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**SAIPEM.COM**

**SAIPEM**  
**SOLUTIONS FOR LNG**








# SAIPEM SOLUTIONS FOR LNG



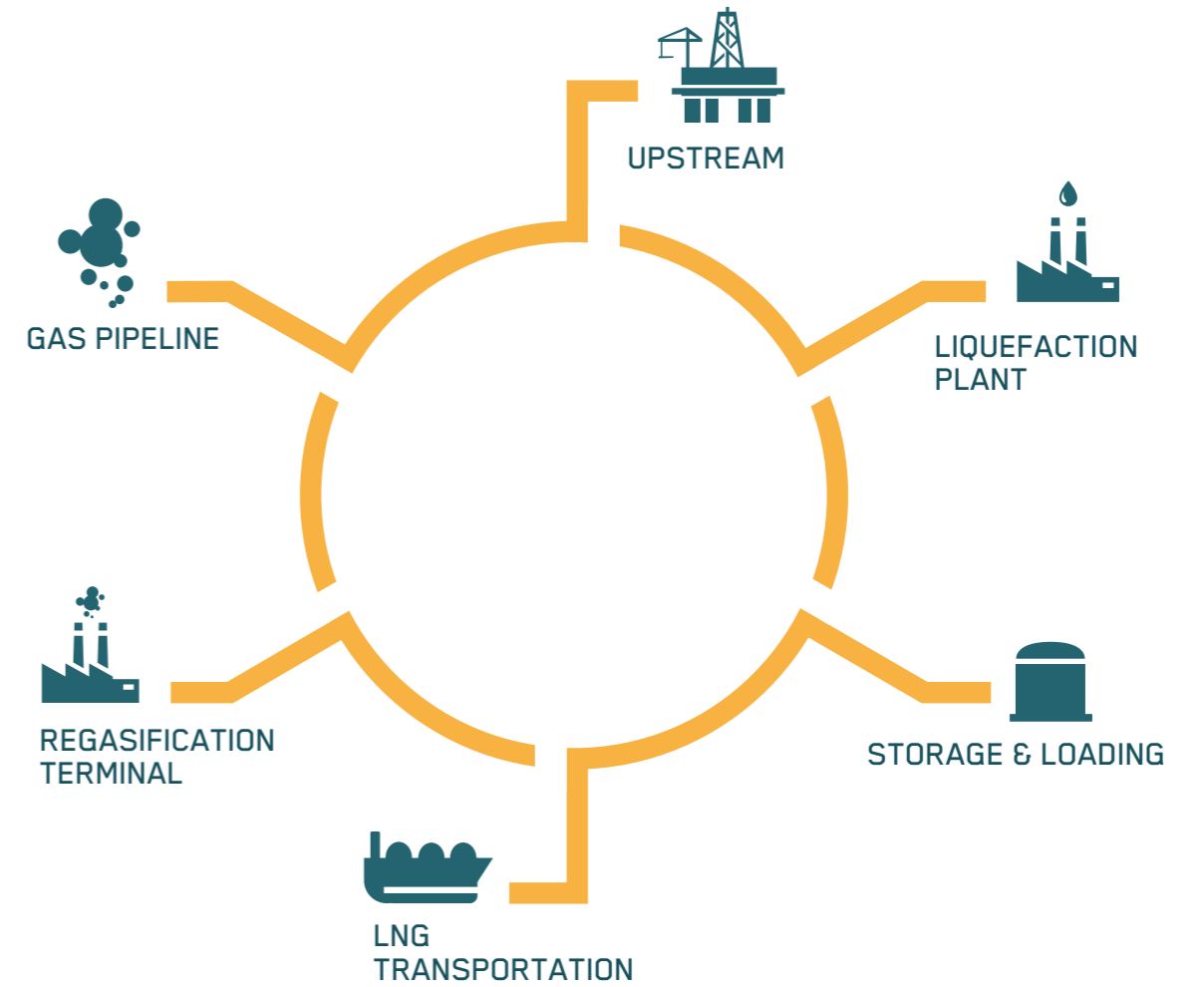
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| <p><b>IMPORT TERMINAL (REGASIFICATION) EPC</b></p> <ol style="list-style-type: none"> <li>Freeport</li> <li>Canaport</li> <li>Fluxys Zeebrugge</li> <li>BBG Bilbao</li> <li>OLT FSRU Toscana</li> <li>Snam Panigaglia</li> <li>Polskie LNG</li> <li>GDF Fos Cavaou</li> <li>Revithoussa</li> <li>Marmara</li> <li>Shell Hazira LNG</li> <li>Peyong Taek</li> <li>CNOOC-Guangdong</li> </ol> | <p><b>EXPORT TERMINAL (LIQUEFACTION) FEED</b></p> <ol style="list-style-type: none"> <li>LNG Canada</li> <li>BG OKLNG</li> <li>NLNG - Bonny Seven Plus</li> <li>Arzew</li> <li>Pars LNG</li> <li>Iran LNG</li> <li>Iris LNG</li> <li>Yamal LNG</li> <li>Petronas PLNG 9</li> <li>Tangguh Expansion Project</li> <li>Browse LNG</li> <li>Arrow LNG</li> <li>Mozambique LNG</li> <li>Eni East Africa Onshore LNG</li> </ol> | <p><b>EXPORT TERMINAL (LIQUEFACTION) EPC</b></p> <ol style="list-style-type: none"> <li>Peru LNG (Marine Works)</li> <li>Sonatrach GNL 3Z</li> <li>Ras Gas Trains</li> <li>NLNG Bonny LNG</li> <li>Angola LNG (Tank)</li> <li>Gorgon LNG (Marine Works)</li> </ol> | <p><b>FLOATING LNG FEED</b></p> <ol style="list-style-type: none"> <li>Petrobras FLNG</li> <li>Coral FLNG</li> <li>Abadi FLNG</li> <li>Scarborough FLNG</li> </ol> |
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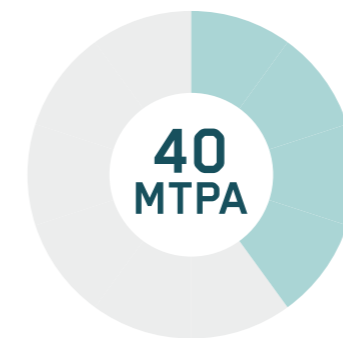
# SAIPEM CAPABILITIES

