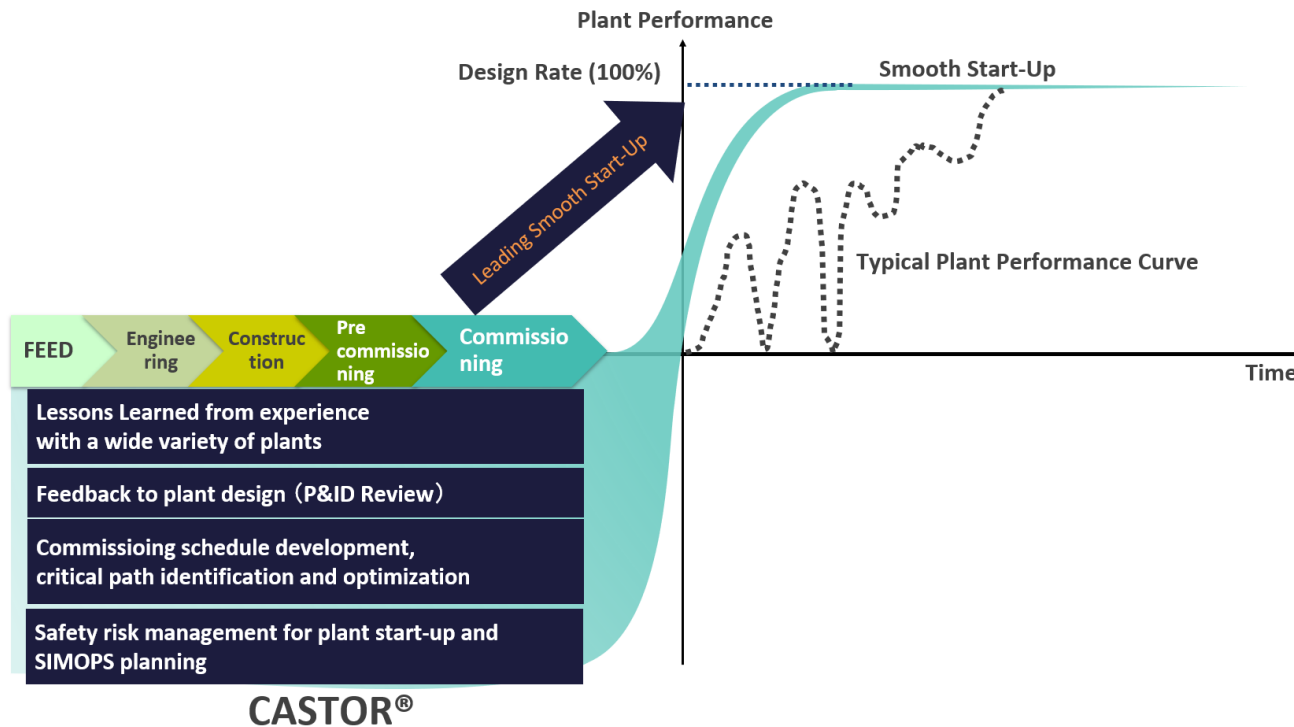


Commissioning & Startup

Our commissioning engineers are passionate about risk in commissioning and start-up management, and work closely with the client to create the optimized plan taking into account lessons learned and our knowledge from our many previous projects, aiming always to deliver the best commissioning and startup service



High-quality Planning Based on a Wealth of Experience

Return to
OE Service menu

Service Menu

◆ Predictable Start up Program

➡ [See the Detail of Predictable Start up](#)

CASTOR®
(Commissioning & Startup Transient Operability Review)

Commissioning Safety

Commissioning & Start-up for FLNG/FPSO/Module

Decarbonized Commissioning and Start up (Under Construction)

Recommissioning service (Restart) (Under Construction)

- Plant Condition Assessment
- Preservation planning

◆ Operations Readiness & Assurance Program

Operations Readiness & Assurance (OR&A)



Operational Excellence Services

Commissioning & Start-up Predictable Start up



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Predictable Start up

Do you have any of these issues?

- ☹️ **Reliability of current Commissioning Plan**
- ☹️ **Lack of experience in planning**
- ☹️ **Unfamiliar equipment/unit**
- ☹️ **Resource for unfamiliar countries**



Our Solution

Provide consultation, recommendations and/or improvements for the following items on the following plans/topics:

