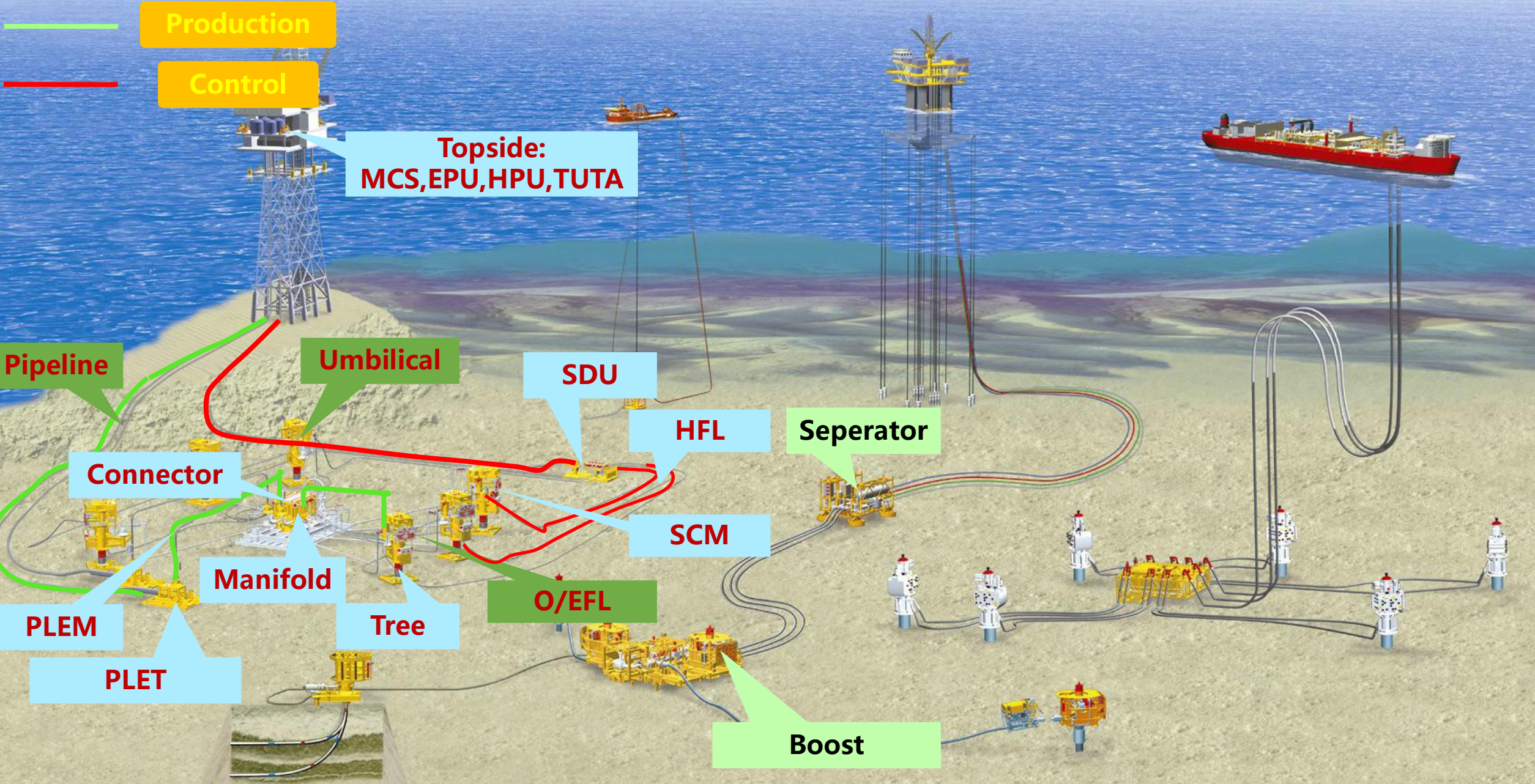


Deepwater Oil&Gas Development Solution Subsea Products and SURF

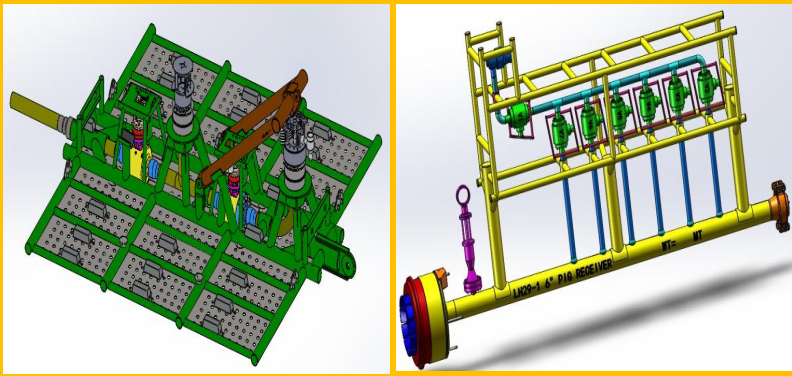
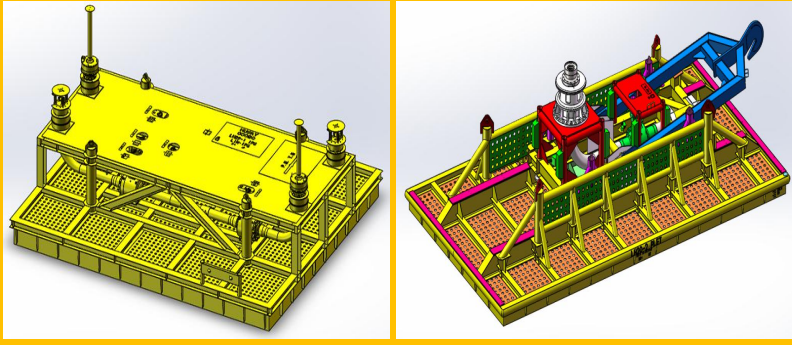


COOEC Subsea Production System



- COOEC has formed a complete set of special technical system documents for 1,500+m Subsea engineering, The PLET design on the side mount, the subsea central manifold for the deepwater belt control system and the subsea umbilical terminal unit (SUTU) manufacturing testing and installation technology reached the international advanced level.