## SAIPEM IS ACTIVE IN THE WHOLE LNG CHAIN

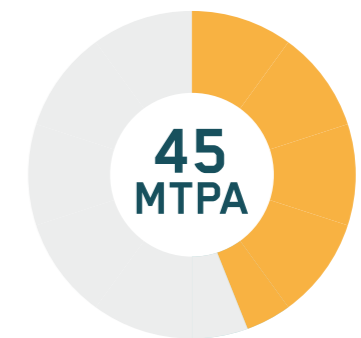


### EPC PROJECTS

- ➔ Executed #10 Base load LNG Trains ranging from 2 to 5 MTPA capacity
- ➔ Design and Construction of #13 Regasification Terminals and more than 40 Tanks



TOTAL INSTALLED LIQUEFACTION CAPACITY



TOTAL INSTALLED REGASIFICATION CAPACITY



## LIQUEFACTION TECHNOLOGIES

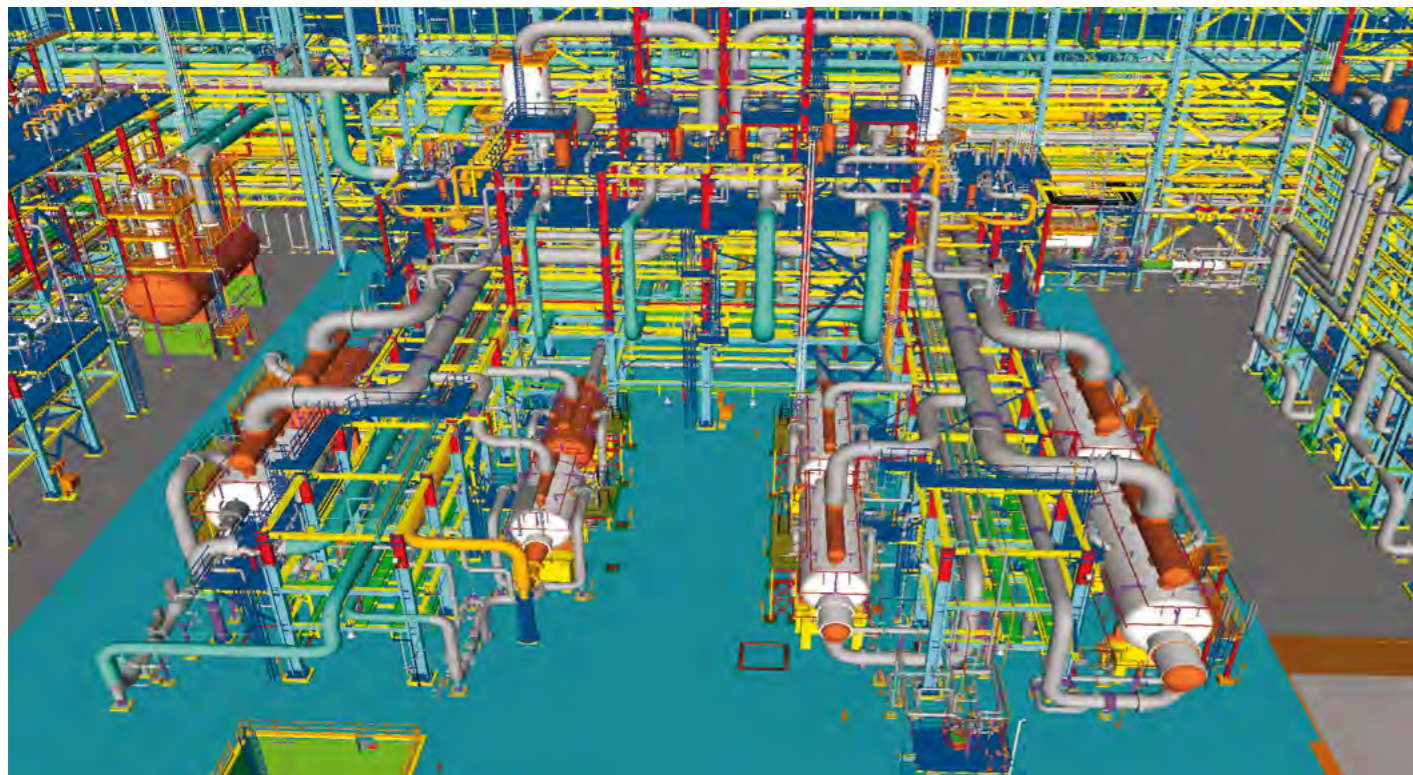
### ACCESS TO PATENTED PROCESS

- APCI
- Linde
- Axens
- Shell
- Black and Veatch
- Moss Maritime (SAIPEM Group)