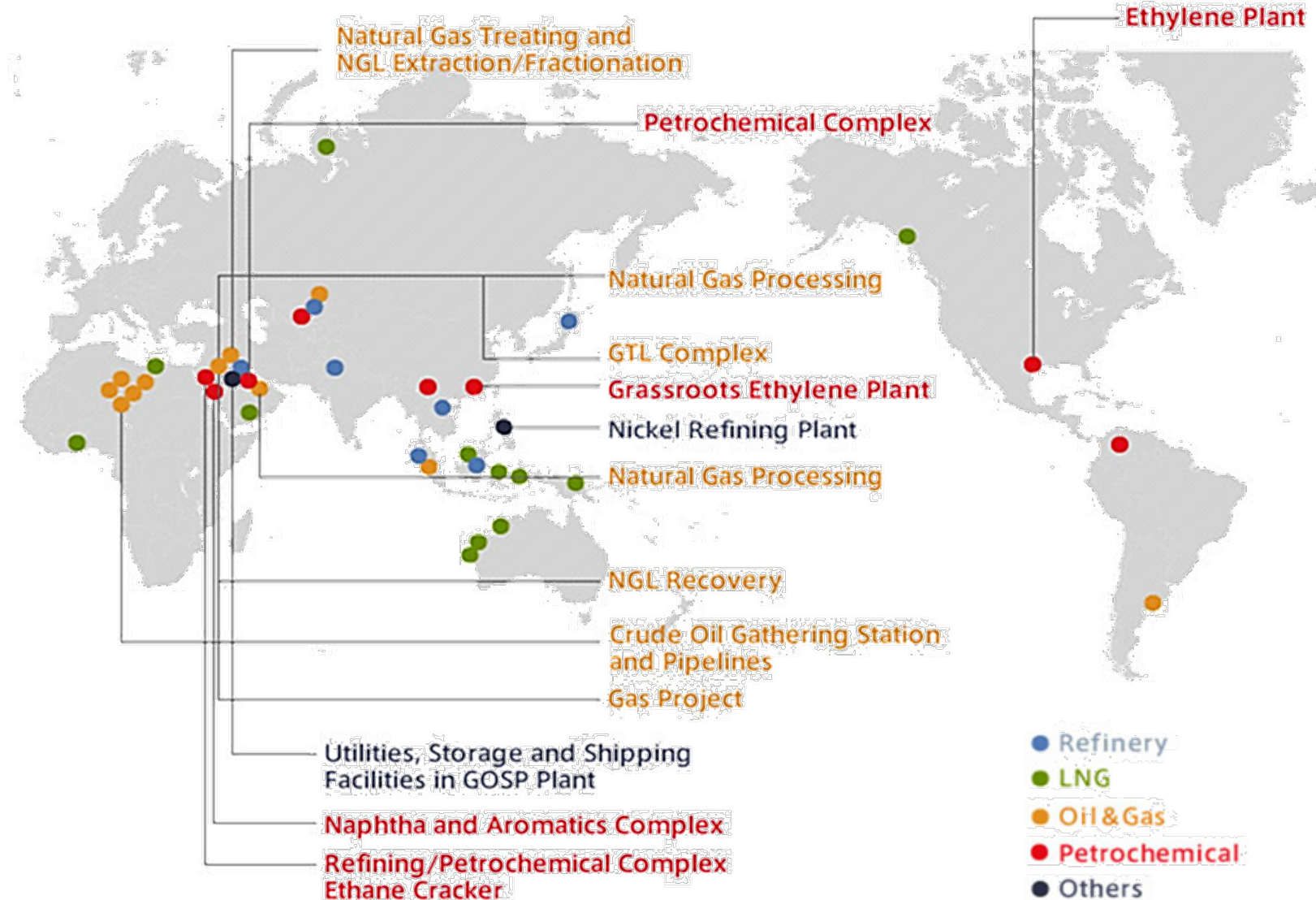
- **Commissioning HSE Plan**
- Commissioning Execution Plan
- **Plan and/or procedure with CASTOR®**
- Completion Plan includes Systemization and/or RFSU Blocks
- **Commissioning & Start-up for FLNG/FPSO/Module**
- Design/Engineering Considerations
- Benchmark Schedule and/or manning against projects completed
- Contractor Strategy (SOW, Technical evaluation, Selection)
- Identifying Commissioning Risks and Mitigation

Predictable Start up

[Return to Commissioning & Startup menu](#) 

Our Strengths and Experiences

Extensive experience in commissioning of refinery, LNG, Gas and petrochemical plants for a variety of clients around the world.





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Commissioning & Start-up CASTOR



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CASTOR[®] (Commissioning and Start-up Transient Operability Review)

Do you have any of these issues?

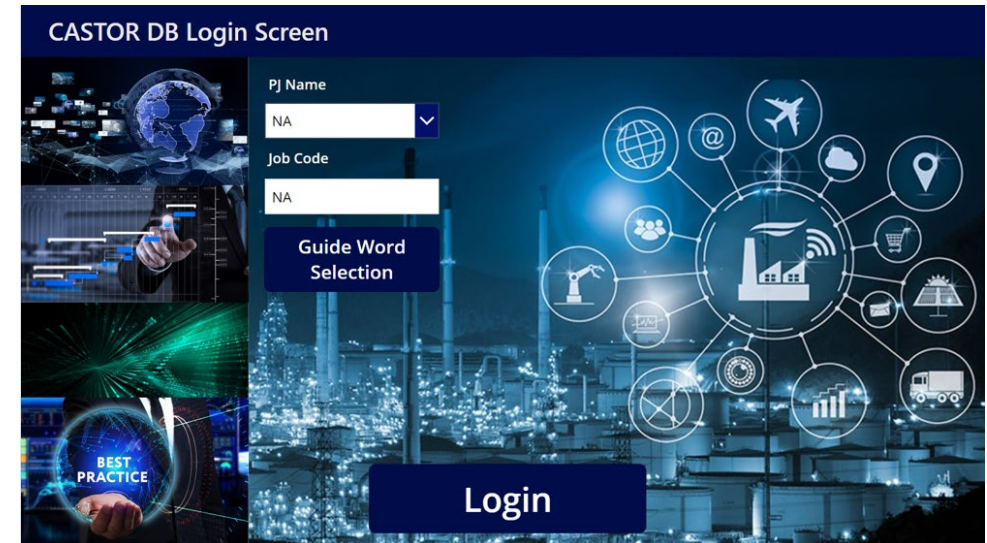
- ☹️ **Concerns on Commissioning and Start-up Plan**
- ☹️ **Lack of (or No) Experience in Plant Start-up**
- ☹️ **Introduction of Unfamiliar Equipment/Unit**

