TARGET ZERO & INCREASED PERFORMANCE SOLUTIONS

MODEC

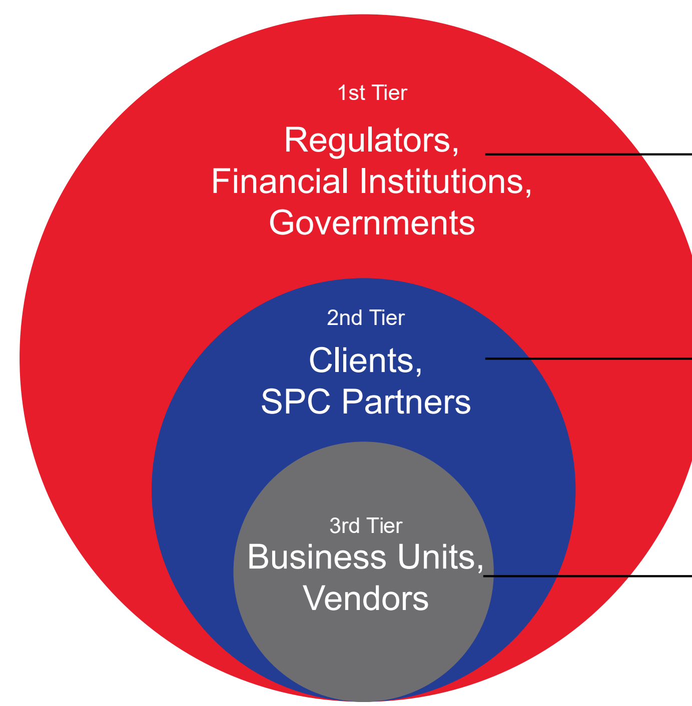
PROFIT FROM OUR EXPERIENCE

TARGET ZERO
LOOKING TO THE FUTURE

MODEC has organically enabled and expanded Targeting Zero Emissions while pursuing portfolio efficencies. This had become an instinctive competency within the MODEC group of companies globally even before the industry had started to subtly mandate the reductions. One of the key objectives of the operations group was the reduction of emission profiles in the continuous improvement program.

MODEC has chosen to take a holistic approach by adopting a colloborative 3 tier segmentation of the industry.

3 Tier Collaboration Sphere



- Rather than simply adhering to Net Zero mandates, MODEC has chosen to aid in pioneering the design of these mandates.
- MODEC is approaching clients to offer innovative carbon reduction initiatives and objectives that align and enhance the offerings of these companies.
- MODEC will adopt a holistic approach to environmental sustainability goals that will encompass the entire company and all vendors that interact with MODEC.

MODEC philosophy on environmental sustainability is divided into Near-Term, Medium Term, and Long Term initiatives.
In the Near Term Performance Metrics are being linked to these measurable efficiencies while optimizing for sustainability; MODEC had already incorporated the following activities/initiatives in our portfolio.

Standard Features

Target Zero Plus base case features currently provided on MODEC Floating Production Unit deliveries:

Predictive Maintenance Programs

- Predictive Maintenance (PdM) composed by Advanced Analytics models, allowing the vesels and equipment to be monitored 24/7 by the SMEs. MODEC has more than 700 models deployed across the fleet in Brazil.
- Predictive Monitoring Dashboards for Major Rotating Equipment and Process Systems (using PI AF/PI Vision), aiming to develop a contion-based maintenance by identifying anomalous conditions and directing to assertive maintenance actions in the field.

Major Benefits:

- Reduce the number of unexpected failure events;
- Reduce the time required to collect equipment information to perform studies like trouble shooting, RCA or post-trip analysis;
- More accurate KPI's measurement regarding industrial equipment's performance;
- Organize a database of equipment information for advance analytics studies.

Monitoring and Analytics

There are other digital tool initiatives to support operations, including:

- e-CoW for electronic PTW
- e-Mustering which provides real-time visibility of personnel to maximize safety, productivity and security on offshore assets
- DBMS (Digital Barrier Management System) to manage threats, major accident scenarios, effects and their barriers in one holistic view – bowtie visualization
- Fugitive Emissions Monitoring by using OGI (Optical Gas Imaging)

Standard Features:

Process Design Considerations Incorporated

- Meet functional requirements of arrival production capacity, pressure & temperature and product specifications at battery limits
- Optimize process scheme/configuration of equipment
- Minimize utility demand (power, fuel gas, heating, cooling, chemicals etc.)
- Select materials meeting design life of the facility
- Perform safety studies and implement recommendations per ALARP principle.

