

Seychelles Parad

Lindenau's Green Coastal Tanker



SEYCHELLES PARADISE

BUILDER
OWNERS

Lindenau Shipyard
Seychelles Petroleum Ltd.



In October 2009 Lindenau Shipyard handed over Seychelles Paradise to her owners Seychelles Petroleum Company Ltd. (SeyPec). The newbuilt Safety Tanker Class coastal tanker is a groundbreaking design with regard to safe, ecological and economical transport of oil and liquefied gas.

The 1,785 dwt coastal tanker Seychelles Paradise is a double-hull 'green design' designed with high manoeuvring characteristics, since its main deployment will be the carriage of gas, oil, diesel oil and LPG from and to the main terminal in Victoria to Praslin, the second biggest island in the Seychelles group. Earlier Lindenau delivered the larger Sechelles Pride, Pioneer, Progress, Prelude and Patriot to the same owner a few years ago. These ships are continuations of the yard's successful Green and Safe Series, first launched in 1990.

Design Criteria

Seypec Ltd. is the national oil and gas company of the Seychelles and operates a modern tanker fleet in the Indian Ocean. The recently inaugurated tanker Seychelles Paradise is a novel ship design concept to improve the maritime infrastructure and to protect the islands from oil spill pollutions and gas accidents. Seychelles Paradise was also designed to supply foreign vessels with bunker fuel at anchorage off Victoria as well as to serve as a crew-training vessel for the national fleet. A lot of emphasis has been put on minimizing fuel consumption and any kind of emission in the preliminary design phase. More than 20% savings of power demand for propulsion and ships service were achieved during the optimisation process in the design phase resulting in a serious reduction of operation costs during the lifetime of the ship. The slender hull form, computational fluid dynamics (CFD) optimisation of ship lines and shaft inclination, low propeller loads (120 kg/m²) and a power management system contributed to this result. Integrated computer systems for cargo handling and monitoring, engine control and navigation are part of the crew-training program and minimize the risk of human error.

Redundant Power Plant

The ship features a redundant propulsion plant with excellent manoeuvrability, consisting of two resiliently mounted main engines, two controllable pitch propellers, two rudders and a bow thruster unit.

The twin-engine propulsion plant is centred on two Volvo Penta D16 MH six-cylinder in-line four-stroke engines driving controllable pitch propellers through gearboxes with a 1:6 ratio. Each engine is able to develop 473 kW at 1,500 min⁻¹ and features a robust block with ladder frame, high pressure injection system, four valves for each cylinder, twin entry turbocharger and charge air cooler. The reduction in charge air temperature combined with the high performance injector system and latest engine management technology has resulted in reduced fuel consumption and low emissions; the whole propulsion plant complies with the latest IMO Tier II legislation.

For the main engines a NO_x-emission of 5.6 g/kWh was measured, which is only 56% of the actual IMO Tier-I limit. Even the emission targets of IMO Tier-II, which will become mandatory for newbuildings constructed on or after 2011, are fulfilled with a reserve of 28%.

Power Generation

Seychelles Paradise has been fitted with two large propellers, each having four blades and a diameter of 2 m. The vessel's propulsion concept ensures unique small turning circles, soft power control and maximum safety against casualties. The diameter of the turning circle is only 40% of the IMO-limit, which is an outstanding performance result for a bunker vessel qualified for ship-to-ship berthing.

As the tanker will be required to fulfil other roles such as provisioning, training and bunkering, and requires good manoeuvrability, two full spade high efficiency rudders and a 150 kW fixed pitch bow thruster have been included. Three diesel generator sets can each supply 400 kVA and are supported by a radial cooled 75 kVA independent emergency diesel generator. The electrical mains operate at 400 V/230 V, 50 Hz and 24 VDC. For the genset engines, a NO_x-emission of 8.9 g/kWh was measured, which is 85% of the actual IMO tier-I limit. The electric load balance was tailored for the simultaneous operation of four



cargo pumps at full load with only two genset aggregates running, and a surplus of about 15%. Auxiliary machinery further includes a sewage treatment plant, a freshwater generator capable of producing 1 t/day, an air conditioning plant, one fire and general service pump and an emergency fire pump. For fire fighting a foam plant with three monitors, a waterspray system and a powder extinguishing plant for the LPG-area are installed. The hull is protected against corrosion by an Impressed Current Cathodic Protection (ICCP) system.