Start-up Scenarios	Failure Scenarios	Startup modes	Start-up issues	Special modes	Special Production Modes	Non-regular/Temporary Modes	Special Scenarios	Commissioning, Tests / Modes	Commissioning, Tests / Modes	Start-up Tests / Modes
Embrittlement/Low temperature	Main process trips	Cat activation	Thermal expansion/contract	Recycle modes	Product Load mode	Recycle modes	Equipment internal (heat/strains)	Equipment internal (heat/strains)	Equipment internal (heat/strains)	Unfamiliar parts tightness test
Over temperature	Main compr trips	Cat re-activation	Controls on manual	Flux removal (jet-oil bath)	Product hold mode	Recycle modes	Heavy rain/snow	ESD/TSD valve leak test	ESD/TSD valve leak test	Blowdown tests on compressor
Overfill	Loss of contain. Leaks (single/phase)	Cat regen	Heavy rain/snow	Flux removal - H2 H2 catalyst	Other feed flow Modes	Product hold mode (static)	Chrysol mode (static)	Chrysol mode / min firing mode	Chrysol mode / min firing mode	Pumps tests not able to test on bench test
Over pressure	Internal leaks/drops (e.g. tube/sheet)	Reactor switch	Tidal/Waves/Move	Catalyst mode	Other feed quality Modes	Other feed flow Modes	Chrysol mode	Chrysol mode	Chrysol mode	Turbo expander tests
Back flow	Feed equipment failure (over/under/pressure/loss)	Cat Circulation	Cyclone/bast storm	Drying & reduction mode	Equipment bypass / trickle mode	Equipment bypass / trickle mode	Firing modes	Firing modes	Firing modes	Compressor tests not able to test on bench test
Vapour breakthrough	Instrument failure	Coating/Decoating	CS2 water / Water/Inertion	Blowdown leave heating / cooling	Batch operation	Batch operation	Depressure down mode	Depressure down mode	Depressure down mode	Equipment test not able to test on bench test
Vacuum filling/emphying	Internal failure	Shipping	Day-Night swing	Regen. Mode	Regen. Mode	Regen. Mode	Offspec. modes	Offspec. modes	Offspec. modes	DM tests
Fertilizer/Ammonia	Falling (Pb)oxide	Cat make up/bast	Human error	Steam out mode	Online flushing / clean modes	Online flushing / clean modes	Flushing mode	Flushing mode	Flushing mode	Measuring tests
Impurity/oxide issues/Break through	Cracking (oxidative thermal, stress, etc.)	Offspec Reactor modes (C modes)	Competence	Depressure/down modes	Specific Maint. Modes	Specific Maint. Modes	Test modes e.g. H2/CS2/NO2 test	Test modes e.g. H2/CS2/NO2 test	Test modes e.g. H2/CS2/NO2 test	ESD trip tests
Offspec. product	Fatigue	RW (Catalytic reaction / run away / pre-heat etc.)	PP's	Start-up	Start-up	Start-up	Manual modes	Manual modes	Manual modes	ESD trip tests
Composition different	Loss of NO	Start-up	Start-up	Start-up	Start-up	Start-up	Manual modes	Manual modes	Manual modes	ESD trip tests
Hydrate/Freeze-out/Up	Loss of heating	CO2 Flare/ignition	CO2 issues (e.g. blockage/leak/through)	CO2 issues (e.g. blockage/leak/through)	CO2 issues (e.g. blockage/leak/through)	CO2 issues (e.g. blockage/leak/through)	CO2 issues (e.g. blockage/leak/through)	CO2 issues (e.g. blockage/leak/through)	CO2 issues (e.g. blockage/leak/through)	ESD trip tests
Water explosion	Loss of cooling	Backflow issues	Backflow issues	Backflow issues	Backflow issues	Backflow issues	Backflow issues	Backflow issues	Backflow issues	ESD trip tests
CO2 ingress (e.g. vacuum, back flow)	Loss of steam	Incompatible components	Incompatible components	Incompatible components	Incompatible components	Incompatible components	Incompatible components	Incompatible components	Incompatible components	ESD trip tests
pH issues (strainer)	Loss of FG	Cat plugging	Cat plugging	Cat plugging	Cat plugging	Cat plugging	Cat plugging	Cat plugging	Cat plugging	ESD trip tests
Solid Polymer/Plugging/Sluggs	Loss of water	Cat Regen issues	Cat Regen issues	Cat Regen issues	Cat Regen issues	Cat Regen issues	Cat Regen issues	Cat Regen issues	Cat Regen issues	ESD trip tests
Thermal Stress/Decompost	Loss of chemicals	Unplanned side reactions	Unplanned side reactions	Unplanned side reactions	Unplanned side reactions	Unplanned side reactions	Unplanned side reactions	Unplanned side reactions	Unplanned side reactions	ESD trip tests
Reactor being start-up (e.g. below the roof)	Loss of air	Reaction conv. Loss	Reaction conv. Loss	Reaction conv. Loss	Reaction conv. Loss	Reaction conv. Loss	Reaction conv. Loss	Reaction conv. Loss	Reaction conv. Loss	ESD trip tests
Flaring	Loss of H2/CO	Cat deactivation	Cat deactivation	Cat deactivation	Cat deactivation	Cat deactivation	Cat deactivation	Cat deactivation	Cat deactivation	ESD trip tests
Overpressure (spark)	Loss of product(s)	CO2 issues	CO2 issues	CO2 issues	CO2 issues	CO2 issues	CO2 issues	CO2 issues	CO2 issues	ESD trip tests
Passing RV	Loss of Power	RV design for upset cases	RV design for upset cases	RV design for upset cases	RV design for upset cases	RV design for upset cases	RV design for upset cases	RV design for upset cases	RV design for upset cases	ESD trip tests
Prime issues (degad. cone)	Loss of Air	Catalyst within tested range	Catalyst within tested range	Catalyst within tested range	Catalyst within tested range	Catalyst within tested range	Catalyst within tested range	Catalyst within tested range	Catalyst within tested range	ESD trip tests
Foaming	Loss of H2	H2/CO	H2/CO	H2/CO	H2/CO	H2/CO	H2/CO	H2/CO	H2/CO	ESD trip tests
Liquid carry over	Loss of H2	Cat flow issues	Cat flow issues	Cat flow issues	Cat flow issues	Cat flow issues	Cat flow issues	Cat flow issues	Cat flow issues	ESD trip tests
Overrun noise/flow/plate	Loss of H2	Particle distribution issues	Particle distribution issues	Particle distribution issues	Particle distribution issues	Particle distribution issues	Particle distribution issues	Particle distribution issues	Particle distribution issues	ESD trip tests
Flaring	Loss of H2	Phase separation issues	Phase separation issues	Phase separation issues	Phase separation issues	Phase separation issues	Phase separation issues	Phase separation issues	Phase separation issues	ESD trip tests
Water/Steam / Fall	Loss of H2	Phase separation issues	Phase separation issues	Phase separation issues	Phase separation issues	Phase separation issues	Phase separation issues	Phase separation issues	Phase separation issues	ESD trip tests
Thermal expansion/contract	Loss of H2	Phase separation issues	Phase separation issues	Phase separation issues	Phase separation issues	Phase separation issues	Phase separation issues	Phase separation issues	Phase separation issues	ESD trip tests

