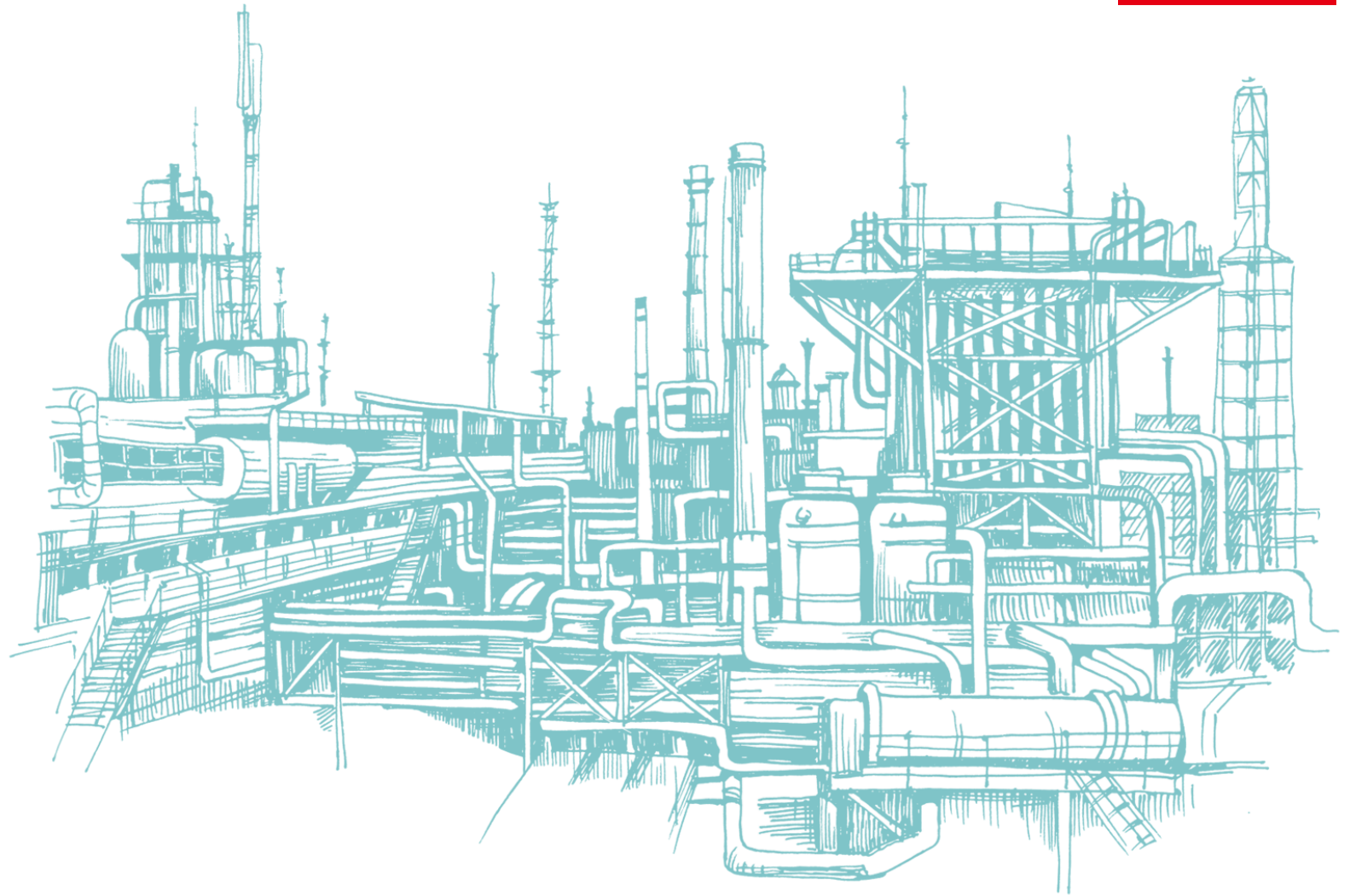




Operational Excellence Services

Services for
Operational Excellence



Long-term Partnering for Our Clients' **Business Success**

Clients' Expectations

For almost 100 years,
JGC has provided solutions
to meet the various
expectations of
plant owners.



Our Approach

JGC offers the highest quality services for your plant operations optimization to solve difficult problems and technical issues you confront.

Operation

- Maximize Profit
- Optimize OPEX
- Visualize Operations
- Perfect Operations Readiness
- Smooth & Safe Startup

Smart O&M Solutions

- Improve Efficiency through Digital Technology
- Utilize AI Power Combining Engineering Knowledge



Decarbonization

- Energy Saving in Operation
- Manage Life Cycle CO₂
- Quantify & Reduce GHG

HSE

- Manage Operational HSE Risk
- Optimize Fire Protection System
- Ensure Emergency Preparedness

Reliability & Maintenance

- Maximize Plant Availability
- Flawless and Smooth Turnaround
- Extend Plant Life

Our Operational Excellence Services Map

Operation

- ◆ Profitability Improvement Program
- ◆ Plant Operation Automation Program
- ◆ Operations Readiness & Assurance Program
- ◆ Predictable Startup Program

Smart O&M Solutions

- ◆ Maintenance Digital Twins Program
- ◆ Smart Turnaround Management Program
- ◆ Plant AI Smartification Program



Decarbonization

- ◆ Decarbonization Program

HSE

- ◆ Operational HSE Risk Management Program
- ◆ Fire Protection Improvement Program
- ◆ HSE Improvement Program
- ◆ Application for Risk-Based Process Safety

Reliability & Maintenance

- ◆ Mechanical Integrity Program
- ◆ Turnaround Assistance Program
- ◆ Maintenance Improvement Program

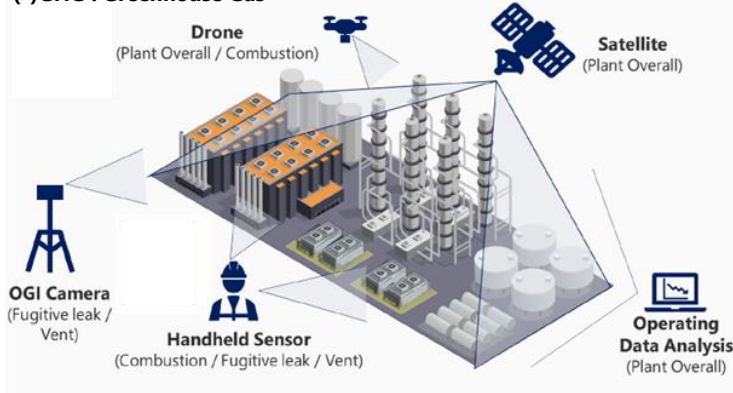
Technical Assistance & Training

- ◆ Technical Assistance Service
- ◆ Training Service

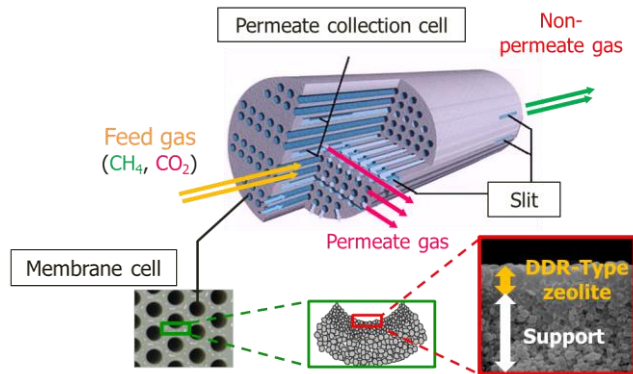
Decarbonization

JGC Group provides a large variety of Decarbonization Programs which are the proprietary GHG^(*)s assessment solution and optimized operation service based on our successful experiences in countless EPC & O&M fields.

(*)GHG : Greenhouse Gas

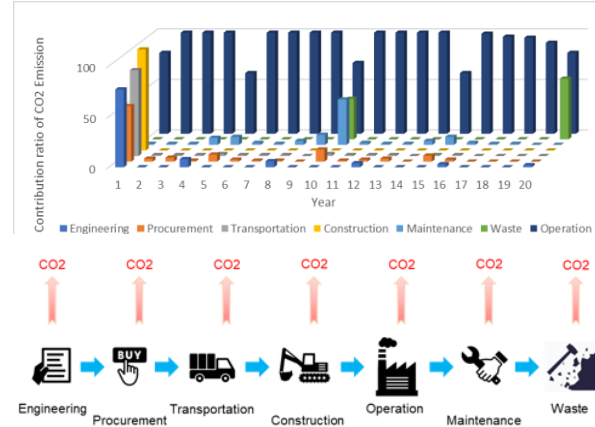


HiHGuard™(GHG Management Service)

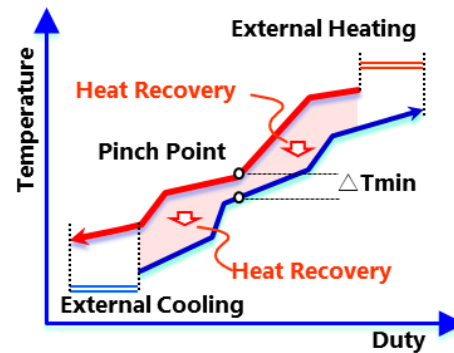


DDR^(*) Membrane (CO₂ Removal)
High Performance Separation Technology

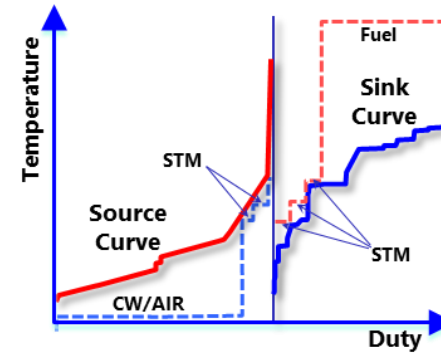
(*)DDR : Deca-Dodecasil 3R, A type of zeolite with a specific crystal structure



Life Cycle Assessment/Management (CO₂ Footprint)

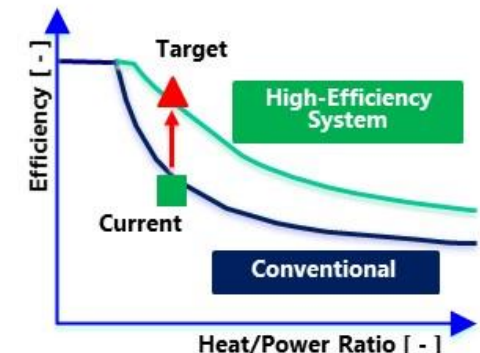


Energy Utilization and Optimization
of Heat Recovery System



Optimization of Site-Wide Energy
Usage

Energy Optimization-Pinch



Optimization of Power-Steam
Supply System

Service Menu

[Return to
OE Service menu](#)

◆ Decarbonization Program

HiHGuard™ (GHG Management Service)

Life Cycle Assessment / Management
(CO₂ Footprint)

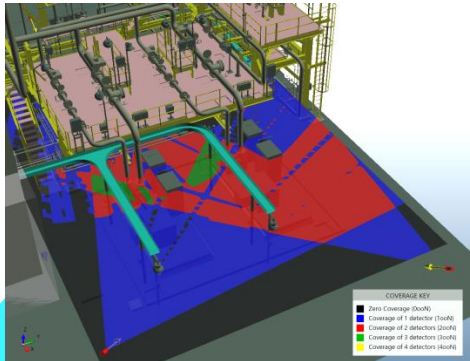
CO₂ Removal Solutions

Energy Optimization

Sustainable Combustion & Heating Optimization

HSE

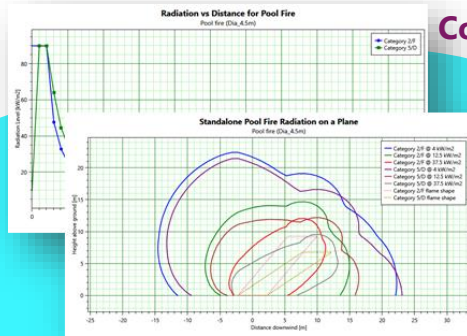
HSE services focus on systematic identification and evaluation of plant risks based on our long experience in on-site HSE and our own excellent evaluation methods, and on proposing systems that can ensure safe plant operation without major CAPEX.



Fire and Gas Mapping Study Technology



Quantitative Risk Analysis (QRA)



Fire Hazard Simulation

Consulting Service

Application Product



CoreSafety®

Service Menu

[Return to
OE Service menu](#)

◆ Operational HSE Risk Management Program

HSE Risk Management

- HAZID/HAZOP/SIL/LOPA (*) /Bow-tie
- Consequence Analysis/CFD/QRA
- Operational Hazard Reduction

◆ Fire Protection Improvement Program

Active Fire Protection Assessment

Fireproofing Assessment

Fire and Gas Assessment

◆ HSE Improvement Program

Escape Simulation and Assessment

Hazardous Area Classification (HAC) Optimization

Noise Assessment

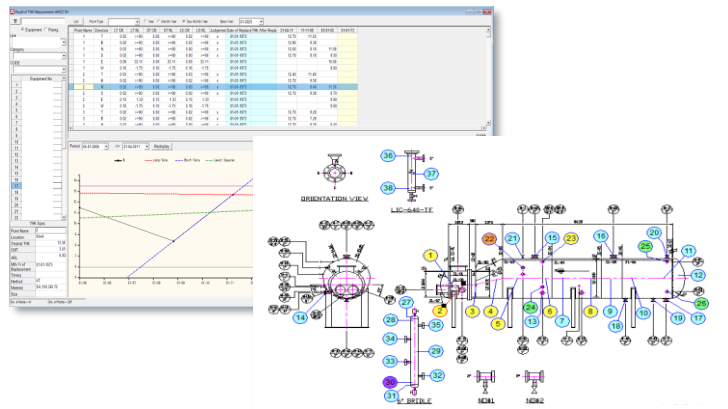
◆ Application for Risk-Based Process Safety

CoreSafety®

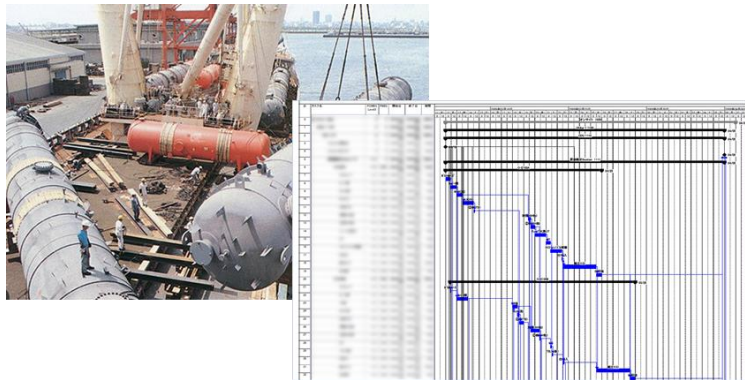
(*)HAZID : Hazard Identification Studies / HAZOP : Hazard and Operability Studies / SIL : Safety Integrity Level / LOPA : Layer of Protection Analysis

Reliability & Maintenance

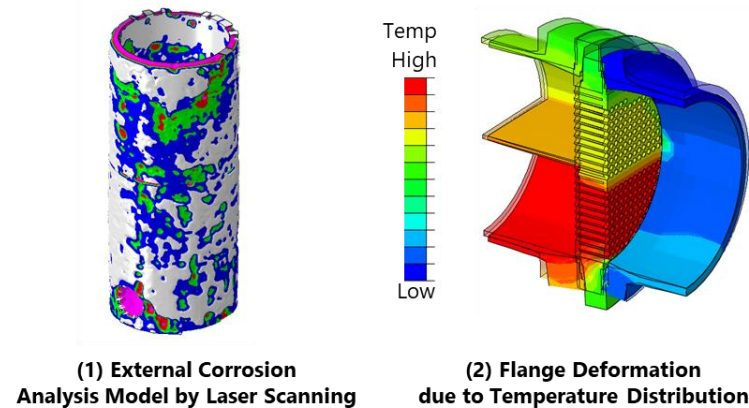
In addition to highly developed engineering technologies and the application of its safety management skills, JGC O&M service improves plant reliability, availability, and quality by collaborating with global affiliate companies and local maintenance companies.



Inspection Data Management System
A-MIS (Asset Integrity Management)



Maintenance Planning



Finite Element Analysis (FEA)



JGC Maintenance Team at LNG Plant

Service Menu

Return to
OE Service menu

◆ Mechanical Integrity Management Program

Risk-Based Inspection (RBI)

A-MIS (Asset Integrity Management)

Plant Life Extension Program (PLEP)

Plant Diagnosis and Lifetime Improvement Service

◆ Turnaround Assistance Program

Turnaround Scope Optimization & Planning

Turnaround Execution Management

Inspection & Diagnosis

◆ Maintenance Improvement Program

Reliability, Availability, Maintainability (RAM)

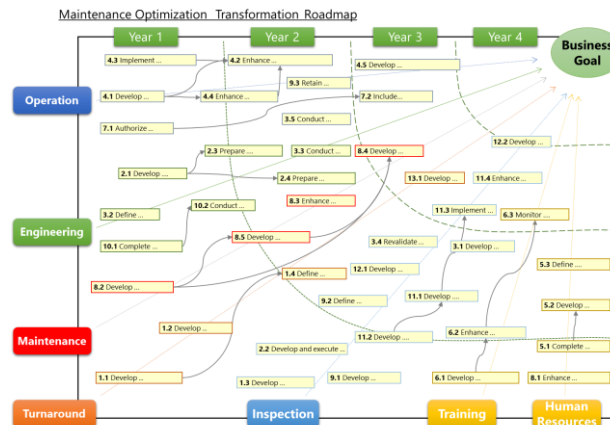
Reliability Centered Maintenance (RCM)

Technical Assistance & Training

Over the past several decades, JGC Group has conducted various engineer training programs and technical assistance programs at plant sites and remote locations. Many of our clients have achieved considerable improvements in their employee skills and plant operations which significantly contribute to the profitability and efficiency of their business.



Asset & Operation Management Framework



Strategic Maintenance Optimization Road Map



Onsite Assistance



Technical Seminars and Training Class

Service Menu

[Return to OE Service menu](#)

◆ Technical Assistance Service

Onsite Assistance (Residential/On-call)

Asset & Operation Due Diligence

OPEX Assessment

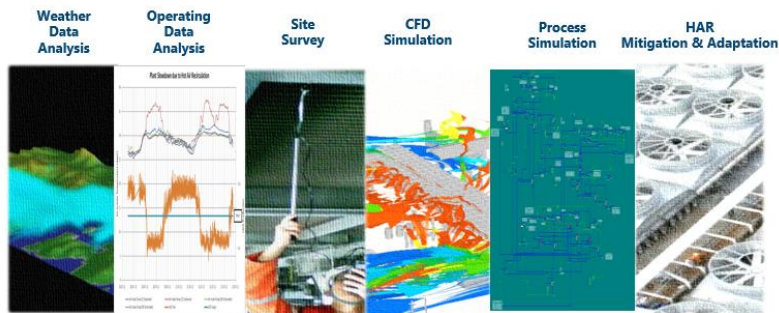
Strategic Operational Improvement Assistance

◆ Training Service

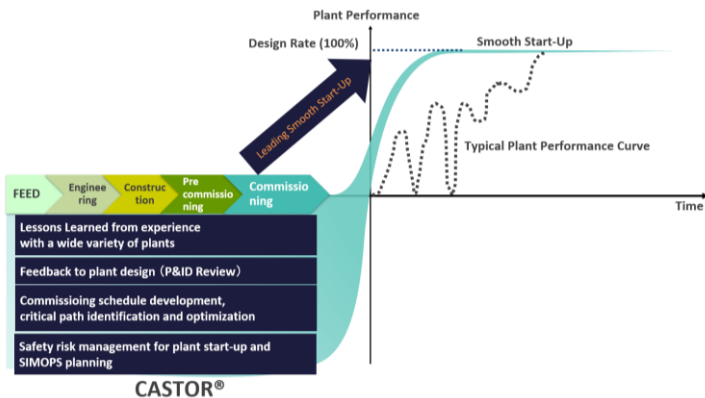
Training and Competency Management Services

Operation

Our engineers have a wealth of plant engineering experience and channel their expertise through cutting-edge engineering tools to provide profitability improvement services and plant automation program. Additionally, we provide expert consultations and recommendations for commissioning and startup, utilizing our extensive knowledge and experience from numerous EPC projects.



Key Activities of AIRLIZE LNG®



CASTOR®



High-quality Commissioning & Startup Planning Based on a Wealth of Experience

Service Menu

Return to
OE Service menu

◆ Profitability Improvement Program

LNG Cube (Engineering Consultation Service)

AIRLIZE LNG®
(Diagnoses services for HAR^(*) optimization)

◆ Plant Operation Automation Program

Automatics Operation

◆ Operations Readiness & Assurance Program

Operations Readiness & Assurance

◆ Predictable Startup Program [See Details](#)

CASTOR®
(Commissioning & Startup Transient
Operability Review)

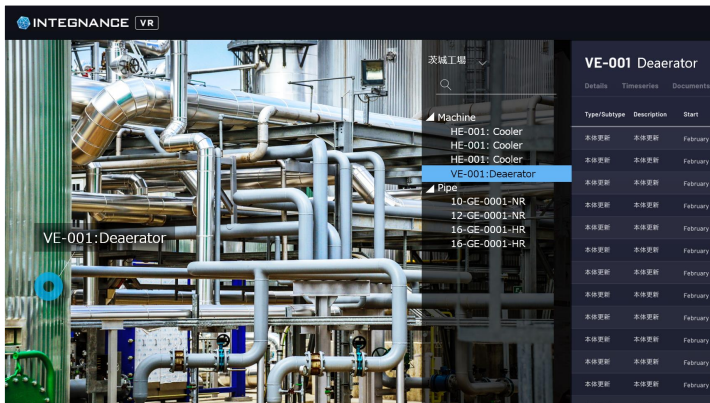
Commissioning Safety

Commissioning & Startup for
FLNG/FPSO/Module

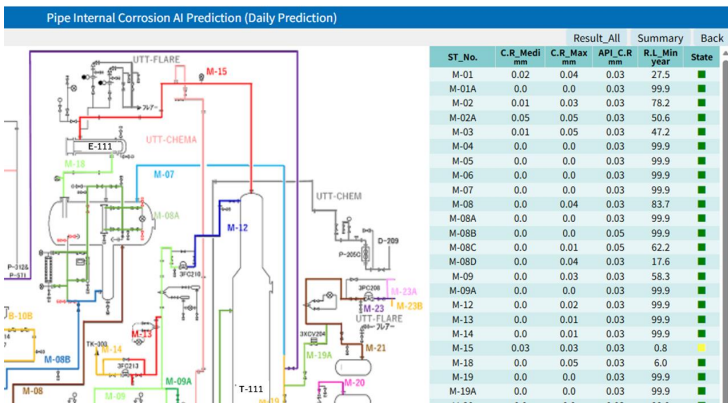
(*)HAR : Hot Air Recirculation

Smart O&M Solutions

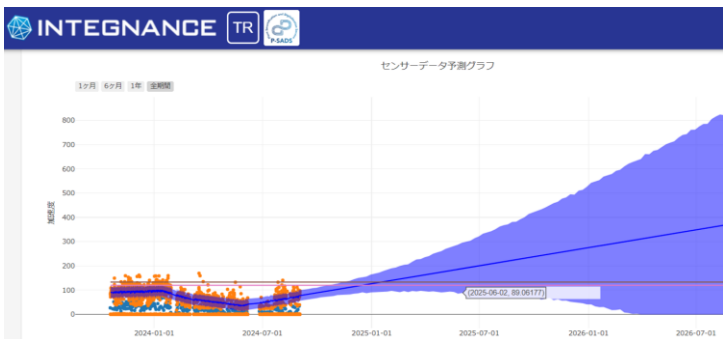
JGC has developed digital solutions utilizing its extensive knowledge and experience from long-term O&M support to achieve work efficiency, sustainable technical transitions, and less manned operations. Additionally, cutting-edge digital twin technologies accelerate the transition of your conventional operation and maintenance to the next stage.



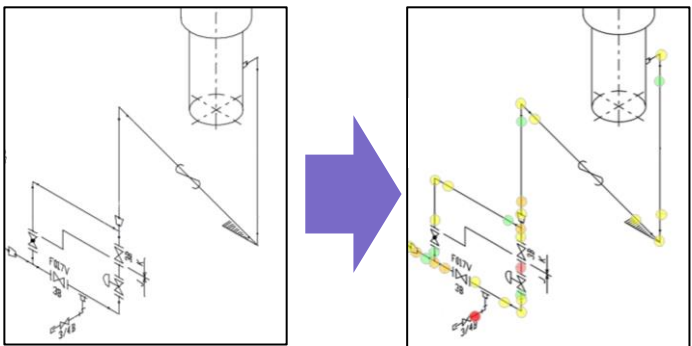
Fast Digital Twin Maintenance Viewer



Piping Remaining Life AI Prediction



Predicting Failure of Rotating Machinery



AI TML Assessment

- Return to
OE Service menu
- Service Menu
- ◆ Maintenance Digital Twins Program
 - INTEGNANCE VR
(Fast Digital Twin Maintenance Viewer)
 - ◆ Smart Turnaround Management Program
 - MODS - Connect
 - ◆ Plant AI Smartification Program
 - Piping Remaining Life AI Prediction
 - AI TML Assessment
 - INTEGNANCE TR
(Predicting Failure of Rotating Machinery)
 - Plant Smartification with AI Technology



Operational Excellence Services

Decarbonization HiHGuard® (GHG Management Service)

Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>



Do you have any of these issues?

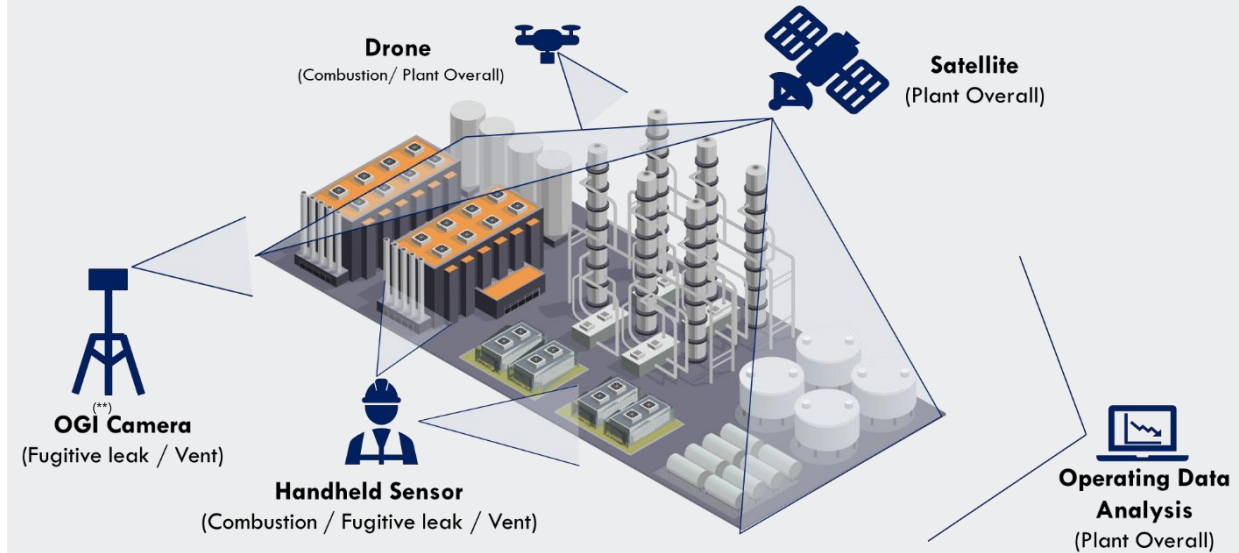
- ☹️ **Need to comply with EU Methane Regulation**
- ☹️ **Difficulty in quantifying CH₄ emissions**
- ☹️ **Need to quantify emissions in actual operation**
- ☹️ **Difficulty in selecting appropriate combinations of measurement technologies**

GHG Management Service

- Provide optimized MRV(*) methodology.
- Conduct actual measurement using drones, satellites, handheld sensors, IR cameras etc., and engineering calculation.
- Report GHG emission to the authorities.
- Provide technical consultation including Zero Routine Flaring (ZRF) study.

(*) MRV: Measurement, Reporting and Verification

Actual measurement



Technical evaluation



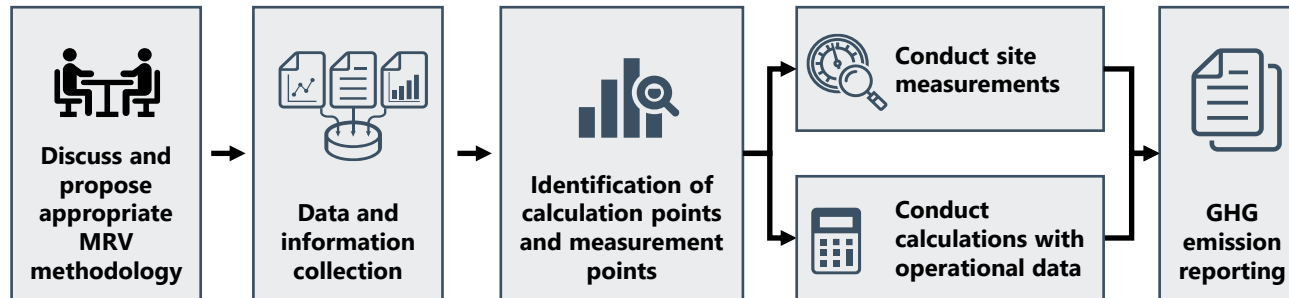
- ✓ Only company in Asia to evaluate methane quantification technology.

Technical consultation



- ✓ Zero routine flare (ZRF) study
- ✓ Operation optimization

Workflow & Results



Steps

- Discuss and propose appropriate combinations of measurement technologies.
- Identify measurement and calculation points based on design documents.
- Conduct engineering calculations and actual measurements.
- Report to client or government agency with preset format.

JGC is

- able to select the most appropriate MRV methodology from international organizations and standards/guidelines.
- familiar with a variety of plants and can provide the optimal combination of drones, satellites, and handheld sensors.

Our Strengths

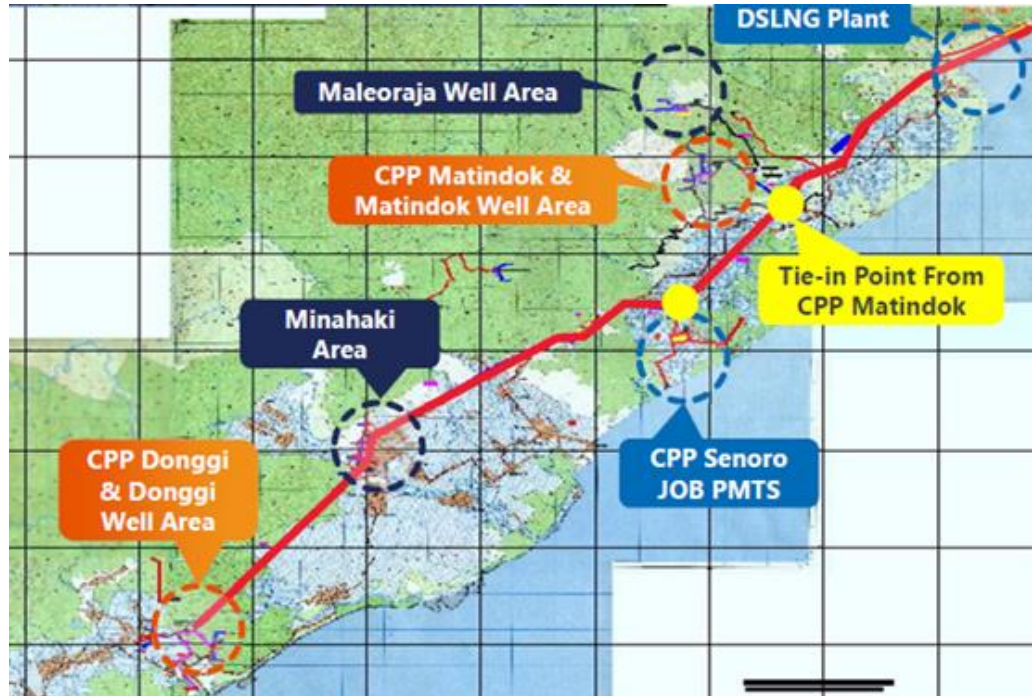
- The only company in Asia to evaluate methane quantification technology in own facilities (JGC METEC).
- Capability to reliably execute MRV based on the experience in EPC and O&M of many types of facilities in many locations around the world.
- Experience in MRV of many types of facilities in several countries.
- Professional HSE, Process, Mechanical Engineer Teams.

Our Background

- JGC has been commissioned by Japan Oil, Gas and Metals National Corporation (JOGMEC) to develop their guidelines.
- The Institute of Energy Economics, Japan (IEEJ) has contracted JGC as a technical adviser for GHG MRV

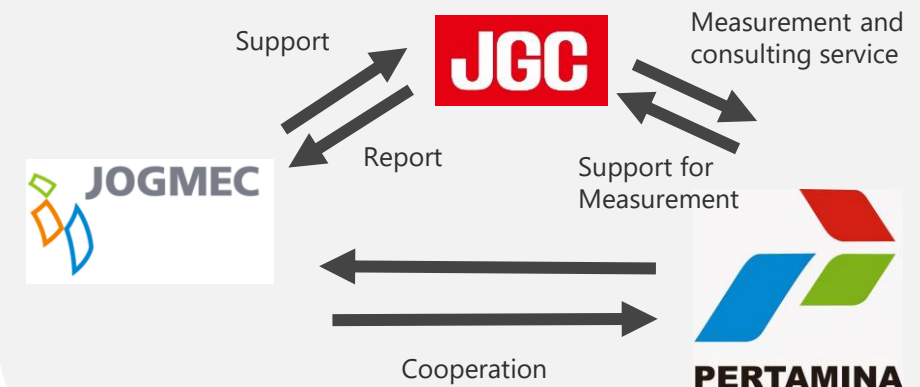
Project in Actual Plant

- JOGMEC/PERTAMINA/JGC completed **direct measurement** to quantify Methane emission in **natural gas production facilities**. (2024-2025)
- **Satellite / Drone / OGI Camera / Handheld Sensor** have been used in the project.
- Contribute to Pertamina's **Zero-Routine Flaring (ZRF)** targets through ZRF study.



Project Area Map

Project Formation



Feasibility Study for Southeast Asia METEC

- SEA METEC is a facility designed for LDAR training and the evaluation of measurement technologies, established by JOGMEC and PETRONAS.
- JGC conducted a feasibility study for SEA METEC based on its expertise from JGC METEC.
- JGC is supporting the establishment of SEA METEC.