Environmental Consideration in Process Design and Equipment/Technology Selection

- System design to minimize power and fuel gas demand reducing GHG emissions
- Select produced Water Treatment system concept with Best Available Technologies meeting or exceeding local regulations for overboard disposal or injection into the reservoir
- Select technologies minimizing solid waste generation and disposal

Enhanced Sparing Philosophy to ReduceFlaring Scenarios

- Optimize compression trains and gas turbine generators installed sparing and associated insurance spares considering life cycle cost, production efficiency, and flaring limitations.

Standardization Philosophies

- Develop discipline-level technical design documents (incorporating lessons learned from EPCI & O&M phases) applying and deriving the benefits of lowest life cycle cost
- Standardize utility equipment with common spares in country supporting fleet operations
- Standardize philosophy of execution reducing overall EPCI schedule

Standard Features:

Gas Turbines with Waste Heat Recovery
- Implement centralized power generation system (all rotating equipment driven by electric motors as far as practical) with waste heat recovery to meet the process and utility/tank heating requirements; Allows option for additional technology around combined cycle

Cargo Tank Fuel Gas Blanketing and Vapor Recovery
- Utilize dehydrated and conditioned LP fuel gas as the primary means of cargo tank blanketing
- Pair with Cargo Tank Vapor Recovery Unit compressor (configured in N+1) designed and built to recover gas evolved during tank loading without venting to atmosphere
- Commingle discharge from Vapor Recovery Unit with production gas from separators
- Maintain Inert Gas Generator as back-up means of blanketing only. Blanketing of cargo tank with displaced inert gas is vented to atmosphere. (As it contains light ends from the gases that have flashed off from the cargo, it represents a loss of product and higher GHG emissions)

LP and HP Closed Flare System
- Purge HP & LP Flares with N_2 while maintaining pilots lit to handle hydrocarbon gas released to flare under upset conditions
- Design recovers any leaks that may be expected through control valves & PSV's connected to the Flare system
- Allows manual depressurization of equipment to within Cargo VRU and LP Gas Compression capacities for recovery of these gases

Heat Integration
- Cross-exchange heated, stabilized crude with incoming non-stabilized crude and produced water to reduce the process heating as well as stabilized crude cooling demand
- Cross-exchange heated produced water with dilution water to recover heat reduceing the process heating as well as produced water cooling demands
- Lower cooling and heating demands reducing circulation pump rates, and piping sizes in combined cycle power generation system concept, reduction in heat demand translates into more steam generator power, thereby reducing GHG emissions
- Further design review and analysis seeking other opportunities to integrate the heating/cooling requirement of facility optimizing overall system design and minimizing GHG emissions

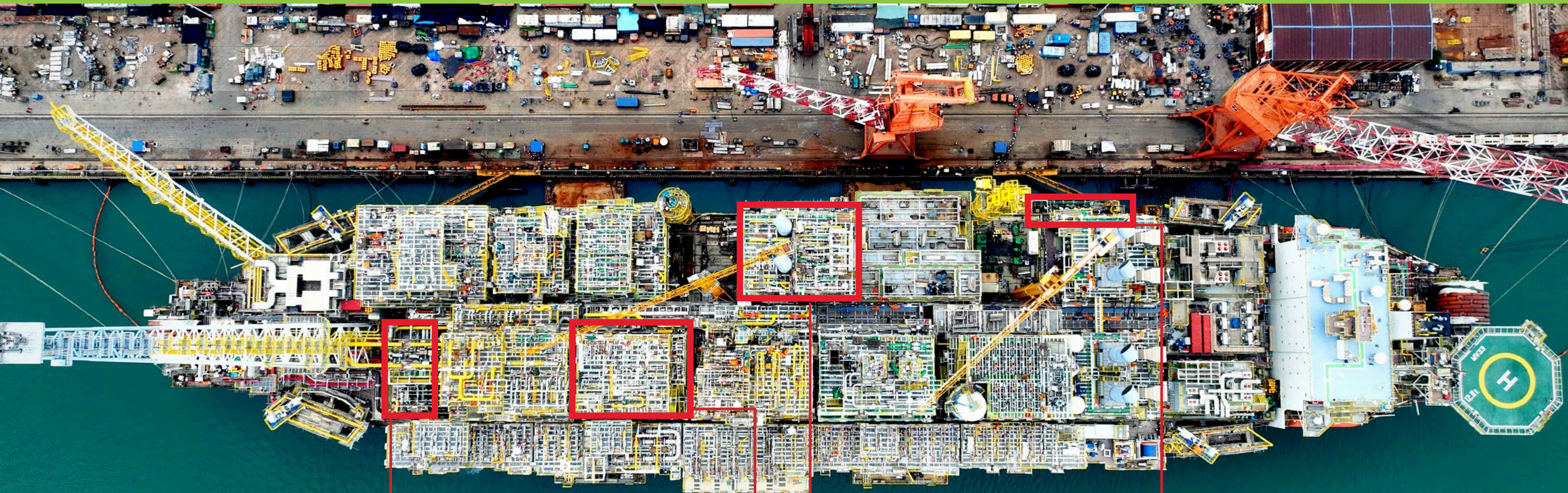
Electric Heaters for Start-up
- Provide electric start-up heater for import (if applicable) and fuel gas superheater. Although electric heaters are avoided in the design for continuous steady-state operation, the provision of electric start-up heaters which are independent of the Heating Medium System allows for on-specification fuel gas without having to wait hours for the Heating Medium System to warm up following a shutdown/cooldown. This, in turn, allows for the turbines to switch from liquid fuel (diesel) earlier, thereby reducing GHG emissions until steady-state is achieved