Design Technology



Manufacturing & Testing Technology



Installation Technology

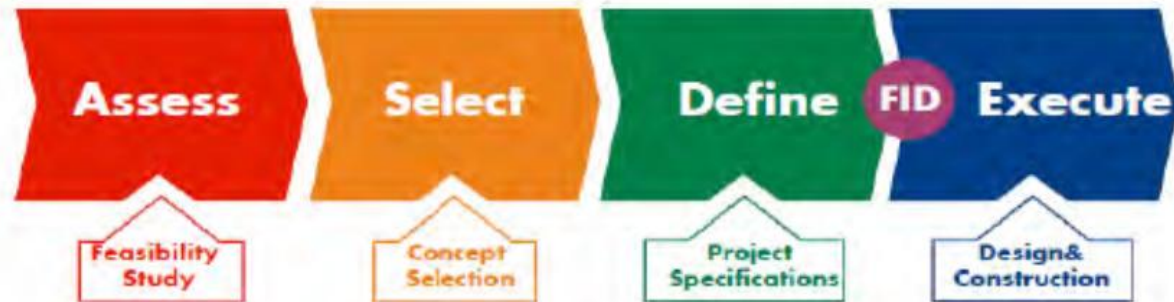


Core Subsea Design Business

- Subsea System / Flow Assurance / Subsea Product / Pipeline/Umbilical/Riser

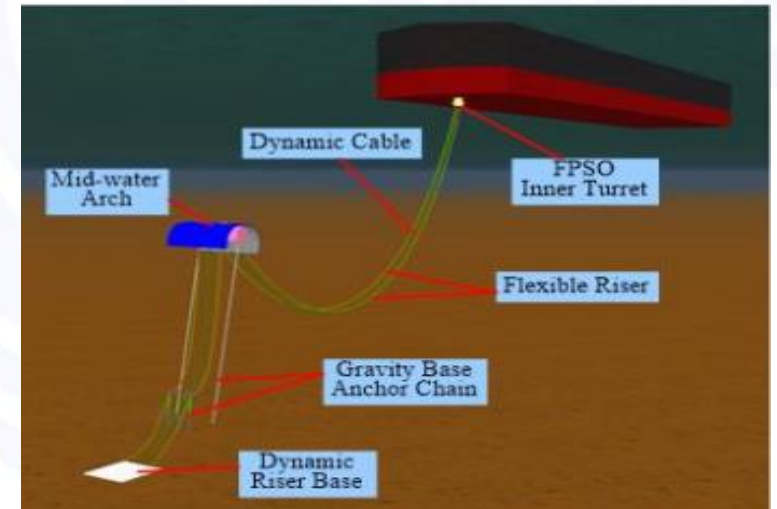
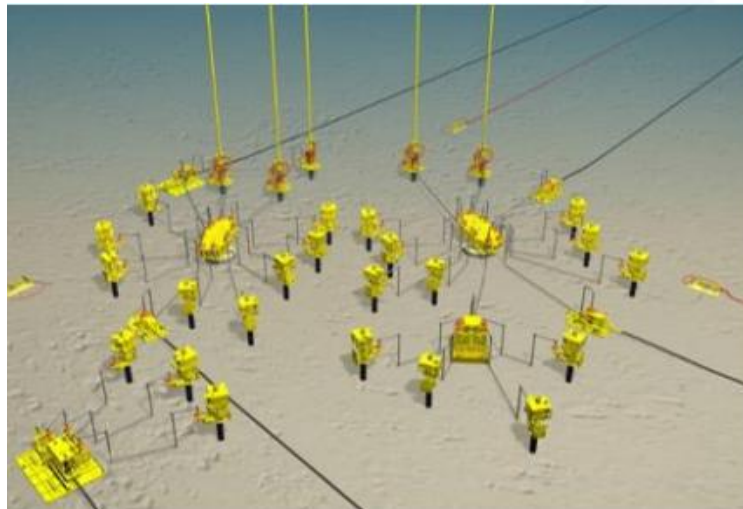
Engineering Service

- Overall Field Subsea Development Planning
- Concept Design & FEED
- Detailed Design Engineering
- Fabrication / Manufacture Support
- FAT & SIT Activities
- Installation, Commissioning, Start-up and Operating Support

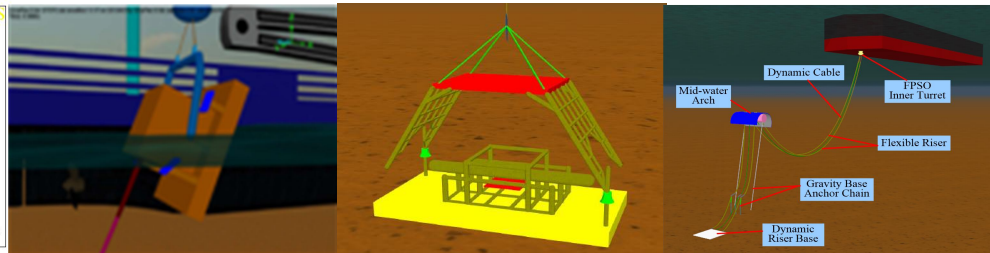
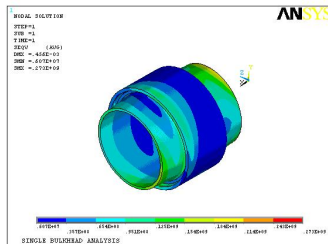
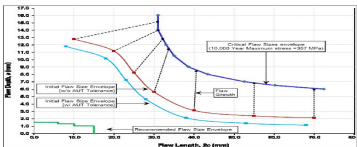
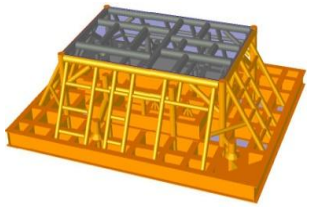
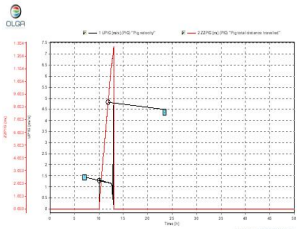
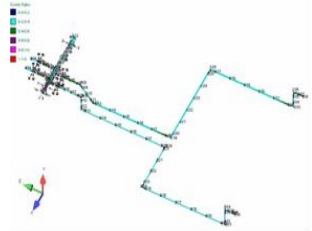


Subsea Products and SURF

- Provide complete subsea production system solutions for the feasibility study, conceptual design, FEED design, detail design, integration and SIT, including:
- Solutions for integrated subsea production system engineering
- Flow Assurance Analysis (Allying with designing institute)
- Trees+Wells Technical Scheme
- PLR, PLET, PLEM, Manifolds & Templates
- EFL and HFL, Connector Systems
- Subsea Control System and Umbilical
- Subsea Distribution Systems
- Subsea Isolation System (SSIV) and Subsea HIPPS System

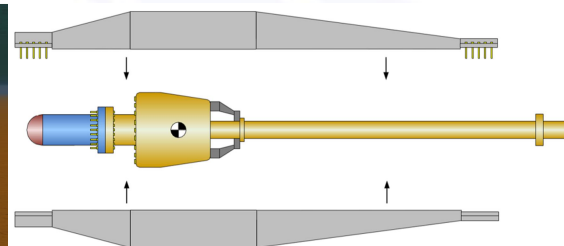
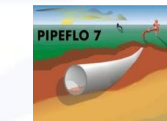


Subsea Products and SURF



- Subsea System Thermal-Hydraulic Simulations
- Hydrate Prediction, Inhibition, and Remediation
- Wax & Asphaltene Management
- Slug Prediction and Slug Catcher Sizing
- Subsea Control System Electrical Analysis
- Subsea Control System Hydraulic Analysis
- Subsea Control System Communication Analysis
- Corrosion Control and Material Selection
- Piping Stress Analysis
- Riser Engineering Analysis
- Subsea Structure Analysis
- Foundation Selection and Stability Analysis
- Dynamic Installation Analysis
- Umbilical In-place Stability Analysis
- Umbilical Installation Analysis
- System Cost & Economics Assessment