(*) METEC: Methane Emissions Technology Evaluation Center

(**) LDAR: Leak Detection and Repair

(***)OGI: Optical Gas Imaging

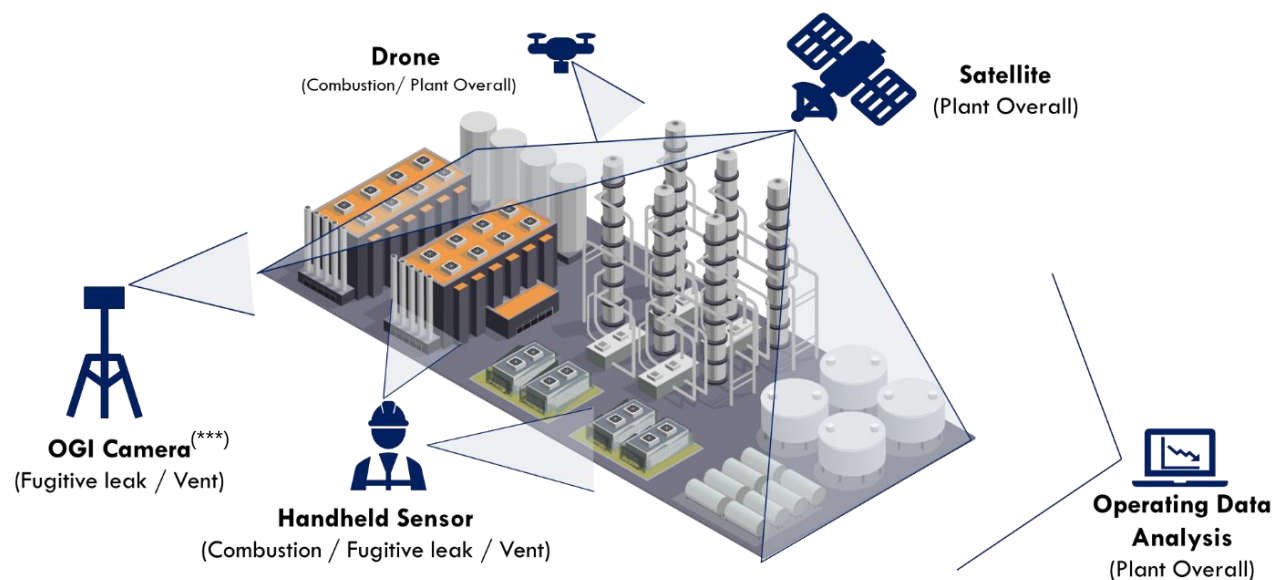


Image of on-site measurement



https://www.jogmec.go.jp/english/news/release/news_10_00076.html



Operational Excellence Services

Decarbonization Life Cycle Assessment/ Management (CO2 Footprint)



Contact Us

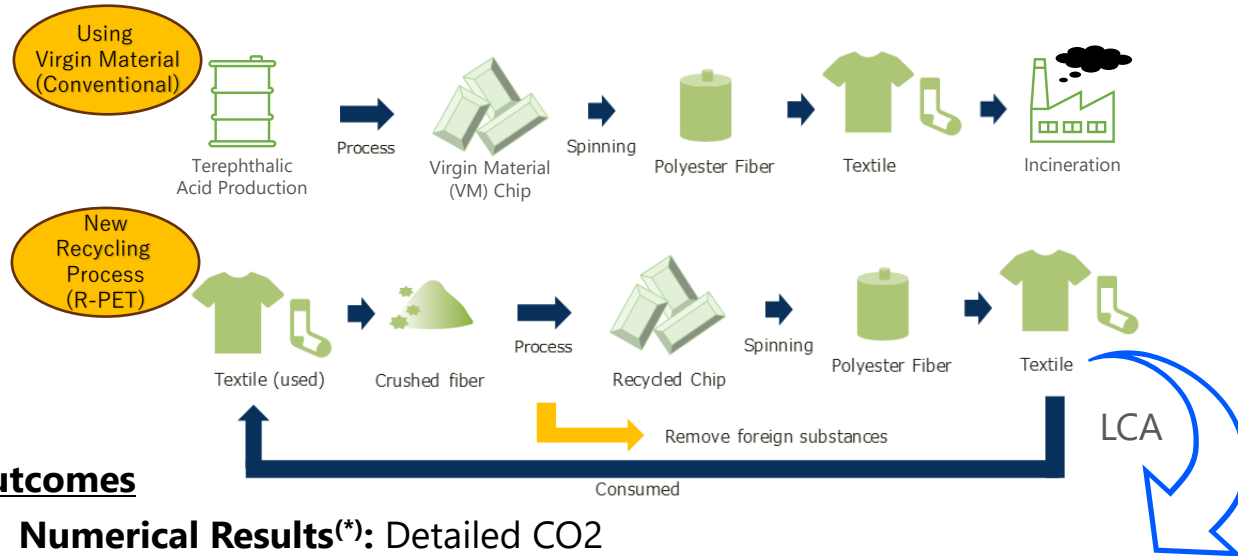
➡ [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

➡ <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

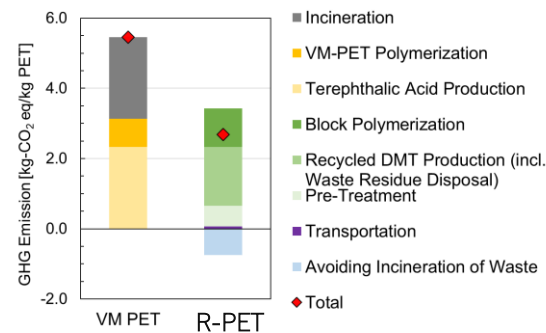
Life Cycle Assessment/Management (CO2 Footprint)

Case Study : LCA for New Recycling Technology



Outcomes

- **Numerical Results^(*):** Detailed CO2 emissions data for each process stage
- **Higher CO2 Reductions:** The new recycling process is expected to achieve significantly higher CO2 reductions compared to the conventional process
- **Visualization of Hot Spots:** Identification and visualization of high CO2 emission hot spots

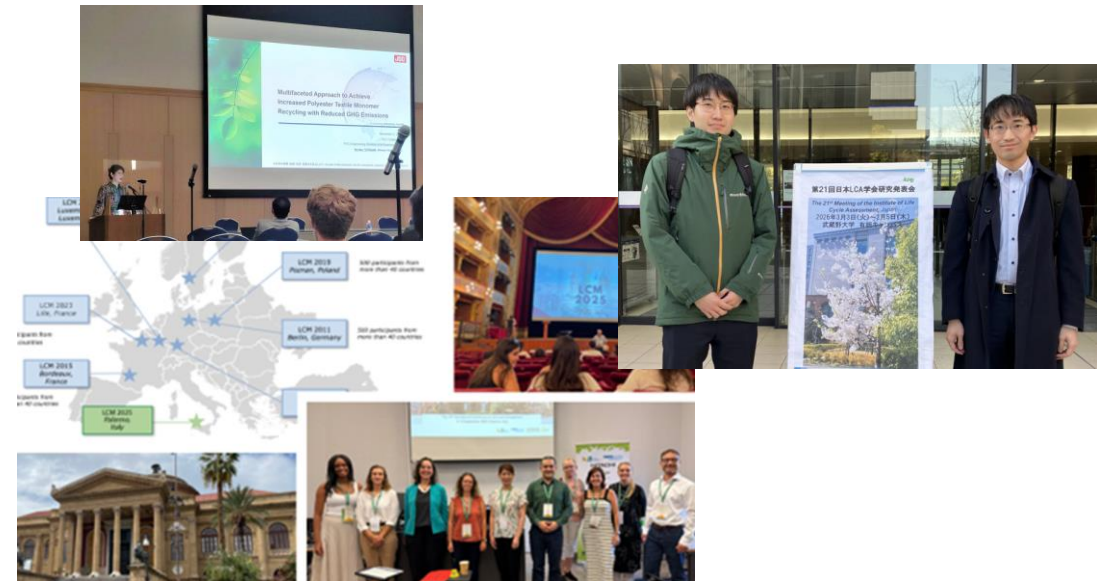


^(*)The scope of evaluation, methods, and assumptions that greatly affect the results, it depends on the implementers and companies

Achievements

Conference Participation:

- Presented at the Conferences (EcoBalance 2022/24, LCM 2023/25, the Society of Chemical Engineers, Japan 2026)
- Attended the 8th S-LCA Conference 2022 – Leave No One Behind –



CO2 Footprint Calculation:

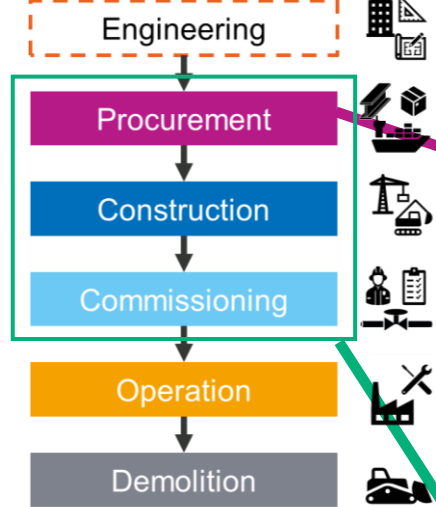
- Calculated CO2 footprint (Scope 1/2/3) for CDP Report from 2021

Life Cycle Assessment/Management (CO2 Footprint)

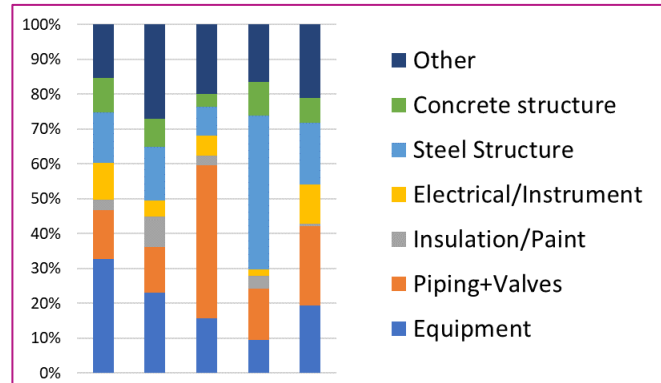
Return to
Decarbonization
menu

Case Study : LCA for EPC Business

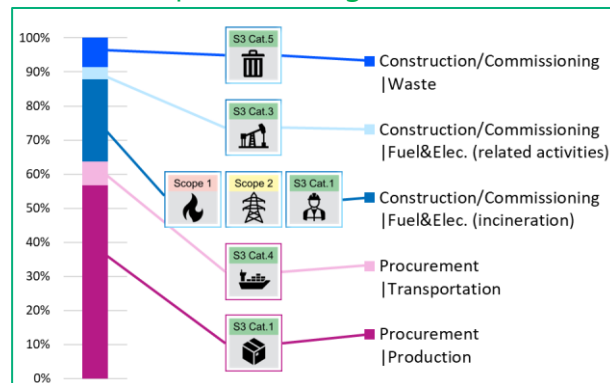
Life Cycle of Plant Facilities



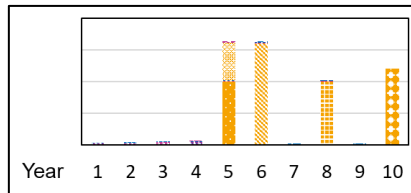
GHG emissions for procured equipment/materials
across multiple projects.



GHG emissions from
Procurement phase through to Commissioning



Report for
annual GHG emissions
of a contractor Scope 3



Outcomes

- **Numerical Approach for Plant Life Cycle:** A comprehensive assessment is applied to focus on for GHG Protocol scopes (1/2/3)
- **Real-Time Monitoring:** With a data-centric (DX) approach, both environmental impact and operational data can be monitored in real time, allowing for the identification of hotspots
- **Visualization of CO2 Emission Hot Spots:** High CO2 emission hot spots are visualized throughout the plant life cycle
- **CAPEX/OPEX and CO2 Emissions Relationship:** Understanding the relationship between CAPEX, OPEX and CO2 emissions

Our Strength

- **Broad LCA Expertise:** Conducting Life Cycle Assessment (LCA) not only for the manufacturing business but also for the construction industry
- **Process Engineering Perspective:** Utilizing a process engineering perspective to optimize material flow and reduce GHG emissions
- **Advanced Visualization:** Capability to visualize emissions using the in-house 3D maintenance viewer **INTEGNANCE VR** [See Details](#)



Operational Excellence Services

Decarbonization CO2 Removal Solutions



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

CO₂ Removal Solutions

Challenges for CO₂ Capture in Operating Assets

Management of Increased CO₂ in Feed Gas

CO₂

- ✓ Natural gas and associated gas quality varies over the life of oil and gas fields.
- ✓ Unexpected increases of CO₂ in the feed gas requires additional CO₂ capture units or enhancement of the CO₂ capture performance.

Limited Space and Utilities



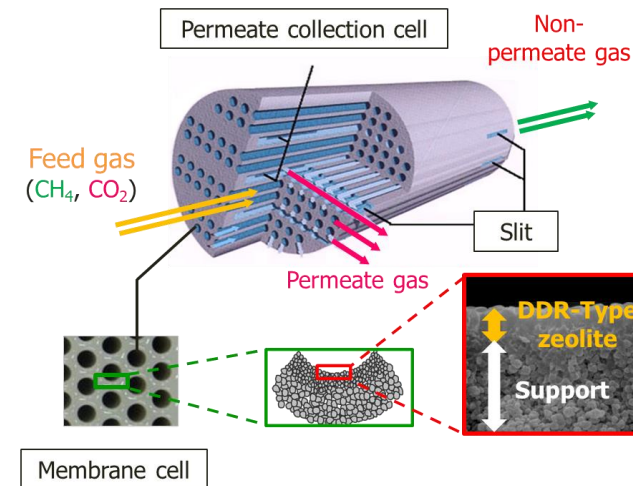
- ✓ Limitation in the available space to accommodate the new unit or expansion of the unit.
- ✓ Limitation in the available utilities to operate the CO₂ removal unit

HiPACT® - an Innovative CO₂ Capture Process



Commercial HiPACT™ plant (NIS, Serbia)*1

DDR Membrane - High Performance Separation Technology



CO₂ Removal Solutions – DDR Zeolite Membrane

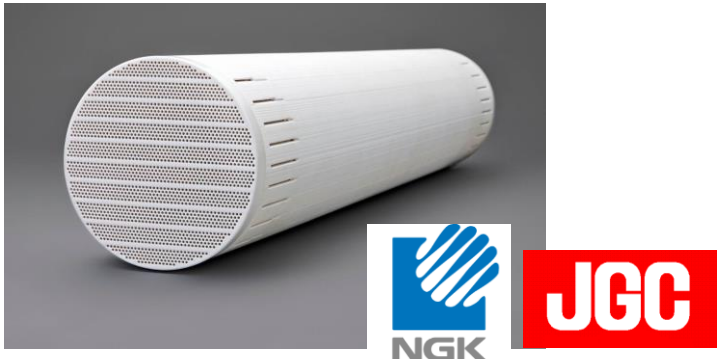
DDR Zeolite Membrane

■ Technology

- Technology jointly developed by JGC and NGK
- World's largest zeolite membrane element

■ Advantages

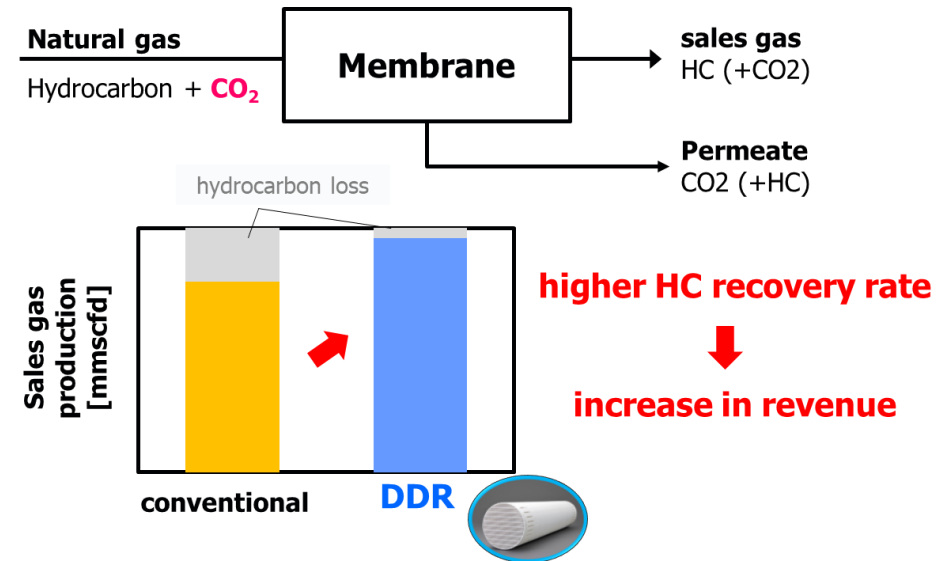
- Enhanced separation performance
= minimal hydrocarbon loss
- Tough under high pressure, high CO₂ concentration
= longer membrane life
- Significant lifecycle cost saving (20-30%)



■ Application

- Natural Gas Processing (CO₂ removal in CO₂ rich gas fields)
- CO₂ recovery from associated gas for CO₂-EOR^(*) projects

(*) EOR: Enhanced Oil Recovery



■ Technology Development Status

- Field tested at U.S. oil field (2017, completed)
- Commercial scale field test at U.S. oil field (from 2020)

Details of the technology can be found at:

<https://www.jgc.com/en/business/tech-innovation/environment/ddr-membrane.html>

CO₂ Removal Solutions - HiPACT®

HiPACT® - CO₂ Capture Process

■ Technology

- Chemical absorption process, using newly developed absorption solvent (jointly developed with BASF)

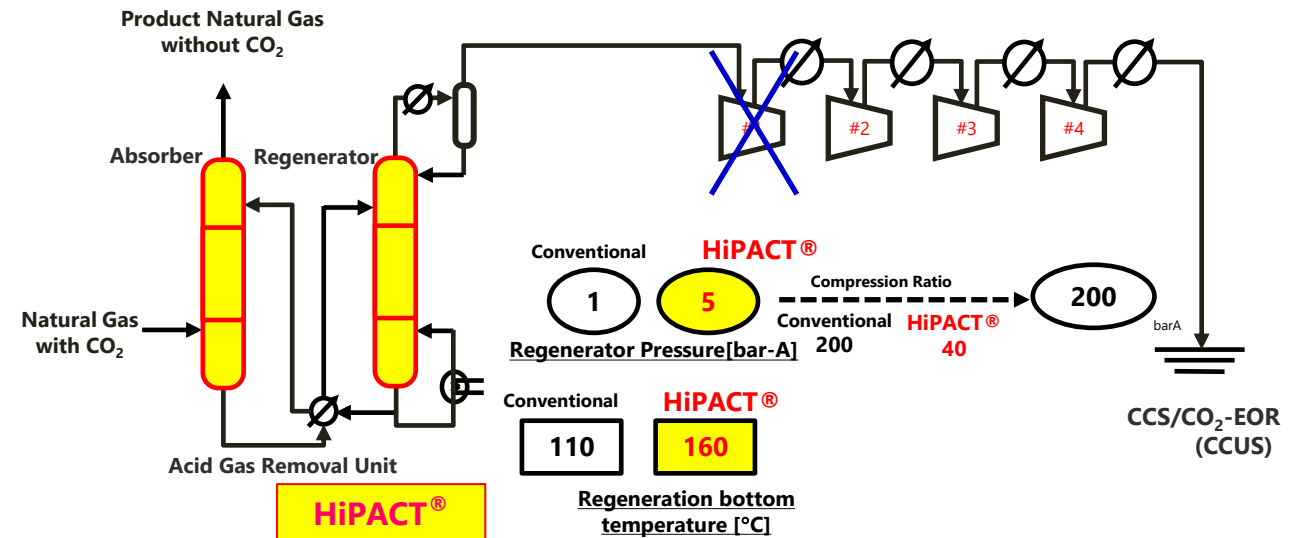
■ Advantages

- Highly stable against thermal degradation
- Enables high pressure CO₂ stripping, leading to significant energy and cost saving (25 to 35% reduction)
- Reducing the number of compression stages, optimizing the space



■ Reduction of initial investment and reduction of operating costs

by high pressure CO₂ stripping process

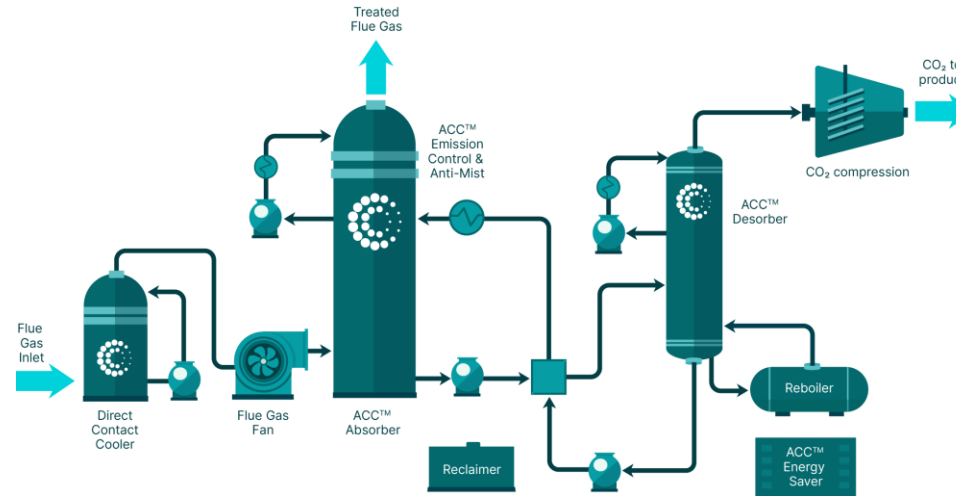


Details of the technology can be found at:

<https://www.jgc.com/en/business/tech-innovation/environment/hipact.html>

CO₂ Removal Solutions – flue gas (e.g. gas turbine)

JGC and SLB Capturi initiated strategic collaboration dialogue.



- ❑ Applied to hard to flue gas in abate industry: Cement, Biomass Power, Waste Energy
- ❑ The solution contributes to GHG reduction in FPSO (e.g. CO₂ capture from gas turbine flue gas)
- ❑ There is a dedicated design concept suited to offshore application.



Operational Excellence Services

Decarbonization
Energy Optimization



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Energy Optimization

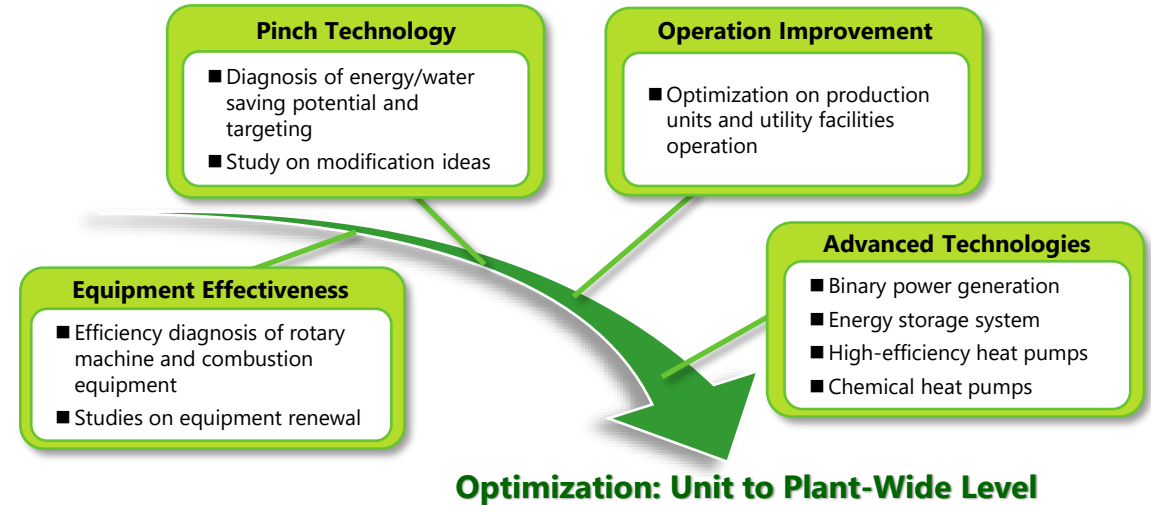
Do you have any of these issues?

- ☹️ **How to reduce energy consumption?**
- ☹️ **How to eliminate equipment bottlenecks?**
- ☹️ **What kind of equipment should be updated to improve efficiency?**

What is our service ?

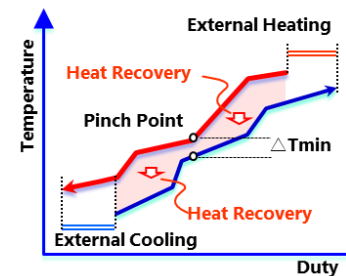
- **Equipment Effectiveness:** Diagnosis to identify the efficiency of existing facilities to be improved and suggestions for types of equipment to be modified.
- **Pinch Analysis:** Identify heat recovery target and create solutions such as heat recovery networks that balance the trade-off between investment costs and energy savings.
- **Operation Improvement:** Studies on unit operation and utility facilities modifications to improve energy efficiency.
- **Advanced Technology:** Studies and proposals on the introduction of high-efficiency equipment and new heat recovery technologies.

Our Approach

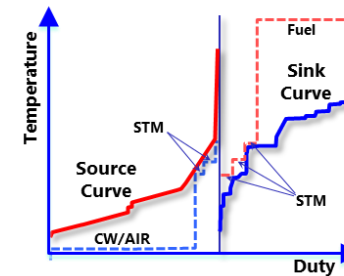


What is Pinch Analysis?

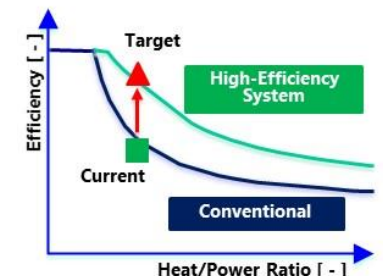
Systematic and Visualization Methods to Identify the Target



Energy Utilization and Optimization of Heat Recovery System

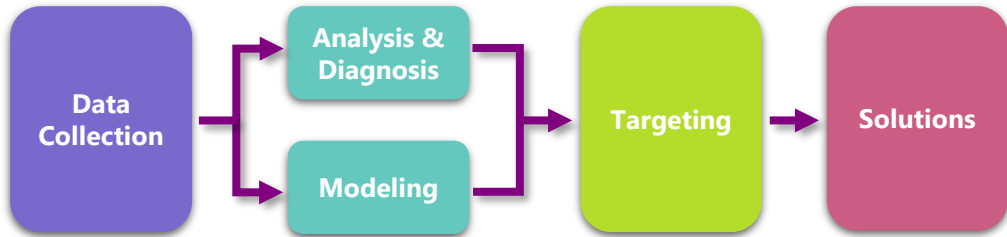


Optimization of Site-Wide Energy Usage

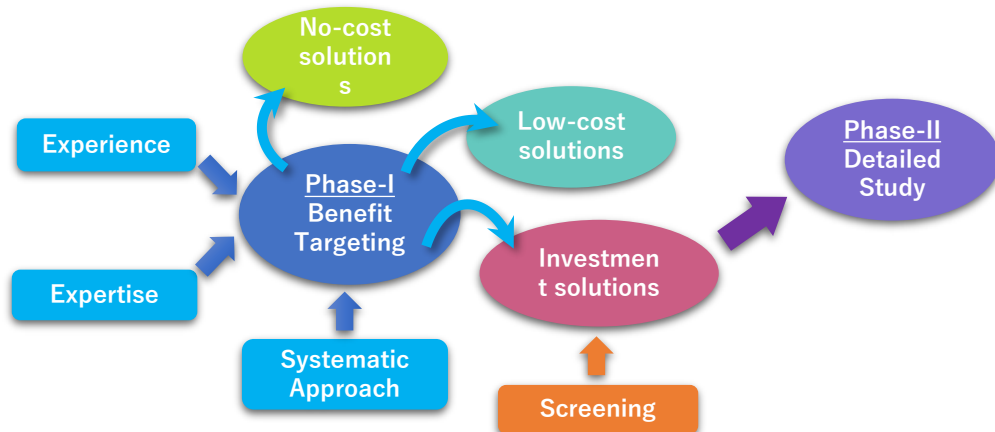


Optimization of Power-Steam Supply System

Workflow & Result



- Plant Data collection(Operating Data, Climate Data)
- Analysis and diagnosis
- Modeling for Pinch Analysis, and Targeting
- Prioritization of solutions into tree categories as Phase-I
- As Phase-II, detailed study to materialize the investment solutions proposed in Phase-I



Our Strengths

- The proven and successful experiences in executing similar consultancy services.
- Extensive technical knowledge and know-how for energy and water conservation.
- Qualified professionals.
- Collaboration between overseas EPC-capable group companies and out-sourcing for consultancy services.

Our Experiences

50+
Projects

Industry	Japan	Overseas
Petroleum Refinery	26	11
Petrochemical	6	4
Chemical	5	-
Steel	1	-
Total	38	15

- Contributed to over 50 projects in various phases (FS, Pre-FEED, FEED, EPC, Revamps) for Petroleum Refinery, Petrochemical, Chemicals, etc.
- We are certified by a national oil company as an energy consultant.



Operational Excellence Services

Decarbonization Sustainable Combustion & Heating Optimization

Achieving stable heater operation and reducing carbon emissions



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Sustainable Combustion & Heating Optimization

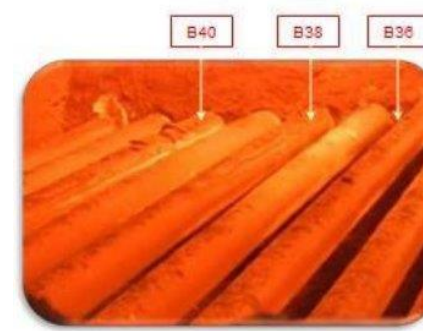
Do you have any of these issues / challenges ?

- ☹️ **Frequent trips, tube damage, or unstable heater operation**
- ☹️ **Pressure to reduce CO₂ emissions and meet CI(*) targets**
- ☹️ **Difficulty in identifying root causes of incidents**
- ☹️ **Integration of multiple fuel networks**
- ☹️ **Transition to electrification and reduced fossil fuel dependence**

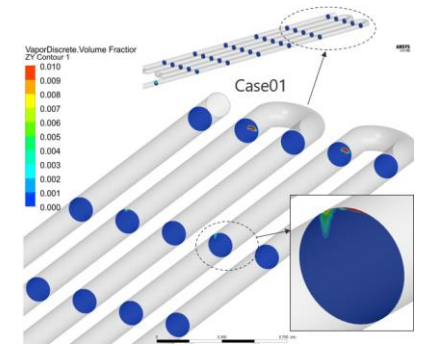
(*) carbon intensity

Our Solutions

- Identify optimal decarbonization pathways
(efficiency improvements, hydrogen, electrification)
- Evaluate combustion and heating system performance
(flame stability, NO_x, flashback, control philosophy, fuel systems)
- Perform root cause analysis
(based on operational data and incident history)
- Identify bottlenecks and engineer practical retrofit solutions
(based on design and operational data)
- Implement solutions and ensure no recurrences
(engineering, modification, and operational improvement)



Operating Conditions
Assessment



Fluid Behavior
Assessment



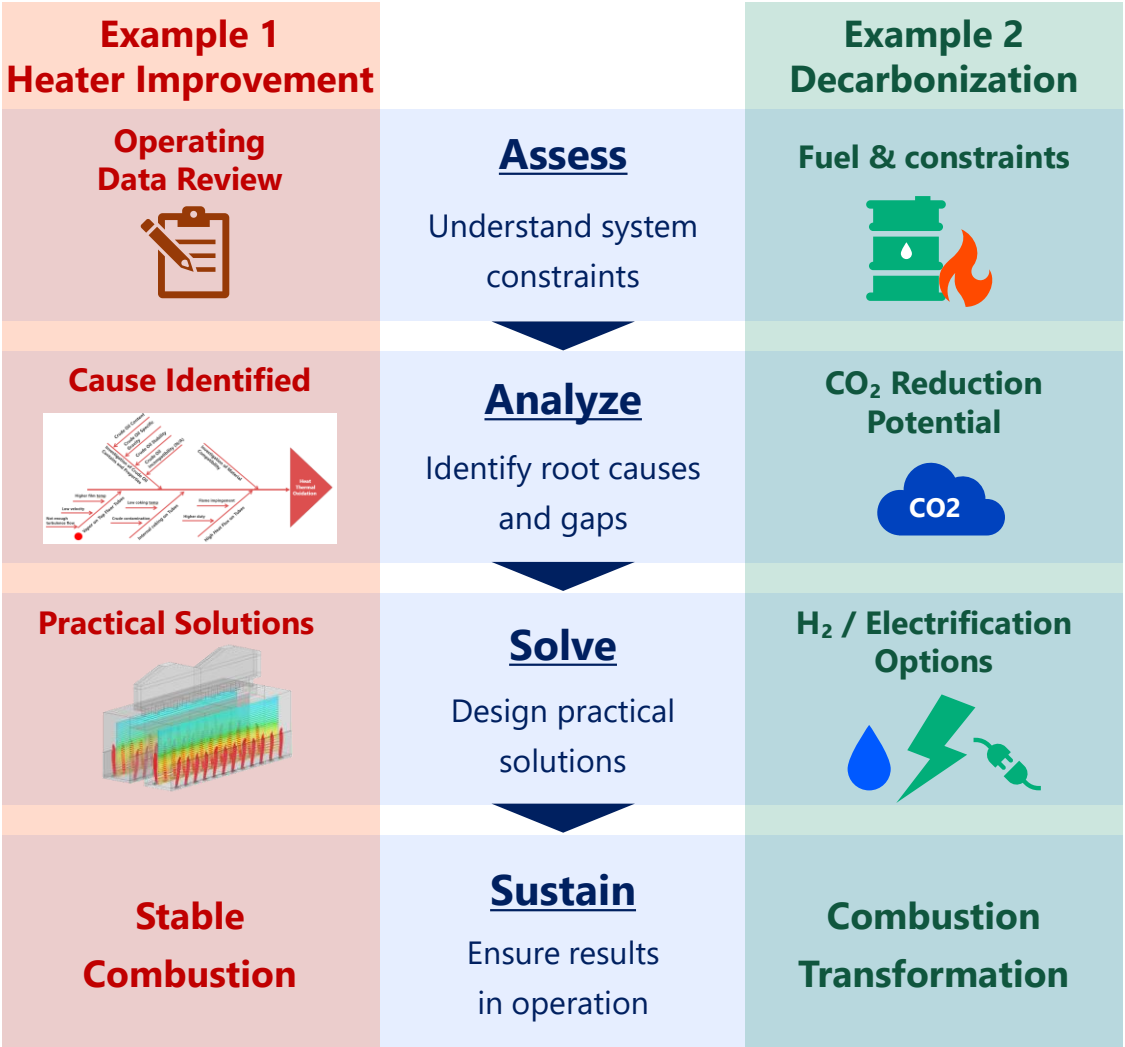
Detailed Tube Damage Assessment



Driving the Transition to
Sustainable / Stable operation

Sustainable Combustion & Heating Optimization

How We Deliver Sustainable Heating Optimization



Our Strength

End-to-End Delivery from Analysis to Execution

- Deep expertise in combustion and system interfaces
- Integrated engineering across combustion, process, and advanced analysis (CFD, simulation)
- Extensive retrofit know-how for existing facilities
- Practical solutions as an EPC contractor, covering entire plant systems
- End-to-end capability from study to FEED and EPC

Our Experiences

100+

Plants

Evaluation, Improvement and Troubleshooting for IOC and NOC customers

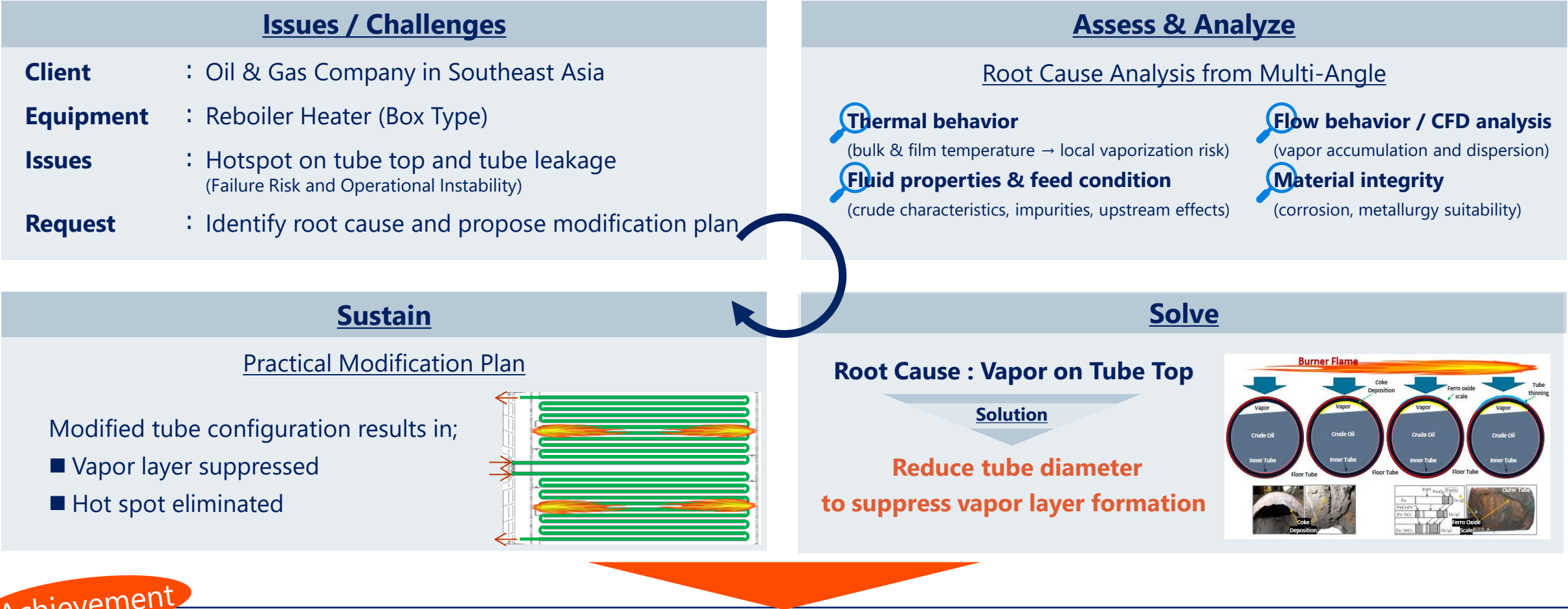
100+

Cases

Evaluation, Improvement and Troubleshooting cases

Sustainable Combustion & Heating Optimization

Case Study : Furnace Tube Overheating (Root Cause Analysis and Optimization)



Achievement

Identified root cause and delivered a practical solution enabling stable heater operation and improved profitability



Operational Excellence Services

**Health · Safety · Environment
(HSE)**

HSE Risk Management



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

HSE Risk Management

Do you have any of these issues?