CASTOR Guideword Template (General)

CASTOR[®] Solution

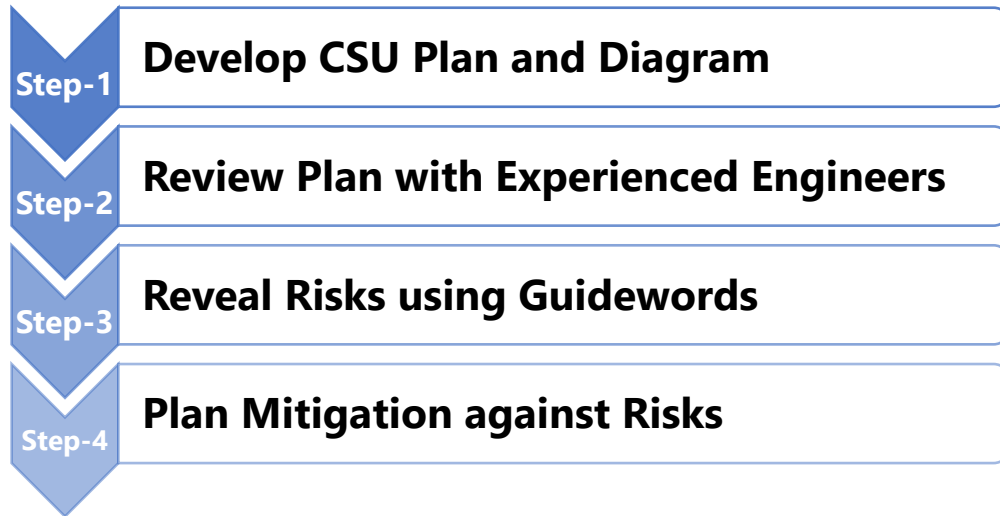
- Reveal risks during transient state operation at commissioning and initial start-up phase
- Plan mitigation actions against risks
- Increase likelihood of successful commissioning and plant start-up
- Minimize downtime due to trouble
- Eliminate risks of schedule delay



