



Sevan Marine - Petrobras

Turbine Model	OP16-3A Dual Fuel
No. of Packages	3 Units
Application	Floating, production, storage, offloading (FPSO)
Location	Piranema Oil Field, Aracaju, Sergipe. Brazil
Certification	DNV
Installation Year	2007

The FPSO Sevan Marine is moored in 1000 m of water, where it operates under lease to Brazilian national oil company Petrobras S.A. With an oil storage capacity of 300 000 barrels and an oil processing capacity of 30 000 barrels per day, the FPSO also has a processing plant for hydrocarbons installed on the deck, and depending on the characteristics of the field the processing plant has different modules for processing oil, gas and water.

OPRA Turbines supplied three of the OP16-3A dual-fuel all-radial gas turbine generator sets for Sevan Marine, each rated at 1.85 MW. In total, OPRA Turbines deliver up to 5.55 MW of electrical power under ISO ratings, with specially requested generator to produce 690 volt at 60 Hz for powering all of the FPSO's operating, utility, living and emergency needs.

Before arriving at the Piranema Oil Field, the OP16-3A gas turbines were operating as liquid fuel engines to provide electrical power for the FPSO and its onboard crew. When field production began and associated gas became available, the units switched to gas fuel. As long as natural gas is available on the FPSO, it will

be the fuel of choice. For example, when natural gas is not available due to field shut down, the units will again be operated as diesel fueled turbines. Furthermore, The OP16-3A gas turbines is capable of operating using the associated gas, which would normally be released as flare gas, with ease. Due to the gas corrosive nature and the high amount of particulates, its composition would be a damaging factor to any ordinary axial gas turbine. By using the associated gas to run the OP16-3A gas turbines, Sevan Marine managed to reduce their carbon emission significantly.

Each of the OP16-3A gas turbine is installed in its own weatherproof, sound-attenuating enclosure incorporating a control room at one end of the turbine generator package. The air intake filter house with demisters, filters and inlet silencer is mounted on top of the enclosure. The filter house has a separate integral section to provide ventilation air to the enclosure. However, Sevan Marine main reason for selecting the OPRA Turbines to provide their base electrical consumption is due to the highly compact and reliable design of the OP16-3A gas turbines. Since the amount of space on the FPSO platform

is limited, the gas turbine must be able to function within limited amount of space while providing the reliable power to sustain its production demand and to ensure the crew's comfort.

OPRA Turbines' OP16-3A gas turbines is designed with the main criteria of being robust and compact while providing a reliable nominal 2 MW of electrical power. Some of these design aims could have been met by using a conventional axial compressor and axial turbine but such a configuration does not allow all of the above benefits. An axial configuration requires multiple stages of internally cooled turbine discs, blades and guide vanes, which all add length and complexity to an axial turbine. The compactness of an all-radial gas turbine is achieved through the use of a single-stage, one-piece centrifugal compressor and a single-stage radial turbine.

To ensure a highly efficient and reliable system, the OP16-3A was incorporated with a range of further design features. These features include four reverse-flow combustion cans with manifold and radial inlet guides, which allow the compressor and turbine to be mounted back-to-back with no added space requirements for

the combustion system. By using four combustors in the gas turbine, fuel flexibility was also achieved along with the ability to configure fuel nozzles and mixing swirlers for a variety of liquid and gaseous fuels. OP16-3A gas turbines can also be operated using fuel with calorific value as low as 215 BTU/ft³.

Confronted with extreme challenges on a daily basis to ensure a sustainable production, safety and comfort, Sevan Marine requires highly robust gas turbines capable of operating with minimal amount of servicing or downtime periods. The OP16-3A all-radial gas turbine was designed to operate in the most severe environmental condition as it consists of less blades and radial flow guide vanes making it more robust than axial gas turbine. The gas turbine has 13 blades and 29 radial flow guide vanes as contrasted with the many blades and guide vanes of an axial gas turbine.

This configuration not only allows the gas turbine to operate on a wide range of fuels, it also allows a self cooled process of the turbine blades to take place, therefore eliminating the need of cooling holes on the turbine blades. Without cooling holes, the OP16-3A gas turbine is highly resistant to foreign object damage and the combustion deposit build-up that could easily constrict the flow path of an axial turbine. As a result, the OP16-3A gas turbine has a proven life-time of more than 40 000 hours without major overhaul.

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