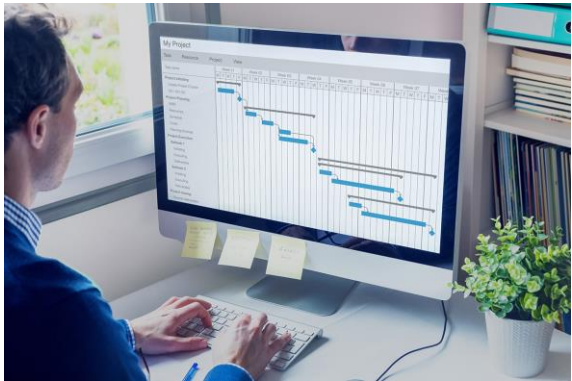
- ☹ **Formalizing facility safety**
- ☹ **Revalidation of facility safety**
- ☹ **Process and operational safety concerns**
- ☹ **High insurance fees**

HSE Risk Management Solutions

- Formal Safety Assessment
 - Quantitative Risk Analysis (QRA)
 - Hazard Identification (HAZID)
 - Hazard and Operability Studies (HAZOP)
 - Layer of Protection Analysis (LOPA)
 - Bowtie Analysis
- Consequence Analysis, CFD Modeling
- Operational Hazard Assessment/Reduction Study
- HSE Management System Review

Hazard Assessment		Potential Hazards		Previous Hazards (Incidents/Near Misses)
		General	Process	
Hazard Identification		HAZID	HAZOP	OHR *
Risk Assessment	Qualitative	HAZID	HAZOP	OHR *
	Semi-Quantitative	LOPA		
	Quantitative	Consequence Analysis / QRA		

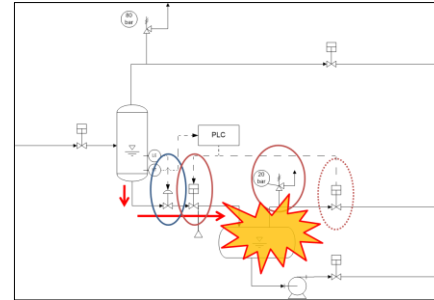
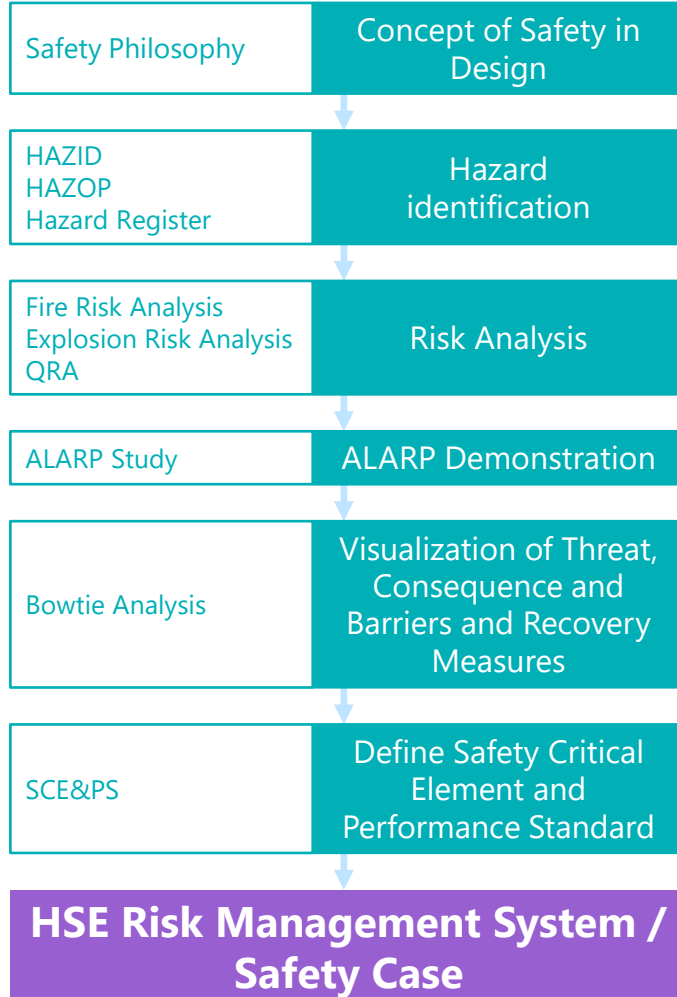
* OHR : Operational Hazard Reduction Study



Combination of Desk-top Study and Workshop



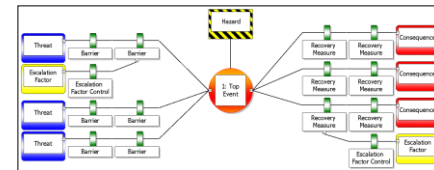
Workflow & Results



Hazard Identification in P&ID



QRA



Bowtie Diagram

Our Strengths

- Professional Safety, Process, Control, Mechanical, Operation and Maintenance Teams**
- Top global experience of EPC** execution and Consultation
Plant types - Refinery, Gas Processing, LNG, Chemical
Plant locations – Onshore, Offshore
Clients – IOC, NOC
- Huge record of HAZID/HAZOP/LOPA/QRA** and Operational Hazard Reduction
- CFD Analysis Specialist** for detail simulation

Our Experiences

20+
Cases

20+ HAZOP revalidation, OHR, and HSEMS development

500+
Cases

500+ Process safety plant design



Operational Excellence Services

**Health · Safety · Environment
(HSE)**

Active Fire Protection Assessment



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Active Fire Protection Assessment

Do you have any of these issues?

- ☹ **Fire and explosion incidents**
- ☹ **Modification of facility**
- ☹ **High maintenance and inspection cost**
- ☹ **High insurance fees**

Active Fire Protection Assessment Solution

- Re-evaluation for facilities based on credible fire scenario and codes and standards
- Fire scenario simulation based on identified fire scenario
- Fire fighting system evaluation by:
 - Hydraulic calculation
 - Fire water monitor coverage assessment
 - Foam system performance evaluation
 - Etc.



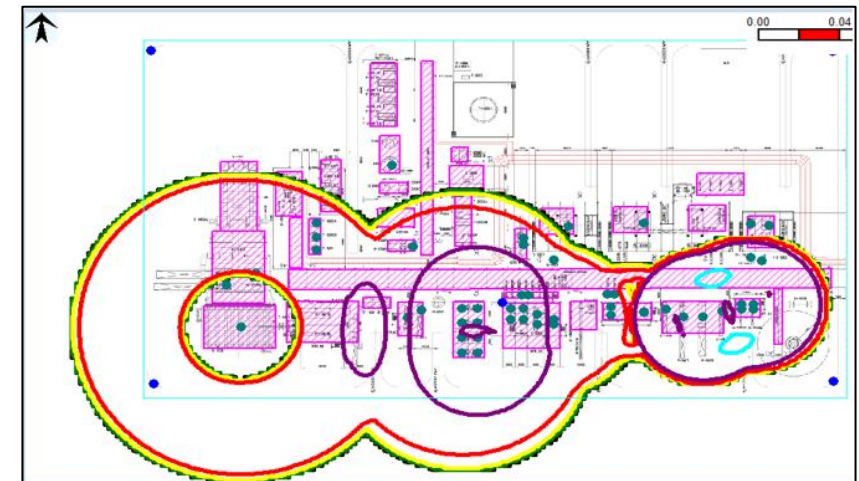
Foam Extinguisher System



Monitor Protection

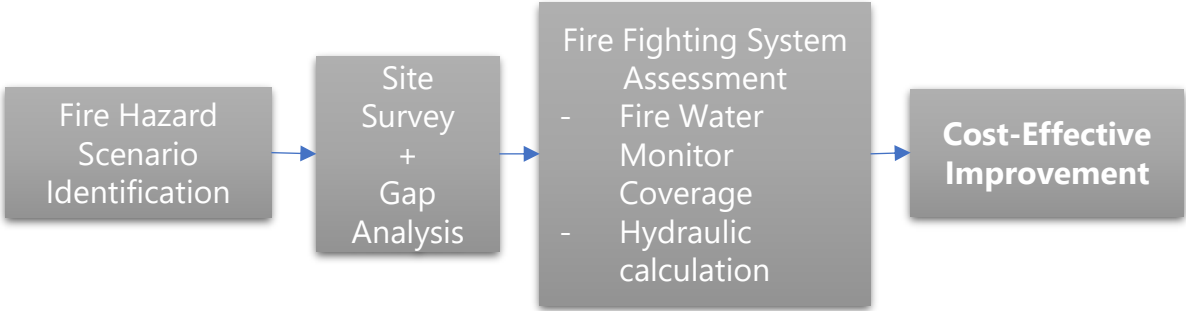


Water Spray Protection

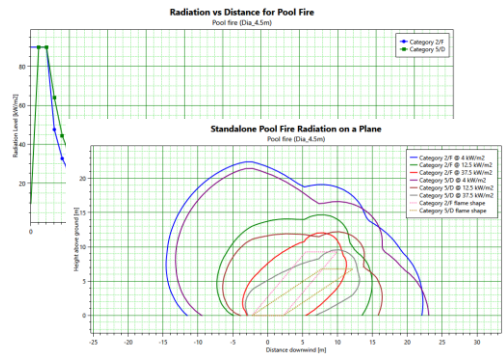


Example of Jet Fire Risk Contour

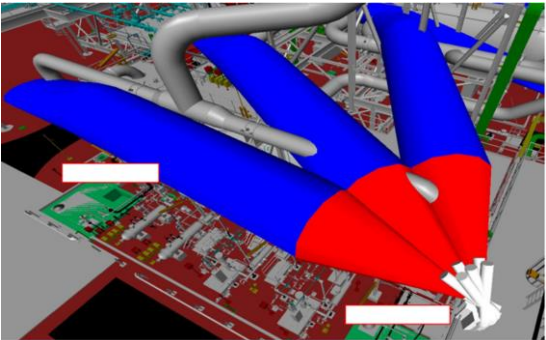
Workflow & Result



Fire Hazard Scenario + Fire Water Monitor Coverage Assessment



Fire Hazard Simulation



Visualizing Monitor Coverage in 3D model

Our Strengths

- **Professional Fire Protection and Analysis Teams**
- **Top global** experience in active fire protection design and application from EPC execution
Plant type - Refinery, Gas Processing, LNG, Chemical
Plant location – Onshore, Offshore
Client – IOCs, NOCs
Code and Standards – NFPA, API, BS, etc.
- **Strong relationships with global firefighting equipment suppliers**
- **Analysis software** – Phast (DNV), FLACS (Gexcon), in-house simulation,

Our Experiences

20+
Studies

Fire water monitor coverage
assessment 20+ studies.

500+
Cases

Active fire protection design
500+ cases



Operational Excellence Services

Health · Safety · Environment
(HSE)

Fireproofing Assessment



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Fireproofing Assessment

Do you have any of these issues?

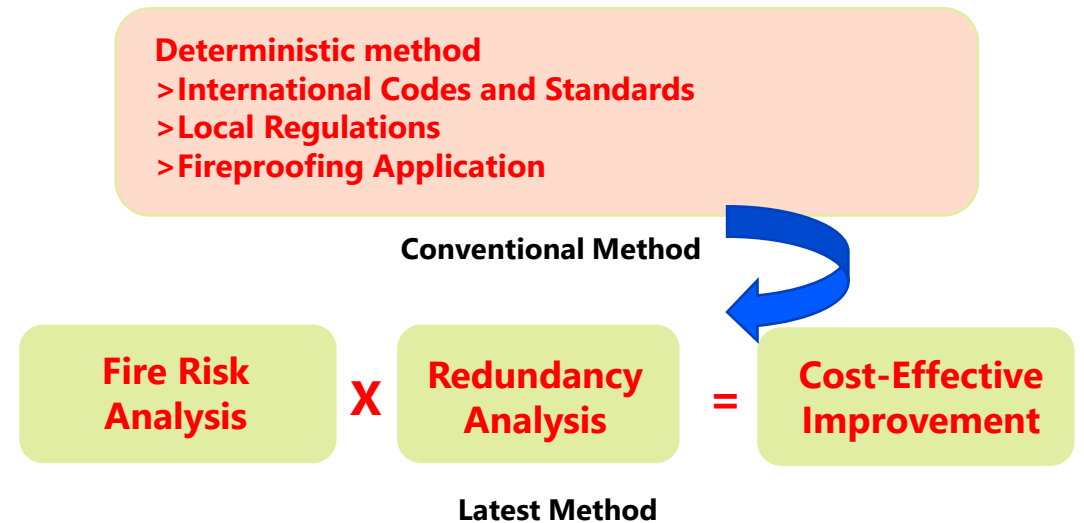
- ☹️ **Is Our Plant Really Safe from Fire Hazards?**
- ☹️ **High Maintenance Cost for Fireproofing**
- ☹️ **Compliance with Latest Standards?**

Fireproofing Assessment Solution

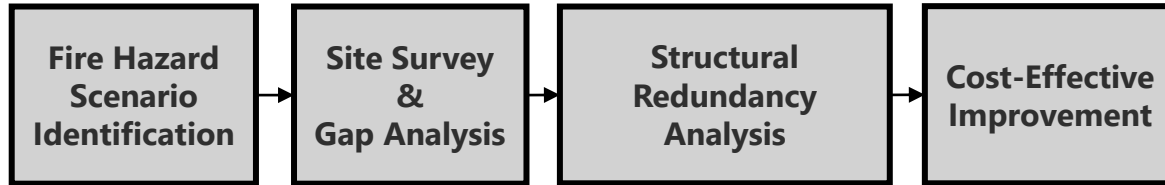
- Evaluation of existing fireproofing based on identified fire hazards and latest standards.
- Identification of critical fireproofing improvement points.
- Optimization of fireproofing by fire risk assessment and structural redundancy analysis.
- Recommendations of cost-effective improvement solutions.



Evaluation of Existing Fireproofing

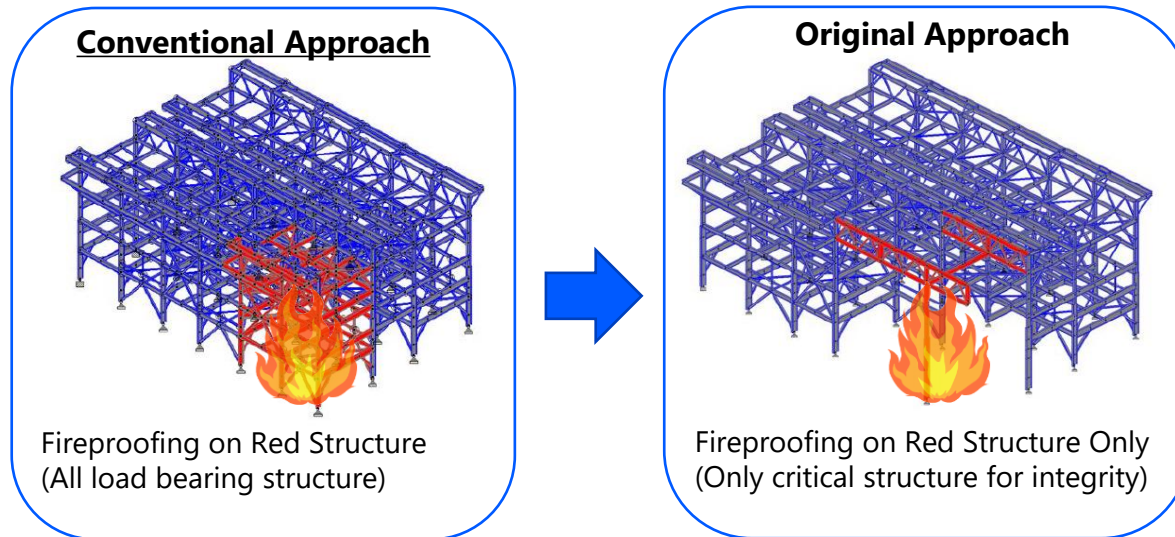


Workflow & Result



Structural Redundancy Analysis

- **JGC original method** to optimize fireproofing based on API RP 2FB



Significant Reduction of Fireproofing / Justify the Available Fireproofing

Our Strengths

- **Professional Fire Protection, Structure, Material and Analysis Teams**
- **Top global experience in fireproofing design** and application from EPC execution
Plant type - Refinery, Gas Processing, LNG, Chemical
Plant location – Onshore, Offshore
Client – IOCs, NOCs
Codes and Standards – NFPA, API, BS, etc.
- **Strong relationships with global fireproofing material suppliers**
- **Analysis software** – Phast, FLACS, STAAD.Pro, Abagus, etc.

Our Experiences

3+

Plants

Fireproofing assessment service for 3+ plants.

500+

Cases

Fireproofing design 500+ cases



Operational Excellence Services

**Health · Safety · Environment
(HSE)**

Fire and Gas Assessment



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Fire and Gas Assessment

Do you have any of these issues?

- ☹️ **Insufficient Fire and Gas detector coverage**
- ☹️ **High Maintenance Cost of fire and gas detectors**
- ☹️ **High Insurance Fees**

Fire and Gas Assessment Solution

- Evaluation of facility and gap analysis
- Identification of credible fire and gas leak hazards
- Conduct fire and gas mapping study to ensure the effectiveness
- Safety improvement by appropriate fire and gas detector placement



Gas Detector



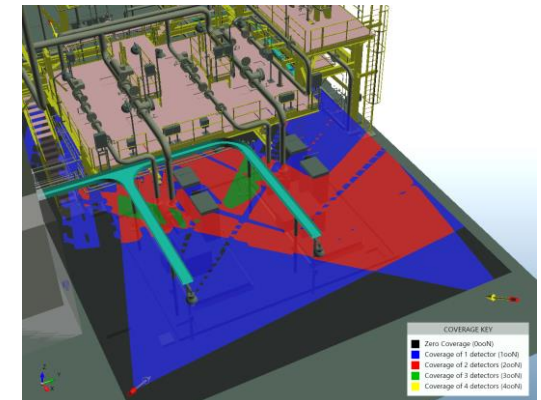
Plant are Covered by Fire and Gas Detectors



Flame Detector

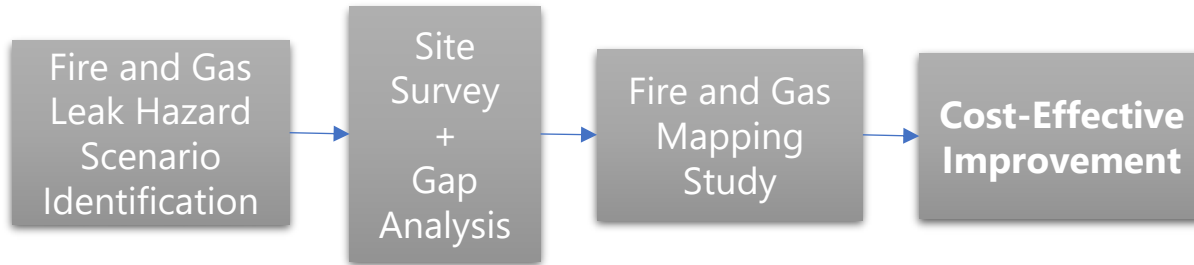


Evaluation of Facility



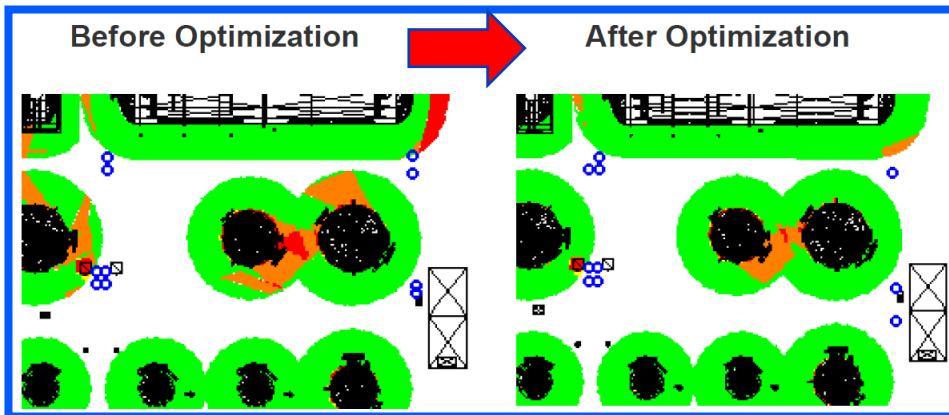
Fire and Gas Mapping Study Technology

Workflow & Result



Mapping study

One of the methods to analyze the effectiveness of fire and gas detectors, and optimize detector location



Same quantity of gas detectors --> Better coverage (wider green area)

Our Strengths

- **Professional Safety, Instrument, Process and Analysis Team**
- **Top global experience** in fire and gas system design and application from EPC execution
 - Plant type - Refinery, Gas Processing, LNG, Chemical
 - Plant location – Onshore, Offshore
 - Client – IOCs, NOCs
 - Code and Standards – NFPA, API, BS, etc.
- **Relationship with global fire and gas detector suppliers**
- **Analysis software** – Detect 3D(Insight numerics), Phast (DNV), FLACS(Gexcon)

Our Experiences

30+

Mapping Studies

Fire and Gas Mapping Study
Experience 20+ Studies

500+

Cases

Fire and Gas Design 500+ Cases



Operational Excellence Services

**Health · Safety · Environment
(HSE)**

Escape Simulation and Assessment



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

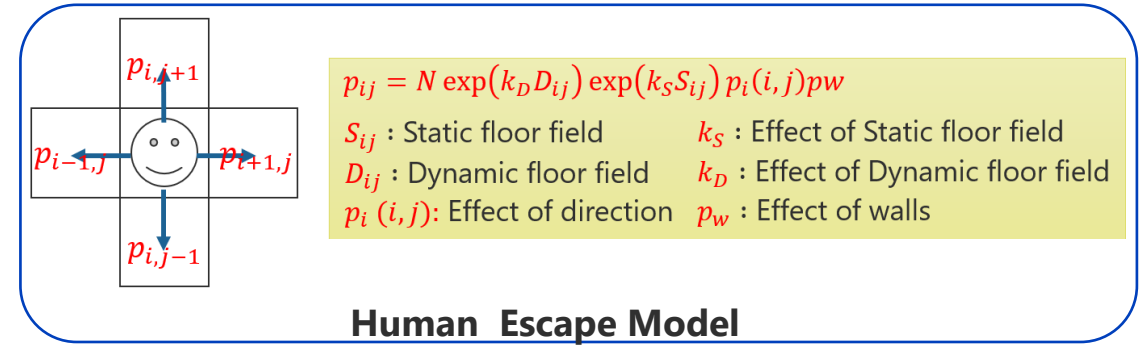
Escape Simulation and Assessment

Do you have any of these issues?

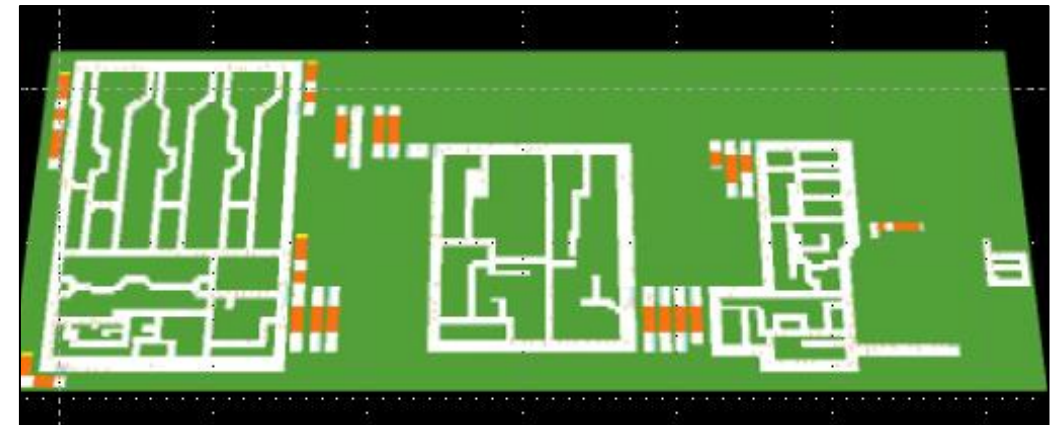
- ☹️ **Insufficient escape and evacuation plans**
- ☹️ **Maintenance plan without safety considerations**
- ☹️ **Many modifications in the facility**

Escape Simulation and Assessment Solutions

- Evaluation of current escape route by specialized escape route simulation program.
- Identification of critical points (bottlenecks) in escape route plan
- Provide improvement plan of escape route
- Escape simulation in accident scenario
- Provide safe maintenance plan (location of maintenance, number of maintenance persons, barricade plan in maintenance period)



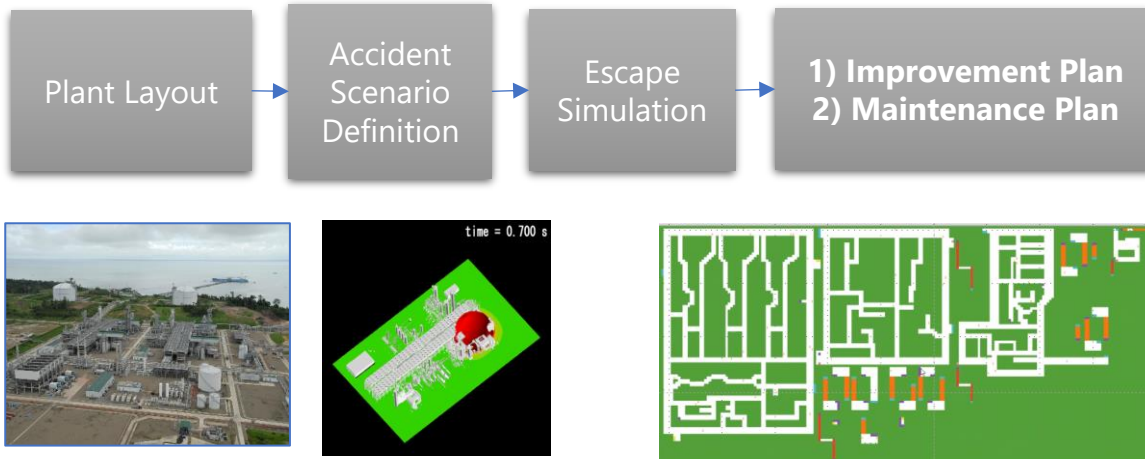
+Characteristics of Plant Facility



Specialized Plant Escape Route Simulation Program
(developed with the University of Tokyo)



Workflow & Result



OUTPUTS

1) Improvement Plan

- ✓ Modification plan of escape route to enhance safety for operators in normal situation and accidental situation

2) Visualization of Escape Behavior

3) Maintenance Plan considering safe operator escape

- ✓ Maintenance activities in same location
- ✓ Number of maintenance persons
- ✓ Barricade plan

Our Strengths

- **Professional Safety, Operation and Maintenance Teams**
- **Top global experience in escape route design** and evacuation planning from EPC execution
Plant type - Refinery, Gas Processing, LNG, Chemical
Plant location – Onshore, Offshore
Client – IOCs, NOCs
- **Specialized escape simulation program** developed with the University of Tokyo. Research article is available in "Chemical Engineering Transactions (CET) Journal Vol 90(2022)"

Our Experiences

**Plant and Escape Route
Design Cases**

500+ Cases



Operational Excellence Services

**Health · Safety · Environment
(HSE)**

**Hazardous Area Classification
(HAC) Optimization**



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Hazardous Area Classification (HAC) Optimization

Do you have any of these issues?

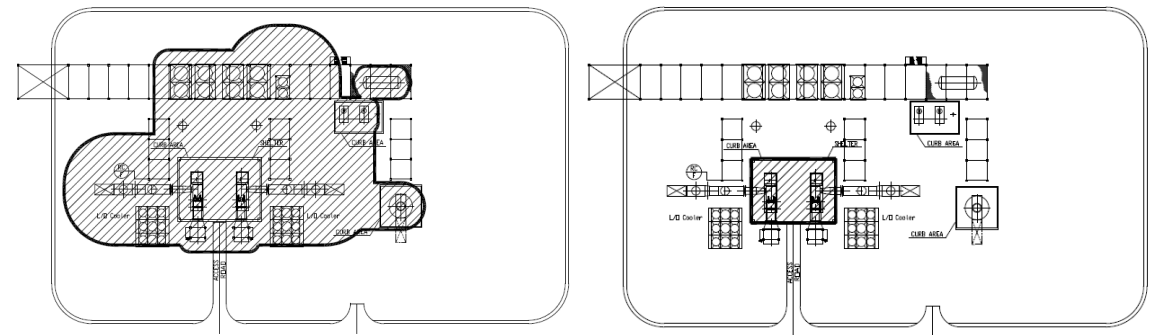
- ☹ **Cannot use unclassified electrical devices at site**
- ☹ **Many manual works for inspections and recording**
- ☹ **Increased cost for inspections and recording**

HAC Optimization Solution

- Optimize the hazardous area for unclassified electrical device with International Standards (IEC 60079-10)
- Based on the detail analysis, the classified area can be reduced or optimized
- Propose a plan to use unclassified electrical devices to minimize the accident risks



Unclassified electrical devices can not be used in hazardous areas



HAC for permanent items

HAC for portable items

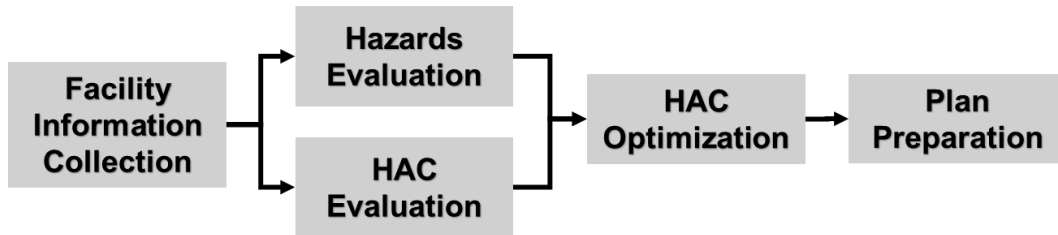
Hazardous Area Optimization for temporary use of unclassified electrical devices

Hazardous Area Classification (HAC) Optimization

[Return to
HSE menu](#)



Workflow & Result



- Collection of facilities information
- Evaluation of existing hazardous area classification
- Evaluation of potential hazards' magnitude
- Optimization hazardous area classification considering not only hazardous area classification requirements but also potential impact in case of ignition
- Preparation of plan for use of unclassified electrical devices



Our Strengths

- **Professional safety and electrical engineers** for not only hazardous area classification but also risk assessment
- **Top global experience in hazardous area classification design**
Plant type - Refinery, Gas Processing, LNG, Chemical
Plant location – Onshore, Offshore
Clients – IOCs, NOCs
- **Wide knowledge of international standards** such as, IEC, IP, EI, API, NFPA, JIS, etc.

Our Experiences

**Hazardous Area
Classification Design
Experiences**

500+ Cases



Operational Excellence Services

Health · Safety · Environment
(HSE)

Noise Assessment



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

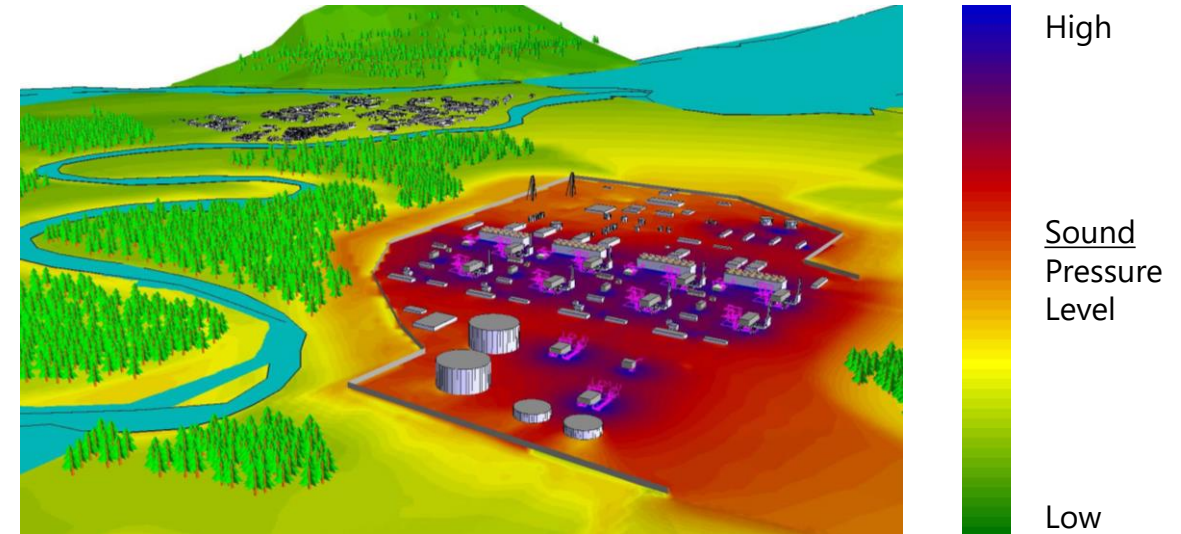
Do you have any of these issue?

- ☹️ **Noisy work environment**
- ☹️ **High cost noise mitigation for noise emitters**
- ☹️ **Need for consulting partner for noise assessment**

Noise Assessment Solution

- Through noise survey;
 - Identify noise sources
 - produce noise contour maps before and after noise mitigation plans
- Propose most effective and cost-minimum noise mitigation plans based on result of noise simulation
- Verify the effectiveness of noise mitigation plans

Noise contour map



Example of noise mitigation plan (Acoustic insulation)

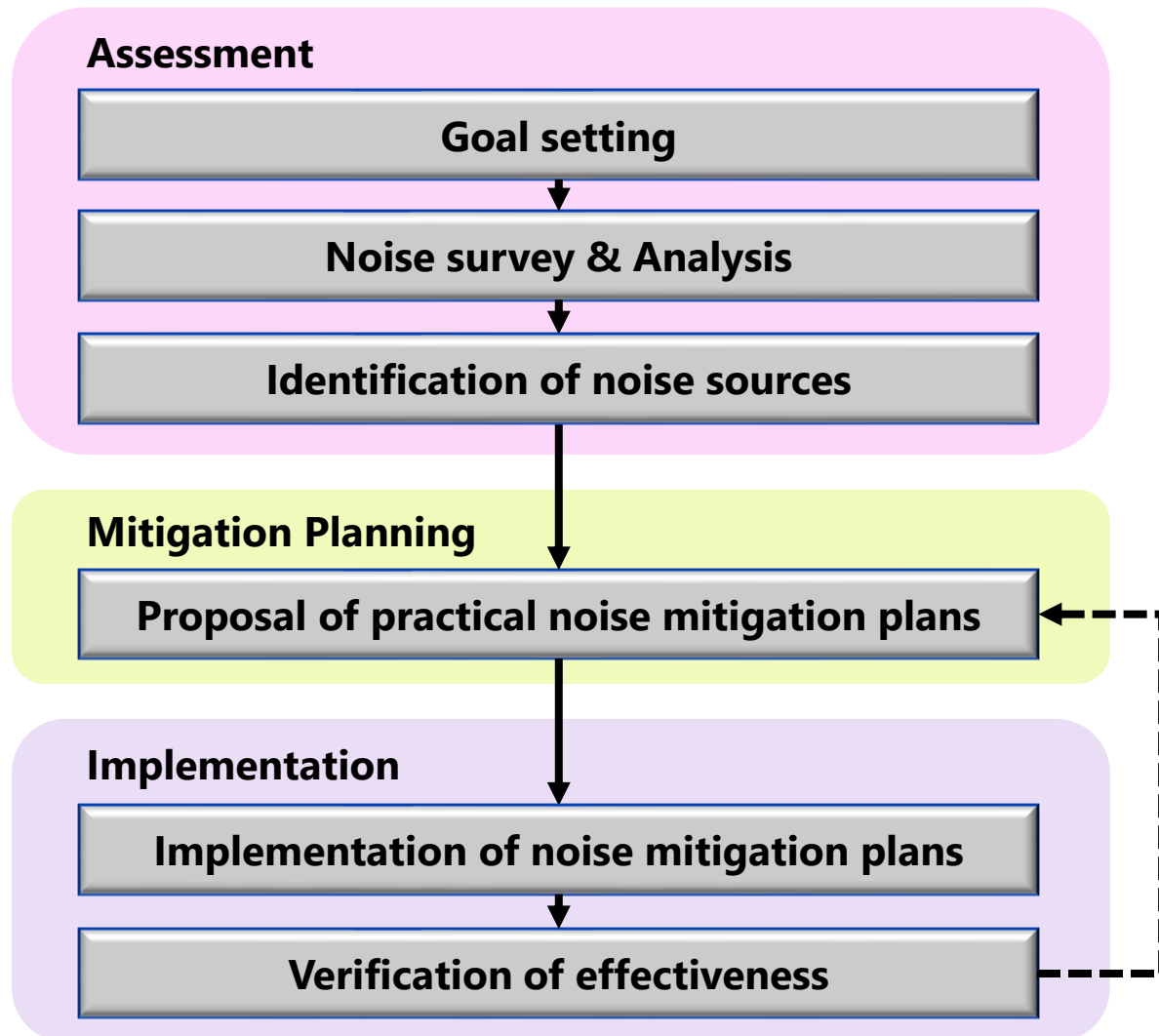


Before



After

Workflow & Result



Our Strengths

- Experienced with noise assessment/control technologies for domestic and overseas customers for many years, and solved various noise problems
- Provided services for noise survey, evaluation, planning of countermeasures, and confirmation of effectiveness after implementation of countermeasures

Our Experiences

600+

Cases

Noise assessment/control technology for 600+ cases.