- Hysys
- Pipeflo
- PVT Sim
- OLGA
- SACS
- ANSYS
- Orcaflex
- DNV Spreadsheet Software
- Fluent
- Autopipe/Caesar II
- Offpipe
- Pipelay
- Simulation X
- AMEsim
- Solidworks



ASSEMBLY INTEGRATION TESTING CENTER

- Equipped with tubing pipe bending, inner wall cleaning and flushing equipment, the problems of automatic beveling and controlling the inner wall cleaning are solved
- FAT, EFAT test flow and technical requirements of test equipment for underwater central manifold
- Engineering MQC products (fixed end, logic cap, long-term pressure cap, protective cap, washing cap) disassembly, installation, testing technology
- Installation and testing technology of horizontal multi-hole connector, underwater control module, electric distribution box, subsea accumulator, electric flying line, optical flying line and other underwater special equipment
- Manufacturing, testing and transportation technology of large suction anchor
- Key system testing techniques of various sub-system testing, integration testing



TT WM



Pile Welding



Tubing Pipe WM



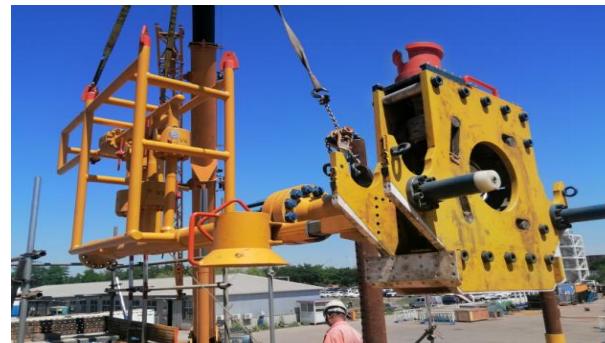
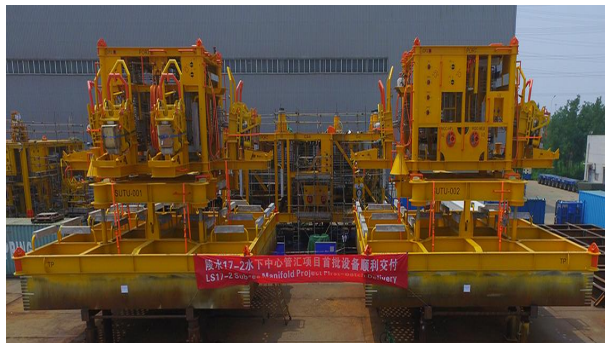
Turning Center



Gantry Processing



Vertical Machining



Automatic bending



Cleaning device



CNC beveling



Pipe beveling

ASSEMBLY INTEGRATION TESTING CENTER

- As the assembly integration test industry chain of CNOOC, COOEC coordinates the development of large-scale assembly integration test mode
- Underwater production system on land integration testing capabilities
- Sea joint debugging support capabilities
- Formed a set of standardized documents for the integration test on land and joint test on sea for subsea production systems
- Developed and equipped integrated test equipment for subsea production facilities



Subsea Products and SURF

COOEC Owns 19 installation vessels in 6 types and 17 Rovs(Work & Observation). The capability of installation is up to 3,000m depth



Lanjing 7500 Derrick (7,500tons)



HYSY201 Derrick & Lay (DP3, 4,000tons)



Lanjiang Derrick & Lay (3,800tons)



HYSY202 Derrick & Lay (1,200tons)



HYSY285 MSV (DP3, 3,000m)



HYSY286 MSV (DP3, 3,000m)



HYSY287 MSV (DP3, 3,000m)



HYSY289 MSV (DP2, 3,000m)



HYSY291 MSV (DP2, 3,000m)

19
Vessels

17
ROVs



HYSY278 Semi-Barge (DP2, 50,000tons)



HYSY229 Launching Barge(38,500tons)



HYSY295 Dredging Vessel (DP2, 300m)

4
Derrick & Lay

2
Heavy Lifting

7
Barge

6
Multi Service Vessel



01

Pipeline
Installation
海底管线安装



02

Mooring
Installation
锚泊系统安装



03

Subsea Facilities
Installation
水下设施安装



04

SURF
Installation
SURF安装

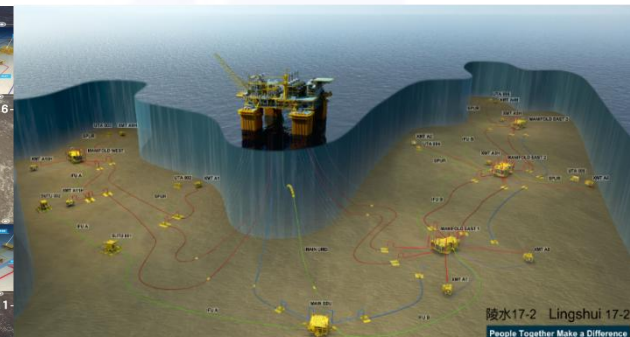
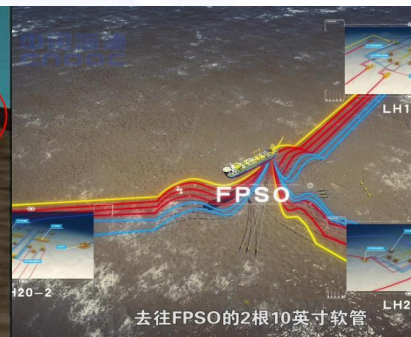
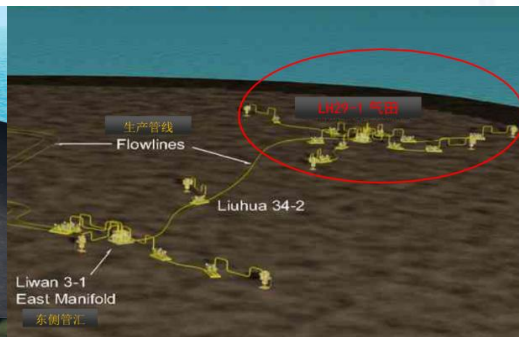
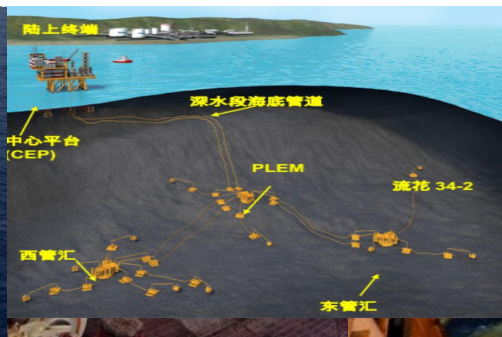
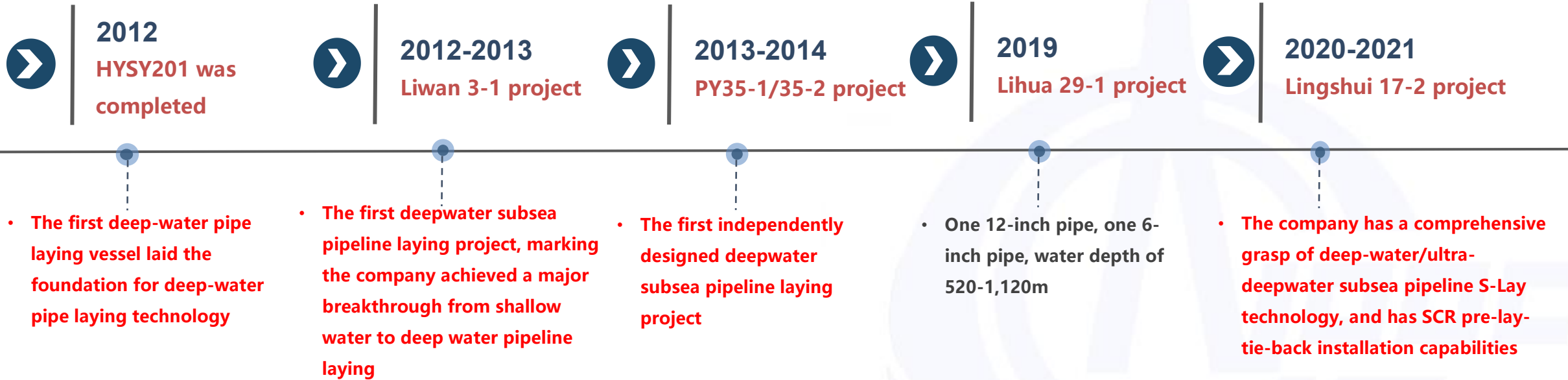