CASTOR Database

Workflow & Results

Workflow of CASTOR[®]



- Develop Commissioning and Start-up (CSU) Plan and Diagram
- Review CSU Plan and Diagram with highly experienced engineers
- Reveal risks related to transient operation during Commissioning and Start-up using Guidewords and experiences of engineers
- Plan mitigation actions against revealed risks
- Improvement of Operation Manuals, Procedures (SOP), Training Programs and updating of procedures for existing plants

Our Strengths

- Professional Process & Commissioning Engineer Teams
- World-class experiences and expertise in Plant Commissioning and Start-up as an EPC Contractor
- A wealth of Lessons Learned about Commissioning and Start-up
- Experiences in various types of plant like LNG, Refinery, NGL, GOSP, Floating LNG, Chemical, etc.

Our Experiences

- CASTOR[®] for LNG, NGL, GOSP, Floating LNG, Ethylene, etc.
- Not only for EPC but also for FEED projects
- Long history of start-up review as the predecessors of CASTOR[®] == > **CASTOR Database**



CASTOR[®]
Since 2015
7 Cases



Operational Excellence Services

Commissioning & Start-up Commissioning Safety



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Commissioning Safety

Do you have any of these issues?

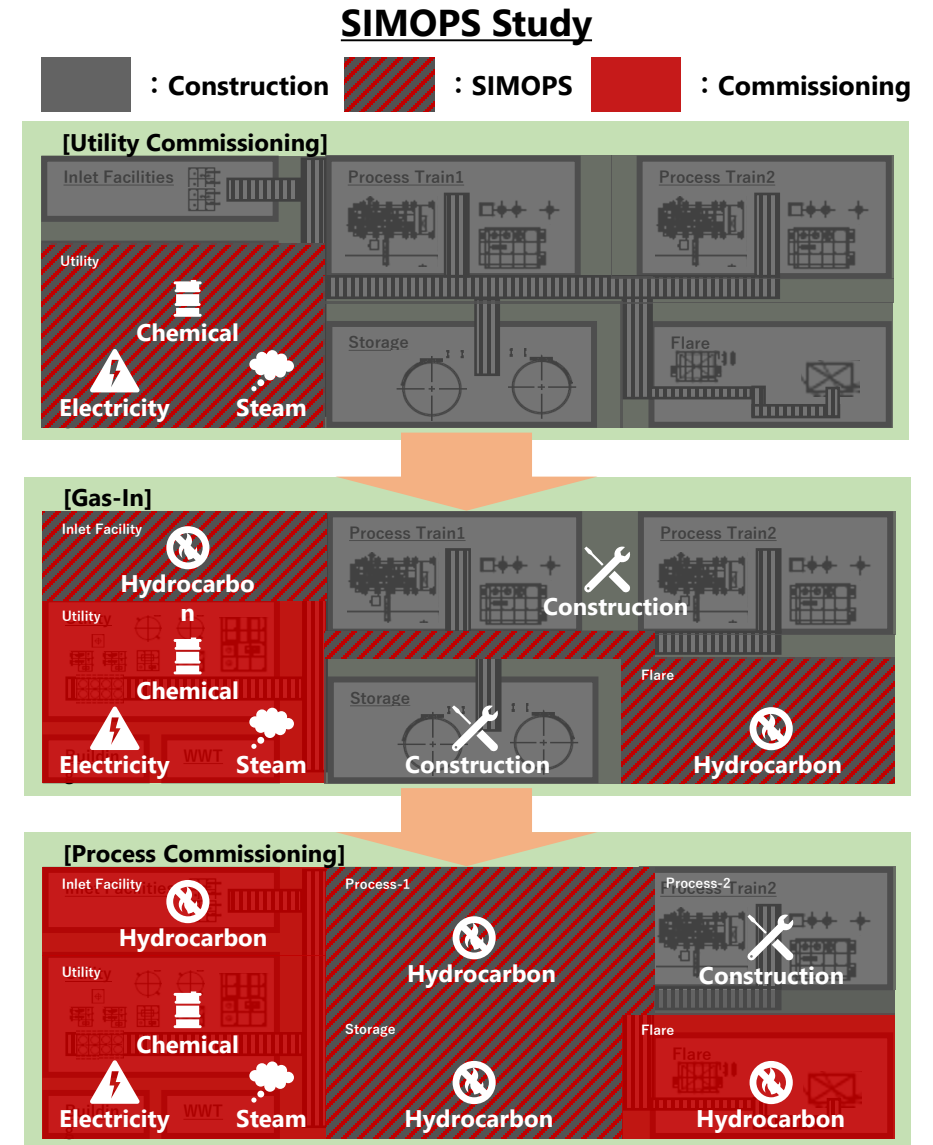
☹️ **Introduction of hazardous material in areas where construction is still in progress**