50+

Years

We have been accumulating noise assessment/control technologies for more than 50 years through EPC businesses and consulting services.

Regulatory Inspections

We provide prompt and accurate measurements and analysis of site boundaries and neighborhood measurements for regulatory inspections, as well as equipment, piping, and indoor measurements within the plant site.

➤ All Inclusive (Noise maps & Proposal)

Measurement results are shown as noise maps, and proposal of variety of noise mitigation measures are included.

➤ Latest Measurement Technology

In addition to the conventional noise level measurement using a sound level meter, we offer the best measurement method such as measurement system using a tablet, cell phone or unmanned noise monitoring measurement with the latest technology. We will propose the most suitable measurement method for each client.

Noise Measurement and analysis



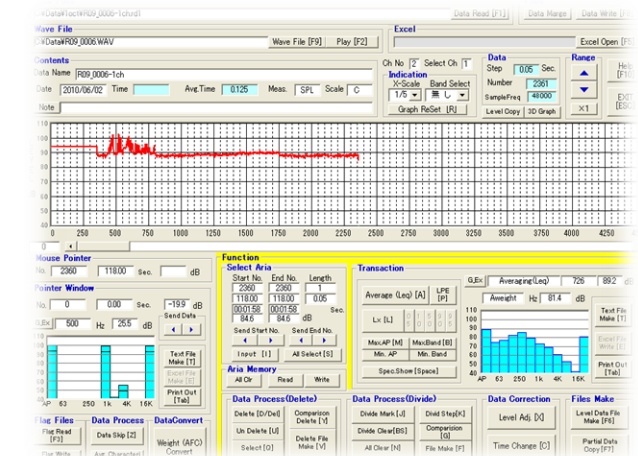
Conventional measurement



Noise monitoring



Tablet measurement system



Noise analysis



Operational Excellence Services

Health · Safety · Environment
(HSE)

CoreSafety®

Application for Risk-Based Process Safety

Powered by Brownreverse



Contact Us

 [Technology Inquiries](#) | [Contact Us](#) | [JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Do you have any of these issues?

- Only limited persons know where PHA(*) data such as HAZID, HAZOP, LOPA(**) is stored
- PHA data is not actively used for optimization of asset management program
- Risk profile of facilities is not shared in organization

(*)PHA : Process Hazard Analysis

(**) HAZID : Hazard Identification Study
HAZOP : Hazard and Operability Studies
LOPA : Layer of Protection Analysis

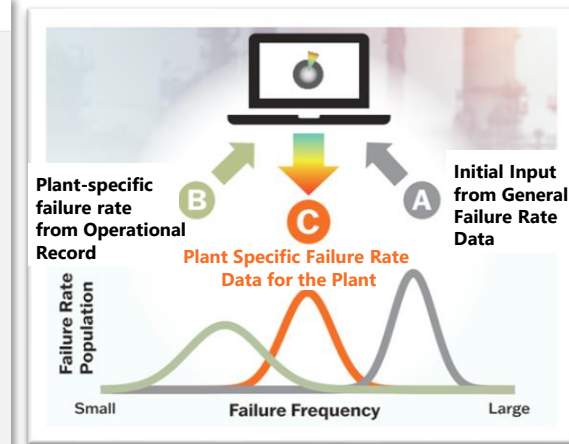
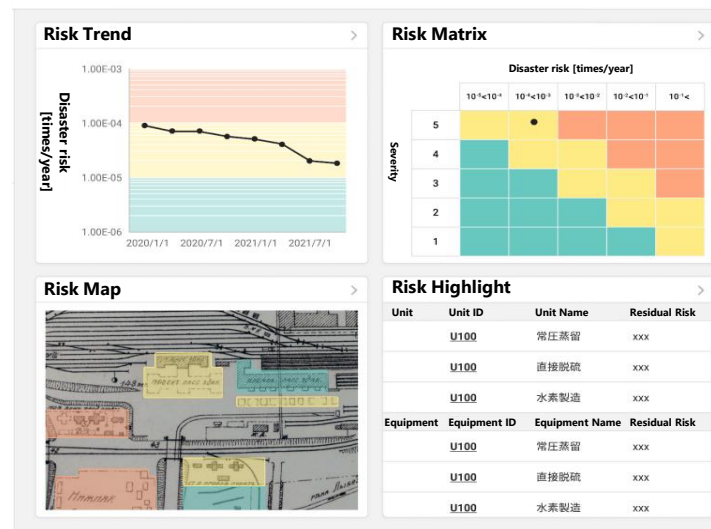
Functional Features

CoreSafety®, one of JGC in-house application, can summarize and register PHA results to visualize Risk Profile, and easily accessed through a web browser

- Risk Dashboard
- Up-to-date risk by Bayesian Update(***)
- Fault Schedule (i.e., hazard register)
- Functional Requirements' management tied with risk scenario
- Safety Performance KPI monitoring

(***) A statistical method that updates the probability for a hypothesis as more evidence or information becomes available.

Risk Dashboard



Bayesian Update

Fault Schedule

Unit	P&ID	Equipment Tag	Equipment Name	Initiating Event Group	Loss of Containment	Cumulative Initiating Event Frequency [times/year]
▶ 041	41-PID-PS-1160	041-T-1003	Depropanizer Column	気相出口閉塞	圧力超過なし (内部破壊/Process upset)	5.04 × 10 ⁻⁴
▶ 041	41-PID-PS-1160					3.29 × 10 ⁻⁴
▼ 041	41-PID-PS-1160					1.65 × 10 ⁻⁴

Initiator Tag	Initiator Name	Initiator Frequency [times/year]
▼ 041-FV-2710	041-T-1002塔底 コンデンサート流量調整弁	1.65 × 10 ⁻⁴

Consequence Type	Severity	Consequence	Target Mitigated Event Likelihood [times/year]	Residual Risk [times/year]
Safety	4			
Economic loss	3			
Environment	2			

▼ 041	41-PID-PS-1160	041-T-1003	
-------	----------------	------------	--

Outline of a risk scenario

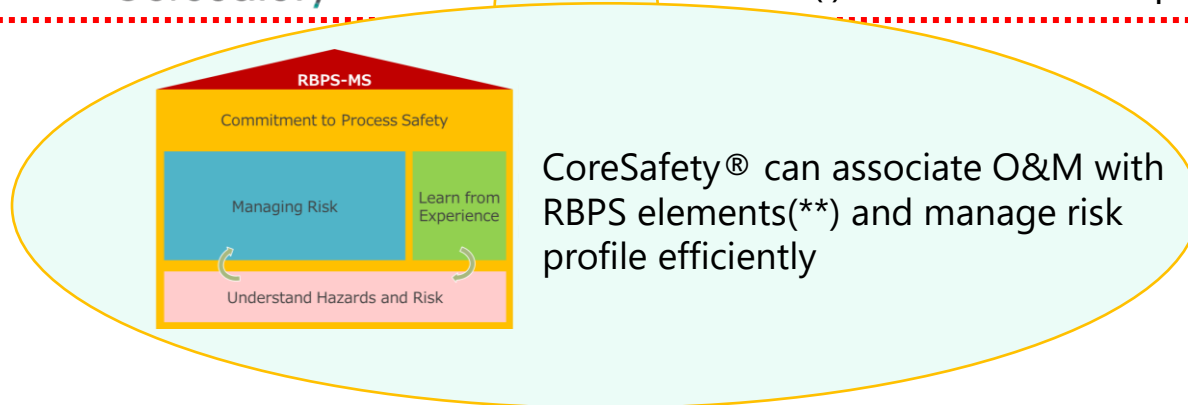
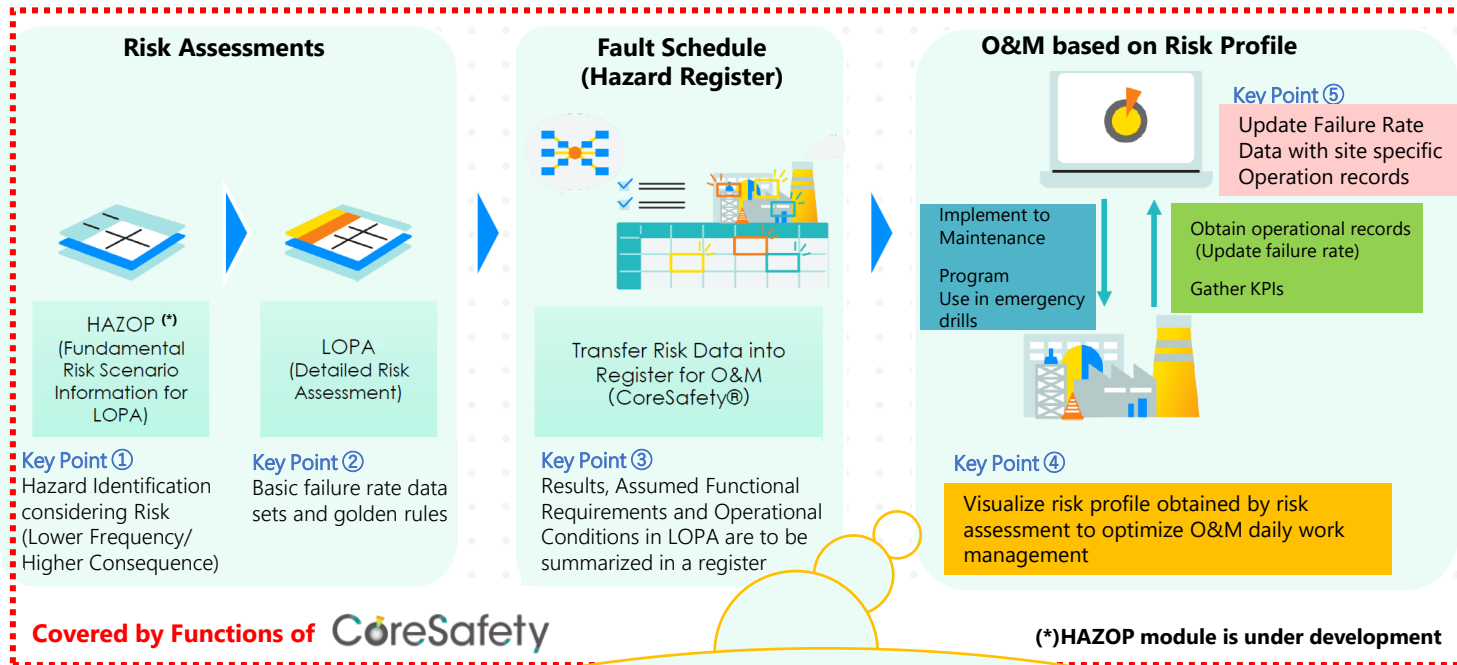
- Contributors of a risk scenario (i.e, failure rate of initiators, probability of failure on demand of safeguards)
- Residual risks for each consequence type (Safety, Economic loss, Environment)

Functional Requirement of the initiator and safeguards for reducing the risk (i.e., maintenance plan)

Risk Scenario

Measures

Implementation of Smart RBPS (Risk Based Process Safety)



(**)RBPS Elements are suggested by AIChE CCPS (American Institute of Chemical Engineers Center for Chemical Process Safety)

Advantages of CoreSafety®

- **Assured by Collaborative Research Projects:**
Smart RBPS methodology taken in CoreSafety is assured by a collaborative research project involving academia, regulatory bodies, and industry in Japan.
- **Risk Profile Library:**
 1. **Based on our experience**
Be built on extensive Process Safety Management (PSM) and Process Hazard Analysis (PHA) experience in global Oil & Gas, Chemical, and Nuclear industry projects.
 2. **Standardized Profiles**
Provides standardized risk profiles for various equipment types (e.g., pumps, fractionation columns, drums).
 3. **Efficient Assessment**
Enables efficient risk assessments without needing detailed design information.

e.g.) Two Phase Separator
Standardized **P&ID** and **Risk Scenario** are available for risk assessments

CoreSafety® -Risk-Based Process Safety Application

Return to
HSE menu



User Benefits

BEFORE

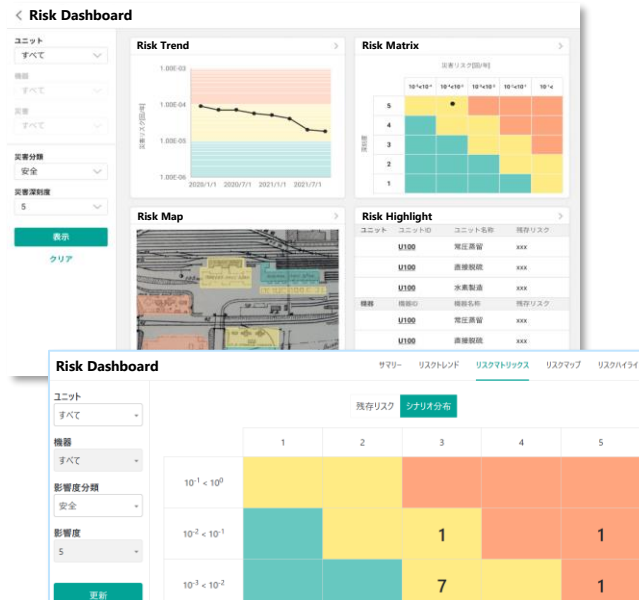
PHA by Excel/Paper

Implementation CoreSafety

AFTER

RBPS's cycle is improving

Scenario Number	Equipment Number	Scenario Title: Hazare Storage Tank Overflow. Spill not contained by the data.
2a		
Date:	Scenario Number 2a	Equipment Number
Consequence Description/Category	Scenario Title: Hazare Storage Tank Overflow. Spill not contained by the data.	
Risk Tolerance Crite (Category or Frequency)	Date:	Scenario Number 2a
Initiating Event (Typically a Frequency)	Consequence Description/Category	Equipment Number
Enabling Event or Condition	Risk Tolerance Crite (Category or Frequency)	Scenario Title: Hazare Storage Tank Overflow. Spill not contained by the data.
Conditional Modifi	Initiating Event (Typically a Frequency)	
Frequency of Unmit Independent Protect	Enabling Event or Condition	Frequency
Safeguards(non-IPL)	Conditional Modifiers (if applicable)	
Total PFD for all IPL	Frequency of Unmit Independent Protection I	
Frequency of Mitigat	Safeguards(non-IPL)	
Risk Tolerance Crite	Total PFD for all IPL	
Actions Required to Meet Risk Tolerance Criteria	Frequency of Mitigat	
Notes	Risk Tolerance Crite	
References (links to LOPA analyst (and team members, if applicable))	Actions Required to Meet Risk Tolerance Criteria	
	Notes	
	References (links to LOPA analyst (and team members, if applicable))	



- Visualizes Risk and Optimizes O&M Tasks
- Brings "Risk Data" to the center of RBPS Management System.

Actual Benefits of adopting CoreSafety®

Achievement of ALARP(*) Decision for Higher Risk Items

(*)ALARP : As Low As Reasonably Practicable

Improved Response and Procedure for Safety Critical Alarms by efficient training utilizing CoreSafety®

High Integrity and Reliability of Equipment and Safety Systems

Enhanced Risk Management at MOC and PTW (**)

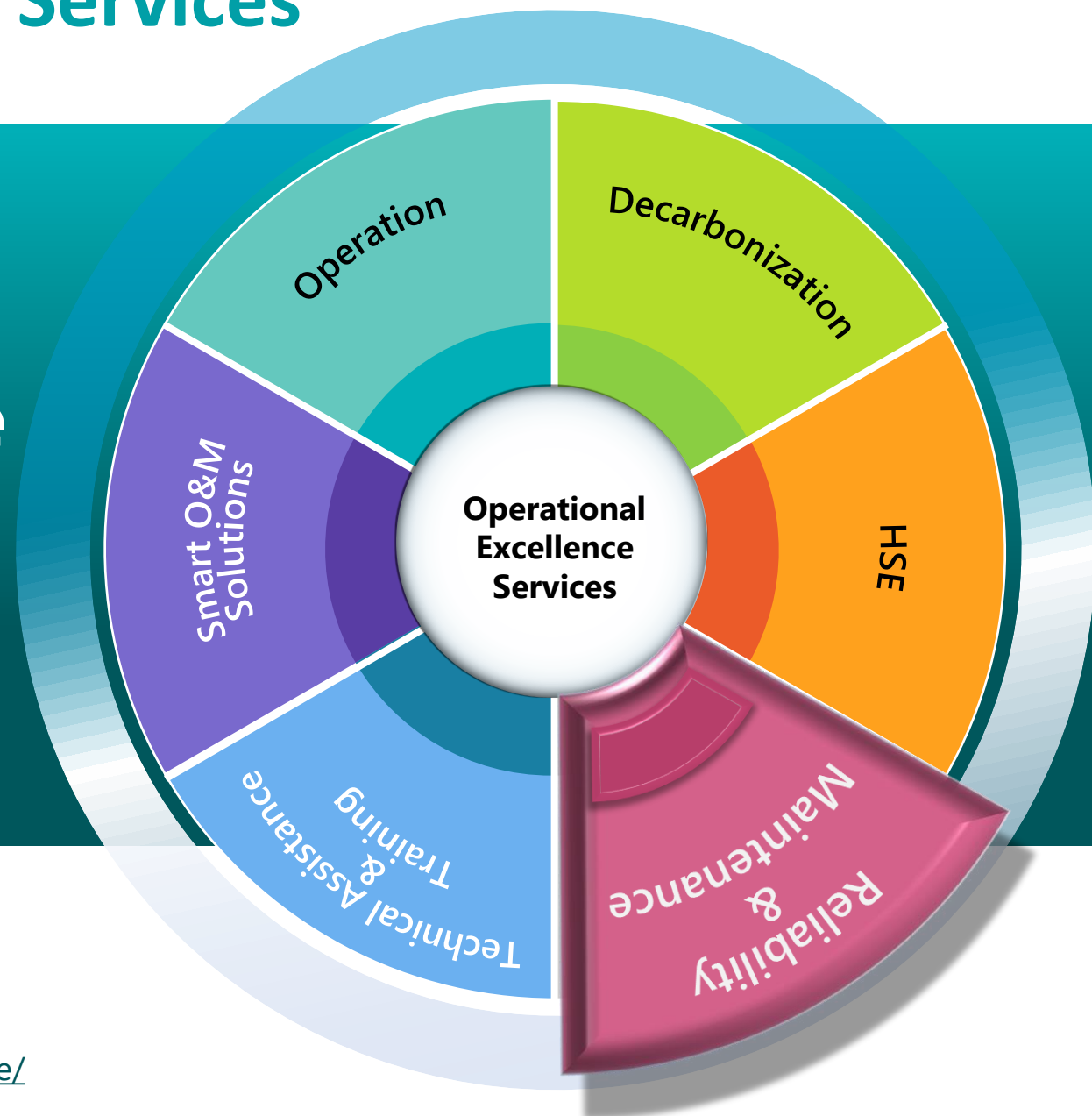
(**)MOC : Management Of Change, PTW : Permit To Work

Sophisticated Emergency Planning for Designated Process Incidents



Operational Excellence Services

Reliability & Maintenance Risk-Based Inspection (RBI)



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

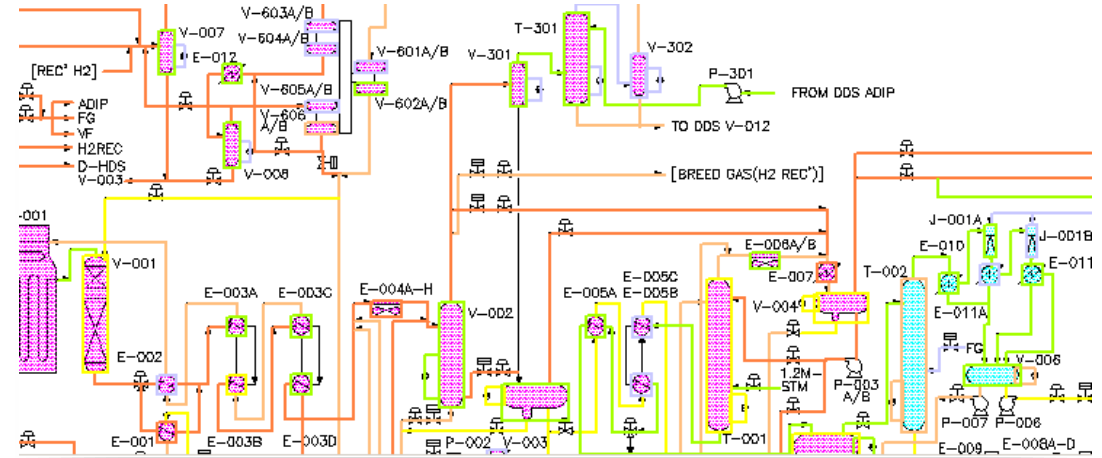
Risk-Based Inspection(RBI)

Do you have any of these issues?

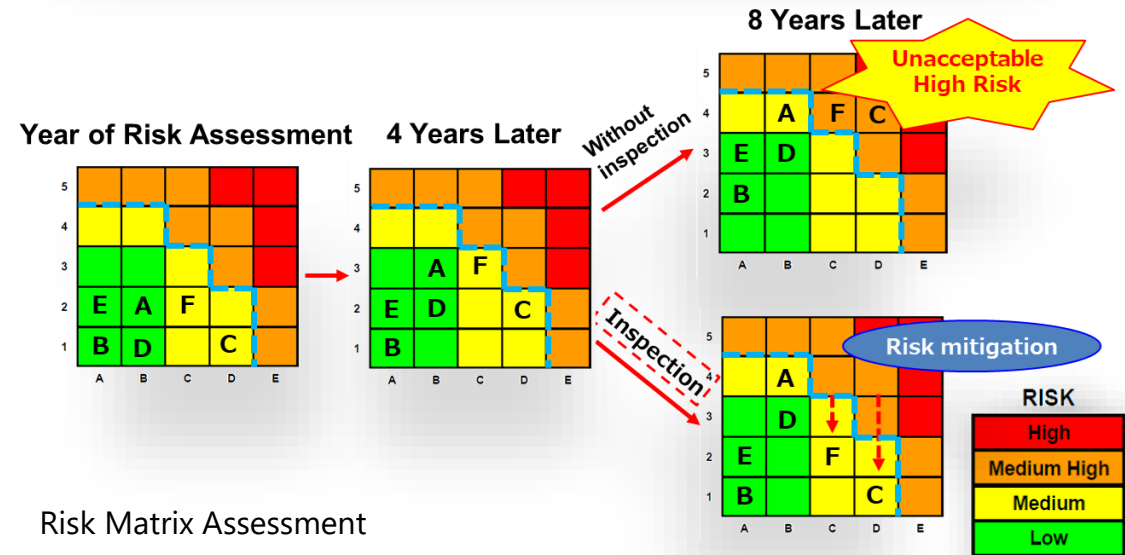
- ☹ **Many Reliability Incidents**
- ☹ **High Maintenance and Inspection Costs**
- ☹ **High Insurance Fees**

RBI Solution

- Determine Risk with probability and consequence of failure
- Prioritize and effective inspection based on risk assessment to static equipment, piping
- Improve reliability while reducing maintenance & inspection costs and insurance fees

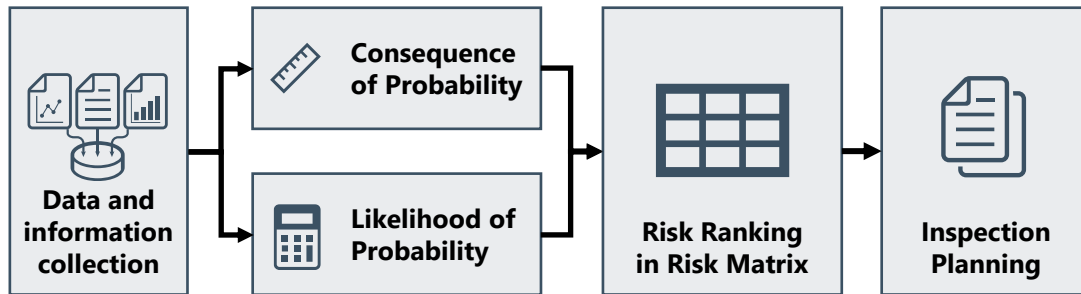


Corrosion Loop Marking

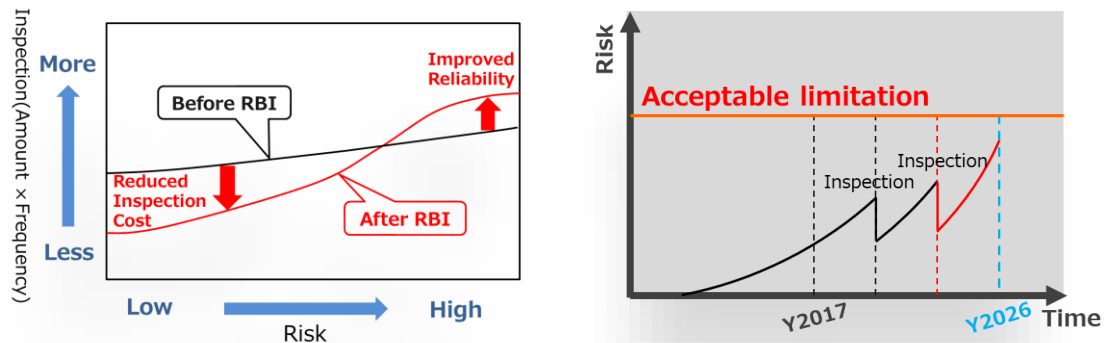


Risk Matrix Assessment

Workflow & Result



- Evaluation of the Potential Risks
- Development of Inspection Task Plan
- Development of Computerized Maintenance and Inspection System
- Development of Integrity Operating Window



Reduced inspections and cost cuts with RBI

Our Strengths

- Professional Process and Material Engineer Teams
- Global experiences and performances on risk assessment, inspection planning, on-site Inspection.
- Integrating JGC's many years of inspection and plant design experience to achieve lower inspection costs and longer plant life
- Collaboration between overseas EPC-capable group companies and local maintenance companies.

Our Experiences

Worldwide Achievement

RBI Experience in Far East, Middle East, Southeast Asia, Africa, North America

15+ Projects

Refinery, GTL, Gas Processing, Gas Oil Separation, FLNG, LNG, LNG Terminal



Operational Excellence Services

Reliability & Maintenance Asset Integrity Management

Introduction of

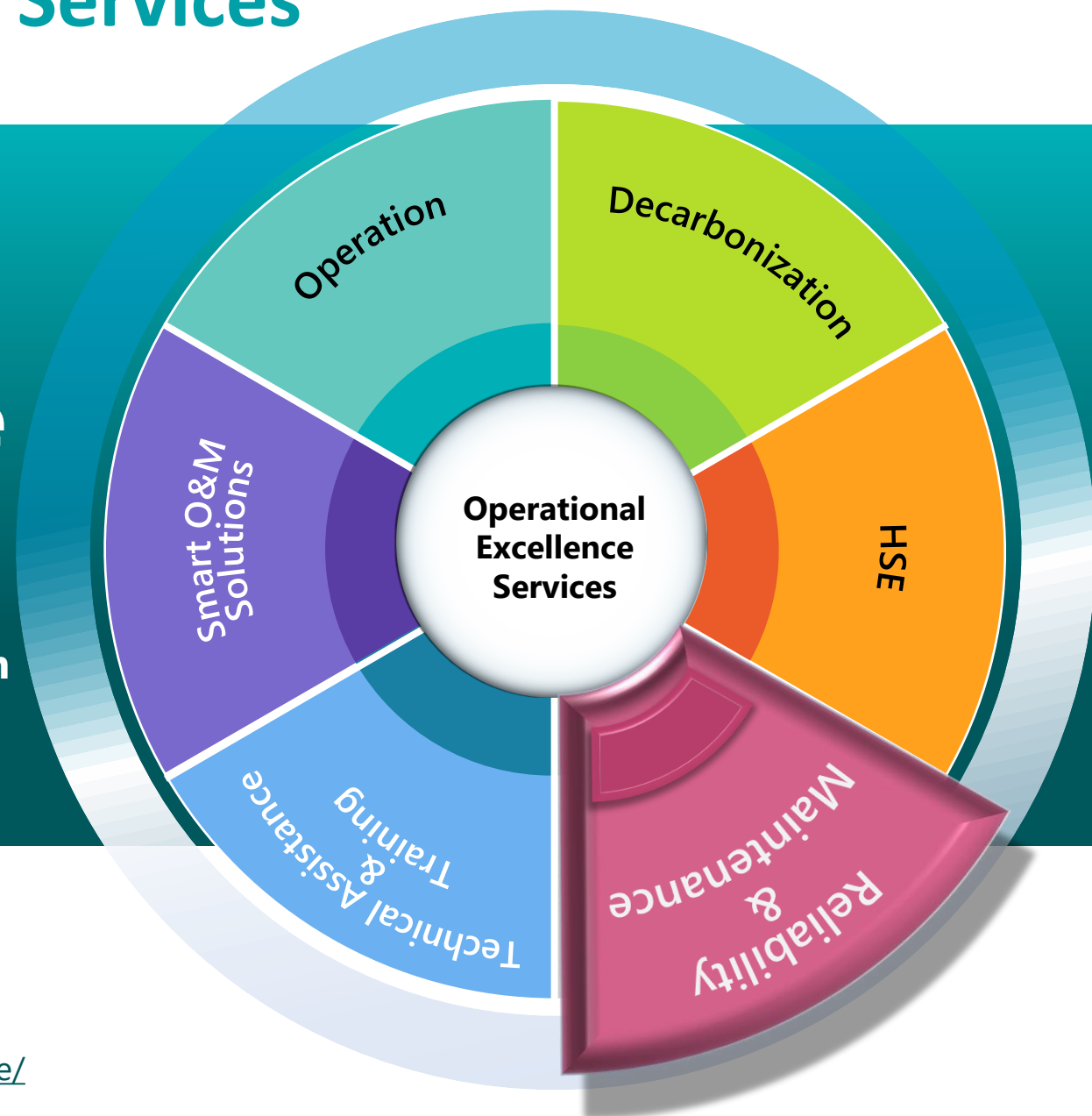
“**A**dvanced **M**aintenance **I**nspection Support **S**ystem
(A-MIS)”

Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>



A-MIS (Asset Integrity Management)

A-MIS Share

90%

Selected in Japan

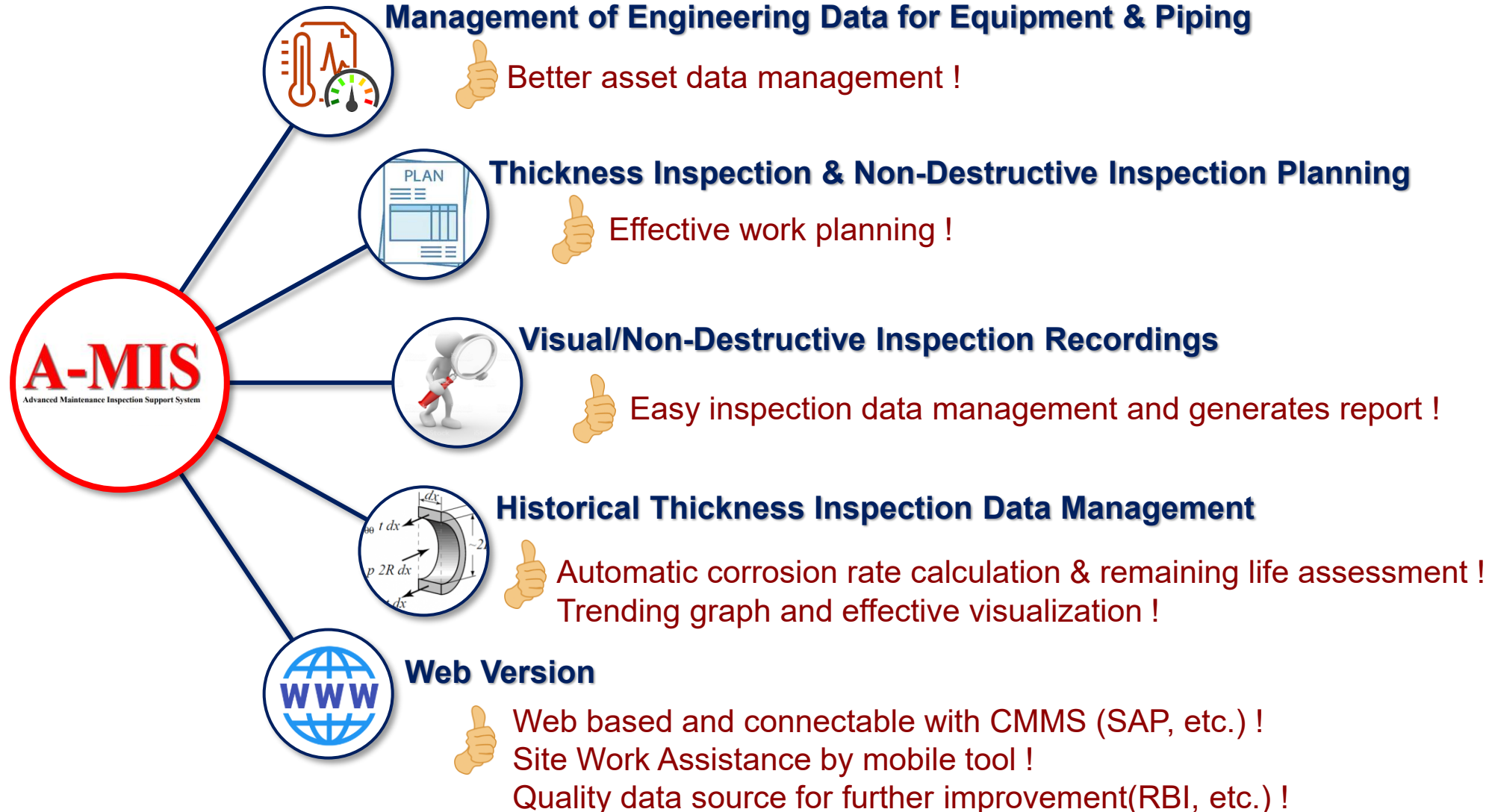
12

Countries

128

Plants

A-MIS features and Benefits



A-MIS (Asset Integrity Management)

A-MIS will solve your problem!

Do you have any of these issues?

- ☹ Many asset integrity issues (e.g., leaks)
- ☹ Missing asset information, docs, inspection records
- ☹ Unsure how to utilize inspection data
- ☹ Unsure of asset condition (e.g., remaining life)
- ☹ Leave inspection matters to contractors



Voice of A-MIS Users

- 😊 Able to reduce more than 50% MH and expenses and increased efficiency. I will highly recommend this system.
- 😊 How useful! A-MIS can visualize equipment, piping condition directly on drawing. I wanted to know A-MIS system earlier.
- 😊 A-MIS makes us find suspicious inspection point easily. Reliable data made it possible to plan next inspection more accurately. Now I can cut out excessive cost for maintenance inspection work.

A-MIS developed with our experience and users' feedback!



Implementation Steps and Our Strength

- * Maintenance Business Analysis
- * Engineering Data Collection

STUDY



- ✓ Experts of asset integrity management, unlike an IT vendor.

- * Cleansing Data
- * Develop initial data plan
- * Insp. plan & procedure

DEVELOP



- ✓ Full range of Asset Integrity Management Risk Assessment, Inspection Planning, Corrosion Management, Shutdown Inspection Support, etc.

- * A-MIS Set-up
- * Initial data input
- * Data migration

SET UP



- ✓ Digitalized historical data stored in A-MIS for better asset management.