Deep Seawater Lift Depth
- Supply seawater required for process cooling and reservoir pressure maintenance injection requirements from ~100 m from mean sea level. Applied for permanently-moored installations and where the water depth allows for it

LED Lighting
- Utilize LED lighting in lieu of fluorescent lighting: lasts up to 15 times longer; less number of fixtures required to achieve the same lux (illumination) over a process area according to IEC 61892; much less maintenance required and reduced replacement frequency over the facility design life; overall reduction in life cycle costs. Much less maintenance required and reduced replacement frequency over the facility design life than required for fluorescent lighting

Additional Features

Other features that MODEC has delivered on past Floating Production Units upon request by the client for improved efficiency or carbon reduction initiatives



Start-up Flare Reduction / Restart from Settle Out

- Pre-commission and commission the facilities at the shipyard as much as possible to minimize start-up time offshore (example running gas compression system with simulated gas)
- Design the facilities to restart from compression system settle-out pressure utilizing either a start-up VFD or system-specific VFD (based on GHG reduction study recommendations)

Pre-Combustion Carbon Capture

- Remove CO_2 from the incoming reservoir fluid for exporting as well as fuel gas (to a CO_2 content less than 3%). CO_2 in fuel gas will add to the GHG emissions. CO_2 removal after pre-treatment of gas can be achieved using membrane technology and recovered CO_2-rich gas is disposed by compressing and reinjecting in the reservoir for permanent disposal or enhanced oil recovery

VFD on High Powered Motors

- Provide a system-specific (operational) VFD for compressors and/or large (water injection) pumps. With fixed speed electric motors driving compressors and pumps, process turndown requirements are met by minimum flow or anti surge control recycle. Recycle is waste of energy meaning increased GHG emissions, and VFDs serve to cover a wider range of operation without recycling (note, VFD's themselves have a 2% inefficiency.) Life cycle cost estimate performed based on VFD cost versus reduced power/fuel gas and GHG emissions (if any benefit) over the expected operating life of the facility

Extended Seawater Lift Depth

- Lift seawater from lower depths (beyond 100 m from mean sea level). In most locations, seawater temperature is lower than ambient surface temperatures. It is best to review the sea water temperature profile to decide the beneficial depth to lift sea water. Deeper suction water also will be comparatively clean, demanding less costly filtration equipment for injection requirement. Deeper seawater reduces required seawater flow rate for cooling, smaller pump and caisson sizes, lesser power demand and reduced GHG emissions. Life cycle cost to be evaluated for optimal depth of seawater lift, considering additional lift hose installation, maintenance cost versus reduced CAPEX and OPEX due to smaller pump and reduced power/GHG emissions

Additional Features:

Combined Cycle Power Generation

- Generate steam from excess heat (more than process facilities heating demand) and generate power thereby reducing GHG emissions
- Potentially eliminate a gas turbine generator or select a lower rated gas turbine generator model. A reduction in gas turbines (quantity or size) reduces associated O&M costs. Life cycle cost comparison to be conducted based on gas export monetization (reduced fuel gas for combined cycle) and CO_2 emission tax

Re-Bundling of Compressors

- Re-bundle compressors at some point in operations improving the efficiency, minimize recycle and reduce power demand and GHG emissions. During production life, gas compression system flow may vary quite a bit from early phase until end of plateau design. Re-bundling serves to match the production profile and eliminate or reduce recycling in late life when production rates are lower