- ✓ **Electricity**
- ✓ **Chemicals**
- ✓ **Steam**
- ✓ **Hydrocarbon**

Our Solution

Provide consultation on the following plans/topics:

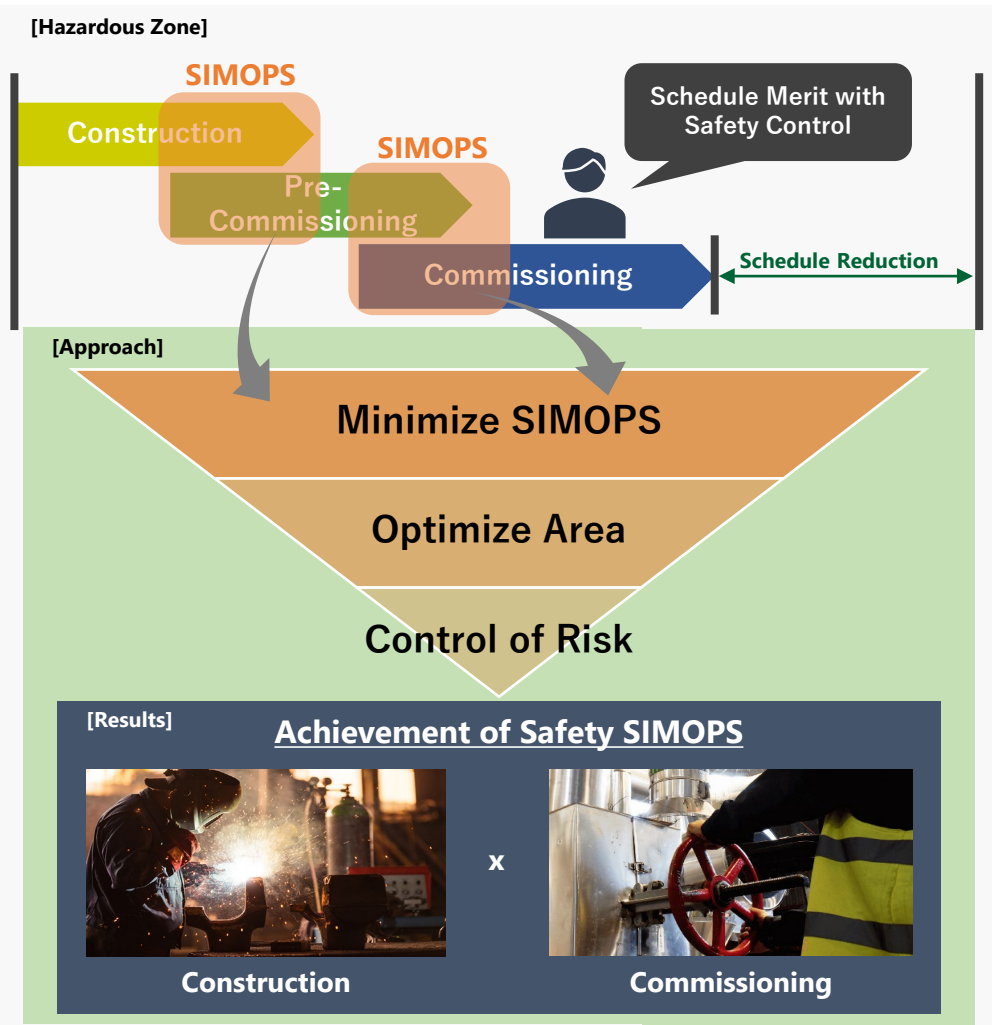
- Completion Plan
- Systemization
- Identify Safety Risks and Prepare Risk Mitigation (SIMOPS Study)
- Design/Engineering Considerations (Additional Isolations)
- QRA Study with Technical HSE Engineering



Commissioning Safety

Return to Commissioning & Startup menu 

Workflow & Result



Our Strengths

- Professional Process & Material Engineer Teams
- Top global results and performances on Degradation Assessment, Inspection Planning, On-site Inspection.
- Utilization of big data that integrates customer plant operating data and JGC design data to forecast future plants' needs
- Collaboration between overseas EPC-capable group companies and local maintenance companies.



Our Experiment

- CSU planning using system definitions since early 1990s
- SIMOPS study since early 2000s
- Continued to ensure commissioning safety in recent larger and more complex projects.



Operational Excellence Services

Commissioning & Start-up

Commissioning & Start-up for FLNG/FPSO/Module



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Commissioning & Start-up for FLNG/FPSO/Module

Do you have any of these issues?



What shall be conducted at each location??

- ✓ At Module Fabrication Yard
- ✓ At Shipyard / Onshore
- ✓ At Offshore (both Pre-RFSU and Post-RFSU)



What shall be prepared at each phase??