05

Pre-commissioning
& Commissioning
预调试与调试支持

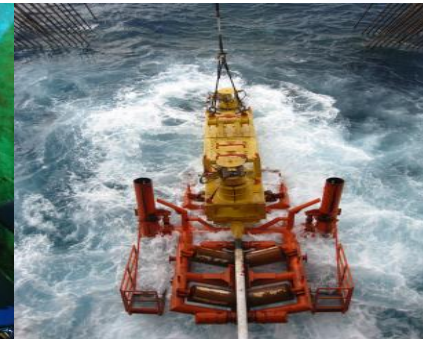
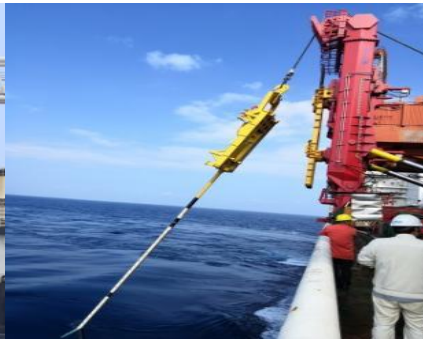
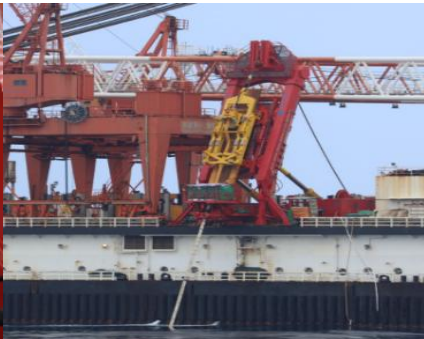
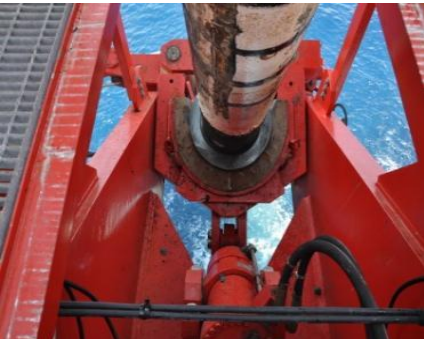
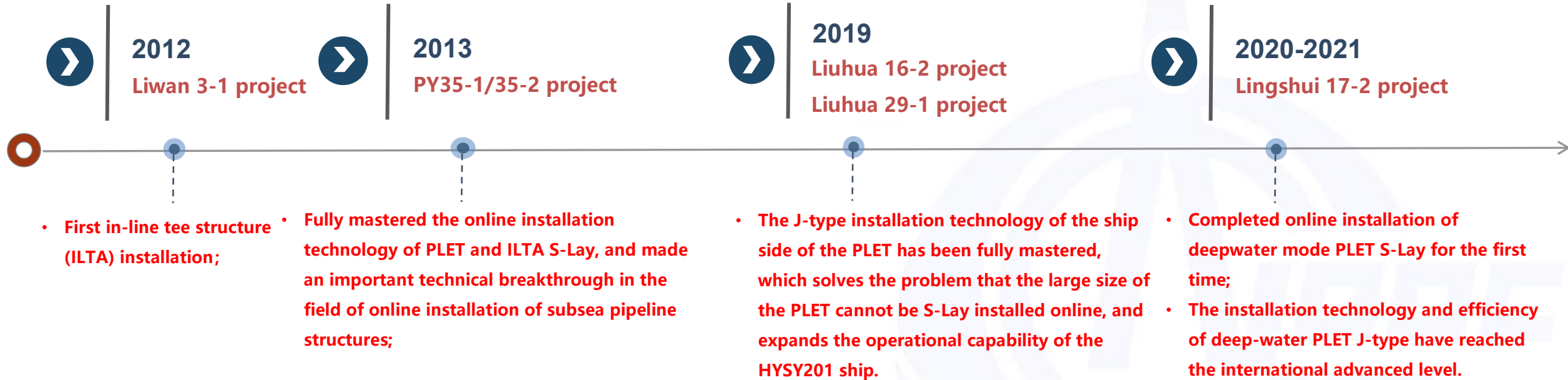
Deep water submarine pipeline laying

COOEC has mastered deep water and ultra-deep water S-Lay offshore pipe laying technology, deep water VIV Strake online installation technology, SCR riser S-Lay pre-laying and tie-back installation technology.



Pipe structure installation

COOEC has mastered the online installation technology of the deepwater and ultra-deepwater pipe end structure (PLET) S-Lay, the online three-way structure (ILTA) S-lay installation technology and the J-type installation technology of the side side of the pipe end structure (PLET).