Skills to evaluate performances provided by Licensors and capability to select and integrate the proper machinery configuration and heat exchanger in the overall process scheme

Capability to determine the combination of operating parameters minimizing the consumed refrigerant compressor power

Experience in compact arrangement of cold section exchangers and plant layout optimization complying with specific site environmental conditions



## REGASIFICATION TECHNOLOGIES

### VAPORIZER TYPES

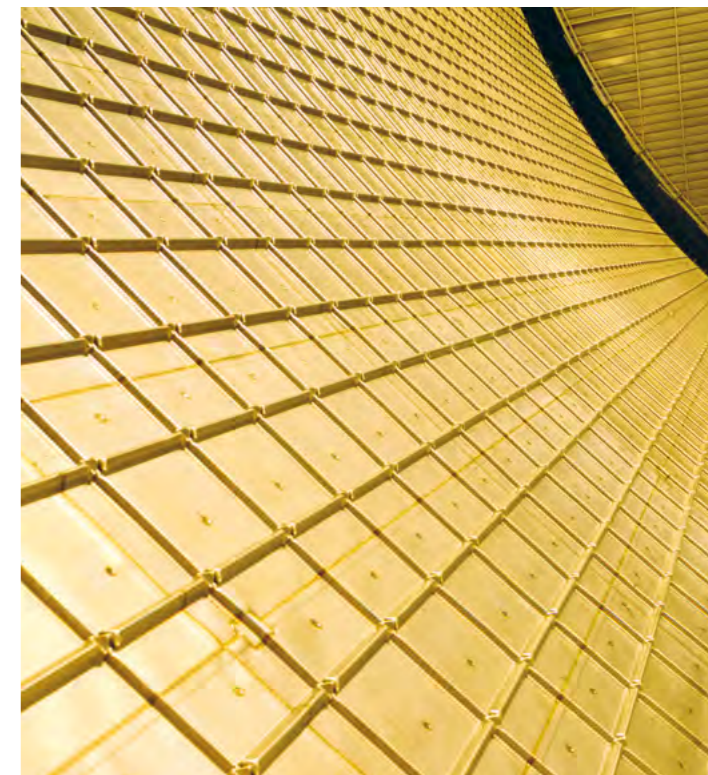
- ORV - Open Rack
- SCV - Submerged Combustion
- IFV - Intermediate Fluid
- S&T - Shell and Tube
- SMART - Air Vaporization