Re-gearing of Compressors

- Re-gear compressors as an option to track any changes in pressure requirements over time (for example, change in injection pressure)

Segregation of SW Lift Pumps per service

- Separate the seawater lift pump services based on discharge pressure requirements feeding downstream systems (e.g. process cooling medium and seawater injection) to reduce overall power, which translates to GHG emissions reduction

Heat Rejection into Seawater to be Injected

- Reject heat into seawater that is lifted for injection into the reservoir. When seawater injection is required, this feature can be implemented in the design rendering the facility more efficient. Utilizing the treated seawater for injection to take some of the heat rejected from the plant minimizes the overall amount of seawater lifted

Tertiary Water Treatment for Produced Water

- Utilize tertiary water technologies which achieve even lower oil content (<20 ppm). Approximately 20 to 30 ppm dispersed oil content can be achieved using conventional Produced Water Treatment technologies (Hydro cyclones, Flotation Units)

Strategic Use of Waste Streams for Fuel

- Utilize a hydrocarbon stream (with mid-range components) as fuel that neither can go into the export gas to meet its specification nor into the stabilized crude to meet its specification

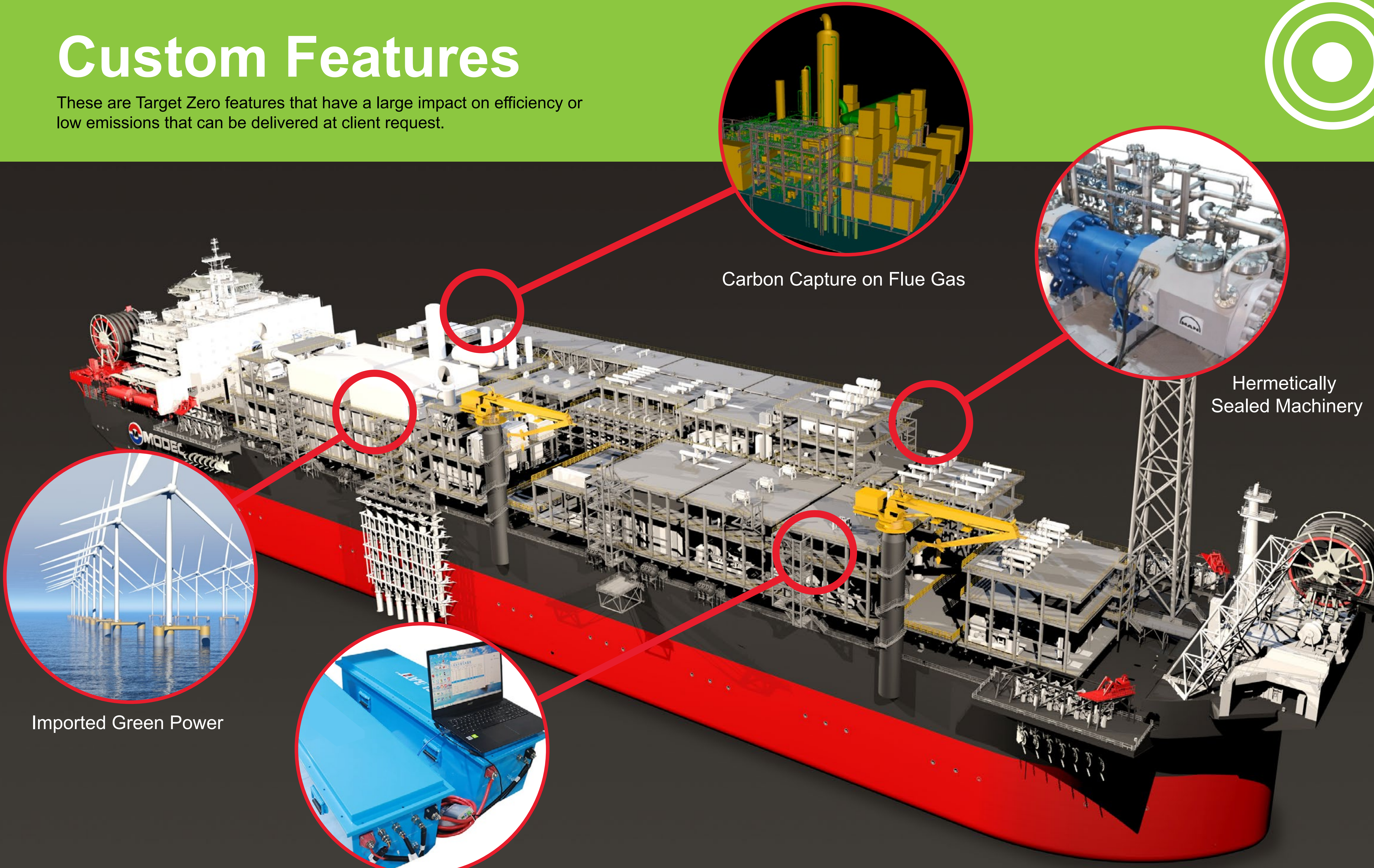
Reduced Manning/Enhanced Remote Operation and Control