Cargo Tank Section

The vessel is suitable for the carriage of oil products with flashpoint $<60^{\circ}\text{C}$, maximum density $1,025\text{ t/m}^3$ and maximum filling temperature 60°C . A double hull surrounds all cargo and fuel oil tanks. Six epoxy-coated cargo tanks with smooth surfaces are provided to ensure short discharge times and minimum slop residues. The cargo tanks are served by four frequency-controlled screw pumps with a simultaneous discharge rate of $600\text{ m}^3/\text{h}$. The cargo tank section allows three cargo segregations, separated by vertically corrugated bulkheads. To achieve maximum flexibility these tanks differ in size, enabling a better volume to deadweight ratio. All structural stiffening is outside the tank, giving short discharge times and minimal residue after discharge. Total cargo capacity – including the slop tanks – is $1,700\text{ m}^3$. The three cargo segregations are serviced by four electrically driven, deck mounted, screw type pumps, each with a capacity of $125\text{ m}^3/\text{h}$ at 8.5 bar. Separate frequency converters control the cargo pumps. A 118 m^3 LPG-plant is carried on deck, consisting of two cylindrical tanks with 7 bar working pressure, two pumps at $20\text{ m}^3/\text{h}$ and a one-grade piping system with crossover. There is no cargo heating facility or fixed tank washing equipment but two $15\text{ m}^3/\text{h}$ cold seawater portable tank washing machines have been supplied.

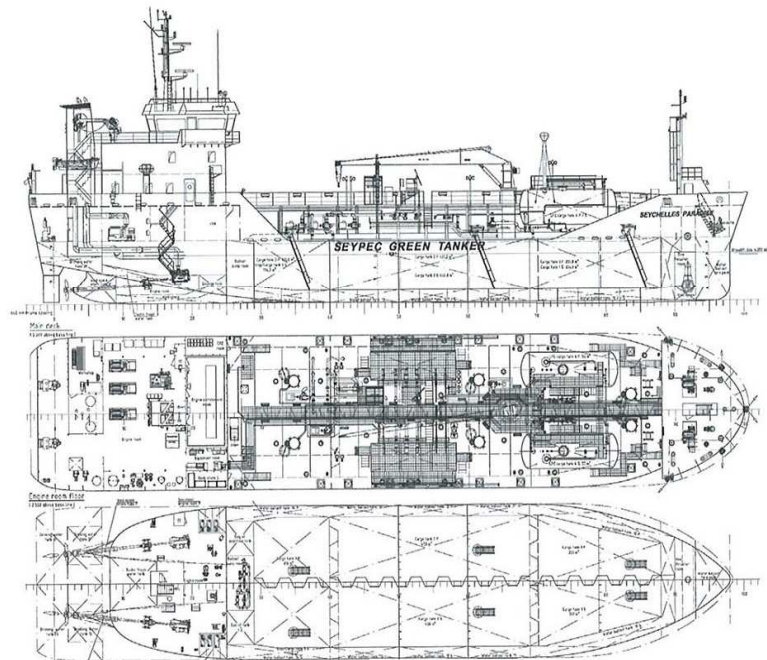
Cargo Handling Installation

The cargo handling installation includes a computer based monitoring and indication system in the wheelhouse which controls functions such as: cargo and slop tank level indication, cargo temperature indication and monitoring, using twin sensors mounted at different heights and tank pressure monitoring with over-pressure and vacuum alarms. The vessel has three cargo manifolds each with a flow meter and manually operated valves. A 5t crane with a 16m outreach is fitted on deck to handle the hoses.

Hull draught is monitored using four sensors. Levels in the ballast and storage tanks are also indicated on the panel. Operation of the cargo pumps, cargo pressure and drop-line valves, and ballast valves is computer controlled from the wheelhouse. Operation of the ballast pumps, although manual, can also be controlled from the wheelhouse cargo console. The two $100\text{ m}^3/\text{h}$ ballast pumps are situated in a pump room aft of the cargo tanks.

Loading Computer

A loading computer is linked to the integrated cargo monitoring and indication system as well as to



the ballast and engine room storage and service tanks. The computer enables the crew to control and monitor the vessel's longitudinal strength as well as the intact and damage stability during loading and discharging. For planning purposes, it is possible to simulate the loading and discharge procedure to calculate potential loading conditions.

The ship has been built with a strong hydrostatic stability to allow a flexible bunker service with changing drafts and slack cargo tanks; to avoid roll resonance in the Seychelles Sea (Area 69); and to compensate the top weights of the spacious deckhouse and the deck-mounted LPG tanks. The main dimensions are an optimal compromise to ensure a superior speed/power ratio despite of the high hydrostatic stability demand. For Seychelles Paradise the periods of roll ($<7.6\text{ s}$), pitch (5.6 s) and heave

Shipbuilding Technology With Success

Lindenau Shipyard, successfully spearheaded by managing director Dieter Kühne, is a German shipyard well-known for its specialisation in the construction of large double-hull tankers optimising overall-economy, safety and environmental compatibility. These ships have an excellent global reputation and have received fourteen international awards for their excellent qualities.

