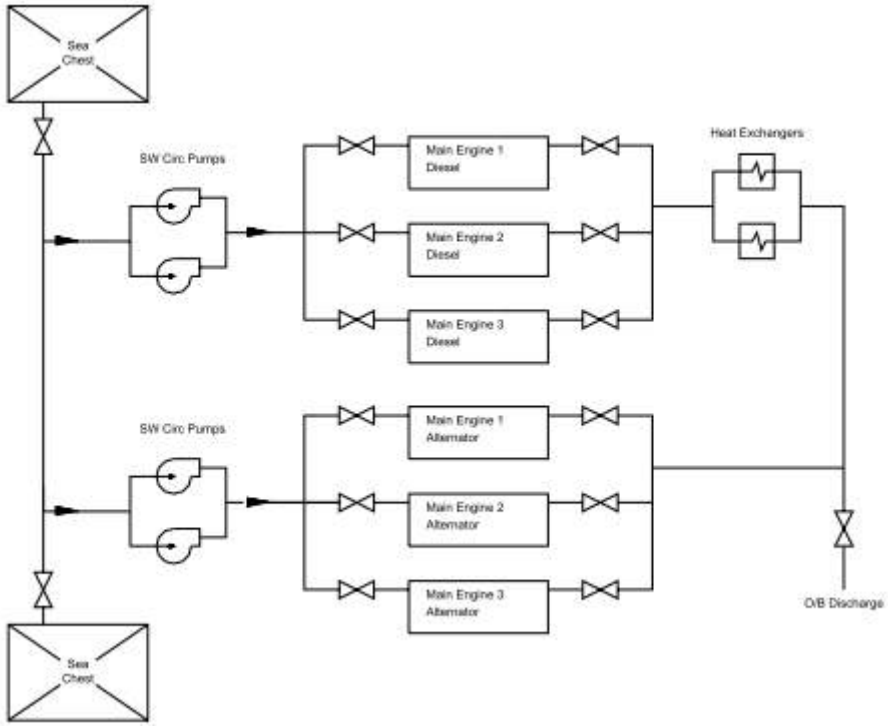


AUXILIARY SUPPORT SYSTEMS

- **Lubricating Systems**
- The vessel is not equipped with a centralized lubrication oil system. Each engine and thruster has its own internal lubrication oil system. Each diesel engine has an engine driven lube oil pump, a cooler, filters, valves and sump. Each engine's lube oil system is monitored, has alarms and lube oil failure will automatically shutdown the engine. Engine lubrication coolers are supplied by the freshwater cooling system.
- Two electric pumps provide each main azimuth thruster's lubrication. Alarms notify of the duty engineers of low lube oil pressure, high lube oil temperature or low lube oil level. Bow thruster and swing-down thruster lubrication is provided by the hydraulic oil and equipment rotation. Thruster lubrication oil cooling is provided by the sea water surrounding the lower thruster gearboxes.
- **Hydraulic Oil Systems**
- The thrusters have self-contained hydraulic power units and the operation of these systems is described in section 2.4. Failure of cargo or deck equipment hydraulic systems has no effect on DP.

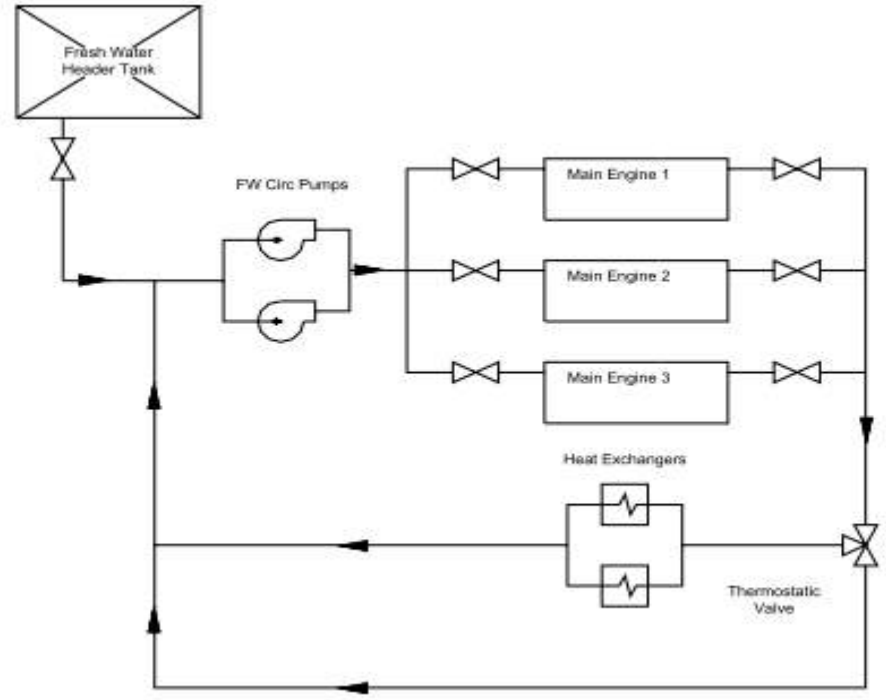
AUXILIARY SUPPORT SYSTEMS

- **Sea Water Cooling System**
- Two main sea chests connected by crossover piping provide suction for two sets of seawater circulating pumps. One set of pumps provides cooling water for the main alternators and one set of pumps provides flow through the main engines and the main engine heat exchangers. Discharge lines from both pump systems feed to a common overboard discharge line.