Subsea Products and SURF

深水/超水深海管铺设
Deepwater Pipelay



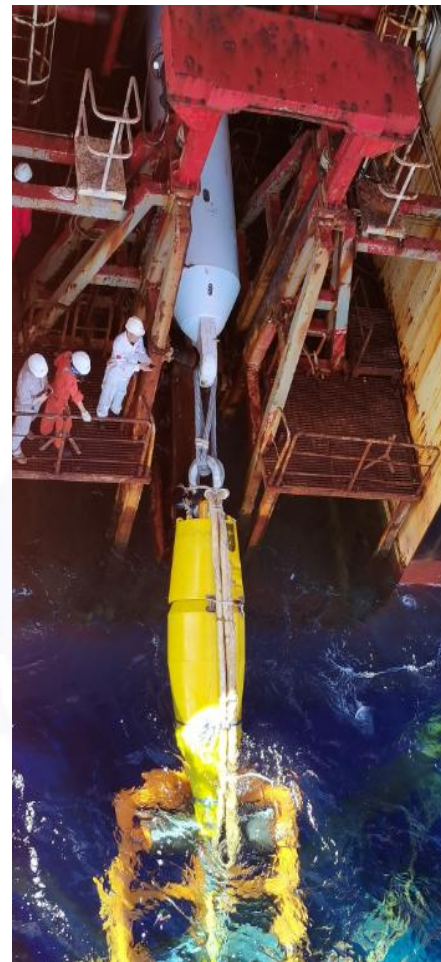
整体式管道终端船侧安装
PLET J-mode Installation



分体式管道终端/三通结构物在线安装
PLET / ILTA S-lay Installation



钢悬链立管预铺设
SCR Pre-Lay



钢悬链立管回收及回接
SCR Recovery & Hook Up



1,500+m 深水/超水深海管铺设 Deepwater Pipelay

80t 整体式管道终端船侧安装 Integrated PLET J-mode Installation

1,500m 分体式管道终端/三通结构物在线安装
PLET / ILTA S-lay Installation (Mudmat Max. 110t)

1,500m 钢悬链立管预铺设、回收及回接 SCR Pre-lay Recovery & Hook Up

锚泊系统安装 MOORING INSTALLATION

Professional T&I service for a wide range of mooring components from suction anchor, pile anchor, drag anchor to large diameter of chain, wire rope, polyester rope, and large MWA, etc. The company has significant experience in FPSO station keeping and mooring system hook up from shallow water to ultra deepwater up to 1,500+m.

提供从吸力锚、桩锚、拖曳锚到大直径锚链、钢丝绳、聚酯绳、大型MWA等各种系泊系统的专业T&I服务。公司拥有丰富的经验，可提供高质量的平台、FPSO的解脱、拖航、安装与回接服务，服务范围覆盖浅水到超深水，达到1,500米级。

1,500+m Deepest complex mooring system installed
200t Biggest suction anchor installed
10+ Large FPSO/FPS mooring system hook up completed

1,500+m 深水锚泊系统安装记录
200t 最大吸力锚安装记录
10+ 大型FPSO/FPS 锚泊系统安装与回接服务记录



水下结构物安装 SUBSEA STRUCTURE INSTALLATION

01 Subsea spool 水下膨胀弯

02 Deepwater rigid jumper 深水硬质跨接管

03 Rigid riser/J-tube 立管/J-tube

04 Subsea manifold structure 水下管汇结构

05 Subsea mudmat foundation 水下防沉板基础

06 Suction pile foundation 吸力桩基础

07 STFL/HFL/EFL/OFL etc. 各类电、液飞线

SERVICES

RECORD

• **242t**

Heaviest subsea manifold installed 大型水下管汇安装记录

• **261t**

Heaviest subsea SSIV installed 大型SSIV安装记录

• **1,526m**

Heaviest subsea manifold installed 超深水安装记录

• **18-in**

Largest subsea rigid jumper installed 深水跨接管安装记录

• **48-in**

Largest subsea spool Installed 水下膨胀弯安装记录

2019



LH16-12 Manifold Installation
流花16-2 管汇安装

400+m

2020



LH29-1 Jumper Installation
流花29-1 跨接管安装

700-1,200m

2020



LS17-2 Manifold Installation
陵水17-2水下管汇安装

1,500+m

2023



LS25-1 Suction Anchor Installation
陵水25-1二期吸力桩安装

1,500+m

2023



LS25-1 Manifold Installation
陵水25-1水下管汇安装

1,500+m

水下生产系统安装 SPS Installation

Professional technology in subsea production tree T&I, including engineering design, loading, transportation, lifting and installation etc. Track record of Cameron and FMC SPS installation in 300-1,100+ meters deepwater.

通过方案研究和工程实践，公司已成功掌握深水采油树安装技术，并在实际项目中完成了300-1100米水深级，由Cameron和FMC提供的两种不同类型的采油树安装方案设计、陆地装船、海上运输、海上起吊、海上安装等工作，形成了一套完整的水下采油树安装技术体系。

Field 油田	LH29-1 Oilfield 流花29-1油田	LH16-2 Oilfield 流花16-2油田
SPS Count. 水下采油树数量	7 Sets 7套	26 Sets 26套
Water Depth 水深	520m-1120m	390m-420m
Vessel 作业船舶	HYSY285	HYSY285, HYSY287
Tree Type 采油树类型	No PGB, no Protection Frame 无PGB、无防渔网水下采油树	PGB + Protection Frame PGB+防渔网水下采油树
Supplier 采油树供应商	Cameron	TPFMC



SURF安装 SURF Installation

Umbilical T&I 脐带缆T&I

- Platform terminal umbilical 平台终端脐带缆
- Dynamic umbilical 动态脐带缆
- Subsea terminal umbilical 水下终端脐带缆

- The longest laying distance : **39.5km**
最长铺设记录
- Max. water depth: **1,500m**
最大铺设水深

Flexible Pipe T&I 软管T&I

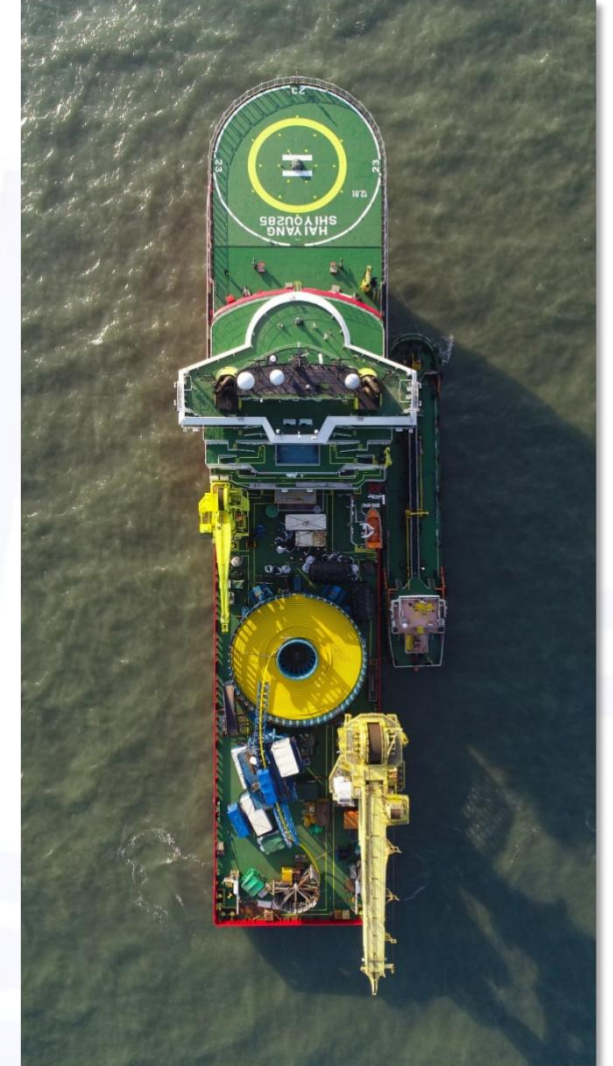
- Dynamic riser 动态立管
- Static flexible pipes 静态柔性管缆
- Flexible jumper\flexible spool 柔性跨接管/膨胀弯