Digitalization is a fundamental part of MODEC strategy used in delivering our core business objective.
To this end, the strategy is focused on three (3) drivers:

1.- Ability to increase availability and transparency of real time data for reporting
2.- Support minimum manning offshore
3.- Innovate (by reducing Cost, Time, and Resourcing) any or all the following in a tangible way; Production, Health, Safety, Security, Environment, Quality or Compliance

Custom Features

These are Target Zero features that have a large impact on efficiency or low emissions that can be delivered at client request.



Custom Features:

Energy recovery from SRU and RO units via Energy Recovery Turbine (ERT)

- Feed water is forced into the membrane module by a high-pressure pump at pressures in the range of 55 to 69 barg for seawater. The desalted product (permeate) is removed from the opposite side of the membrane at low pressure, and an ERT with reject by-pass valve on the brine (reject) side is used creating backpressure and control system recovery. The pressure drop on the brine side is minimal, which allows the high-pressure brine (reject) to be fed to the ERT to facilitate the pressure recovery

Inlet Air Chilling

- Gas turbine generator power output can be increased at least 5% from site-rated conditions (~ $30^{o}C$) by cooling the combustion air
- This additional power output may help to eliminate a gas turbine and thus saving CAPEX.
- Chilling system demands additional CAPEX
- Life cycle cost benefit analysis to be performed deciding whether inlet air chilling is the most appropriate technology to be adopted for a specific project

Carbon Capture on Flue Gas

- Gas turbine generator based power generation system exhaust contains CO^2 around 3.4 to 3.5 mole% on wet basis
- For a 28 MW power gen system with 90% loading, this is equivalent of 370 TPD CO_2 emission.
- For a more typical 3 +1 gas turbine generator installation, CO_2 emsission will be equivalent to 1,000 TPD.
- With a carbon capture system, the CO_2 from the exhaust can be captured, dehydrated, compressed and injected for permanent disposal
- Cost benefit analysis to be done for the carbon capture system design, build installation, O&M versus CO_2 tax penalty and decision to be made

Hermetically Sealed Machinery

- The driver motor and compressor are encased in a housing and the rotating shaft is supported with active magnetic bearings
- Rotating shaft mechanical seals and lube oil console for bearing lubrication are not for hermetically-sealed machinery. Hence, there is no leakage of hydrocarbon primary seal gas to the atmosphere, thereby reducing GHG emissions
- As seal system and lube oil system are not required for hermetically-sealed machinery, auxiliary utility supply such as cooling water, nitrogen, and electrical is eliminated
- Reducing the energy consumption of these utilities reduces GHG emissions

Imported Green Power

- Power demand for the Floating Production Unit will be met by imported power with back up Essential and Emergency Generators (to assist initial pre-commissioning, commissioning and station keeping minimum requirement as per IMO/Classification Society rules)
- Floating Production Unit can be designed and built to receive the Green Power through subsea cables and connect to the Switchgear in the E Building through step-down transformers using latest technology, assuring reliability and operability criteria.

Battery Technology

- This technology may be applied as part of external Green Power source utilization and not on stand-alone mode. Batteries are used in Floating Production Unit providing critical systems power demand and maintaing station keeping
- Renewable Fuel Generation/Usage
- Potential to be explored to generate renewable fuel (Green H_2/Green Ammonia) to meet the Floating Production Unit's power demand
- Monitor technology maturity for offshore generation of renewable fuel and adopt the same without compromising processing requirement, reliability/availability
- Footprint and weight considerations generating renewable fuels are a focus area of technology to watch

DECARBONIZING ASSETS WITH GREEN ENERGY

ENERGY COST REDUCTIONS THROUGH WIND FARMS

Renewable energy for offshore production assets can substantially reduce carbon footprint for Oil companies. This could also cut electricity bills for offshore units substantially. For example the power needed can be imported from offshore floating turbines. Companies can pre-select assets that require decarbonization and provide the necessary requirements such as power needs, E-house requirements for alternating current, met-ocean data and other parameters for MODEC to design and deliver a solution to decarbonise your offshore asset.

MODEC, INC.
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