Lindenau is one of the most modern and productive medium-size shipyards in Germany and ideally located in Kiel, just outside the northern entrance to the Kiel Canal. The shipyard has implemented a quality management system according to DIN ISO 9001 as well as an environment management system fully in compliance with DIN ISO 14001. The company comprises of five dedicated departments: Ship Newbuilding, Offshore and Marine Technology; Ship Conversions and Extensions; Ship Refit & Repair; Non-Marine Division; Consulting & Engineering.

With nearly 80 years of experience in the shipbuilding industry, Lindenau has become a trustful partner for developing, designing and building any kind of ship newbuilding or constructions for offshore or marine. Ships built by Lindenau shipyard are internationally renowned for their outstanding reliability, high quality, innovative design, economic operation and environment friendliness. Today more than 225 vessels built by Lindenau are successfully navigating the seven seas.

Lindenau Shipyard also is a competent partner for all kinds of ship conversions and extensions. The yard's range of services also includes competent and flexible ship repair supported by an experienced team of qualified experts guaranteeing around the clock service, 365 days a year.

Since its establishment in 1919, Lindenau has also been very successful with projects involving new technologies in non-shipbuilding sectors. Lindenau's consulting and engineering department uses consistent market research analyses and the outstanding know-how of a team of 25 engineers to guarantee custom-made, competitive, market and future-orientated products. Modern CAD/CAM techniques, ongoing improvement of production runs and close co-operation with the supply industry, research institutes and universities are the guarantee for innovative design, continuous product improvement and cost optimisation.



(5.1 s) were calculated from typical loading cases and found to have at least 15% gap to the most probable wave periods according to global statistics. The longitudinal strength is significantly improved to allow a bunker service with flexible cargo tank fillings. The issued permissible bending moment is 62% above the minimum classification requirement (hogging & sea condition) and the permissible shear force exceeds the GL-minimum requirement by 87%. These values are a comfortable margin to allow a flexible service with various stop-overs for discharge of small parcels during a round trip.

Main Suppliers & Subcontractors

Acta Cranes | Alfa Laval Fuel separators | API / Heinrich Level gauging system for cargo, ballast & fuel tanks, Tank monitoring system | Aqua signal Lighting fittings general | B+V Industrietechnik Stern tube seals | Bornemann Cargo pumps, screw pumps | Cummins Genset | Daikin / Sick Cooling plants, central air conditioning plant | Desmi Gear pumps | Deutsche Schlauchboot Life rafts | DvZ Bilge water separator | Emersson (Damcos) Valve remote controls | Germanischer Lloyd Classification | Grundfos Marine centrifugal pumps | Hamworthy Sewage treatment plant | Hatecke Davit/rescue boat | Heimdahl Gearbox | Helsteth / Heimdahl Variable pitch propeller | Hempel / ELBKO Marine paints, Cargo tank paints | Iron Marine centrifugal pumps | Jastram Transverse thruster, drive motors incl. starter for thruster | Leroy Somer Emergency generator | Leroy Somer / Janssen Auxiliary generators | MAN Emergency diesel engine | MAN / Janssen Auxiliary engines | Marine Service LPG tanks + system | Nord-Lock Bolt securing system | Prang Tube type heat exchangers | R & M Accommodation system, sanitary cabins | Raytheon gyrocompass, auto pilot | Rolf Janssen GmbH Switchboard & control consoles, motor starters, machinery monitoring system | SAM Internal communications, public address, radar system, echo sounder, log, GPS, GMDSS radio station | Sauer & Sohn Compressors | Scanjet Tank cleaning equipment | Siemens Cable installation work | Sterling SIHI Marine centrifugal pumps | Ten Hoorn / SEC Anchor/mooring winches | Triton Format Fresh water generator | Unitor / Wilhelmssen Foam fire extinguishing system, CO₂-fire extinguishing system | Van Der Velden Steering gear | Volvo Penta Main engine | Vulkan Elastic couplings | Wesco Navy Galley equipment, laundry equipment

www.lindenau-shipyard.de

Photo courtesy of Lindenau Shipyard

Facts & Figures Seychelles Paradise

Principal particulars	
Length o.a.	67.80 m
Length b.p.	63.70 m
Breadth	13.20 m
Depth	5.20 m
Draught design	3.90 m
Draught scantling	4.20 m

Tonnages	
Gross tonnage	1,545 t
Deadweight scantling	1,785 t

Tank volumes	
Six oil cargo tanks	1,700 m ³
LPG Cargo tanks	2 x 59.00 m ³

Performance	
Trial speed (80% MCR)	11.00 knots
Endurance	2,900 nm

Accommodation	
Crew	15 persons
Single-berth cabins	5
Twin-berth cabins	2
Six-person cabins	1

Classification	
Class notation	GL ✕100 A5 RSA (50) Product Tanker, equipped for the carriage of oil products in bulk, equipped for the carriage of liquefied petrol gas in bulk ✕ MC AUT