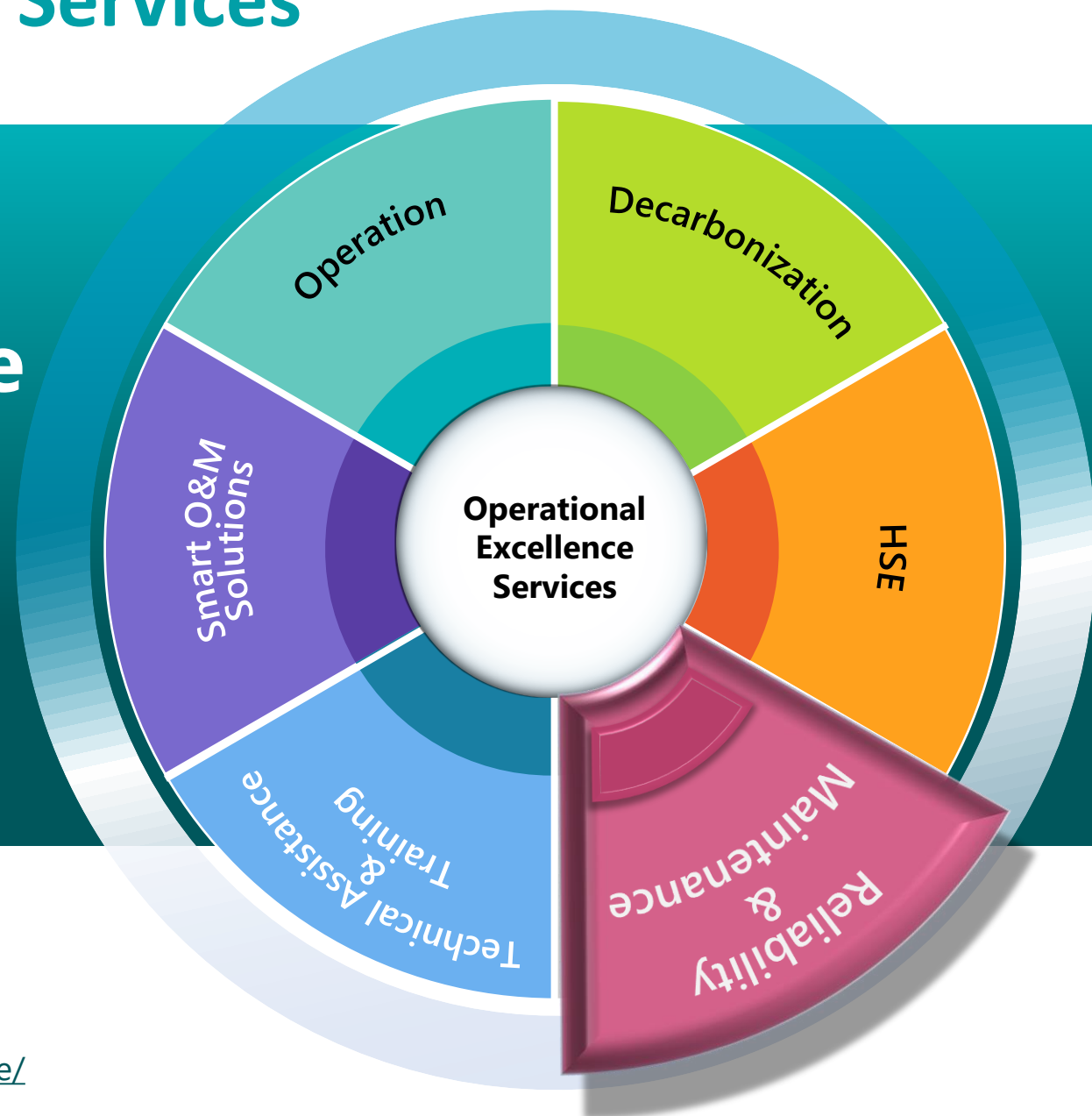
DELIVER





Operational Excellence Services

Reliability & Maintenance Plant Life Extension Program (PLEP)



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Plant Life Extension Program (PLEP)

Do you have any issues about plant materials ?

☹️ **Plant Aging**

Approaching the lifespan, material degradation is accelerating...

☹️ **Operating Condition Changing**

Conditions becoming more severe, deviating from the design range...

☹️ **Competitiveness Stagnating**

O&M cost increasing, maintenance intervals shortening...

PLEP Solutions

- Identification of facility and locations having materials and inspection concerns
- Suggestion of practical and economical solutions to solve the concerns
- Projection of revamp work, inspection and maintenance work, etc., to extend plant life

Example of issue:

Furnace tube bowing

○ Cause

Bowing on the specific location

→ Main cause: coking

○ Countermeasures

- Periodical IR Monitoring (Hot Spot Monitoring)
- Periodical Pigging
- Visual, DPT, UTM, Creep/PI.Tape, PMI, Hardness, etc.

○ Recommendation for Life Extension

- To measure circumference length on bowed and sound tube periodically in order to assess the creep in every shutdown.
- CFD modeling and consultation may be an option for detailed assessment.

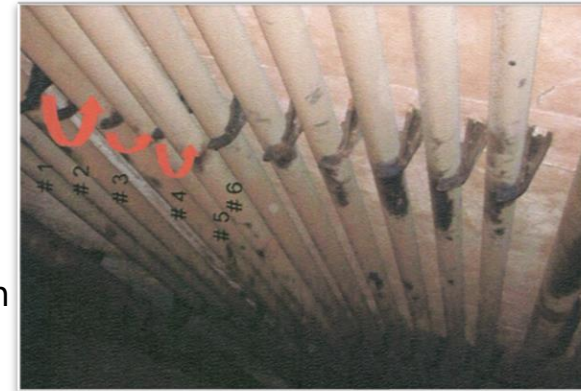
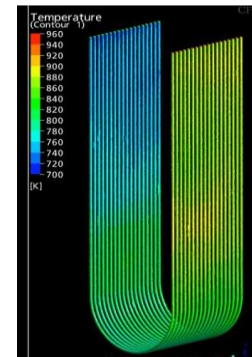


Photo: Bowing



CFD Analysis

Plant Life Extension Program (PLEP)

PLEP for preventing troubles in advance...



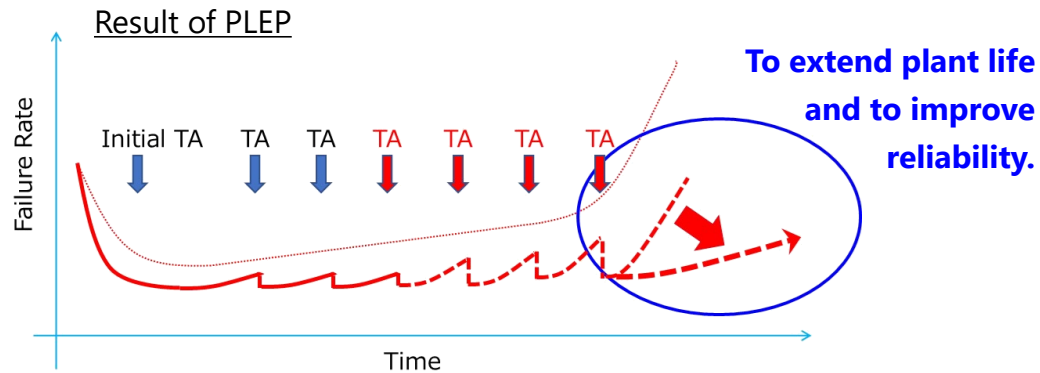
Workflow & Result

1st Step - Plant Integrity Assessment (PIA) : Finding / Screening

- ✓ Assessment of materials selection, inspection program, etc.
- ✓ Site visit and discussion with client.

2nd Step - Integrity Improvement Initiative (III) : Detail Study

3rd Step - Life Extension Project (LEP) : Project Development and Execution

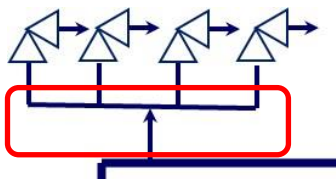


Our Strengths

- ✓ **One-stop** service of engineering, construction and maintenance services to make convenient for client
- ✓ **Practical and efficient** approaches including workshops and site observations will provide best solutions
- ✓ **Easy** methods without special software will avoid client burden
- ✓ **Flexible** program will run along with client's demands to the goal.

Our Experience

- **CDU/VDU, Asia**
83 findings / 22 recommendations
- **Gas Processing Unit, Middle East**
116 findings / 34 recommendations
- **GOSP, Middle East**
88 findings / 7 key recommendations



✓ TML setting at RV manifold

<Finding>
Severe condition is expected because of stagnant condition.

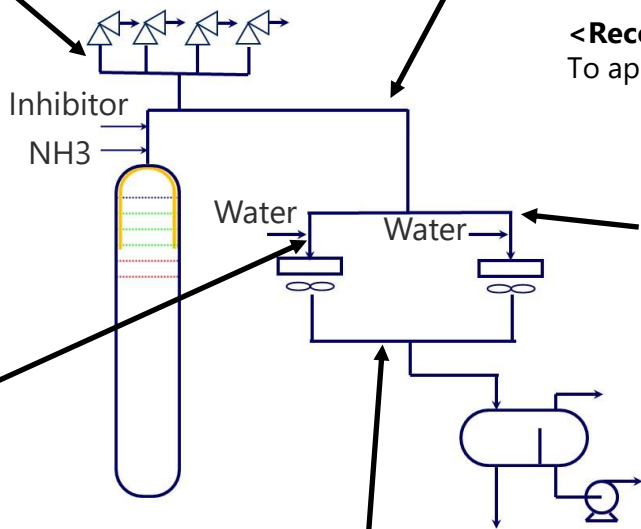
<Recommendation>
To set thickness measurement locations (TMLs) around the manifold.



✓ Flow-meter trouble

<Finding>
Flow-meter malfunctioned, and flow rate could not be measured

<Recommendation>
To fix the flow-meter and to adjust proper injection rate.



✓ Hot insulation setting

<Finding>
Due to inadequate length of hot insulation, corrosive water condensed, and it induced severe corrosion.

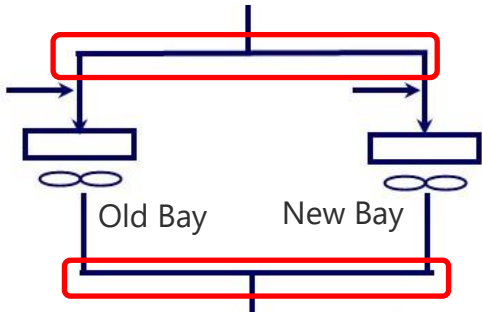
<Recommendation>
To apply hot insulation.



✓ Assessment of flow distribution

<Finding>
The actual corrosion rate is significantly different between old and new bays (condensers), and it suggests uneven flow distribution.

<Recommendation>
To conduct flow distribution analysis.



✓ TML setting at condenser downstream

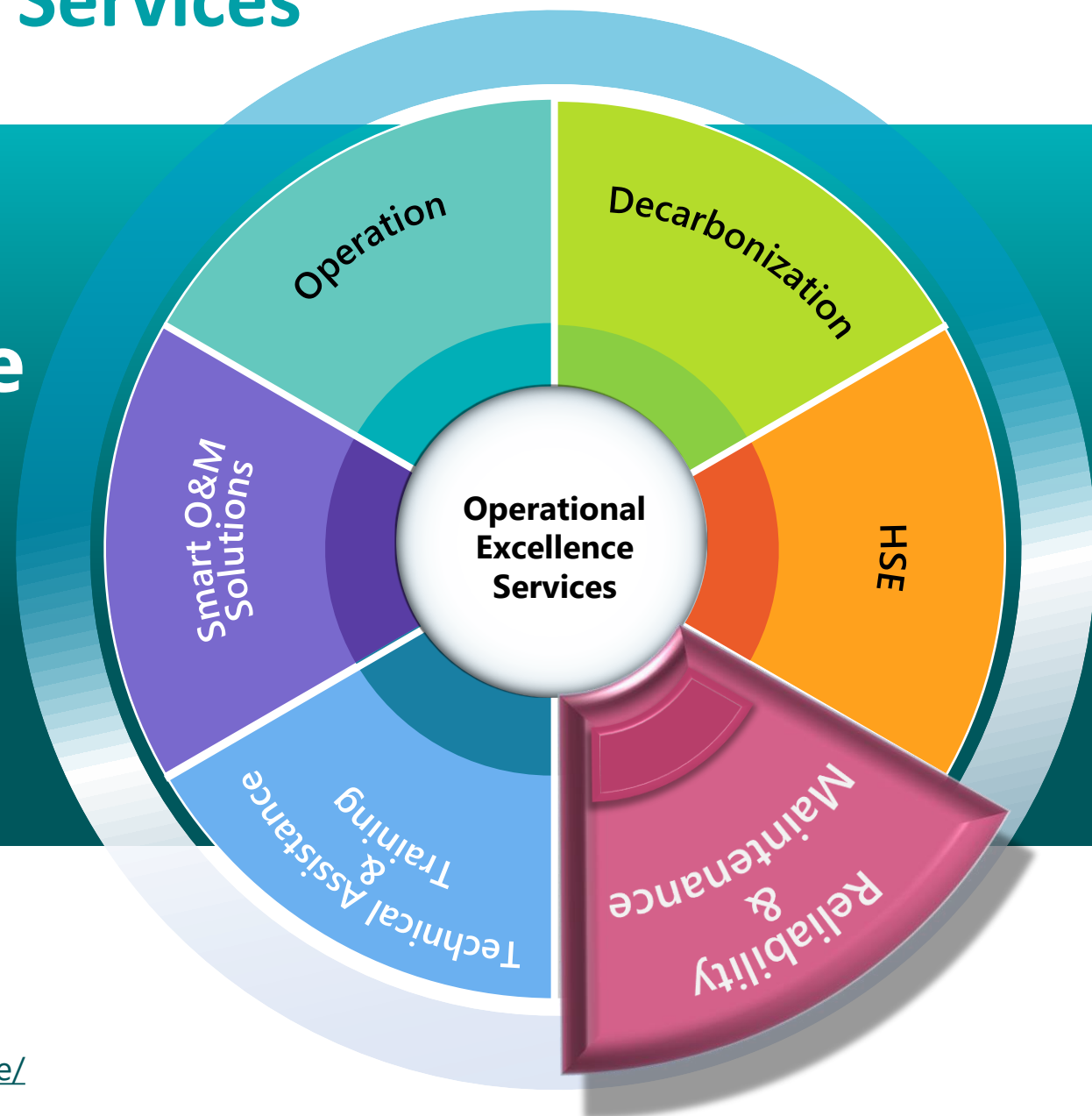
<Finding>
Corrosion monitoring device is installed, but thickness measurement location was not set.

<Recommendation>
To add thickness measurement locations to monitor actual corrosion rate. This can also check the efficiency of corrosion inhibitor and NH3 injection at upstream.



Operational Excellence Services

Reliability & Maintenance Plant Diagnosis and Lifetime Improvement Service



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

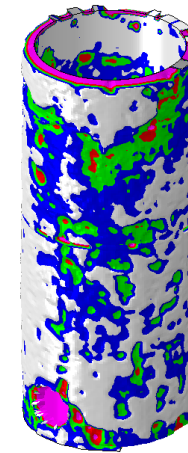
Do you have any of these issues?

- ☹️ **Mechanical damage occurred!**
Can we continue operation? Should we replace?
- ☹️ **What is the root cause?**
- ☹️ **Which improvement plan is the most efficient?**

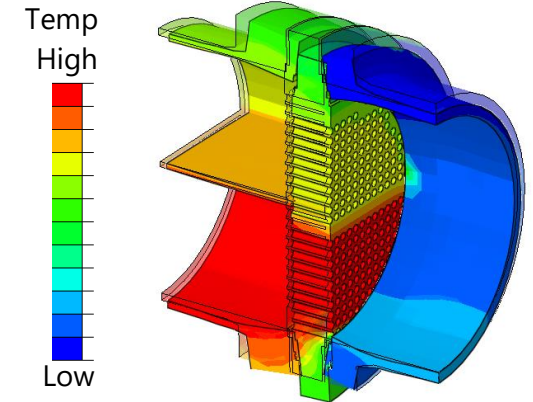
PLANT PLUSSM Solution

- JGC's simulation-based engineering service
- Investigate the root cause of the mechanical damage
- Diagnose whether a damaged equipment can continue operation or should be reinforced, revamped partially, replaced totally
 - Leads to reduced cost of repair/revamp
- Propose effective improvement/reinforcement plan

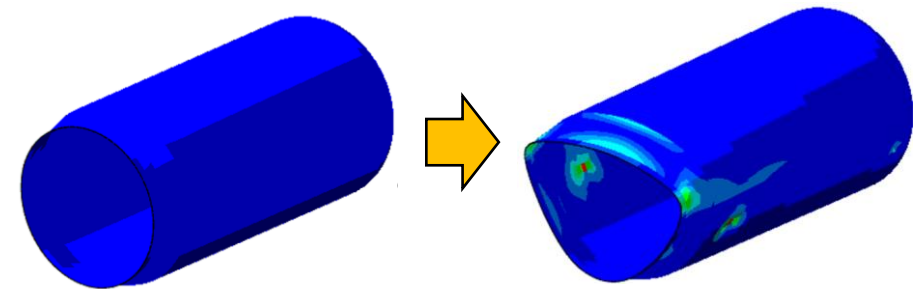
Examples of Finite Element Analysis (FEA)



(1) External Corrosion
Analysis Model by Laser Scanning

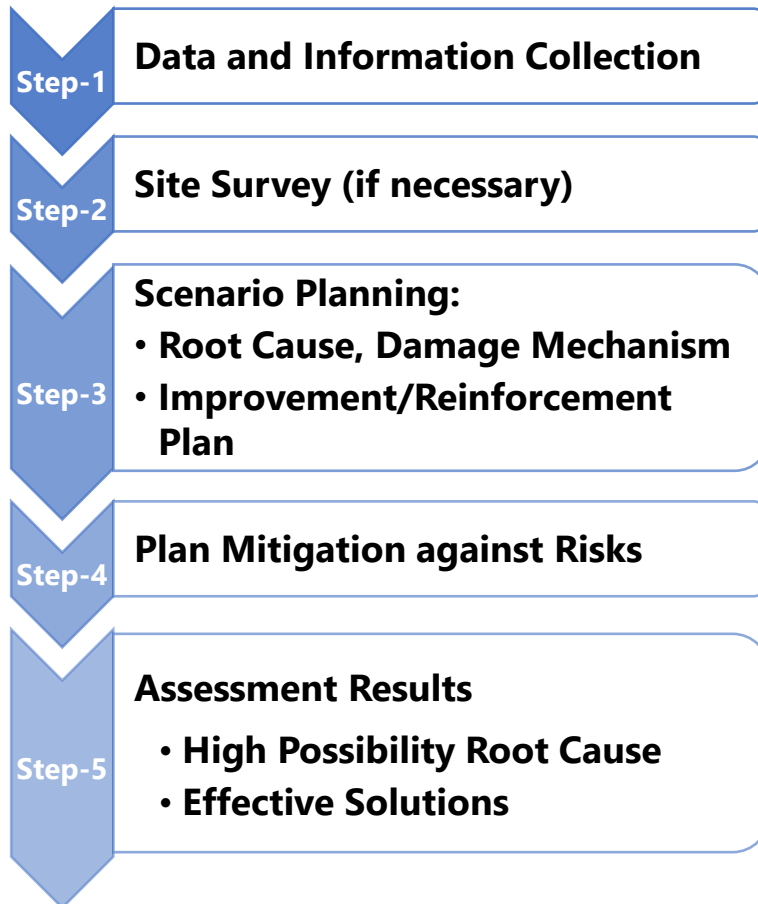


(2) Flange Deformation
due to Temperature Distribution

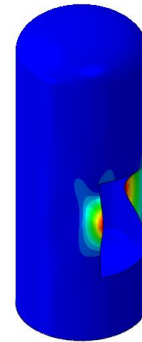


(3) Creep Deformation of Vessel during PWHT

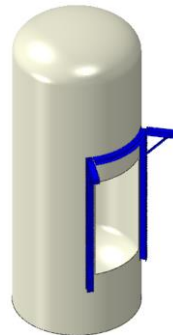
Workflow & Result



Example: Large opening discovered during Turnaround



Assessed buckling risk for vessel with large hole



Proposed reinforcement plan

Our Strengths

- Diagnosing from various perspectives such as international design codes, fitness-for-service codes, post construction codes, guidelines often used in the plant industry, and JGC's own company standards
- Providing quantitative and easy-to-understand study results and countermeasures using structural analysis techniques such as finite element analysis (FEA)

Our Experiences

1000

Plant Diagnoses

Structural analysis technology, computational fluid dynamics technology and noise assessment/control technology for 1,000+ diagnoses

50+

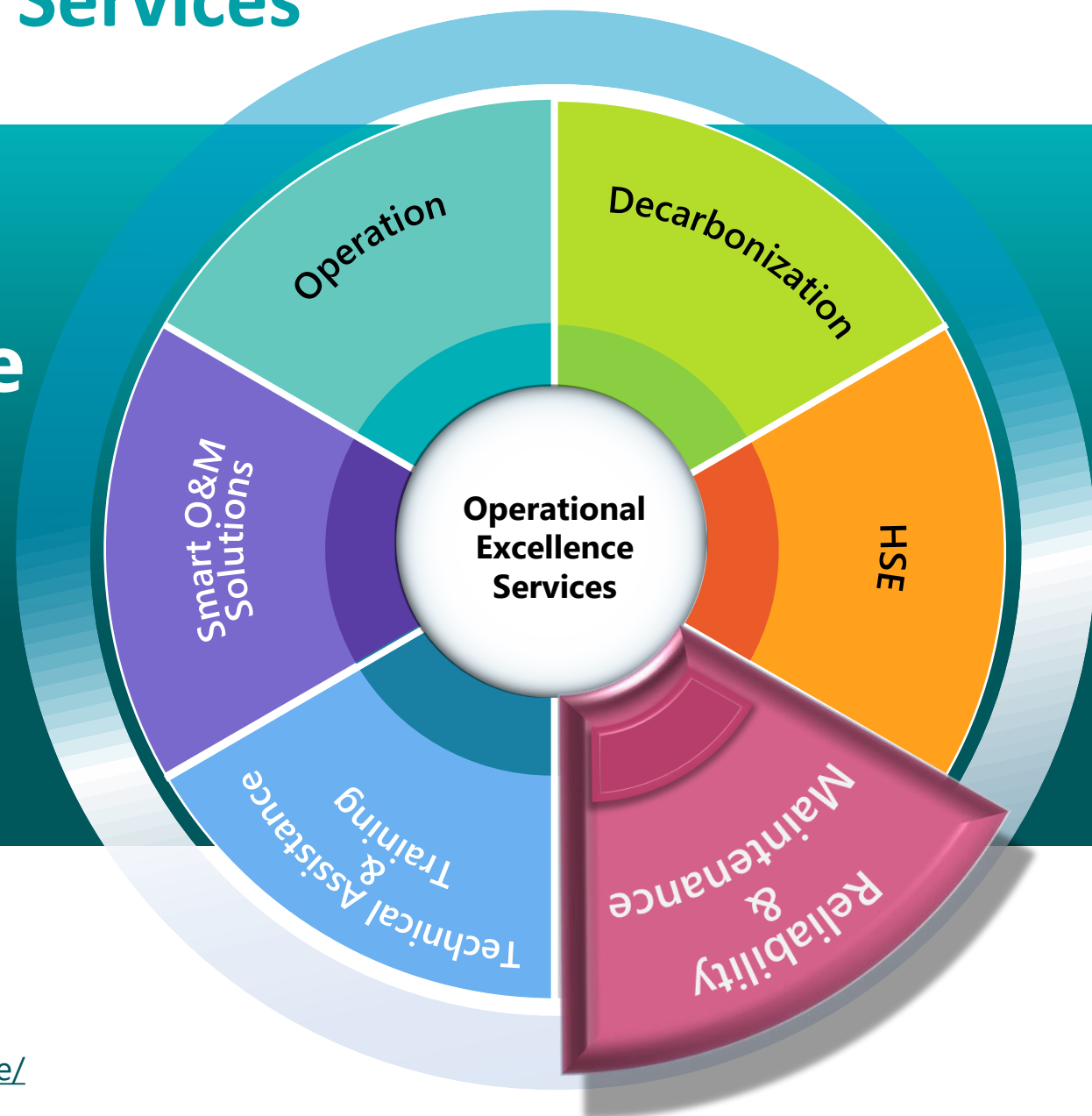
Years

Simulation-based engineering service for plant diagnosis and lifetime improvement



Operational Excellence Services

Reliability & Maintenance Turnaround Scope Optimization & Planning



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Turnaround Scope Optimization & Planning

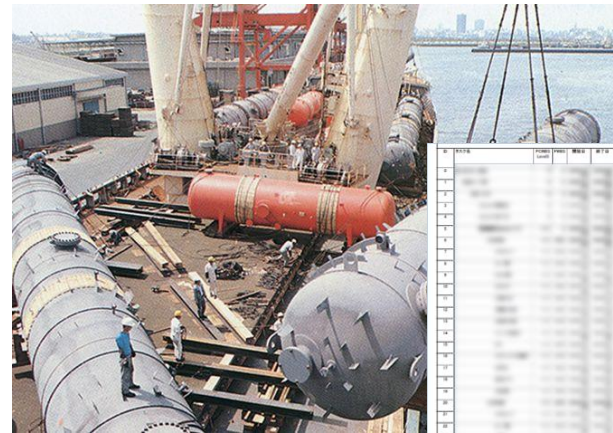
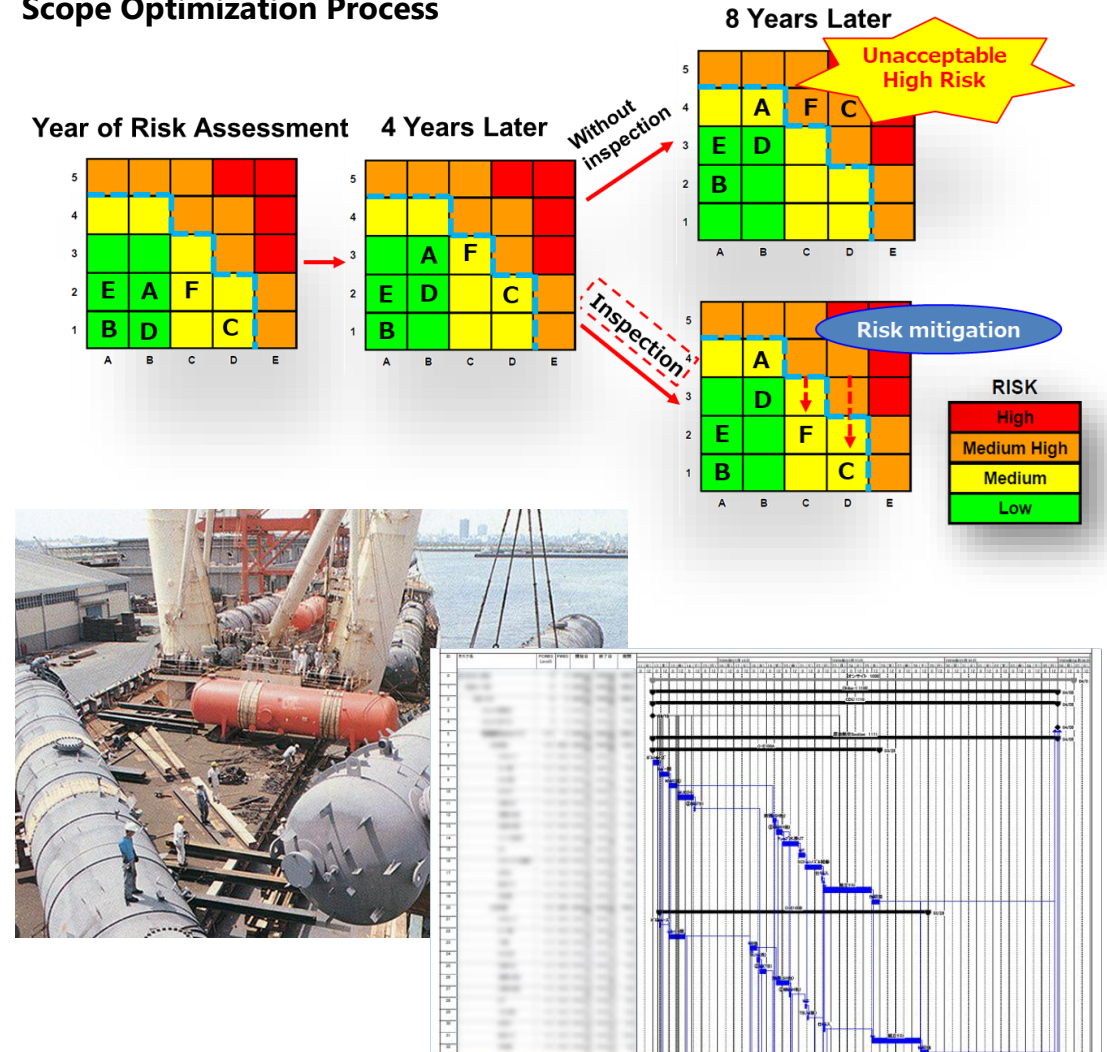
Do you have any of these issues?

- ☹️ **Many reliability incidents during operation**
- ☹️ **High turnaround maintenance cost**
- ☹️ **Fail to achieve Solomon First Quartile Target**

Turnaround Solution

- Setting of turnaround leadership and steering team
- Risk based process of maintenance and inspection work scope definition by multi-disciplined team
- Comprehensive review process for high cost/long duration items to find lower cost/shorter duration alternatives
- Setting milestone based on turnaround complexity

Scope Optimization Process



Turnaround Scope Optimization & Planning

Turnaround Planning Process

- **Turnaround (TA) planning starts 12 months prior to turnaround (for Medium / High Complexity TA)**

- 12 to - 10 months

Basic Maintenance & Inspection Planning

- **Develop TA execution plan** based on turnaround strategy and finalized work scope
- **Develop inspection plan** based on inspection strategy
- **Bidding for long lead item**
- **Provide cost information** for budget

- 9 to - 7 months

Procurement and Contract Preparation

- **Procurement plan**
- **Preparation of job package** for service contract
- **Specification preparation** for material procurement
- **Contracting for major services**
- **Ensuring availability of specialty service** e.g., refractory specialist

- 6 to - 2 months

Detail Implementation Planning

- **Develop detail work steps and resource requirement** to finalize timeline chart
- **Issue TA Schedule** with Critical Path works
- **Detail cost forecast** to be provided

Our Strengths

- Professional Maintenance Engineer Teams
- Global resources
- Practical application of Risk Based Work Selection process such as RCM and RBI
- Rigorous turnaround readiness review methodology
- So many experience of turnaround planning

Our Experiences

Executed Project

40+ Cases

Turnaround Scope Optimization & Planning

Return to
Reliability &
Maintenance menu

Background:

A Refinery in Southeast Asia encountered some difficulties in managing hot spots in several sections and some damage at air lift pipe and air rings in regenerators of the RFCC unit after their completion of the second Turnaround & Inspection (T&I).

Objective:

The third turnaround maintenance work is itemized properly for 4 years continuous operation after turnaround.

Achievement:

JGC provided the mechanical and refractory assessment for the major maintenance work itemization for the third turnaround, and the engineering for modification of air lift pipe and air rings including root cause analysis.

Key Deliverables :

1. Root Cause Analysis of Hot Spots
2. Maintenance Planning Worksheet (Mechanical/Refractory)
3. Location Map of Major Work (Mechanical/Refractory)
4. List of Major Spare Parts
5. Method Statement of Critical Work
6. Preliminary Scaffolding Assembling Plan

Sample Deliverables



Reference Services

FCC Unit in a Refinery Complex in Middle East

- ♦ 2010 - 2011 : T&I Planning and Execution Support at site
- ♦ 2015 : T&I Execution Support at site
- ♦ 2018 : T&I Planning
- ♦ 2025 : T&I Planning & Execution Support at site

RFCC Unit in a Refinery Complex in Southeast Asia

- ♦ 2016 - 2017 : T&I Planning

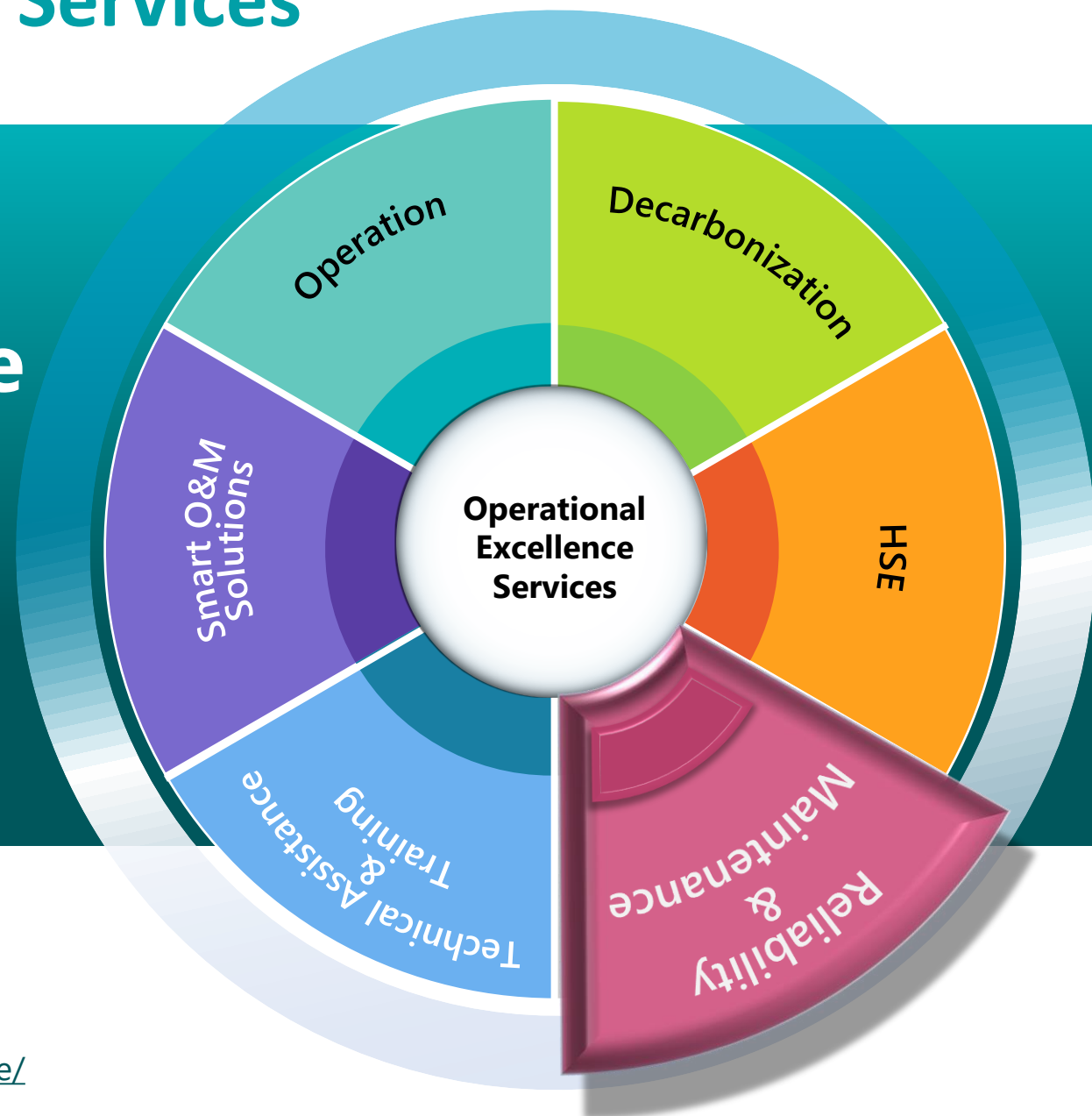
Gas Processing Plant in Middle East

- ♦ 2022 – 2024 : T&I Planning and Execution Support at site



Operational Excellence Services

Reliability & Maintenance Turnaround Execution Management



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

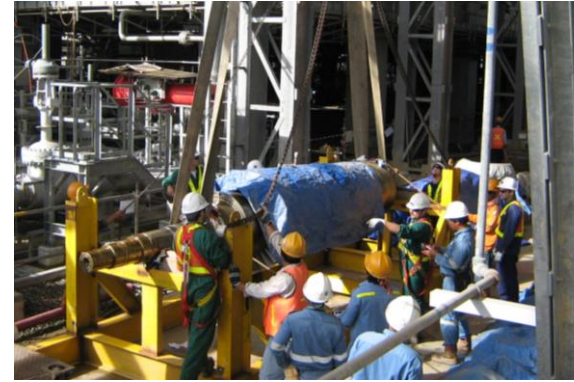
Turnaround Execution Management

Do you have any of these issues?