Experience in managing different heating configurations which may be selected: open vs closed loop, direct vs indirect heating, sea water vs direct heating

### LNG STORAGE TANKS

- Full Containment 9% Ni
- Membrane Stainless Steel

In house capabilities to design and construct cryogenic tanks  
31 Delivered within Regas Terminal, 17 Delivered within LNG plant/Stand Alone







# ONSHORE LIQUEFACTION

## GNL-3Z LNG COMPLEX ARZEW - ALGERIA



### INTEGRATED LNG FACILITY ON EPC LSTK BASIS

- LNG train 4.7 MTPA, APCI C3-SPLIT MR
- Provisions for 2nd LNG Train
- Infrastructures, Storages, Utilities

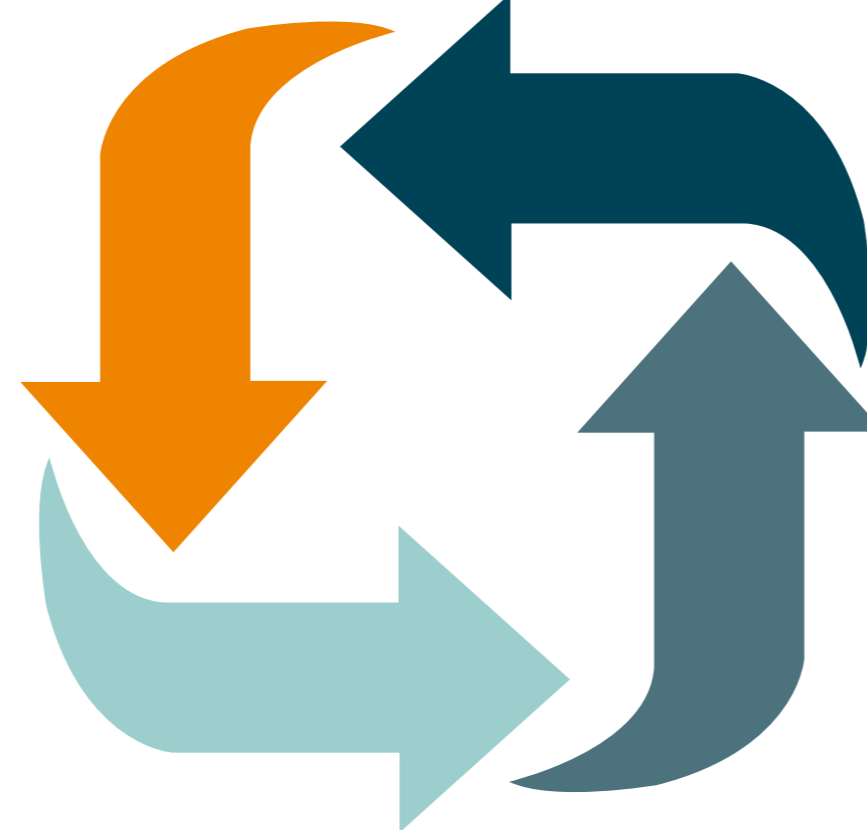


### MAXIMIZE LNG PRODUCTION

LNG production increased above the original 4.0 MTPA up to a peak nominal capacity of 5.7 MTPA using pre-committed equipment (MCHE, Turbines)