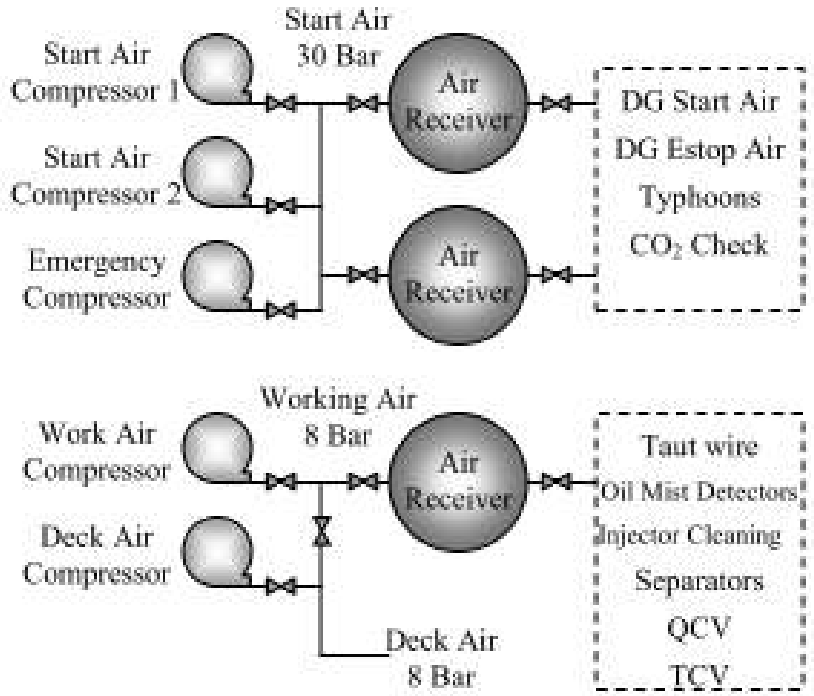
AUXILIARY SUPPORT SYSTEMS

- **Fresh Water Cooling System**
- The fresh water high temperature cooling loop for the main engines is supplied from a central header tank. Duplex fresh water circulating pumps feed the main engine jacket cooling water systems. Discharged water from the engines is passed to a thermostatic valve which directs the water flow through the main sea-water heat exchangers or directly back to the circulating pump suction.



AUXILIARY SUPPORT SYSTEMS

- **Compressed Air Systems**
- The 30 Bar start air system has three redundant compressors and two air receivers connected by a single pipe. The two start air receivers feed the main, auxiliary and emergency engines start air and emergency stop shutdown pressure. It also feeds air horns and the CO_2 Check system.
- The 8 Bar working system is supplied from its compressor and the deck compressor. The working air receiver supplies working pressure to the taut wire, the engine oil mist detectors, the engine injector cleaners, the separators, the temperature control valves and the quick closing valves. The deck air system supplies deck loads.



AUXILIARY SUPPORT SYSTEMS

- **Ventilation Systems**
- The vessel is designed for safe operation in hot or cold climates. All important spaces have heating and either air exchange or air conditioning.
- **Shutdown Systems**
- This vessel has an electrical emergency stop system and a pneumatic valve closing system. The emergency stop system consists of a switch panel in the Bridge and (probably) another switch panel in the ECR.
- The quick closing valve system consists of manually operated valves. Opening one of these valves sends compressed air, from the working air system, to close the associated fuel oil valves. The quick closing valves can be used to shut off fuel to the main DGs, the auxiliary DGs, the emergency DG, the boilers, the separators and the incinerator.
- This vessel does not have gas hazardous areas and does not have a vessel emergency shutdown system.

Switch	System Stopped	Switch	System Stopped	Switch	System Stopped
1	DG Fuel Oil Pumps	8	Incinerator	15	ECR Ventilation
2	Accommodation Ventilation	9	Accommodation Ventilation	16	Former O_2 Ventilation
3	ER, CO_2 & Separator Rm Fans	10	Aft Ventilation	17	CO_2 Room Ventilation
4	Boiler FO Pumps, ER Fans	11	ER & CO_2 Room Fans	18	T7 Room Ventilation
5	T7 Hydraulic Pumps & Fans	12	ER Fans	19	T8 Room Ventilation
6	T8 Hydraulic Pumps & Fans	13	T 9 & T10 Rooms Ventilation		
7	Separators, Aft Ventilation	14	T9 & T10 Hydraulic Pumps?		

AUXILIARY SUPPORT SYSTEMS

- **Fire & Gas Protection Systems**
- A manually activated, fixed CO_2 system protects several electrical and machinery spaces. Each space has its own release cabinet. Opening a release cabinet sounds the CO_2 release alarm and shuts down the associated ventilation in that space. A minimum of two manual valves must be operated to release CO_2. The Engine Room, Separator Room, the O_2 Room, T7 Room and T8 Room are among the spaces protected. Ventilation dampers, fuel pumps and fuel valves must be closed separately.
- The Galley hood has a separate CO_2 release system.

CONCLUSION

The a.m. data is based on manufacturer's manuals and maritime survey reports.
Prepared by "Titan-2" Chief Engineer
Approved by "Titan-2" Captain