- ☹️ **Fail to achieve turnaround targets**
 - ✓ **Safety, Schedule and Cost**
- ☹️ **Lack of experienced execution workforce**
- ☹️ **Shortage of frontend supervisors**

Turnaround Solution

- Management and planning approach using proven methodology
- Detailed work procedures which include description of potential hazard of the work
- Involvement of frontline supervisors in detailed planning of the critical works
- Dedicated coordinators for high-risk works (e.g., inert entry work, critical lifting, etc.)



Turnaround Execution

Work Pack

Web based Advanced Work Pack creation, linked directly to all Connect Modules, removing system interfaces and duplication of work

Completions

Paperless Systems Completion, bridging the gap between construction and commissioning

Progress Tracker

Visible tracking of progress for all phases of Projects, Turnarounds and Operations

Materials Manager

Material and inventory management, linked directly to your Work Pack for seamless material readiness

Joint Integrity

QR driven Bolted Connection management, delivering control, traceability and accountability

SIMOPS

4D scheduling, linking your existing 3D model directly to your plan

Turnaround Work Progress Management System

Turnaround Execution Management

Return to
Reliability &
Maintenance menu

Turnaround Safety Management

■ Drastic cultural change in behavior-based safety



Adaptive Challenge

- Attitude
- Belief
- Intention
- Culture
- Commitment
- Responsibility
- Behavior
- Clarity
- Understanding



Our Strengths

- Abundant experience in turnaround project execution
- Professional maintenance management teams
- Global resources
- Incident & Injury Free (IIF®) culture (Behavior-based safety)
- Advanced work progress management system

Our Experiences

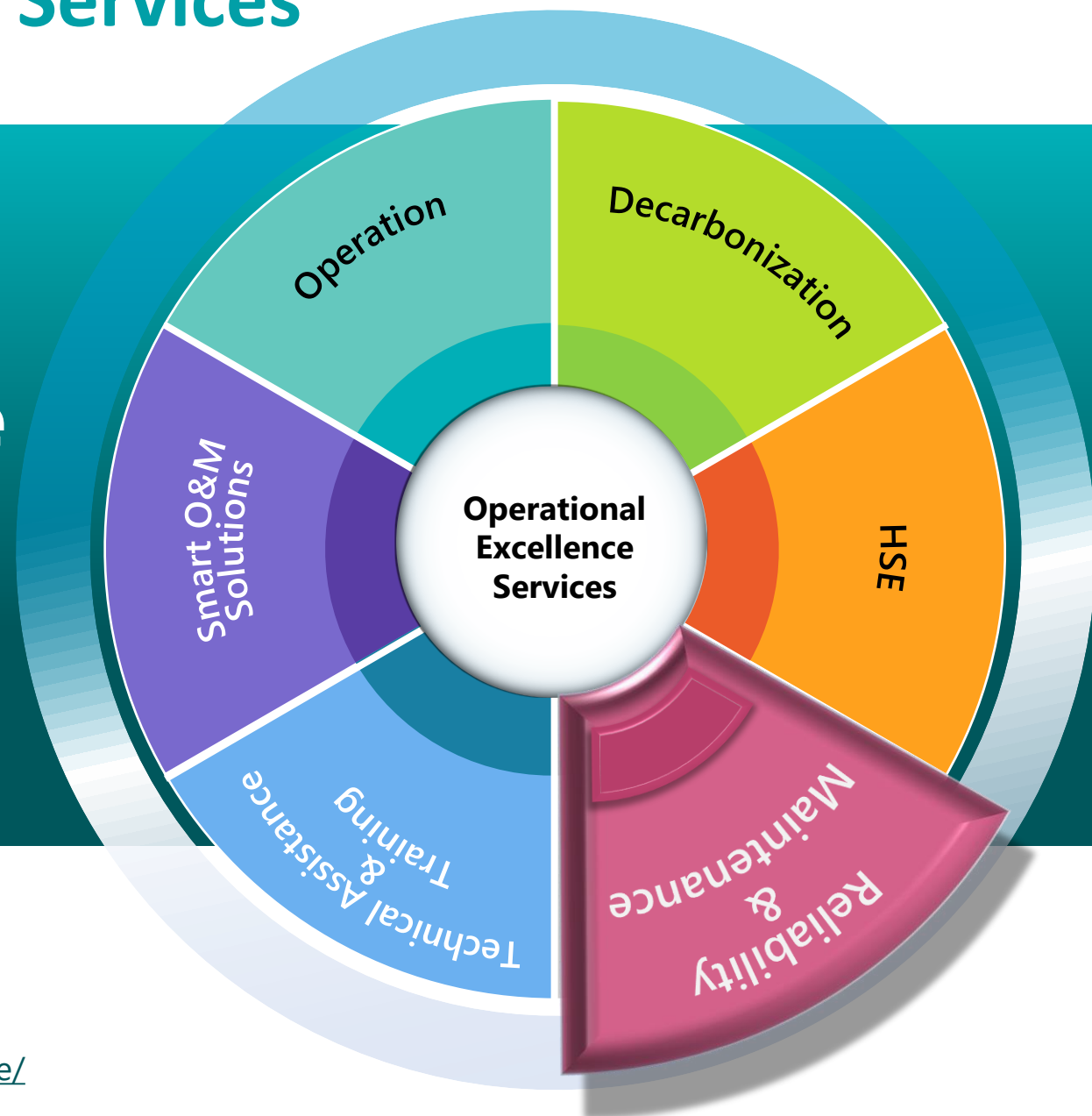
Executed
Project

40+ Cases



Operational Excellence Services

Reliability & Maintenance Inspection & Diagnosis



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

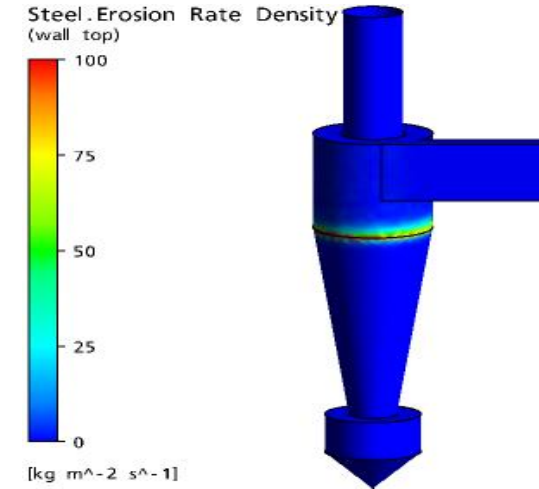
Inspection & Diagnosis

Do you have any of these issues?

- ☹️ **Need to enhance mechanical integrity of process equipment and piping system**
- ☹️ **Lack of experienced inspection and diagnosis engineers**
- ☹️ **Need engineering support during turnaround**

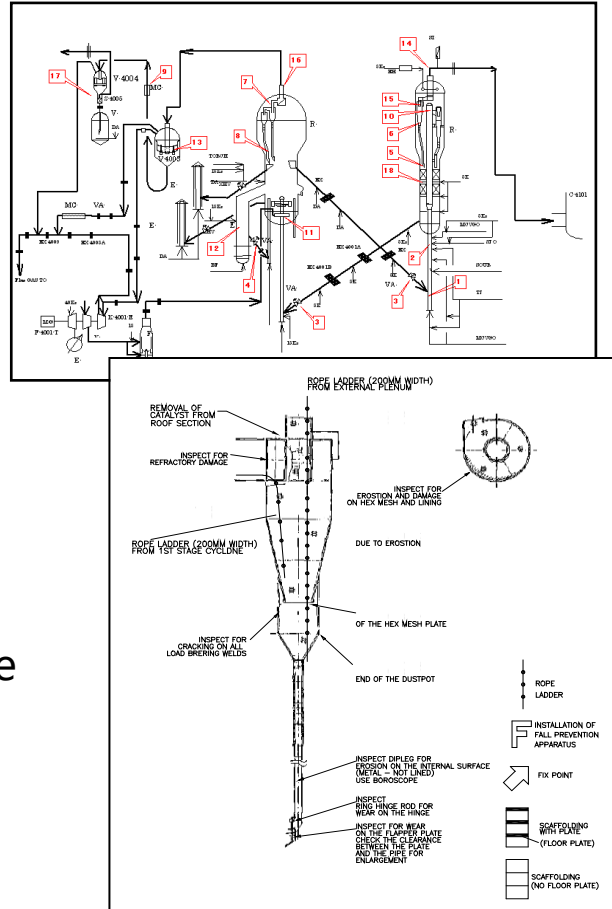
Turnaround Inspection Solutions

- Prioritized inspection planning, reliable inspection execution and practical repair engineering
- Cutting edge simulation technologies and experienced specialist for complex process degradations evaluation
- Use of advanced NDT technologies to fit for purpose
- "Fitness for Service" assessment by experienced engineers.



Turnaround Inspection

- Develop inspection plan based on type of degradations before turnaround
- Inspection related preparation work arrangement
 - ◆ Scaffolding and ladders
 - ◆ Surface preparation for NDT
- Preparation of NDT service package for contract
- Inspection Record Management System



Our Strengths

- Abundant experience in turnaround inspections
- Experienced and qualified inspectors (API 510, API 570, API 936, etc.)
- Simulation with Computational Fluid Dynamic (CFD)
- Fitness for Service assessment by experienced engineers

Our Experiences

**Executed
Projects**

40+ Cases

**Data
Analysis**

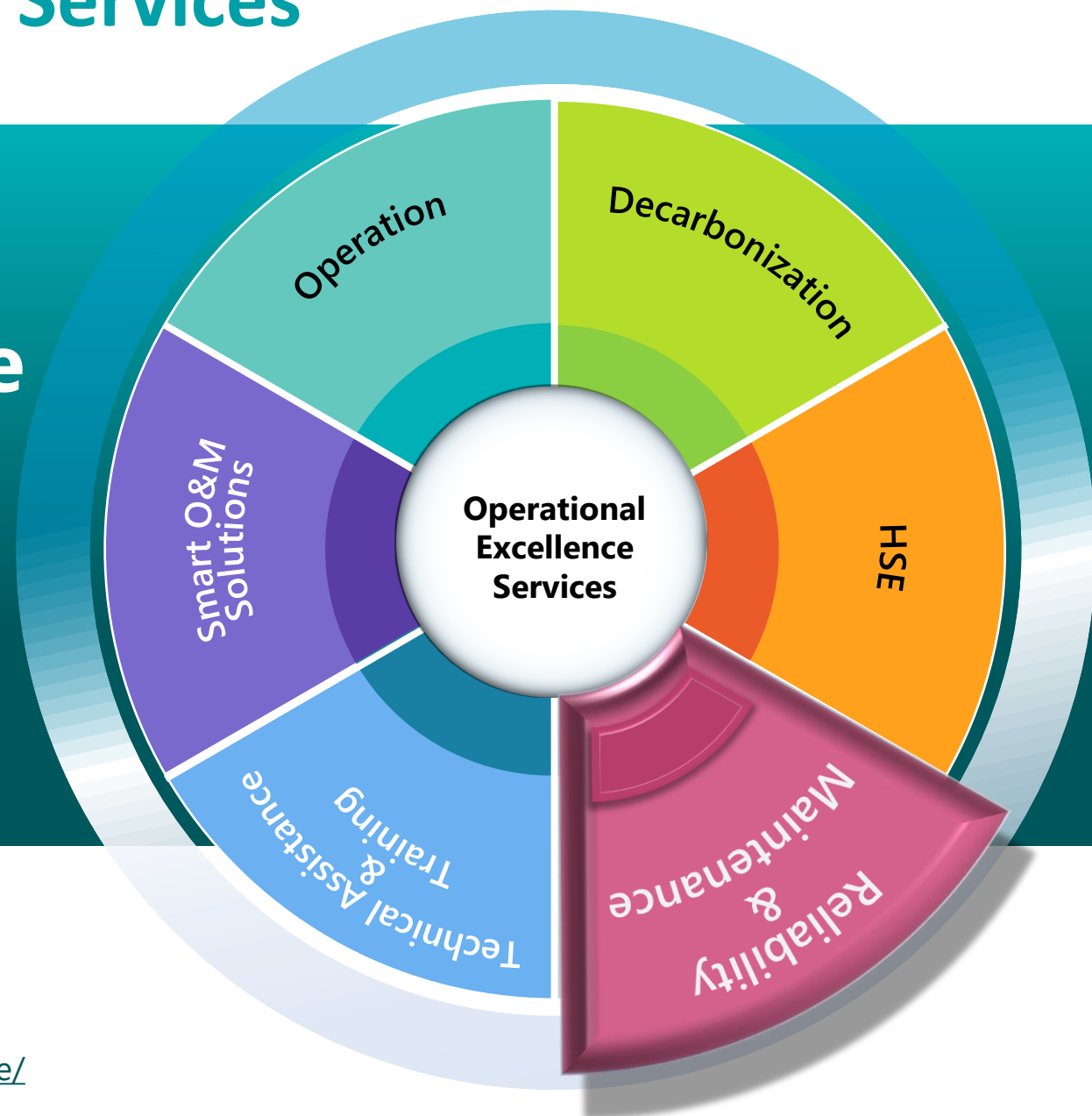
100+ Facilities



Operational Excellence Services

Reliability & Maintenance

Reliability, Availability,
Maintainability (RAM)



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

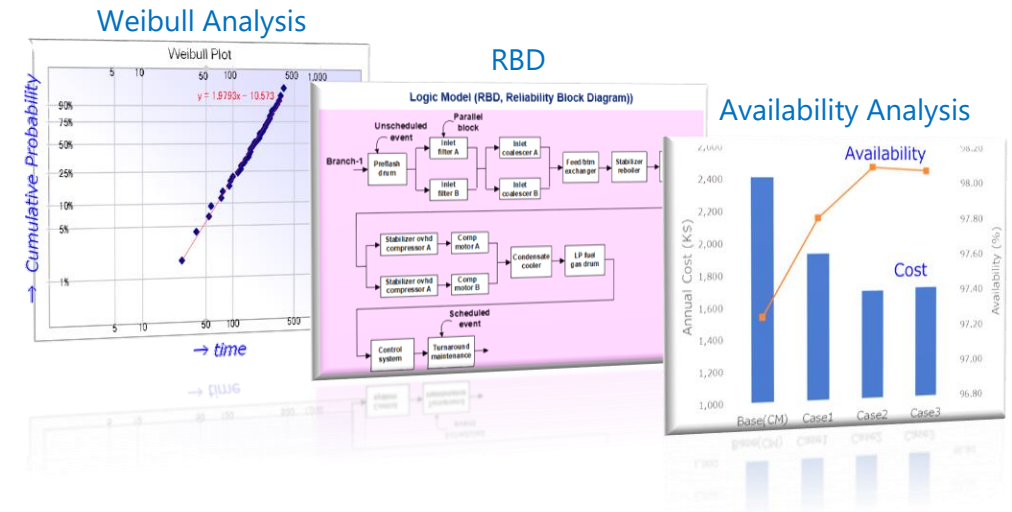
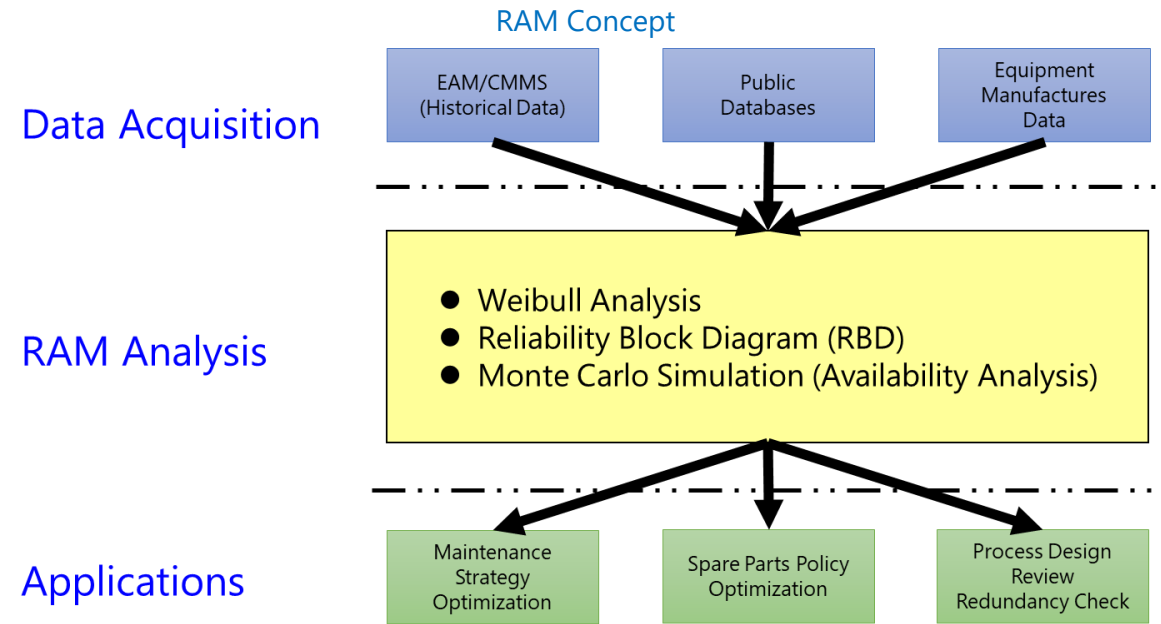
Reliability, Availability, Maintainability (RAM)

Do you have any of these issues?

- ☹️ **No appropriate answer to the conflicting demands of "maintaining the reliability of equipment" and "reducing maintenance costs"**
- ☹️ **Unable to see opportunities for improvement in reliability from data accumulated in CMMS/EAM**

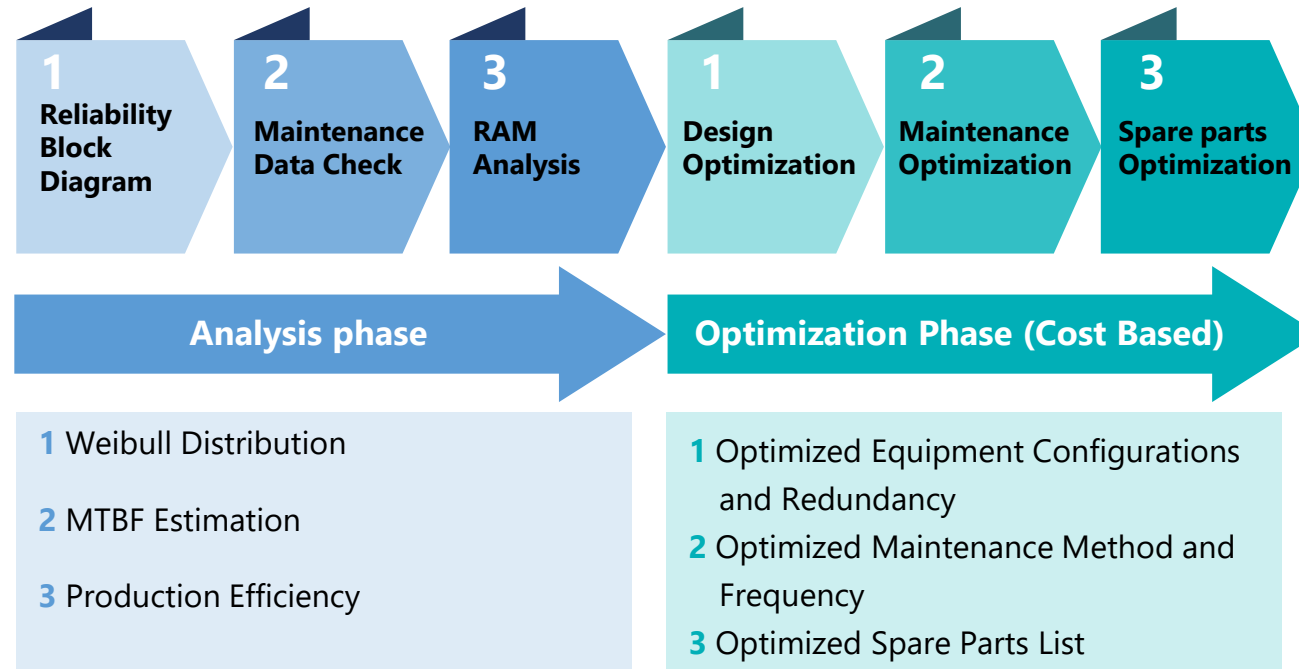
RAM Solution

- Evaluate the current reliability of facilities based on valuable historical data, which are accumulated at EAM/CMMS.
- Select optimal maintenance measures while balancing the reliability of equipment and maintenance costs.
- Establish a strategic PDCA cycle in the operation and maintenance organization



Workflow & Results

JGC's RAM Study Steps



**2-3 months for Unit (e.g., CDU, FCC)
Critical Equipment : Approx. 70 sets**

Our Strengths

- Building an appropriate RAM analysis model based on process engineering knowledge
- Collection of the appropriate reliability data and optimization proposals based on the knowledge of operations and maintenance experts
- Best method approach by combining internal and external resources to meet clients' needs and objectives

Our Experiences

20+
Cases

Not Only O&M phase, but also
FEED and EPC phases.

**Various
Type of
Facilities**

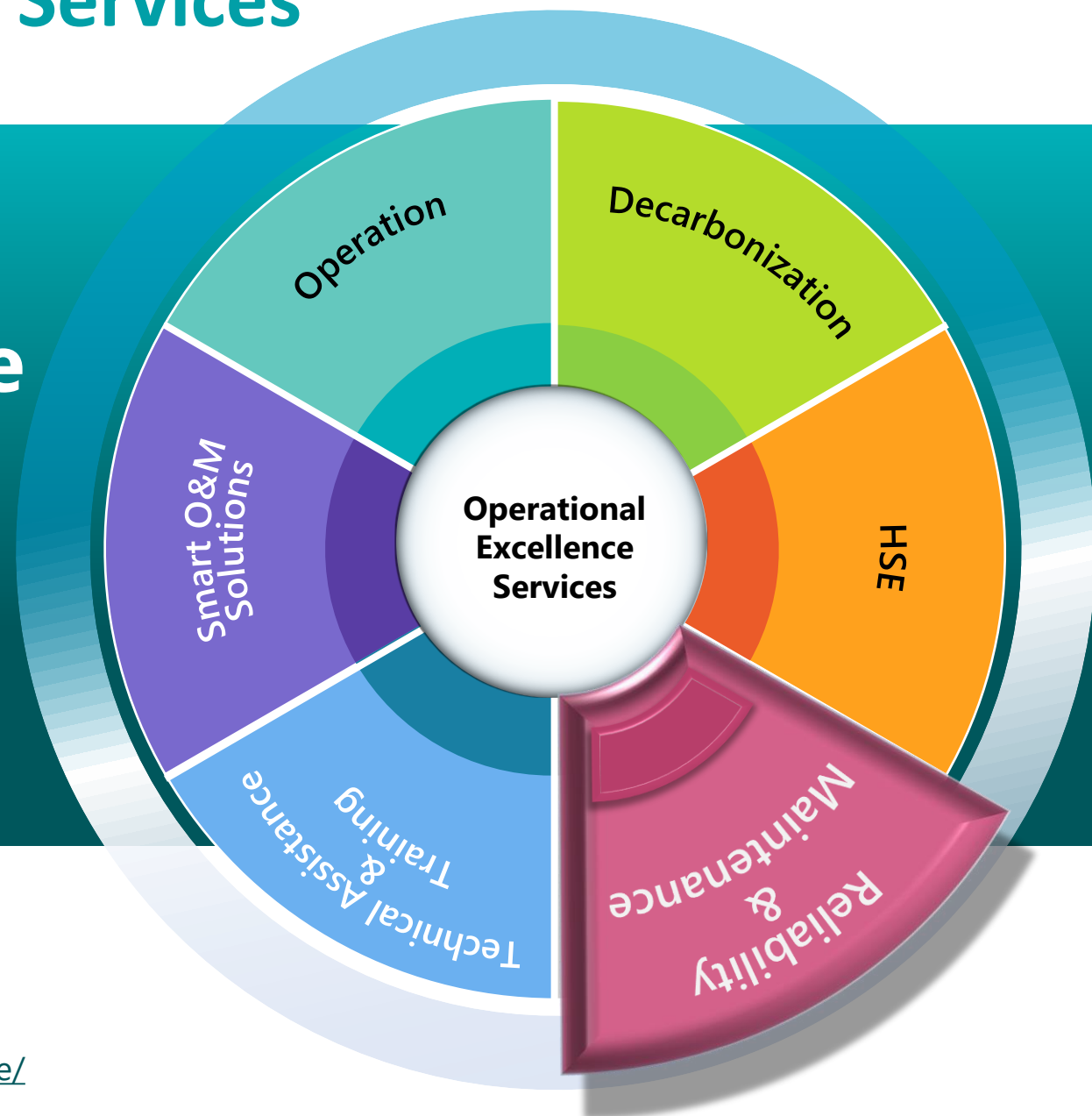
Refinery
Gas Processing
LNG
FLNG,
LNG Terminal, etc.



Operational Excellence Services

Reliability & Maintenance

Reliability Centered Maintenance (RCM)



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

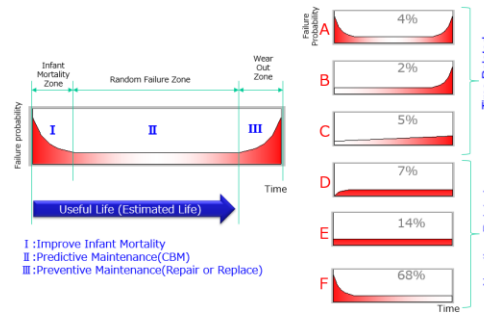
Reliability Centered Maintenance (RCM)

Do you have any of these issues?

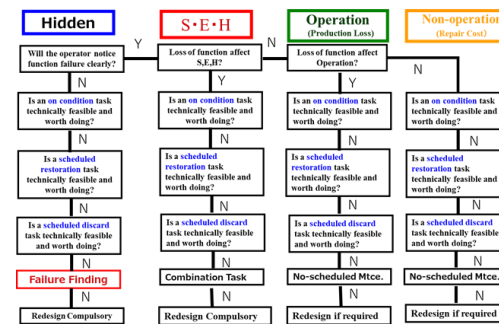
- ☹ **Many unreliability events**
- ☹ **Constant unrequired maintenance work**
- ☹ **High maintenance cost**

RCM Solution

- Determine the optimal failure management strategies for all equipment including risk base approach.
- Provide sustainable Predictive and Preventive Maintenance tasks
- Prevent Functional Failure for Required Function of equipment
- Mitigate Safety, Environment, Production and Asset damage risks

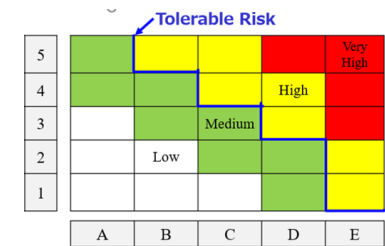


Analyze detailed failure pattern

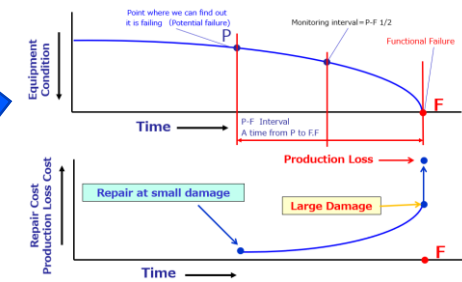


Decision Diagram
Consider Maintenance Tasks

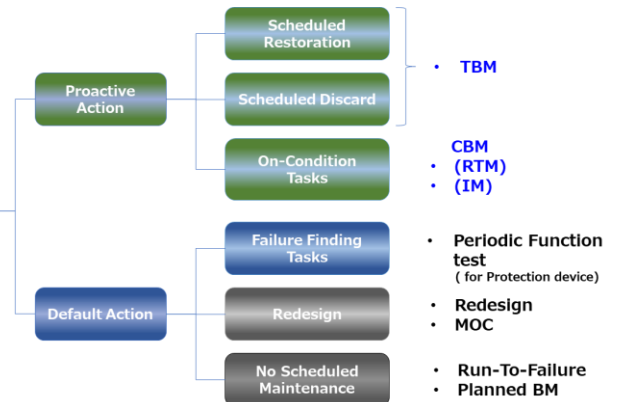
Maintenance



Risk Matrix Assessment

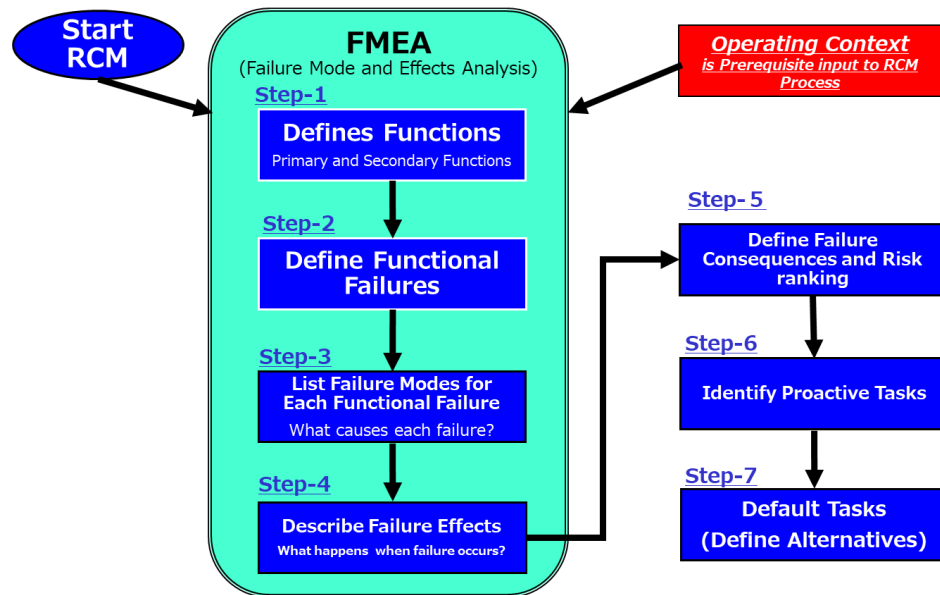


Consider Condition Monitoring



Delivered appropriate Maintenance Tasks

Workflow & Result



- Analyze Equipment Criticality to prioritize RCM study level
- Organize cross-functional RCM study team
- Define Operating Context including desired performance, legal requirement, integrated operating window, safety hazard, etc.
- Start RCM study depend on RCM work steps
- Identify Function, Functional Failure, Failure Mode, Failure Effect, Consequence and Risk ranking
- Identify Failure Management Tasks to prevent required Functional Failure

Our Strengths

- Professional Process & Material Engineer Teams
- Global experiences and performances on Risk assessment, Inspection planning, On-site Inspection.
- Integrating JGC many years of inspection and plant design experience to achieve lower inspection costs and longer plant life
- Collaboration between overseas EPC-capable group companies and local maintenance companies.

Our Experiences

15+
Projects

RCM Study serviced
for over 10 projects

Worldwide
Achievement

RCM Experience in Far East,
Middle East, Southeast Asia,
Africa, North America



Operational Excellence Services

Technical Assistance & Training

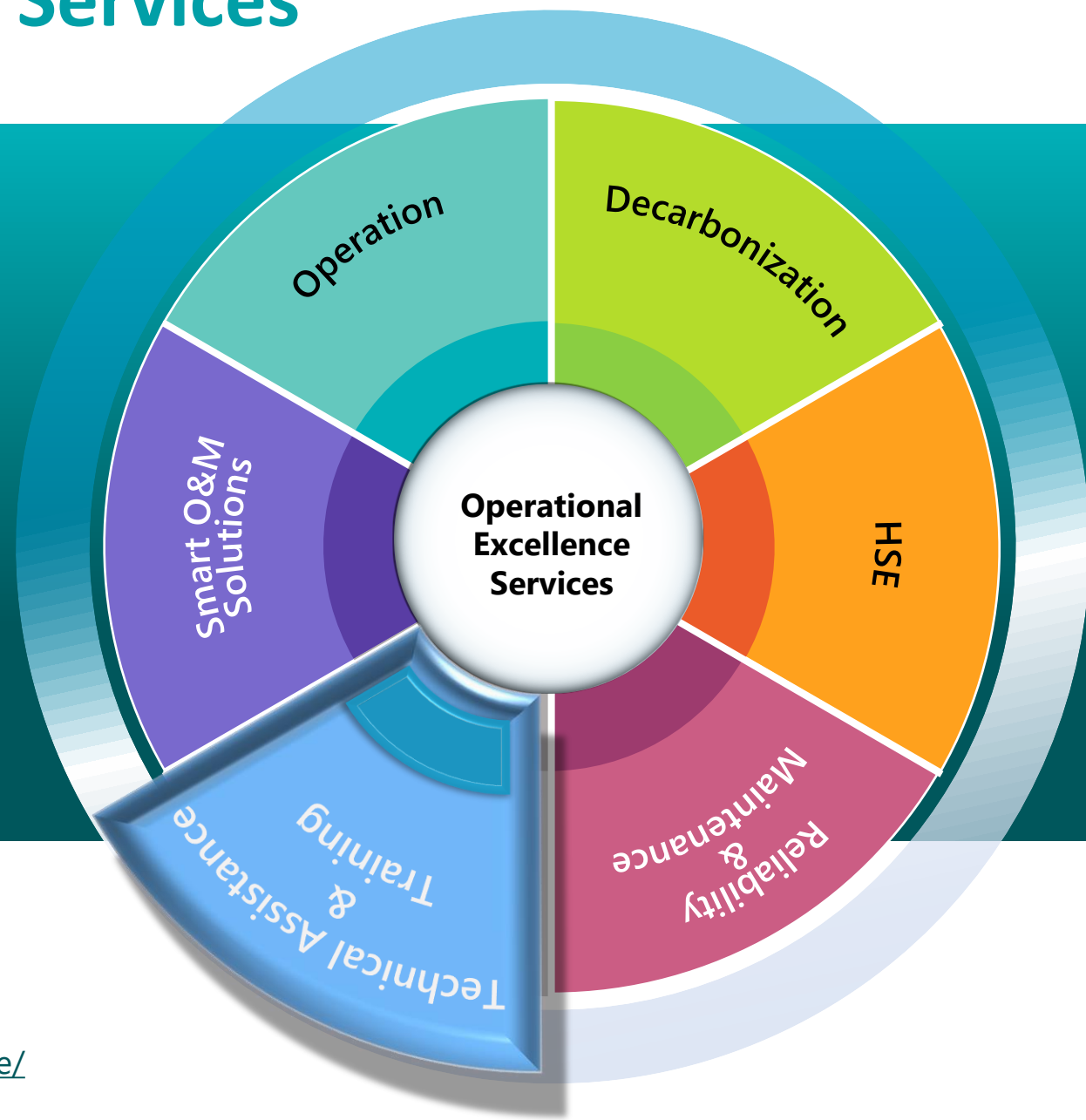
Onsite Assistance
(Residential/On-call)

Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>



Onsite Assistance (Residential/On-call)

Do you have any of these issues?

- ☹️ **Lack of experienced engineers and technicians**
- ☹️ **Need specific expertise**
- ☹️ **Need technical problem-solving teams when in trouble**

Our Solutions

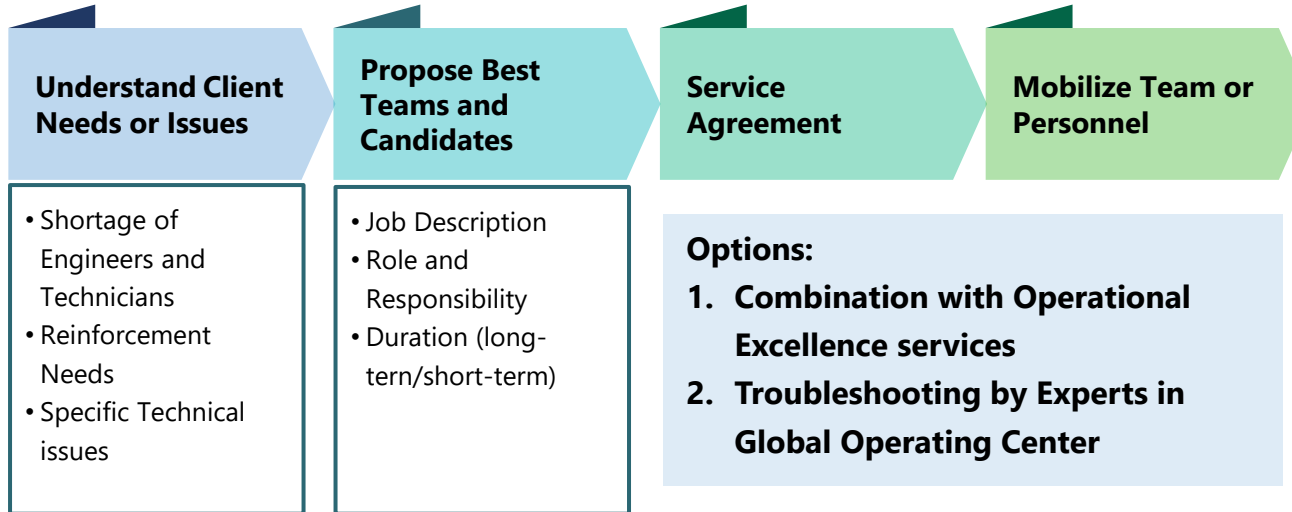
- Dispatch customized teams, experts, and operation and maintenance staff to the operation site to meet the client's needs.
- Select the most suitable resources from JGC network for client's situation over a long period of time or even within a short period of time.
- The dispatched teams and crew will work as an integrated resource with client's operating organization, or work as an independent task force team.