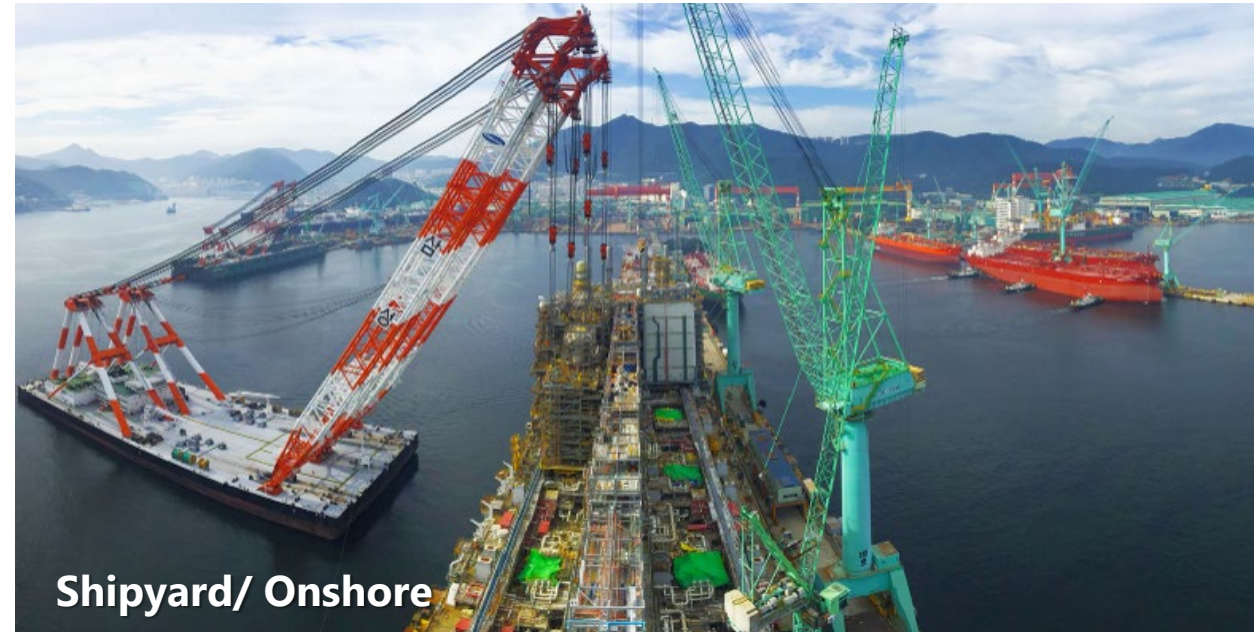
- ✓ Manning (POB Plan/ Flotel)
- ✓ Spare Parts/Special Tools/ Temporaries/Consumables
- ✓ Logistics/Onshore Base/Storage Area
- ✓ Start-up Procedure/Training, etc.

Solution based on actual FLNG EPCIC experiences



Provide consultation on the following topics:

- ✓ Project Completion Plan
- ✓ Design/Engineering Considerations
- ✓ Commissioning Execution Plan
- ✓ Start-up Plan, Procedure and Operator Training
- ✓ Manning including Offshore Training
- ✓ Logistics Strategy and/or Material Arrangement etc.



Commissioning & Start-up for FLNG/FPSO/Module

Return to
Commissioning &
Startup menu 

Workflow & Result

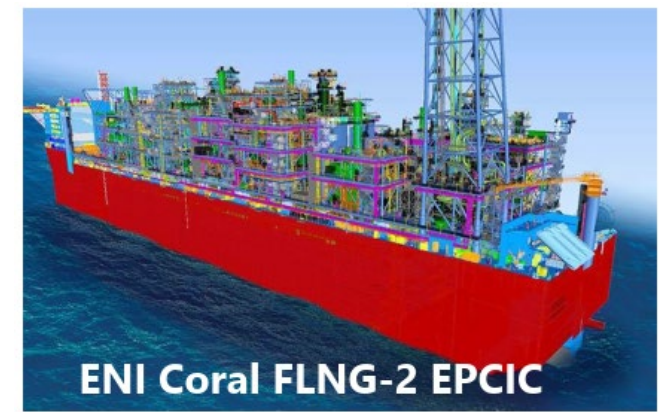


Our Strengths

We are one of leading companies for Modularized Project & FLNG and have several experiences of actual project execution.

- Executed several Modularized Projects for both Onshore and Offshore
- Accumulated know-how to work with Module Fab Yard and Shipyard
- Executed two (2) FLNG EPCIC Project (see below photos)
- Executed Construction Management and Completion Support Service for Prelude FLNG Project

Our Experiment





Operational Excellence Services

Commissioning & Start-up Operations Readiness & Assurance (OR&A)



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Operations Readiness & Assurance (OR&A) Program

Do you have any of these issues?

