Having a power plant that can be moored near-shore or on a river has many advantages. With its new SeaFloat concept, Siemens has resurrected the idea of floating power plants but this time with the possibility of putting almost any of its high efficiency land-based gas turbine plants on a barge. Already, the first order has been secured for the Dominican Republic – a project that will also feature battery storage. Junior Isles

**Floating good ideas**

The idea of floating gas fired power plants is not a new one. But rising global population, many of which are moving to live in megacities, where land is limited and expensive, could see the resurgence of these mobile power plants. Certainly Siemens sees this as one of the key drivers behind the development of a new floating combined cycle power plant concept it calls SeaFloat.

**Hossain:** Customers were asking, ‘can you supply your power plants on a barge.’ Already, the first order has been secured for the Dominican Republic – a project that will also feature battery storage.

**Dominican Republic – a project that will also feature battery storage.**

According to Siemens, SeaFloat technology combines state-of-the-art combined cycle power plant technology with the mobility and flexibility required by the current and future energy market.

Explaining why he thinks the market is now right for SeaFloat, Hamed Hossain, Business Owner SeaFloat Power, Siemens Gas and Power, said: “In the mid 90s, floating power plants were becoming popular. At the time, Westinghouse (later bought by Siemens) was building floating power plants with gas turbines operating in open cycle. However, we saw an increase in oil and gas prices, which meant it was not worth building these plants anymore because of their low efficiency.”

“Now it’s different. We are building state-of-the-art combined cycle power plants with really high efficiency, which means if oil and gas prices increase even more then it’s still worthwhile, economically. And if prices fall, we can use open cycle plants. So we have all the technology that’s available for land-based power plants on a floating structure. This allows flexibility on plant configuration, since installations are less affected by fuel price.”

The real impetus to re-boot the idea of floating power plants, however, came about three or four years ago in response to market demand. Hossain said: “Customers were asking: ‘can you supply your technology on a floating device?’ So we decided to do it again. Two and a half years ago, when we saw that the market was really pushing for it, we set up an entity within Siemens to specifically focus on it.”

Hossain sees SeaFloat as a technology that essentially gives customers more options when it comes to locating power plants, i.e. they can be built on water when land is too expensive or unavailable, and in locations where there is a high country risk.

The technology has numerous applications, such as: powering up remote areas like islands; development of industrial areas on shorelines or major rivers (for example, chemical and desalination plants); the replacement of out-dated plants, allowing the existing plant to continue operating until the new one is in place and ready to be connected to the grid.

SeaFloat power plants, which can provide from 145 MW up to 1.3 GW, can also be used as emergency backup for existing power plants during peak loads or outages and to provide power supply in the event of a humanitarian disaster.

Another area where Siemens anticipates great demand is in the oil and gas sector. “We are in contact with all the oil and gas majors. Our portfolio is to put our power plants on FPSOs (floating storage regasification units),” said Hossain. “Looking at FPSOs (Floating Production Storage and Offloading vessels), traditionally they all use open cycle plants, which have higher emissions relative to power output compared to combined cycle plants. Installing a floating power plant for this application has its challenges, however. Although the SeaFloat power plant is compact and has a high power density, for an oil and gas platform, the weight and footprint has to be reduced even further. For a platform it should also be easy to install and have a high degree of modularisation. “This is how we came up with the ultra-light floating combined cycle power plant, which is part of the SeaFloat portfolio,” said Hossain. “It’s a major game changer, we have reduced the weight and footprint of the power plant by more than 50 per cent compared to combined cycle power plants already installed on existing platforms.”

Installing a SeaFloat power plant would certainly help oil and gas majors improve their green credentials and lower the cost of emitting carbon. In a country or industry where CO2 prices are high, of the order of €50/ton, the savings can be significant.

Putting a combined cycle plant on an oil and gas platform or FPSO could reduce CO2 footprint by 80 000-110 000 tannum. This translates to high single digit millions of euros in savings from CO2 taxes and certificates each year,” said Hossain. Siemens currently offers SeaFloat power plants based on three main gas turbine technologies – the SGT-800, SGT-A65 and the SGT-800H series – but says it is not limited to these machines. “In addition to these, we also have the SGT-750, SGT-A35 (formerly the RB211), which will be for the oil and gas market,” noted Hossain.

Siemens is capable of supplying any size of floating power plant, although the majority of the market requirements are for smaller units in the mid-power range. Siemens is also considering the introduction of a new combined cycle unit which would be best deployed in situations where a large amount of bulk power is needed, and space is limited but the grid is stable. Hossain said: “It’s not possible to take an H-class unit capable of 620 MW or 1.3 GW in a 2-on-1 configuration and feed it into a weak grid in a developing country but in these cases we could offer our transmission grid stability solutions. And the H-class would have advantages. If power generating capacity is being replaced by a coal fired power plant in a region that has a more stable grid, with a more efficient, lower emissions plant, then the H class is the right fit.”

He noted that customers in countries with labour challenges or those wanting to avoid the time and effort involved in obtaining permits to install land-based plants, are interested in installing SeaFloat plants.

Project risk resulting from brownfield activities such as demolition works, site levelling activities, re-location of existing structure, etc., can be avoided when replacing old plants. As the barges are built at modern shipyards, the project schedule does not depend on availability of qualified labour and infrastructure at the final location. According to Siemens, this can cut construction time by 20 per cent.

Siemens believes it is the simple plug and play, connect and go, possibility that makes SeaFloat plants so attractive.