Onsite Assistance (Residential/On-call)

[Return to
Technical Assistance
& Training menu](#)

Our Approach



Our Strengths

- A wide variety of global human resources networks allow flexible use of experienced and knowledgeable experts
- Cooperation with specialized teams at headquarters with expertise from various EPC and Operational Excellence services
- Stand by various experts who can solve problems quickly

Our Experiences

30+

Years in Global Market

Middle East
North Africa
West Africa
Southeast Asia

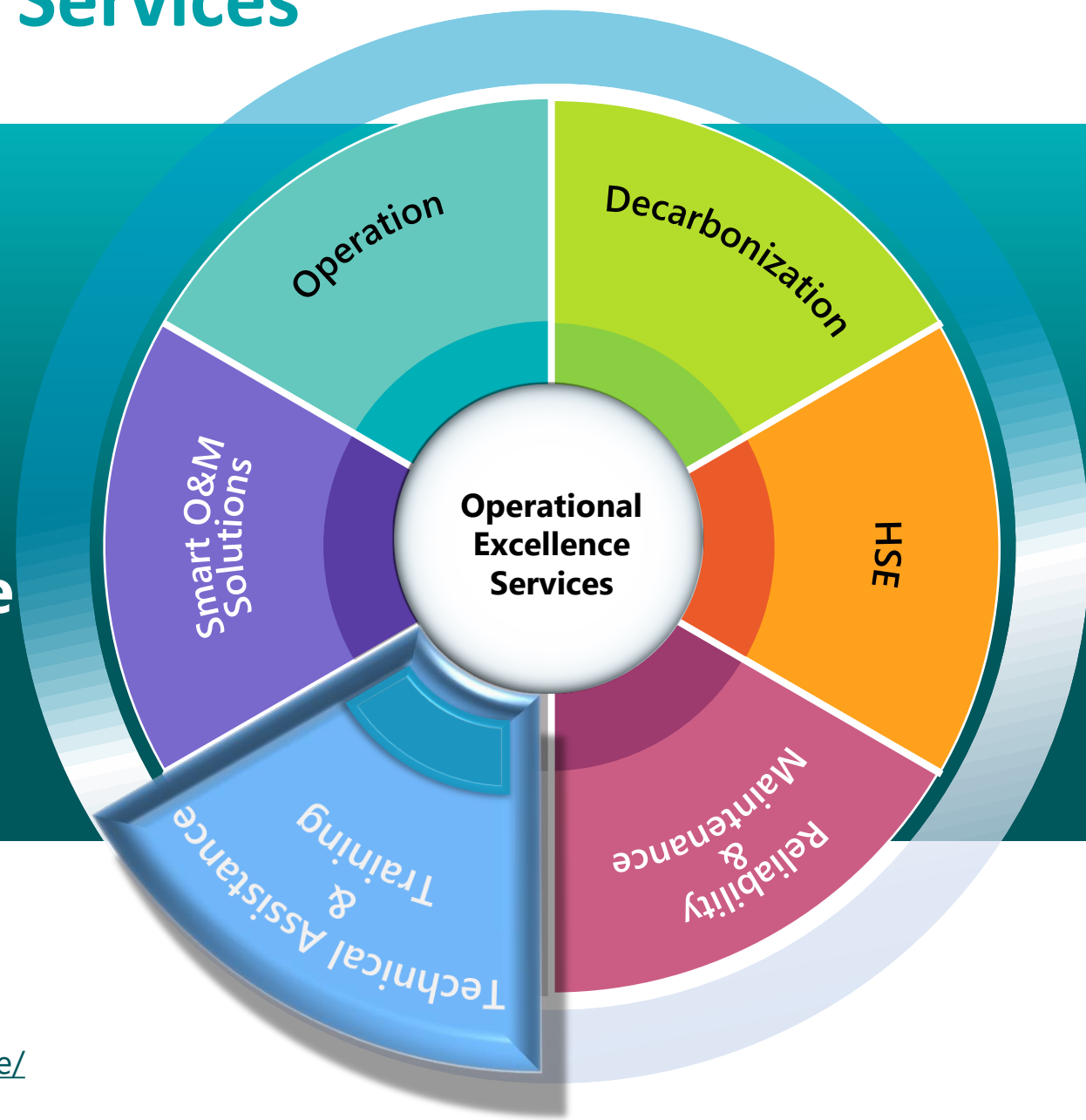
**Various
Type of
Facilities**

Gas Processing
Oil Producing
FPSO
Integrated Water, Steam,
Power Plant, etc.



Operational Excellence Services

Technical Assistance & Training Asset & Operation Due Diligence



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Asset & Operation Due Diligence

Do you have any of these issues?

- ☹️ **Considering investment for operating assets**
- ☹️ **Audit for operation and maintenance of operating assets**

Focus Areas

- **Facility design and construction** in accordance with recognized and generally accepted engineering practices
- Implementation of **Process Hazard Analysis**
- Established **Operation Manual**
 - ✓ Startup and Shutdown
 - ✓ Normal operations
 - ✓ Emergency Operations
- Deployment of **safe work practices**
- **Written procedures** for maintenance, inspections and testing
- Rigorous **quality assurance** systems
- **Training and competency** management system

Asset & Operation Management Framework

1. Management Leadership

2. Risk Assessment

4. Facility Design and Construction

5. Information & Documentation

Maintenance

3. Management of Change

7. Mechanical Integrity

8. Contractors

9. Occupation Health and Safety

Operation

6. Operation Procedure

10. Training

Emergency Response

11. Incident Investigation

12. Emergency Planning and Response

14. Assessment & Improvement

Example of JGC's PSM Assessment Checklist

No.	Requirement	Guideline for Compliance	Observation	Opportunities / Comments
5.0	In accordance with the schedule set forth in (paragraph 3.1) of this section, the employer shall complete a compilation of written process safety information before conducting any process hazard analysis required by the standard. The compilation of written process safety information is to enable the employer and the employees involved in operating the process to identify and understand the hazards posed by those processes involving highly hazardous chemicals. This process safety information shall include information pertaining to the hazards of the highly hazardous chemicals used or produced by the process, information pertaining to the technology of the process, and information pertaining to the equipment in the process.	1. A procedure to manage PSI defined in the paragraph 2.1 through 2.3 should be developed. - Information applicable as PSI should be clearly defined in the procedure. - Management process of PSI, including roles & responsibilities of owners should be developed. - PSI should be periodically updated according to Management of Change processes. (Refer to Element-10)	Observations found during the interview will be described in this column.	
5.1	Information pertaining to the hazards of the highly hazardous chemicals shall include: i. Toxicity data; ii. Reactivity data; iii. Corrosivity data; iv. Thermal and chemical stability data; and vii. Hazardous effects of inadvertent mixing of different materials that could foreseeably occur. Note: Safety data sheets meeting the requirements of 29 CFR 1910.1200(g) may be used to comply with this requirement to the extent they contain the information required by this subparagraph.	1. F... and TLV: Threshold Limit Value TWA: Time Weighted Average STEL: Short Term Exposure Limit TLV-C: Threshold Limit Value Ceiling IDLH: Immediately Dangerous to Life or Health 2. Material Safety Data Sheet (MSDS) should be used to include the information. - All MSDS should be supplied from manufacturers and compiled. 3. When a contractor brings highly hazardous chemicals to the plant then the contractor shall show MSDS to the employer and obtain approval.	Improvement opportunities identified during the interview will be described in this column.	
5.2	Information pertaining to the technology of the process.	1. Most of technology information should be developed during the EPC phase and delivered from the EPC contractor.		

Element 5: Information & Documentation

Our Strengths

- Extensive, worldwide EPC project and maintenance experiences
- Experience in investment for operating assets
- Professional Operation & Maintenance Engineer Teams
- Asset & Operation Management (AOM) system based on OSHA PSM
- Experience in Due Diligence (DD) and audits for operating plants.

Our Experiences

O&M Due Diligence

3+ Cases

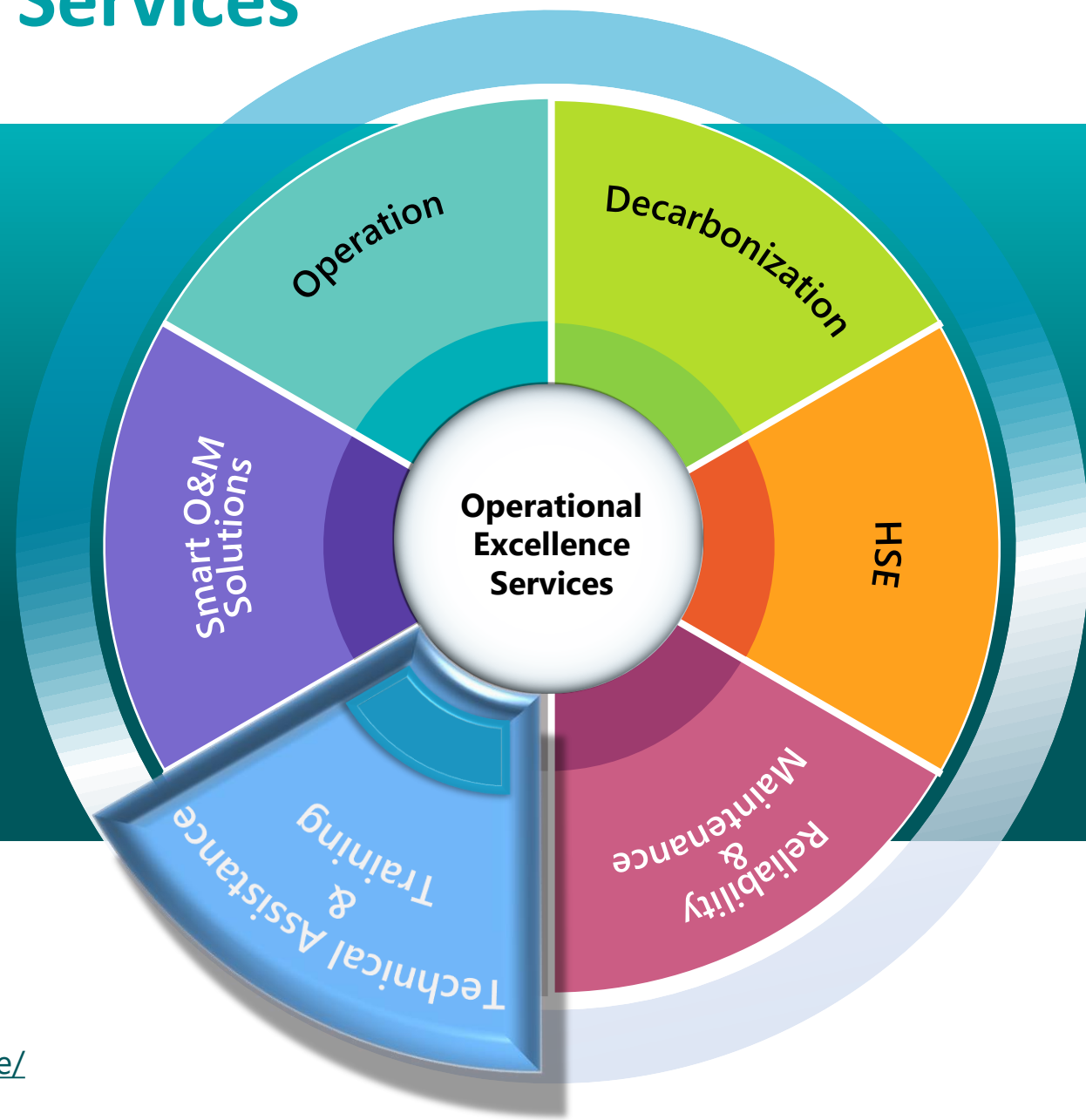
Audits for O&M

5+ Cases



Operational Excellence Services

Technical Assistance & Training OPEX Assessment



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

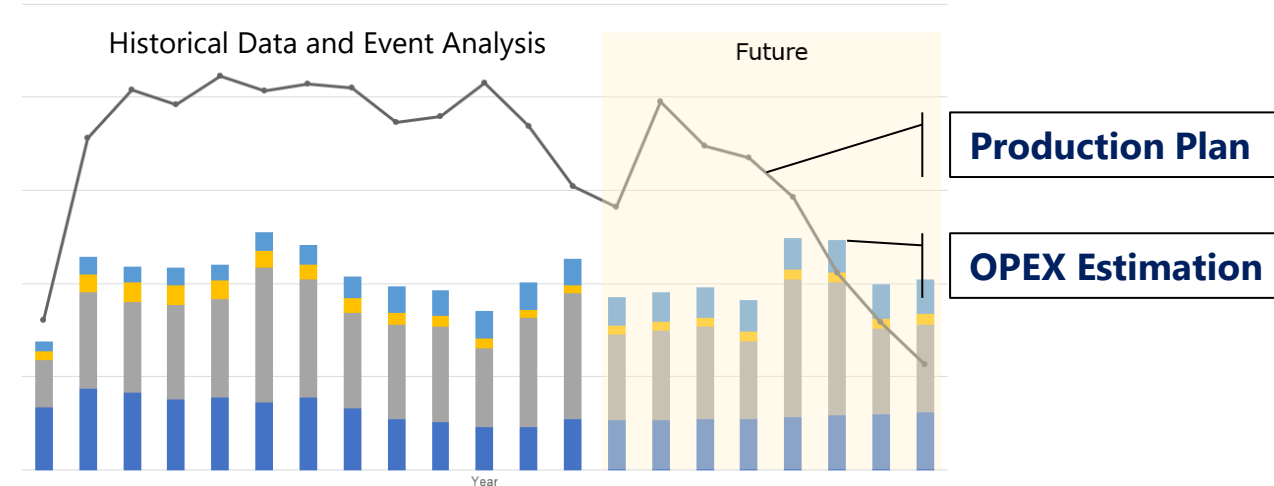
OPEX Assessment

Do you have any of these issues?

- ☹️ **Estimating OPEX to assess the feasibility at business planning phase**
- ☹️ **Verifying future OPEX in operation phase**
- ☹️ **Identifying improvement opportunities on operation and maintenance costs**

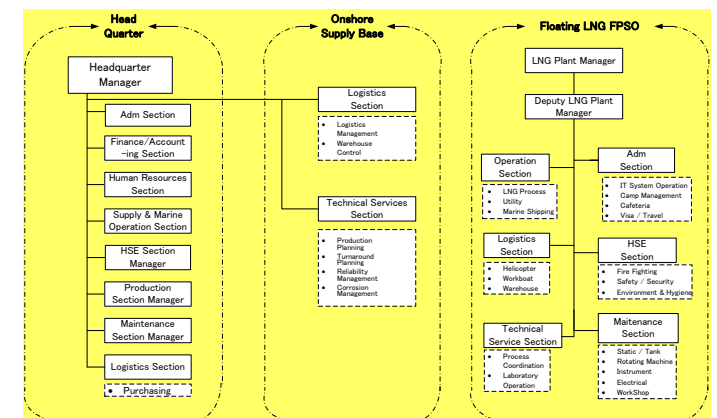
Our Solution

- Estimate or Assess OPEX by experts who understand the processes and regions at business planning phase
- Analyze historical OPEX data from the operation phase
- Conduct a case study to identify the optimized OPEX in either of the above cases



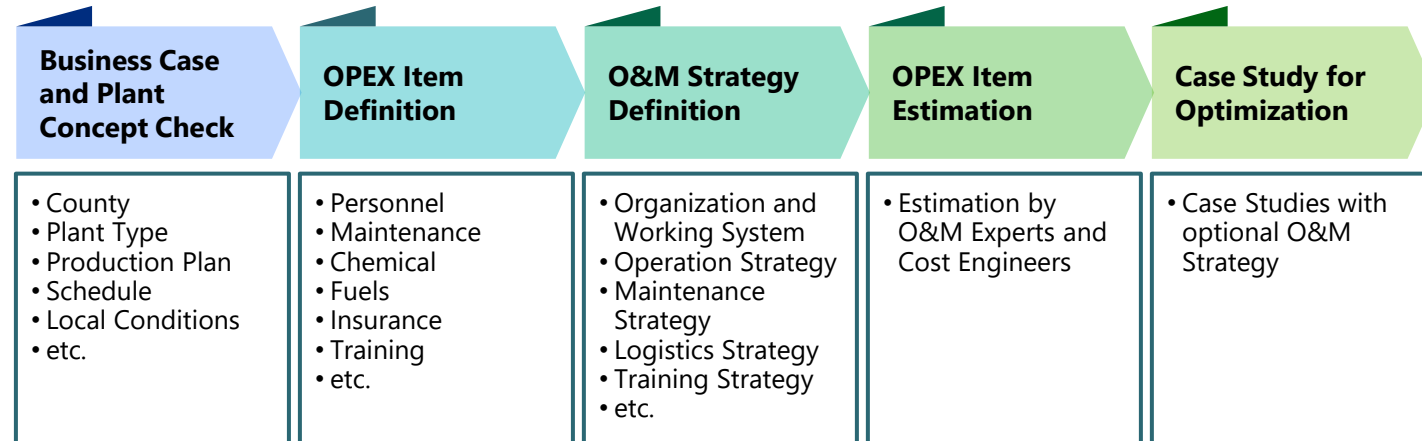
OPEX Estimation based on Production Plan

O&M Strategy Development as the basis of OPEX (e.g., Organization Chart)

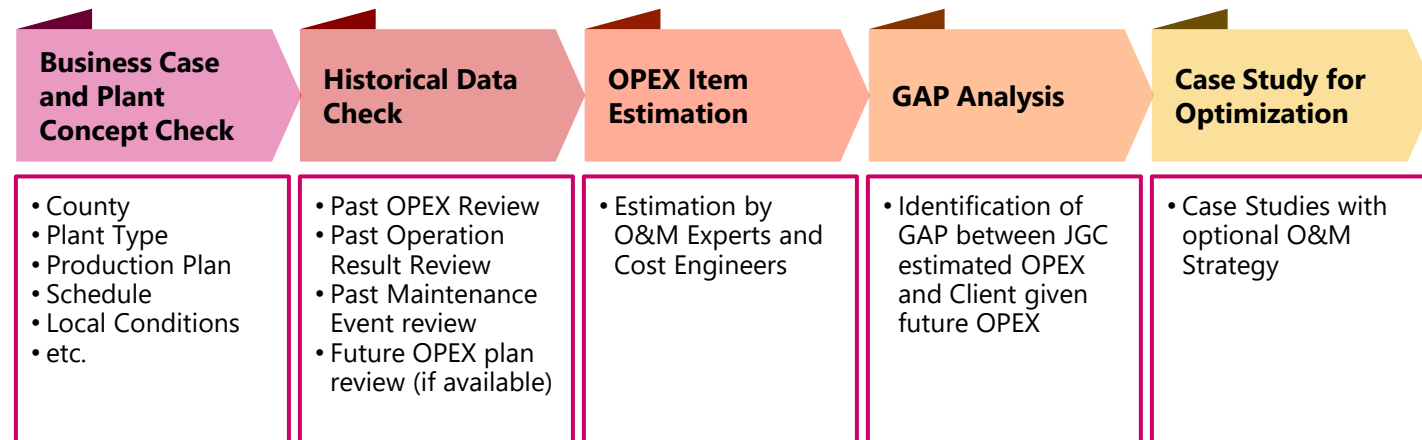


Workflow & Results

Business Planning Phase



Operation Phase



Our Strengths

- Assess using the latest cost information accumulated through plant EPC projects worldwide
- Estimate by experts with plant process, operation and maintenance knowledge
- Provide output tailored to client needs and business phases
- Advise improvement opportunities by experts

Our Experiences

10+
Projects in 10 years

**Various
Type of
Facilities**

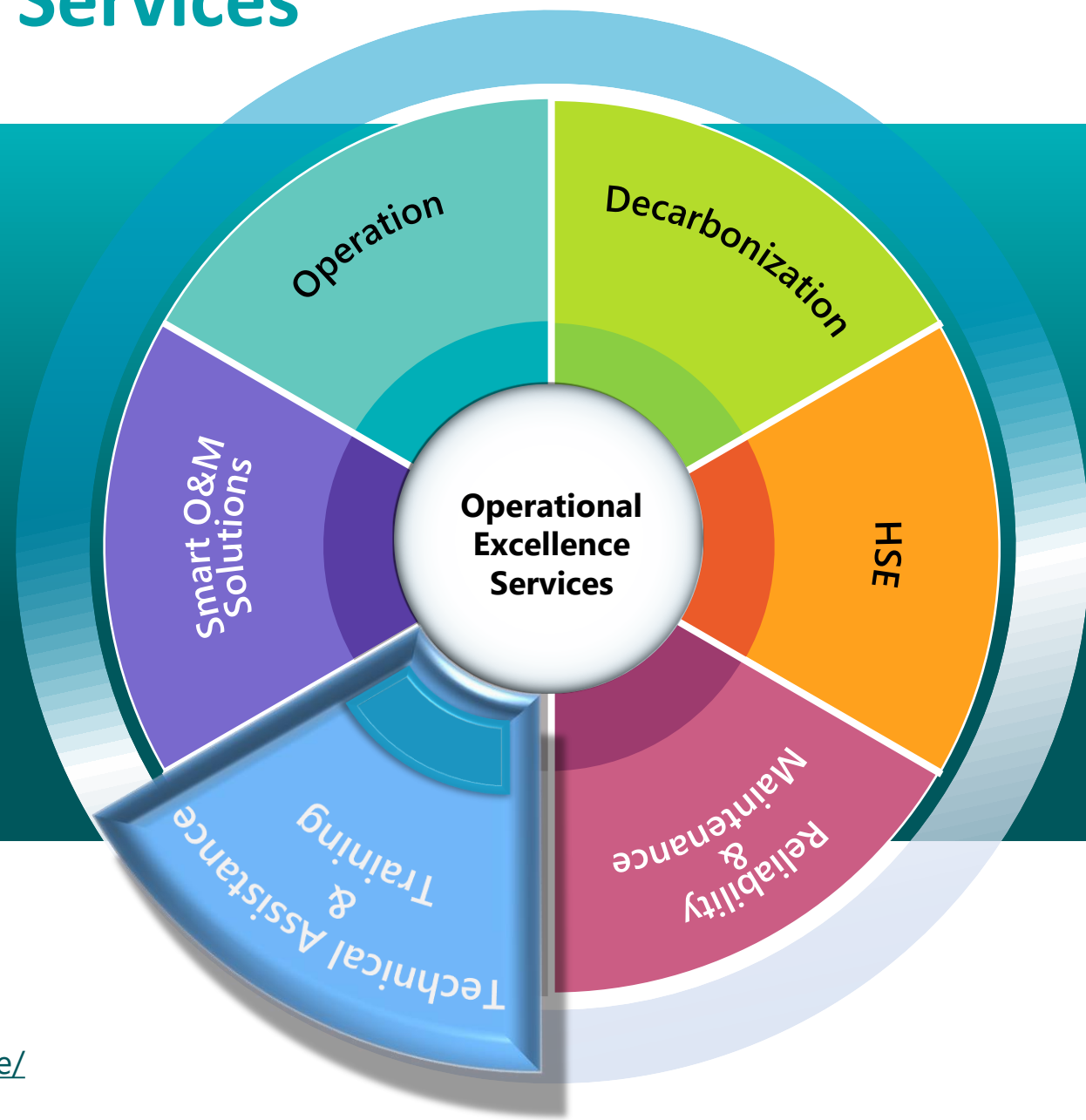
Gas Processing
LNG Terminal
Onshore LNG
FLNG
FPSO, etc.



Operational Excellence Services

Technical Assistance & Training

Strategic Operational Improvement Assistance



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

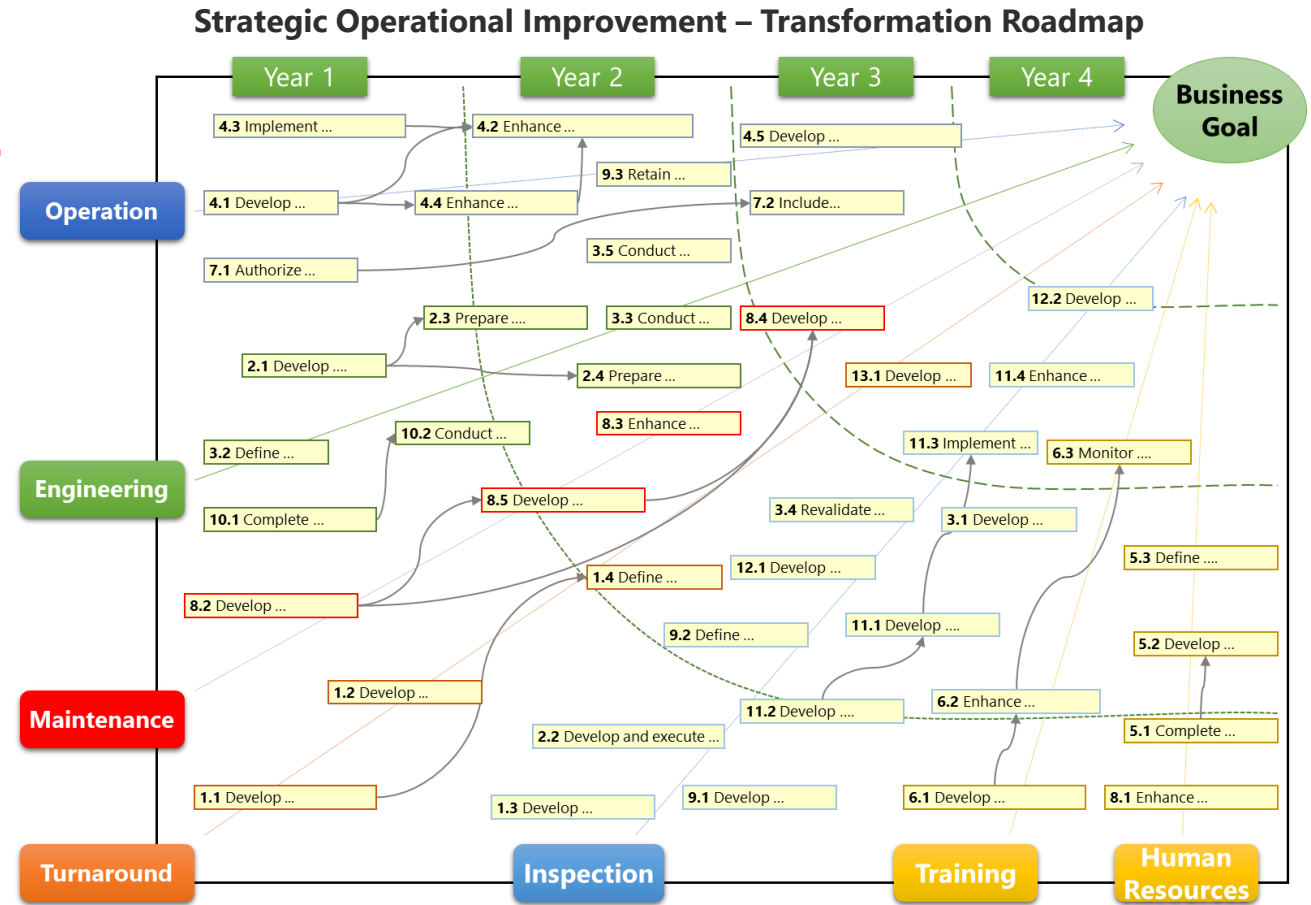
Strategic Operational Improvement Assistance

Do you have any of these issues?

- ☹️ **Increasing Unplanned Plant Outages**
- ☹️ **Increasing Maintenance Costs along with Age**
- ☹️ **Lack of Experienced Maintenance Staff**
- ☹️ **Representing Improvements Visually**

Solution

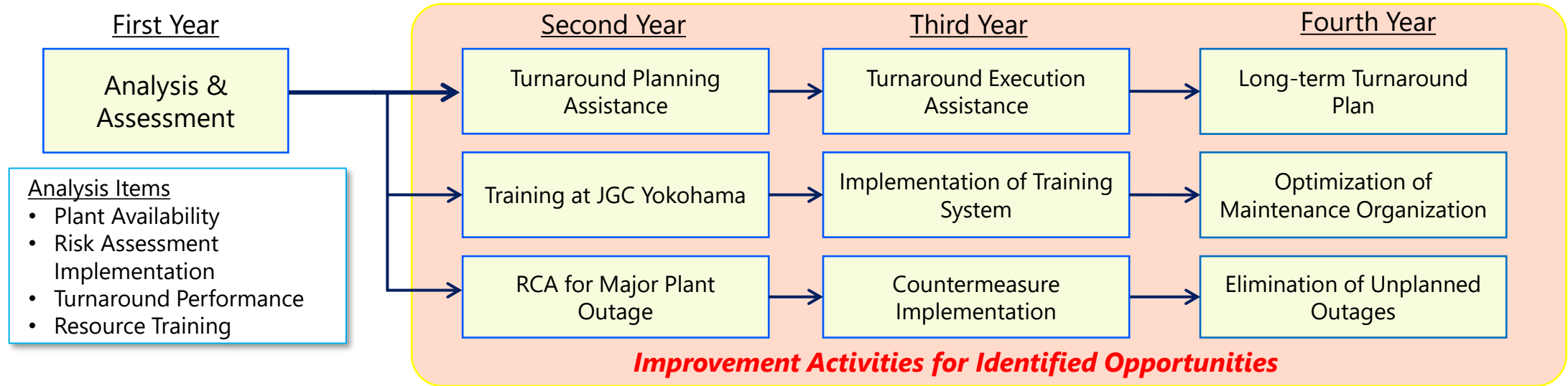
- SWOT Analysis of operation and maintenance organization
- Middle and long-term operation and maintenance plan including turnaround plan
- Setting Key Performance Indicators (KPI)
- Root Cause Analysis (RCA) for equipment failure and countermeasure development
- Training focusing on younger staff and skill/knowledge transfer from experienced staff



Strategic Operational Improvement Assistance

Return to
Technical Assistance
& Training menu

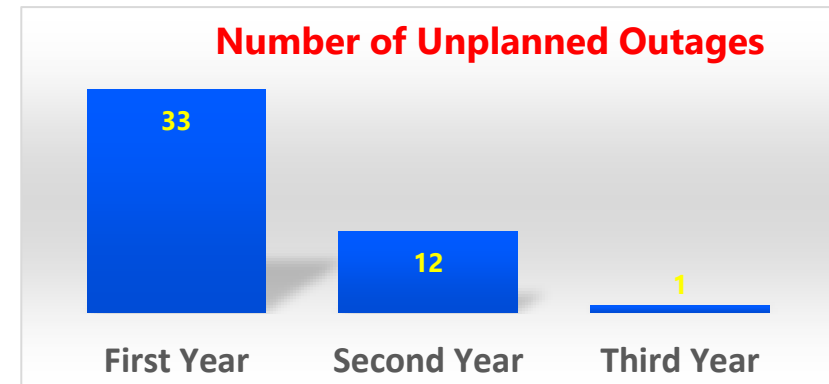
Long-Term Strategic Operational Improvement Assistance Program



Our Strengths

- Professional Operation and Maintenance Engineer Teams
- Global resources
- Practical application of Risk Based Work Selection process such as RCM and RBI
- Rigorous turnaround readiness review methodology
- Many experiences in turnaround planning
- Engineering tools and experienced analytical staff for RCA

Our Experiences Chemical Plant Case in Indonesia

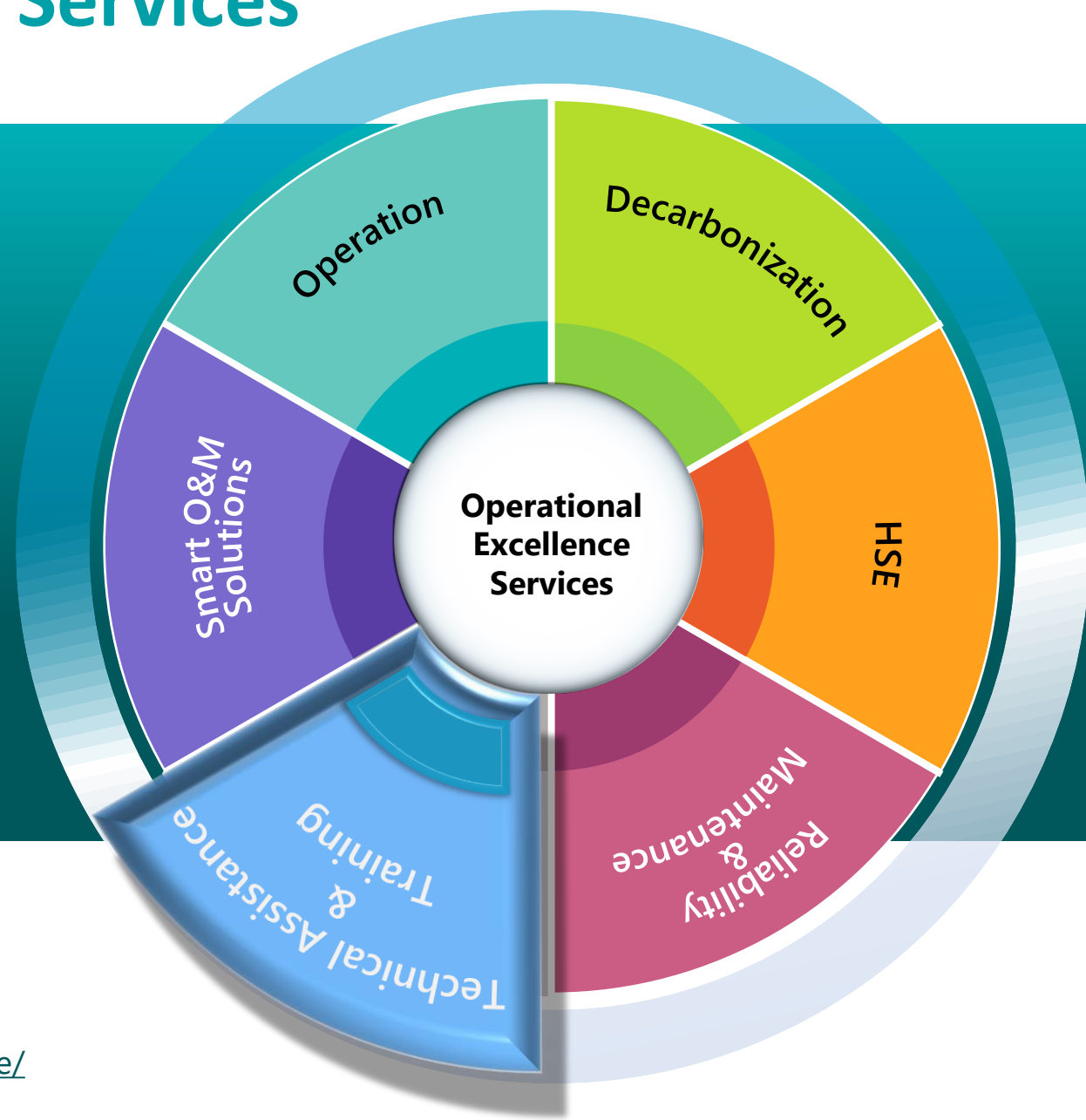




Operational Excellence Services

Technical Assistance & Training

Training and Competency Management Services



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Training and Competency Management Services

Do you have any of these issues?