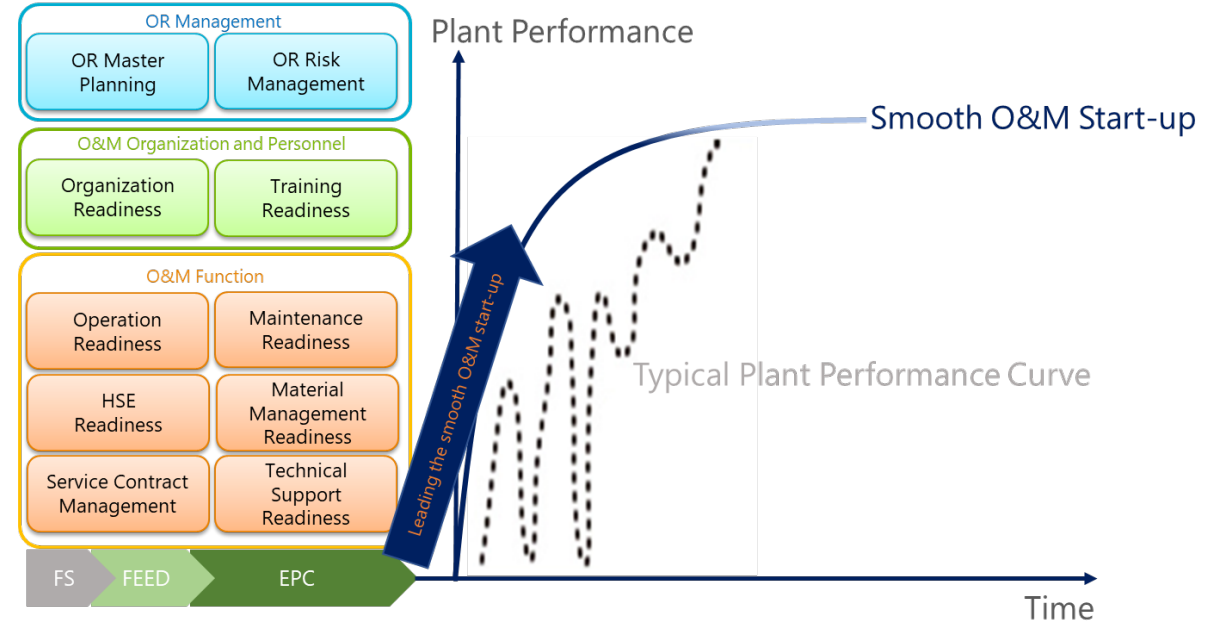
- ☹️ **Concern of safe and smooth start-up of O&M**
- ☹️ **High total cost of ownership**
- ☹️ **Potential areas of concerns and its mitigations in OR***

OR&A Solution

- Execute OR&A program for all OR key components of facilities** by expert team
- Assess OR plan and progress and reporting with findings and mitigations
- Follow up prioritized mitigation actions to reduce OR risk and to minimize the facility total cost of ownership

*OR : Operations Readiness

**facilities : Onshore and offshore O&G plant, chemical plant etc.



Operations Readiness & Assurance (OR&A) Program

Operations Readiness & Assurance (OR&A) Program

Return to Commissioning & Startup menu 

Workflow & Result

A) OR&A Planning Phase

1. Verification of overall OR schedule
2. Define OR elements
3. Establish OR progress and KPI tracking system

B) Assurance Phase

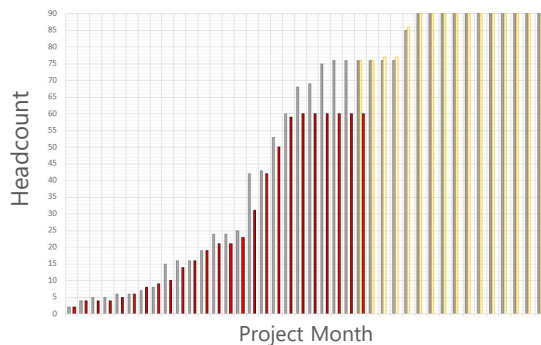
1. Monitor OR activities
2. Assess the progress and risk for OR activities (Health Check)
3. Report and follow up mitigation actions

Our Strengths

- Standardized OR&A program based on FLNG project
- Expert O&M engineers with experiences in operating companies
- Utilization of global project management experiences from over 20,000 FEED and EPC projects

Our Experiences

- OR&A program execution for FLNG O&M
- Operations audit for FPSO in West Africa
- O&M and Training readiness planning and execution for various EPC projects



Recruiting Progress Tracking

OR Components	Business Processes	Status	Plan	Forecast	Actual
Organization Readiness	Recruiting for O&M personnel	Completed	😊	😊	😊
Training Readiness	Competency Assessment	Completed	😊	😊	😊
HSE Readiness	PTW	Completed	😊	😊	😊
HSE Readiness	LOTO	In progress	😊	😊	😊
HSE Readiness	Emergency Response	In progress	😊	😊	😊
HSE Readiness	Spill Prevention	In progress	😊	😊	😊
HSE Readiness	Waste Management Plan	Not Started	😞	😊	😊
Operation Readiness	Production Reporting	Not Started	😞	😊	😊
Operation Readiness	Laboratry Analysis	In progress	😊	😊	😊
Operation Readiness	Crew Change	Completed	😊	😊	😊
Maintenance Readiness	Maintenance Management (Work Process)	Not Started	😊	😊	😊

Business Process Progress Tracking

Sample Progress and KPI tracking system