FROM GRASS ROOTS

TO OPERATION



THROUGH EFFECTIVE DESIGN

WITH SAFE EXECUTION



### DELIVERED TO SONATRACH ITS LARGEST LNG PRODUCTION TRAIN

- An extensive set of Performance Tests successfully completed by an integrated Client-Contractor team
- 4,000,000 m<sup>3</sup> of LNG exported up to Plant Provisional Acceptance May 5th 2015
- Lessons Learnt collected and capitalized



### ENSURING SAFETY

- Total mhhrs no lti 20,500,000
- Manpower peak 12,000



## POLSKIE LNG

### SWINOUJSCIE LNG IMPORT TERMINAL – POLAND

- High local content
- Flexibility for future expansion
- Easy operability and maintainability
- Sinergies with onshore infrastructures and facilities



285,000 Nm<sup>3</sup>/h  
CAPACITY



75,000 to 216,000 m<sup>3</sup>  
LNG CARRIERS



2 x 160,000 m<sup>3</sup>  
LNG TANKS



1.65 km  
JETTY

#### COMMISSIONING AND START UP COMPLETED

Tanks, Terminal Cooldown and Q- Flex Unloading on December 2015



## FSRU TOSCANA

### FLOATING STORAGE REGASIFICATION UNIT LIVORNO – ITALY

- Conversion of Mono-hull carrier (Golar Frost) with four Moss® type LNG tanks
- Towing operation from Dubai to Livorno (via Malta)
- Offshore FSRU installation and commissioning/start-up
- World's first side by side mooring in open sea



4.0 MTPA  
CAPACITY



Side by Side  
LNG TRANSFER



137,000 m<sup>3</sup>  
LNG STORAGE



2,500 tons  
RE-GAS MODULE

#### IN OPERATION

Start-up completed in 2015. Final acceptance in February 2016







# FLOATING LIQUEFACTION

## SAIPEM CAPABILITIES FROM SUBSEA TO TOPSIDE DEVELOPMENT

- ➔ LNG production: from 2.5 to 5.0+ MTPA
- ➔ Lifetime: Over 25-year
- ➔ Water depth down to 2000 m

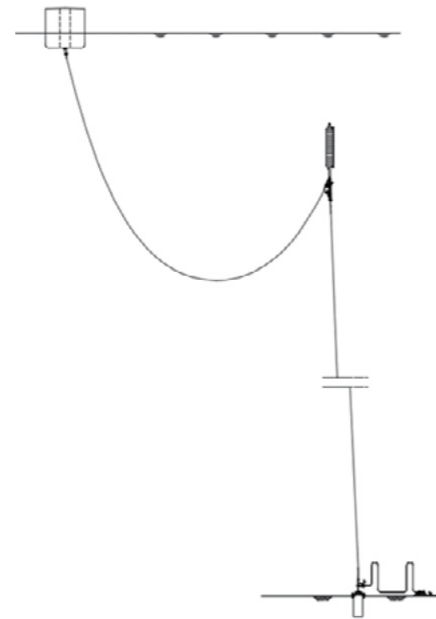
### FLNG

Design of process modules and turret  
 Naval engineering expertise  
 Integration of plant facilities into the hull  
 Motion effects and sloshing evaluation  
 Side-by-side or tandem offloading

### SURF

Subsea field development  
 Risers, Umbilical and Flowlines  
 Material Technologies for Subsea systems  
 Fully modular systems  
 Flexible design for different applications

### HYBRID RISER



## LNG TRANSFER FLOATING HOSE FOR TANDEM OFFLOADING

- ➔ Adapted to FLNG & FSRU applications
- ➔ LNG transfer up to 12,000 m<sup>3</sup>/hr.
- ➔ Safe LNG transfer with waves up to 4m.

### CRYOLINE

Suitable for cryogenic conditions  
 Designed for high LNG transfer flow  
 Low pressure drop and heat ingress  
 No ice formation during LNG transfer  
 Integrated leak monitoring system

### TANDEM OFFLOADING

Integrated storage and maintenance platform  
 Operability in severe environment  
 Reeling test performed  
 Innovative reel for hose storage  
 Qualified to EN 1474-3 and BV NR542

### LNG CRYOLINE Cooperation with Trelleborg