- Max. diameter & WD (dynamic): **491.8mm & 420m**
最大管径与水深记录 (动态)
- Max. diameter & WD (static): **531.5mm & 1,500m**
最大管径与水深记录 (静态)

Submarine Cable T&I 电缆T&I

- Cable between platforms 平台间电缆
- Dynamic cable 动态电缆
- Wind farm cable 海上风机电缆

- Longest laying distance (single cable): **55.2km**
最长铺设记录(单条电缆)
- Max. water depth: **1,500m**
最大铺设水深



管缆铺设设备 SURF Installation



Vertical Lay System (VLS) 垂直软铺系统

- Maximum Line Tension: 325t
最大张紧力：325吨

Flex-lay Equipment 柔性管缆铺设设备

- 1 x 3,000t Carousel
3,000吨卷缆盘1套
- 1 x 2,500t Carousel
2,500吨卷缆盘1套
- 1 x 350t Real Hub Drive System (RHDS)
350吨滚筒驱动装置1套
- 1 x 100t Tensioner, 1 x 50t Tensioner
100/50吨张紧器各1台
- 3 x 15t Tensioner
15吨张紧器3台

预调试设备 Pre-commissioning Equipment

Subsea Flooding & Hydrotesting Module (SFHM)

深水水下清管试压模块

Maximum working depth 3,000m

Maximum testing pressure 700bar

Staged Orifice for stable flooding

4 kinds of chemical injection with total volume of 6m³

Different ways of data monitoring, recording and wireless transferring

最大作业水深3000米

最大试压压力700bar

多级节流设计，注入速度稳定可控

满足4种不同化学药剂同时注入，最大容量6m³

多种数据记录、传输模式，可连续记录数据30天



Deepwater Reel Intervention System

深水海管预调试水下连接系统

Maximum pipeline diameter 3.5-in, maximum length 2,000m

Maximum working pressure 6,900psi

Subsea emergency break-out device

On top emergency cutting device

Suitable for deepwater pipeline pre-commissioning operation

最大管径3.5"，最大长度2000米

最大工作压力6900psi

配备水下紧急自动断开装置

配备甲板应急切断装置

适用于深水海管清管试压排水干燥惰化作业

水下预调试与调试支持 Pre-commissioning & Commissioning

The largest pre-commissioning and commissioning contractor and the pre-commissioning contractor for most of pipeline projects in China. We are also the only contractor for deep water pipeline pre-commissioning and SPS commissioning.

The company independently developed the first set of Subsea Flooding & Hydrotesting Module (SFHM) and Large Bore Coil Tubing Unit specifically designed for deepwater pipeline pre-commissioning.

我们是中国最大的水下预调试和调试支持工程服务公司，同时也是全球第四家掌握模块化水下调试技术和核心装备的企业。

公司自主研发了国内首套专为深水（3000米水深级）管道预调试而设计的水下预调试模块（SFHM）和大口径盘管单元，可自主完成深水管道预调试和水下预调试模块的设计、制造及测试工作。



Pipeline Pre-commissioning 海管预调试

- Flooding, cleaning, gauging & hydrostatic testing 注水、清管、测径以及水压试验
- Dewatering, Glycol swabbing, drying and conditioning 排水、乙二醇扫线、干燥
- Nitrogen purging and packing 氮气惰化及封存

Umbilical Pre-commissioning 脐带缆预调试

- Hydraulic flushing and testing 液压冲洗及测试
- Electrical testing 电测试
- Fibre optic testing 光纤测试

SPS Commissioning 水下生产系统调试

- System Commissioning 系统联合调试
- Methanol replacement 甲醇置换



水下机器人 ROV

17 Deepwater ROV

2 x Observation Class 观察级

- Seaeye Panther Plus (50HP 1,000m)

2 x Work Class 工作级

- Venom (100HP 1,000m)
- Quark (75HP 1,000m)

13 x Heavy Work Class 重工作级

- 2 x Quantum Series (150HP 1,000m)
- 2 x Quantum Series (150HP 3,000m)
- 3 x Quantum MKII Series (200HP 3,000m)
- 2 x HD Series (150HP 3,000m)
- 2 x UHD Series (200HP 3,000m)
- 2 x TXLX Series (150HP 3,000m)



深水安装-潜水能力 Diving

Air Diving System

5 x conventional suit; 3 x Hot Water Suit
4 sets of IMCA certified equipment
1 x Wet Bell

Diving Team

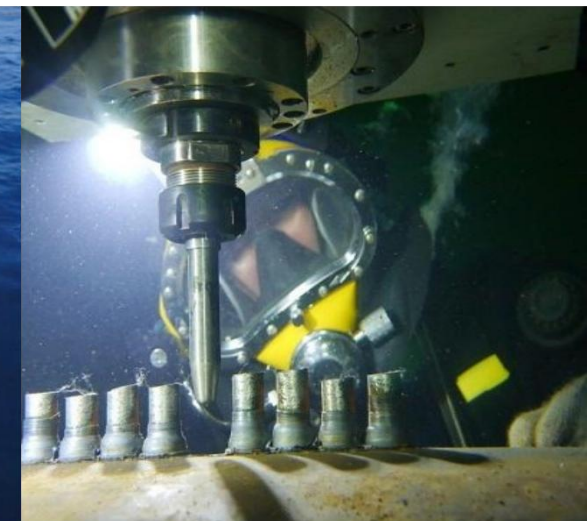
40+ ADCI/CCS certified divers

空气潜水系统

常规空气潜水设备5套; 热水服系统3套
IMCA潜水系统4套
开式钟1套

潜水员团队

ADCI/CCS认证各类专业潜水员40余人



300m Saturation Diving System

Diving bell for up to 3 persons
Maximum diving depth of 300m
DNV GL class
Living chamber for up to 12 persons
Self-launch ultra-high pressure evacuation system
Equipped with self-propelled high-pressure lifeboat