The concept allows fast and easy installation at shipyards. A SeaFloat plant, with the SGT-800 in particular, has a high degree of modularisation, where delivery of pre-assembled and pre-tested plant modules minimises...
the manpower required at the construction yard and the hook-up time at place of operation.

The SGT-800 combined cycle SeaFloat can be provided in SCC-800 2+1, 3+1 or 4+1 configurations to produce 150-450 MW. The SCC-800 2x1 has a length of 55 m and width of 30 m. According to Siemens, these plants are an excellent choice for providing base load power to public or industrial grids, as well as for oil and gas applications. They offer broad flexibility in fuels, operating conditions, maintenance concepts, package solutions, and ratings.

The plant is designed to withstand near-shore conditions, with equipment intended for on-board installa-
tions based on international codes and standards valid for power plants. Certain modifications are imple-
mented to suit the marine environment with respect to, but not limited to, air intake filters, materials, surface treatments and protection against water ingress and corrosion. Movements and deflection are addressed by particular technical modifications.

Hossain noted: “SeaFloat is not re-inventing the wheel; it’s not rocket science for the Gas and Power business. It is the same technology we use on a land-based plant that has been optimised for a floating device. You could look at it as a power plant with a moving foundation. This means it has roll, pitch and acceleration; and the hull of the floating device has deflections. When you want to build a power plant on top of a foundation that is bending and moving up and down, you have to ensure your equipment can withstand the roll and pitch, acceleration, as well as the deflection.”

As an example, he noted that the SGT-800 comes as a single-lift package on a 3-point mount frame, consisting of turbine, mechanical auxiliary systems, gearbox, generator and generator switchgear. It has a weight of about 265 t and comes pre-assembled and system tested with a dedicated electrical and control module.

“This means the solution stands on three legs, designed as a foundation to withstand the deflection of the hull. The gas turbine is almost the same [as the land-based machine]; it’s just the connection point to the foundation needs some smart solutions to really make it happen,” noted Hossain.

“Deflection must not be transferred to the gas turbine, so it has to be decoupled. For roll and pitch and acceleration, you have to address the lube oil systems. If the barge moves in one direction as a result of roll and pitch, you have to ensure the gas turbine bearings remain lubed.”

The single-lift package concept enables 48 h core engine exchange for plants with highest requirements on availability. The easy ‘roll-out’ capability of the gas turbine core engine enables on-board maintenance and overhaul, with turbine inspections/overhauls, hot gas path inspection (HGI) and major overhaul (MO) at every 30 60 000 equivalent operating hours (EOH).

The SST-600 steam turbine (ST) is also provided as a pre-assembled and system tested single-lift package on a 3-point mount base frame. It has a weight of about 475 t. The steam turbine single-lift package consists of steam turbine, condenser with evacuation systems, generator and generator switchgear. It has a size of 25 m x 7.0 m x 5.5 m (length, width, height).

The Once Through Steam Generator (OTSG) will be provided as a package with maximum modularisation. This modular approach has been applied in dozens of units worldwide and, says Siemens, results in safer and better quality fabrication under optimised shop conditions. The arrangement enhances faster and smoother installation at the shipyard. The steel structure for the OTSGs is designed as one combined block, so a rigid structure is formed to withstand marine environment conditions. The OTSG package has a weight of approximately 665 t. The SCC-800 2-on-1 plant configuration has a size for the OTSG combined structure of 14 m x 23.6 m x 28 m (length x width x height).

The entire power plant can be installed under various commercial models, including straightforward sale and various lease options. “We are open to all options,” said Hossain. “At the moment the market is asking for more sale options, where the
Special Technology Supplement

Types of SeaFloat plants

<table>
<thead>
<tr>
<th>Type</th>
<th>Length (m)</th>
<th>Width (m)</th>
<th>Area (m²)</th>
<th>Net power output (MW)</th>
<th>Efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x SSC-A65 (50/60 Hz)</td>
<td>~50</td>
<td>~22</td>
<td>~1.100</td>
<td>147/151</td>
<td>55/55.3</td>
</tr>
<tr>
<td>SCC-800 2x1</td>
<td>~55</td>
<td>~30</td>
<td>~1.650</td>
<td>149.4</td>
<td>56.6</td>
</tr>
<tr>
<td>SCC-800 3x1</td>
<td>~65</td>
<td>~40</td>
<td>~2.600</td>
<td>224.4</td>
<td>56.6</td>
</tr>
<tr>
<td>SCC-800 4x1</td>
<td>~75</td>
<td>~40</td>
<td>~3.000</td>
<td>299.3</td>
<td>56.7</td>
</tr>
<tr>
<td>SCC5-8000H 1x1 (50/60 Hz)</td>
<td>~170</td>
<td>~60</td>
<td>~10.200</td>
<td>665/460</td>
<td>61</td>
</tr>
<tr>
<td>SCC5-8000H 2x1 (50/60 Hz)</td>
<td>~170</td>
<td>~90</td>
<td>~15.300</td>
<td>1330/930</td>
<td>61</td>
</tr>
</tbody>
</table>

Note: SSC = Siemens simple cycle; SCC = Siemens combined cycle

The SCC-8000H SeaFloat can replace a large coal fired power plant in a region with available grid capability
Reliable technology – dependable partner.

Since 1990, Siemens has completed over 500 turnkey power plants with total output exceeding 155,000 megawatts. With more than 7,000 installed gas turbines in over 100 countries, we are the leading original equipment manufacturer – not only for this technology but for all plant needs throughout the lifetime of the asset. With the right ideas, innovations and know-how we are the dependable partner of our customers.

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