300米饱和潜水系统

3人潜水钟容量
最大工作水深300米
DNV GL级
容纳12人的居住区
自动启动的超高压疏散系统
配有自航式高压氧救生艇

Subsea Products and SURF

Liuhua29-1 Deepwater Gas Field Development Project

Client: CNOOC / Husky

Location: South China Sea

Water Depth: 750-1,200m

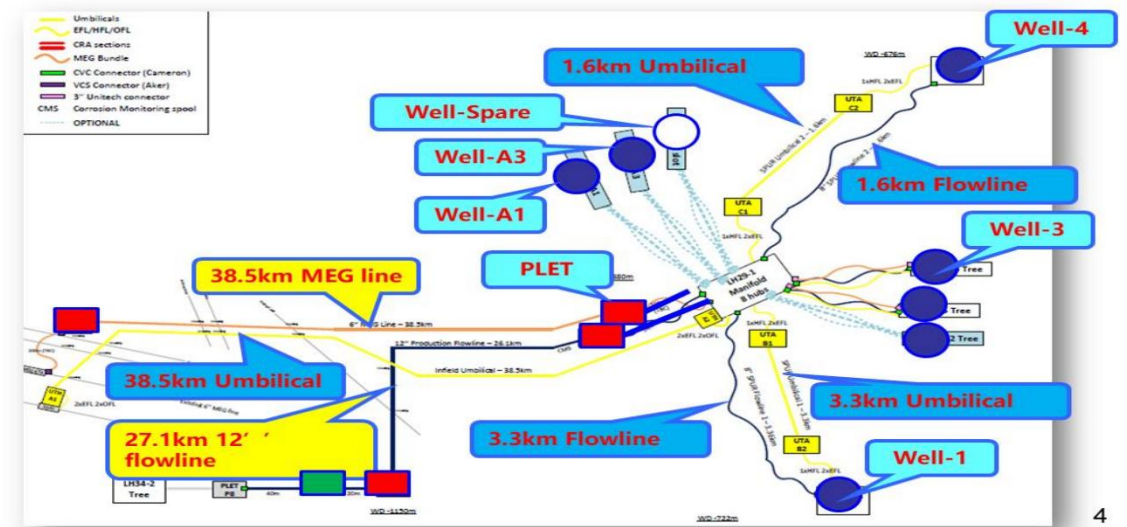
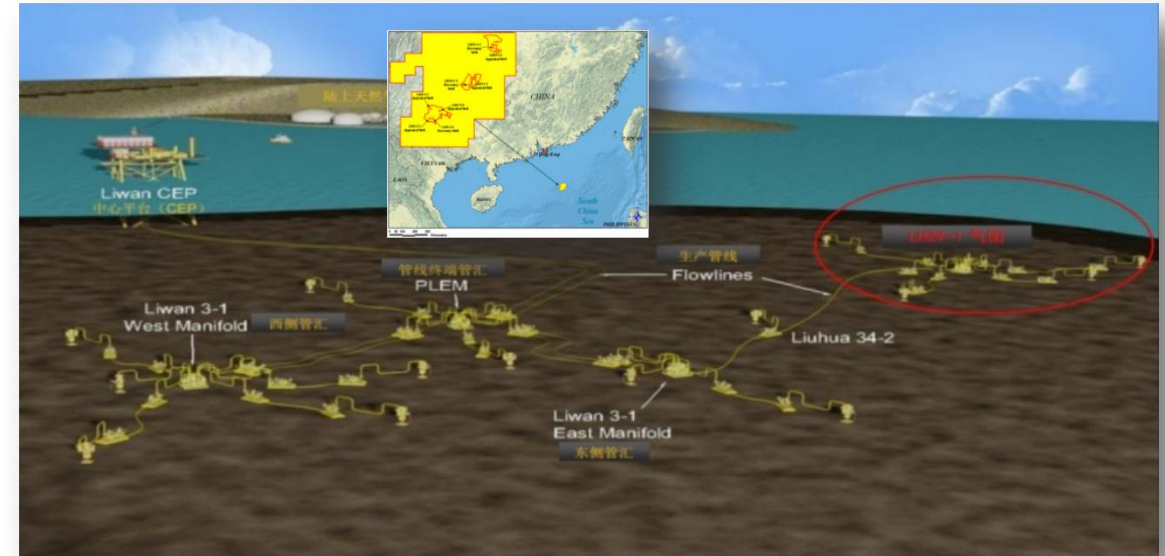
Schedule: 2018-2020

Scope of work:

- 7 x Subsea Production Tree, 1 x 12" gas pipeline (27.1km), 1 x 6" MEG pipeline (38.5km)
- 2 x 7" flexible pipeline (3.3km & 1.6km), 1 x main umbilical (38.5km), 2 x umbilical (3.3km & 1.6km)
- 1 x 200t manifold, 1 x 175t suction pile, 4 x PLETs
- 4 x spool, 5 x 7" flexible jumper, 1 x 5.5" MEG jumper
- 22 x EFL, 9 x MEG flying lead, 9 x HFL, 4 x fiber flying lead

Challenges:

- Internal corrosion control for the elevated temperature section;
- Route selection with local adjustment in rough areas;
- Reduction of pipelay tension in the deep-water section, especially during PLET installation.



Subsea Products and SURF

Deep Sea No.1 (Lingshui 17-2 Project)

Client: CNOOC

Location: South China Sea

Water Depth: 1,500m

SOW:

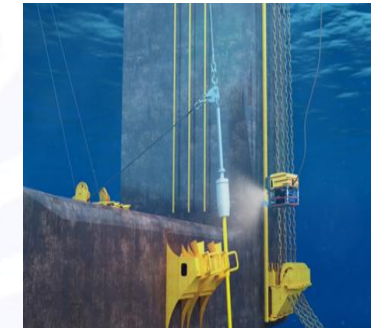
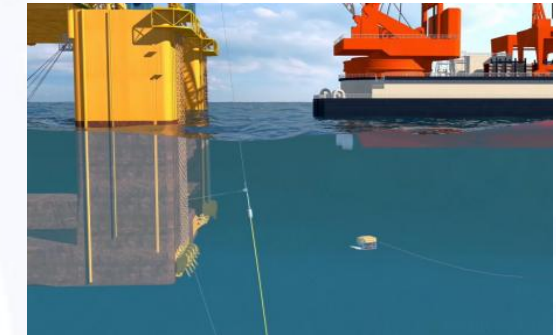
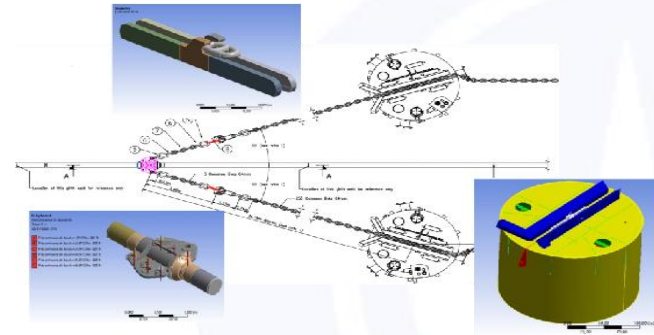
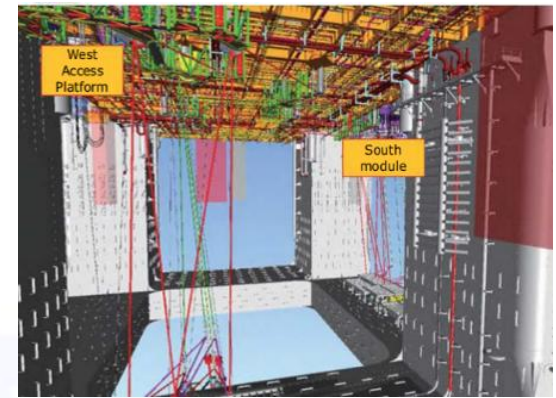
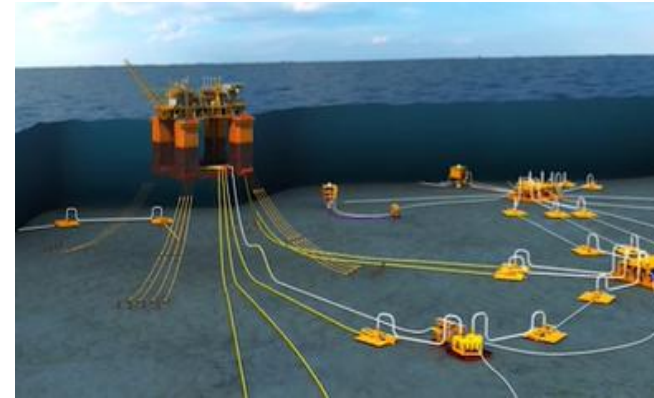
- SEMI: Hull + Topside
- 224km subsea pipelines
- 4 x manifolds, 25 x PLETs, 28 x jumpers
- 68.6km umbilical cables, 17.8km flexible pipelines and etc.

Major Challenges:

- Critical fatigue damage for SCRs
- Two keel-haul SCRs installation plan for personal safety consideration
- Floater offset induced large riser bottom tension and flowline movement
- SCRs pull-in design considering riser from multi-direction

Highlight

- **Fatigue improvement solution:** upset ends, pipe sorting etc
- Different types of **holdback systems** to mitigate excessive flowline movement
- An **integrated pull-in system** for SCRs tie-back
- A **comprehensive technical team** including global system, analysis, interface, hardware delivered and field situation evaluation.



Subsea Products and SURF

SHWE Project Phase 4 Development (FEED)

Client: **POSCO**
INTERNATIONAL

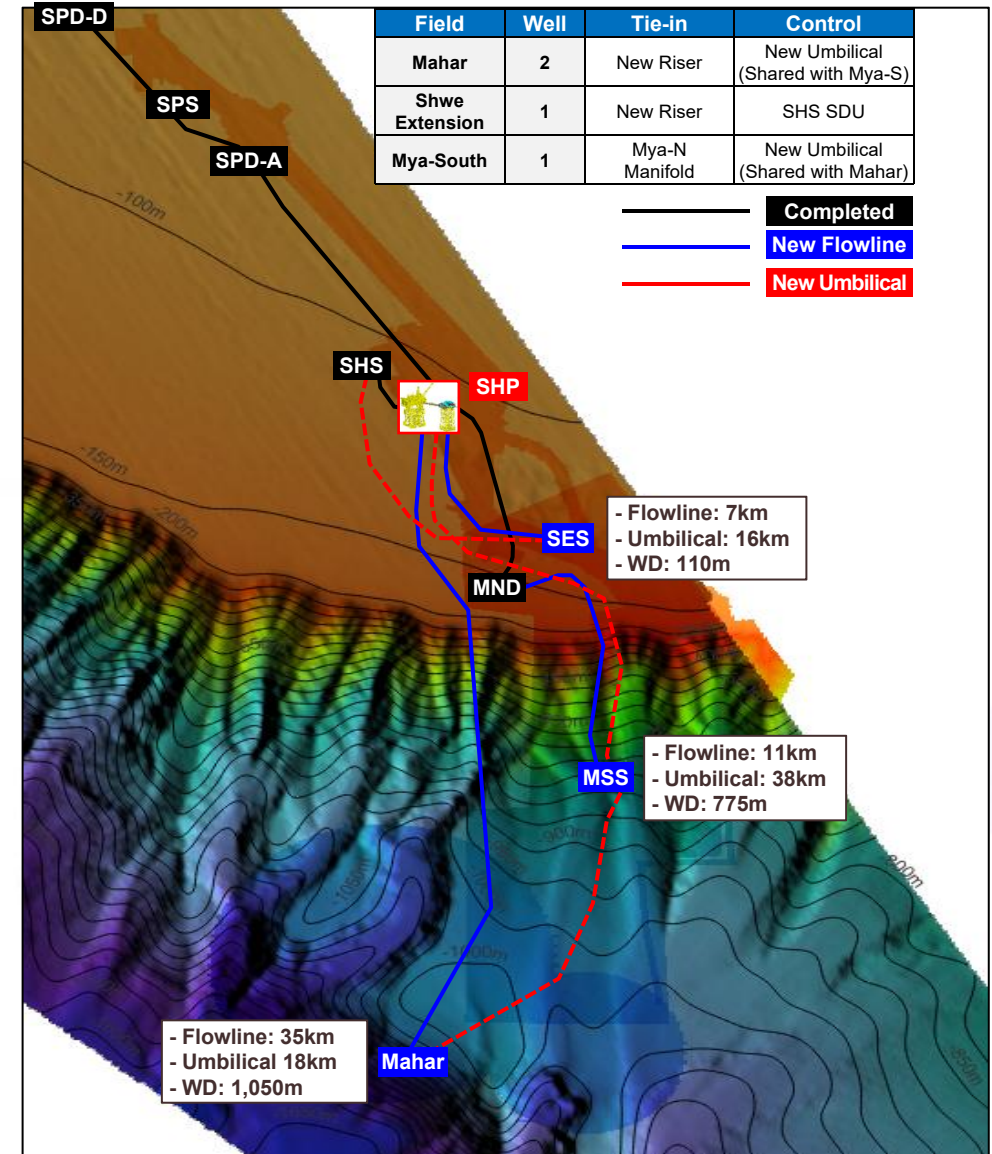
Location: Bay of Bengal Myanmar Water Depth: 110-1,050m

Scope of work:

- Three (3) in-field flowline tie back to existing platform and subsea structure, includes:
 - One (1) 12" x 35km (Mahar – SHP)
 - One (1) 10" x 7km (SES – SHP)
 - One (1) 8" x 11km (MSS – MNS)
- Three (3) main umbilicals for control and chemical injection, includes;
 - One (1) 23km (SHP – MSS)
 - One (1) 23km (MSS – Mahar)
 - One (1) 9.5km (SHS – SES)
- Four (4) well jumpers and thirteen (13) tie-in spools for connecting X-trees/manifolds/flowlines and risers.

Highlights and Challenges:

- Flowline's route cross the escarpment, the route selection to avoid potential geohazards, like faults, instability slope and anomalous soil conditions;
- Installation plan of Ladder-back risers (configuration with two risers with 130m of length connected by guides to a central spine);



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THANKS

谢谢