- ☹️ **Catching up to the latest technical trends**
- ☹️ **Refreshing knowledge on essential technical matters**
- ☹️ **Specific training linked to technical issues**
(e.g., troubleshooting, performance improvement)
- ☹️ **Struggling to fill gap between actual and required skill set**

Training Services

- Organize a tailor-made training program
(e.g., Asset Management, Process Safety Management, TA Management, Plant Life Extension, etc.)
- Deliver training courses and seminars (at site or on-line)
- Implement competency management program
- Dispatch experts to site;
 - for hands-on training
 - for troubleshooting and performance evaluation with follow-up technical sessions



Training and Competency Management Services

Key Categories / Themes for Technical Training

Engineering & Project

P&ID
Hydraulic Design
Process Engineering
Dynamic Simulation Technology
Plant Safety Design and Risk Management
HAZOP
Material Selection
Piping Engineering
Pressure Vessel, Exchangers and Tanks
Energy Efficiency Improvement
Pump and Compressor
Instrument Engineering
Safety Instrumented Systems
Electrical Engineering
Civil Engineering
Welding Technology
Paint Technology
Corrosion under Insulation
Latest Non-Destructive Testing Technology
Vibration Control
Mechanical Handling
Commissioning
Operations Readiness & Assurance

Operation & Maintenance

Process Safety Management
Reliability, Availability, Maintainability (RAM)
Reliability-Centered Maintenance
Risk-Based Inspection
Plant Life Extension Program
Fitness for Service
Simulation Technology for Plant Troubleshooting (CFD)
Turnaround Management
Computerized Maintenance Management System
Computerized Inspection Management System

Our Strengths

- Professional Engineering Experts run our Training Services.
- Training programs are updated in line with latest technical trends and are applicable to actual implementation.
- In association with and funded by Japanese governmental support, such as JCCP (Japan Cooperation Center, Petroleum).
- Continuous follow-up and support are provided by our overseas affiliates and local partners.

Our Experiences

Technical seminars

20+ in past 5 years

Trainees

500+ in past 5 years

Case Study : Customized Training for FCC Unit Reliability Improvement

[Return to
Technical Assistance
& Training menu](#)



Background:

A refinery in Southeast Asia was struggling with stable operation of RFCC unit from the start after EPC project

Attendees:

Maintenance and inspection departments and technical service departments at the plant site and headquarters

Objective:

To share information on various problems that occur in RFCC, analysis methods to solve them, and technical advice from refractory vendors.

Workshops are also held to share examples of problems encountered in their RFCC and to discuss how to plan the next turnaround maintenance.

Reference Services

Process Safety Management Seminar - JGC Headquarter 2016 for E&P Company in Japan

Plant Life Cycle Management Seminar - JGC Headquarter 2017 for E&P Company in Japan

Process Safety Management Seminar - Online 2021 for E&P Company in Japan

FCC Unit Integrity & Reliability Improvement Seminar– Online 2022 for Refinery in Middle East

FCC Unit Integrity & Reliability Improvement Seminar– Online 2023 for a Refinery in Southeast Asia

O&M Engineering Training – JGC Headquarter 2023 for a Petrochemical Plant in Middle East

FCC Unit Integrity & Reliability Improvement Seminar– Online 2024 for Refinery in South America

Examples of customized training programs

Material Degradation and Remaining Life Assessment (Day 1)

1. FCC Unit Process Overview
2. Material Selection and Degradation
3. Remaining Life Assessment Methodologies
4. Experience of Material Degradation and Current Issue (by Client)

Corrosion Management and Inspection Data Management (Day 2)

1. Corrosion Management Program
2. Corrosion Under Insulation
3. Inspection Data Management System
4. Corrosion Management Program and Improvement Plan (by Client)
5. Workshop - Corrosion Management Program (All members)

Fitness for Service and Major Replacement Work (Day 3)

1. Fitness for Service Technology
2. Major Replacement Work
3. Advanced Repair Technology
4. Past Experiences and Future Plans (by Client)
5. Workshop – Major Replacement and Repair Planning and Execution (All members)

Reliability of Critical Mechanical Components (Day 4)

1. Refractory (Vendor)
2. Expansion Joint (Vendor)
3. GRP Piping
4. Future Actions and Wrap Up (All members)



Operational Excellence Services

Operation

LNG Cube  LNG³



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

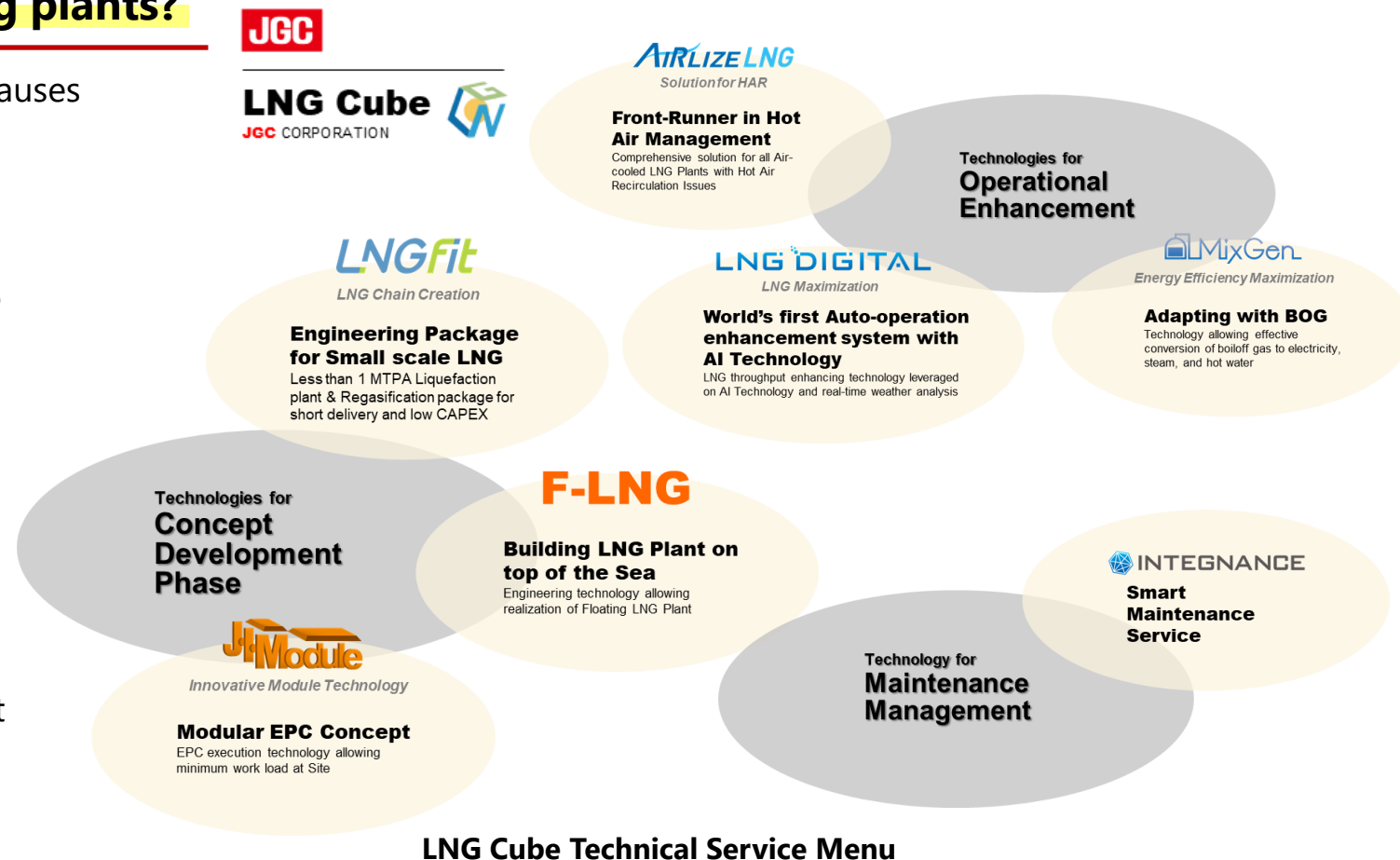
 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Do you have any needs in your operating plants?

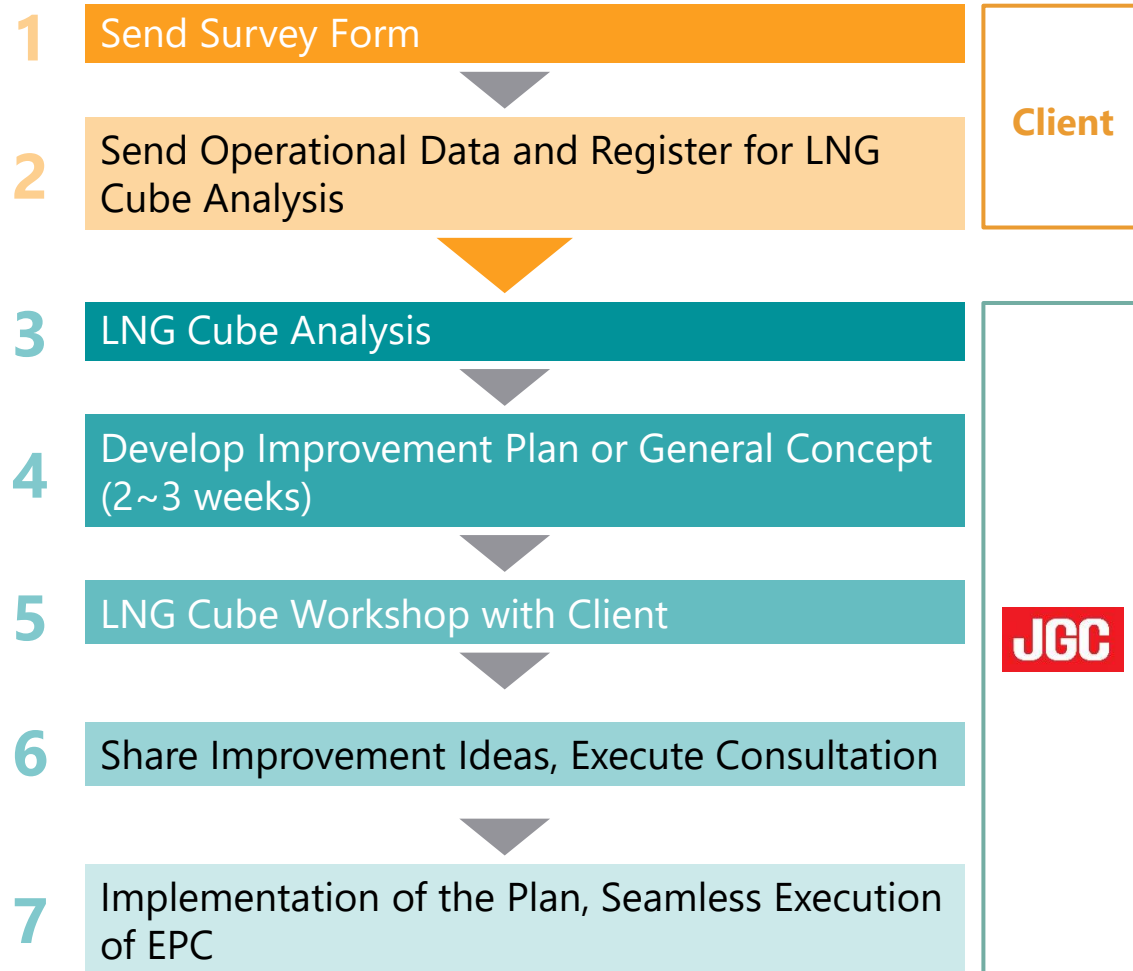
- Sudden shutdown of the plant with unknown root-causes
- Frequent malfunction of equipment
- Unachieved production corrective planning
- Flare minimizing
- Smooth startup operation and flawless maintenance

What is LNG³ ?

- LNG Cube is a comprehensive technical service package related to LNG plants
- LNG Cube starts from Workshop and Consulting by the world's leading LNG specialists
- Analysis and Consulting leveraged on lessons learnt and operational database from past engineering, construction and operational experiences
- LNG Cube technical services are not limited to existing plants but can be applicable to grassroots plants



Workflow & Results



Our Strengths

- Abundant experience in commissioning and startup
- Speedy solutions leveraged on numerous of Lessons Learned from past commissioning and startup experience
- Consulting by Project Manager and Study Manager with extensive site experience and EPC execution experience

Our Experiences

Client	Year	Region	Activity
A Company	2017 - 2019	South East Asia	- LNG Cube Workshop (Development of New Digital Solutions) - Feasibility Study for the implementation of the Digital Solution - Implementation of the Digital Solution
B Company	2018 - 2019	South East Asia	- LNG Cube Workshop (Development of Efficiency Improvement Ideas) - Proposal for Advanced Control System Installation - Feasibility Study of the Advanced Control System Installation (Planned)
C Company	2018 - 2019	South East Asia	- LNG Cube Workshop (Development of Production Enhancement Ideas) - Business Case Study for LNG Production Enhancement
D Company	2018 - 2019	Europe	- LNG Cube Pre-Workshop (Development of New LNG Technology) - LNG Cube Workshop



Operational Excellence Services

Operation

AIRLIZE LNG® *AIRLIZE LNG*



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

HAR^(*) causes loss of LNG production

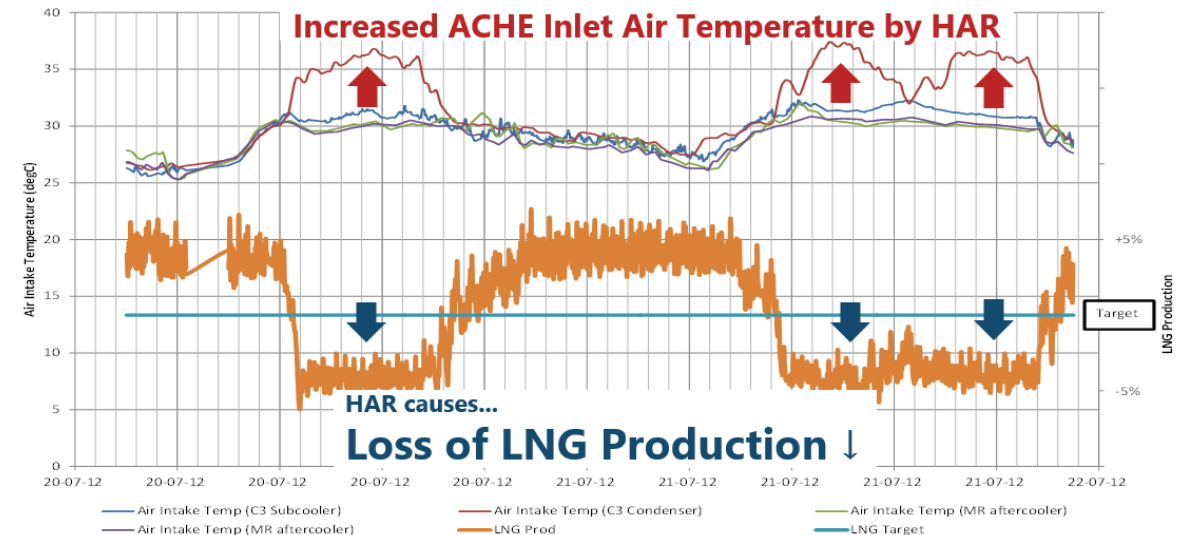
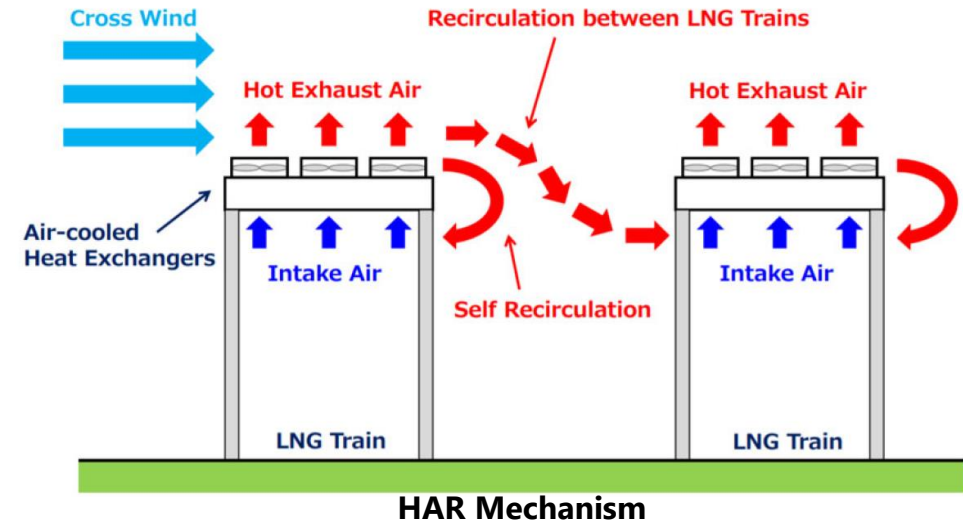
(*) Hot Air Recirculation

- ☹️ **Process performance degradation due to HAR**
- ☹️ **Increased ACHE^(**) inlet air temperature due to HAR**
- ☹️ **It is difficult to identify HAR mitigation plan or adaptation plan**

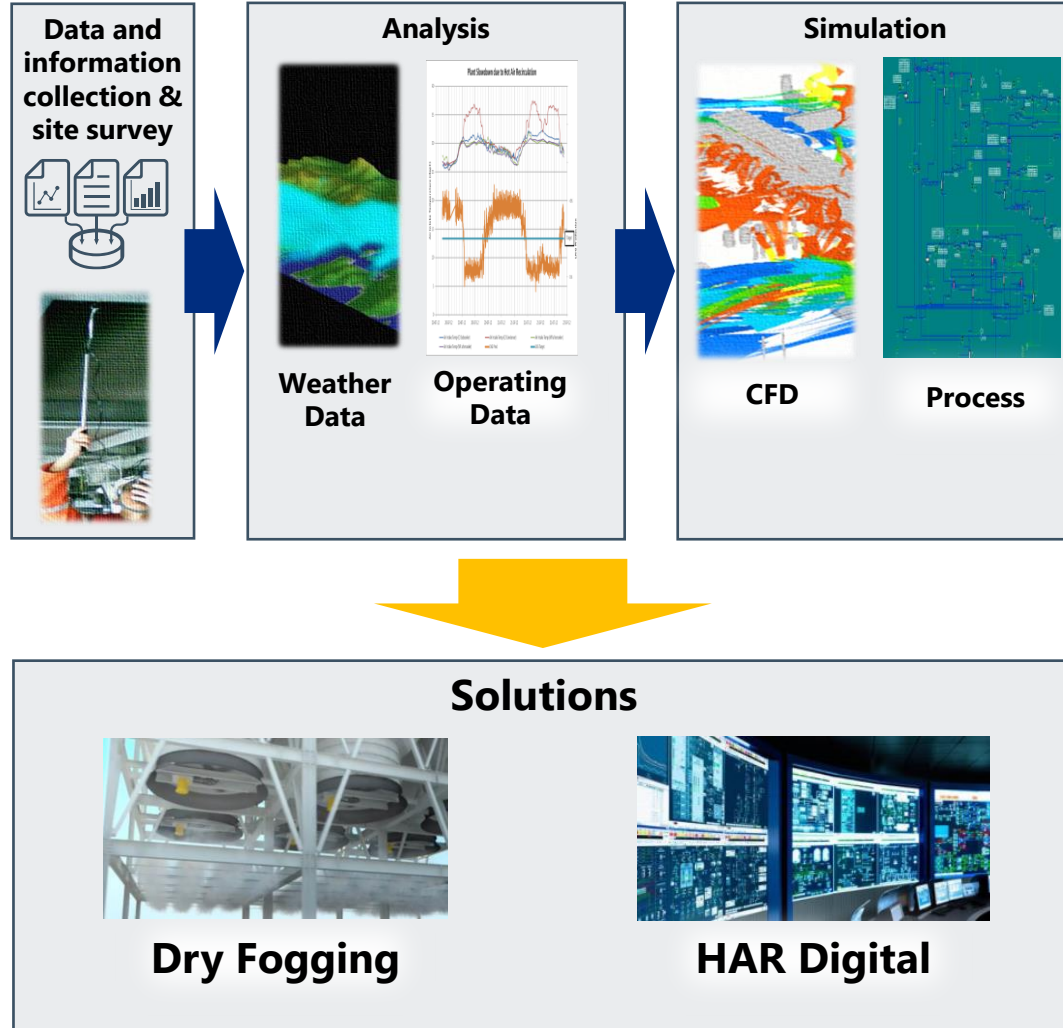
(**) Air Cooled Heat Exchanger

What is AIRLIZE[®] ?

- AIRLIZE LNG[®] is JGC's Comprehensive Life Cycle Support Services for Air-Cooled LNG Plants
- Diagnoses and Analysis services for HAR optimization



Workflow & Result



Our Strengths

- **Real-time Weather Monitoring System:** Introduction of advanced systems for real-time weather monitoring.
- **Advanced Analytical Capabilities:** Expertise in process big data analysis, CFD (Computational Fluid Dynamics) simulation, and rigorous process simulation.
- **Extensive Experience:** JGC's extensive experience in LNG processes and Hot Air Recirculation (HAR) analysis.
- **Comprehensive HAR Management Solutions:** JGC offers two types of solutions for HAR management:
 - Dry Fogging
 - HAR Digital

Our Experiences

20+ Projects

Contributed to over 20 projects in various phases of Project/Plant Life Cycle (FS, Pre-FEED, FEED, EPC, Revamps)



What is Dry Fogging?

Dry Fogging enhance the performance of ACHE by implementing simple water mist system.



The water mist helps lower the air inlet temperature of the ACHE.



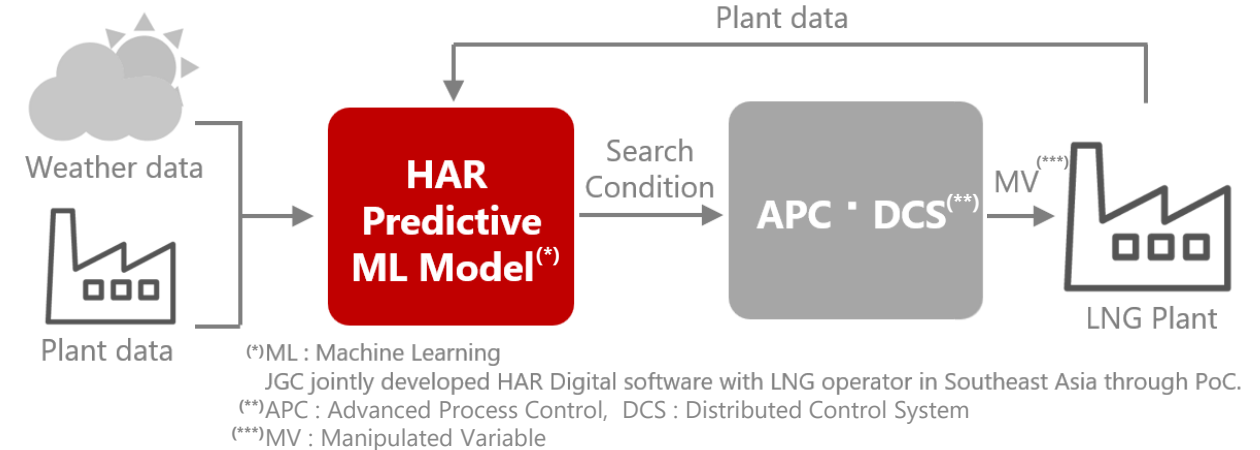
Improves the overall performance of the ACHE.

Advantage of Dry Fogging

- **Increased LNG Production:** By enhancing cooling performance with minimal capital investment, LNG production can be increased by up to 2%.
- **Quick Delivery Time:** From design to installation, the system can be delivered within a year.
- **No Equipment Damage:** The fine water mist ensures no damage or scale formation on the equipment.
- **Simple System and Easy Operation:** The system consists of only pumps, piping, and fogging nozzles, making it easy to operate.

What is HAR Digital?

HAR Digital is an automated control system powered by Artificial Intelligence (AI).



Advantage of HAR digital

- **Increased LNG Throughput:** The feed-forward process control system, powered by a HAR predictive machine learning (ML) model, can increase LNG throughput by up to 2% without any major modifications.
- **Stable Operation:** Achieves stable operation by adjusting in advance.
- **High Performance:** High performance operation can be achieved by maintaining proximity to the operating limit while HAR does not occur



Operational Excellence Services

Operation Automatics Operation



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

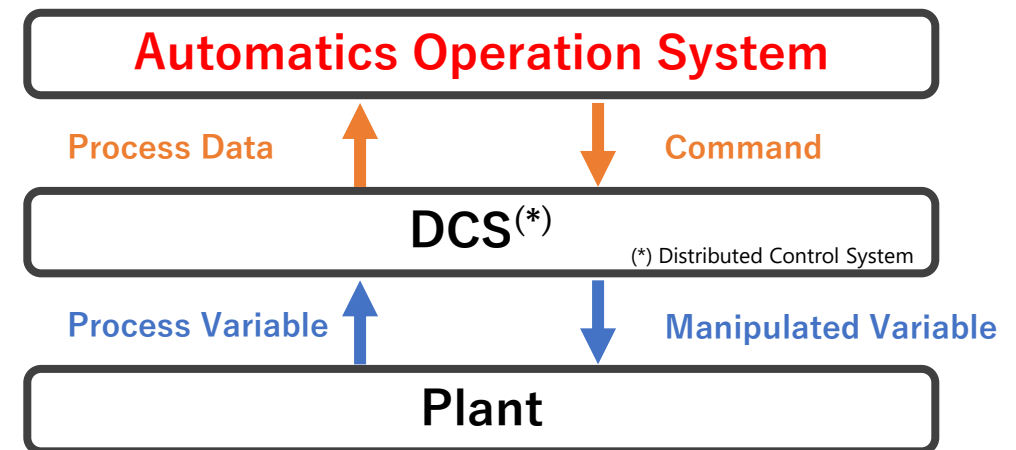
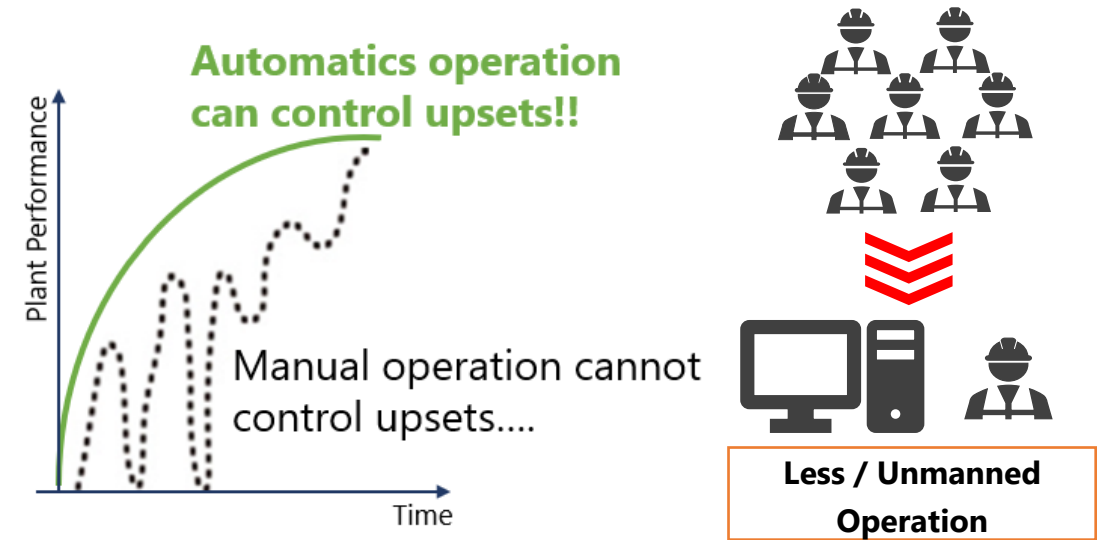
Automatics Operation

Advantages of Automatics Operation

- 👍 **Stabilizing facility performance by reducing process upsets during process operation**
- 👍 **Prevention of equipment damage due to mistakes**
- 👍 **Minimizing transient operation time**
- 👍 **Standardization of transient operation sequence**
- 👍 **Assistance for operators with limited experience.**

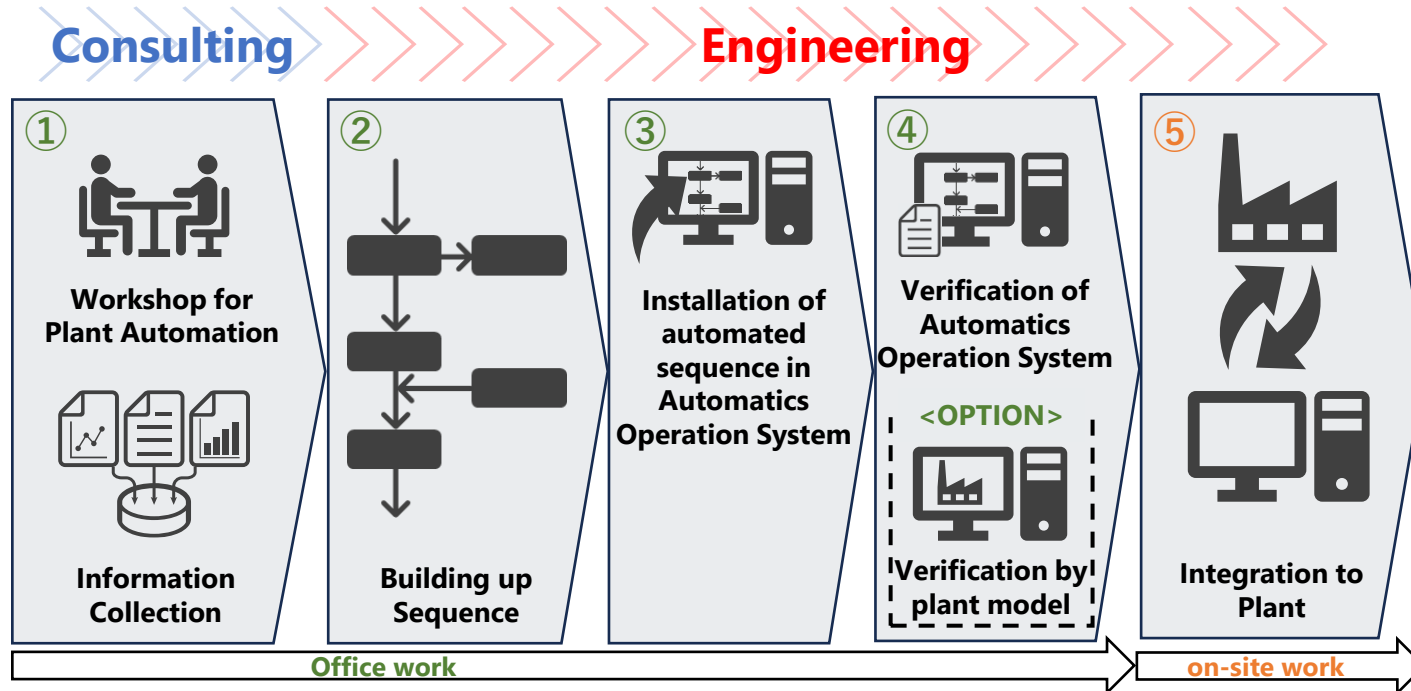
What is Automatics Operation ?

- Automatics Operation achieves an automated operation for numerous types of plant and equipment (upstream, midstream, downstream).
 - Plant Startup and Shutdown
 - Transient Operation (ramp-up/down, etc.)
 - Process Upset (adjusted for stable operation)
 - Package System Startup and Shutdown (Compressor, Expander, etc.)
- JGC provides consulting and engineering services to implement Automatics Operation for existing plants.



Automatics Operation

Workflow for Implementation



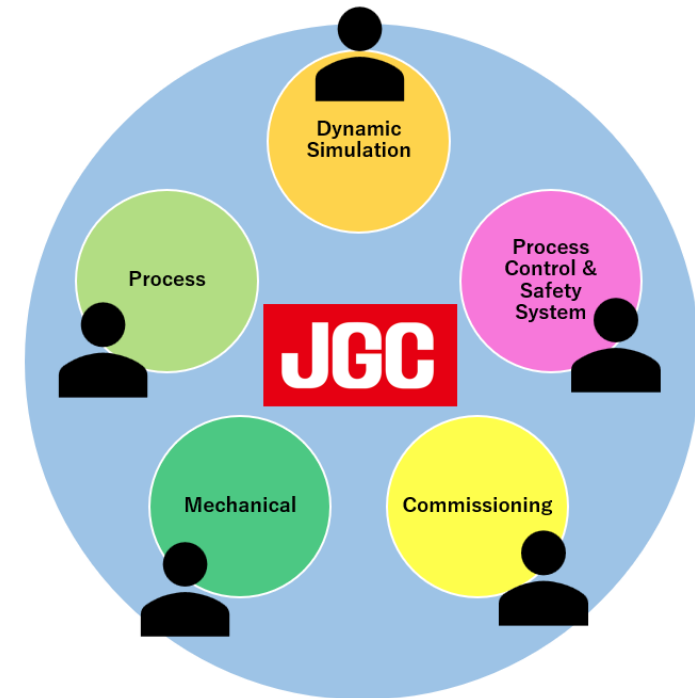
Our Experience

- LNG, Ammonia, Power Plant, etc.
Automation for plant startup and shutdown in various types of plants.
- MCHE^(*) Cooldown, Compressor change-over, etc.
Automatic sequences for startup and shutdown of many types of package system

(*) Main Cryogenic Heat Exchanger

Our Strengths

- Experience in EPC and O&M of many types of facilities in many locations around the world
- Specialist Engineering Team consisting of various experts in JGC to deliver Automatics Operation



Case Study : Success of Automated Startup/Shutdown in IGFC(*)

- Plant owner: Osaki Coolgen Corporation <<https://www.osaki-coolgen.jp/en/>>
- Process: CO2 Capture and Recovery Facility in the IGFC
- Requirement: Fully automated plant startup/shutdown operation

(*) Integrated Coal Gasification Fuel Cell Combined Cycle

Approach

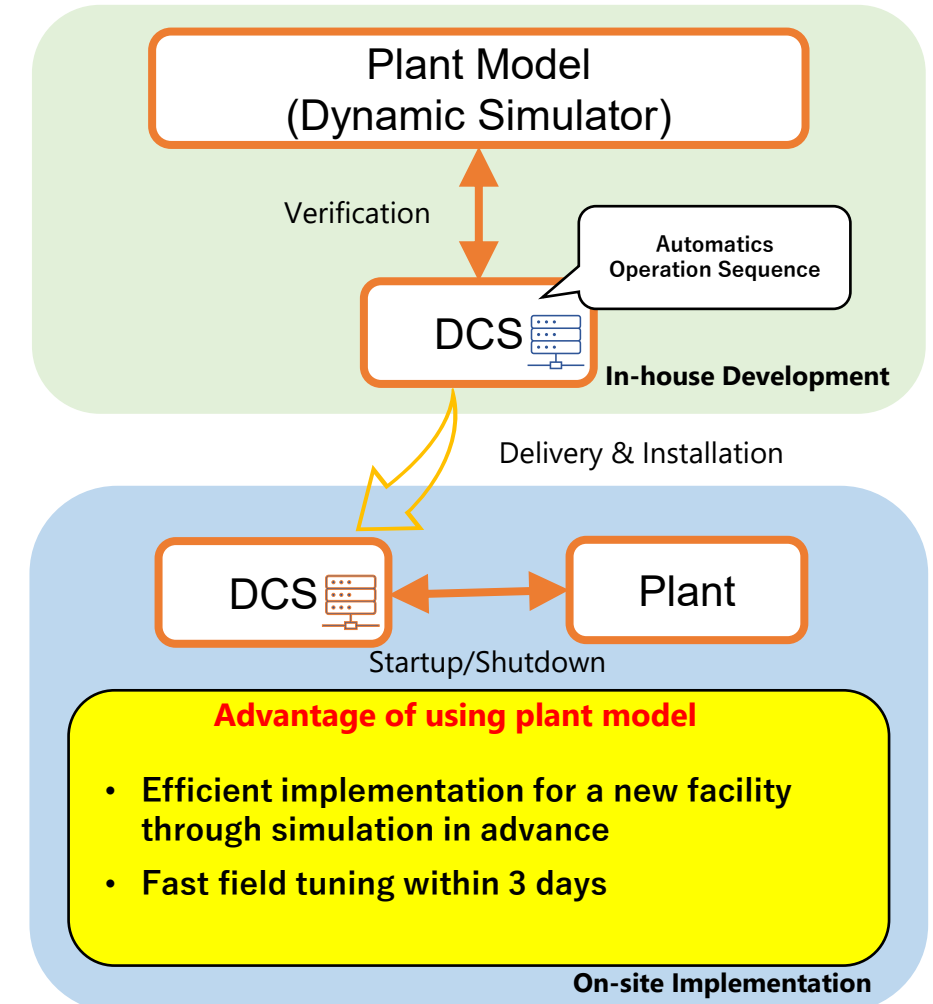
- Developed Plant Model to validate Automatics Operation Sequence for minimizing tuning work during on-site implementation
- Implemented Automatics Operation sequence into DCS according to system configuration at existing unit

Achievement

- Quick startup/shutdown operation by automating over 1000 steps in the procedure
- Safe startup/shutdown operation without any human error and any failure of an equipment



Provided by Osaki Coolgen Corporation



Implementation by using plant model



Operational Excellence Services

Operation

Operations Readiness & Assurance



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Operations Readiness & Assurance

Do you have any of these issues?

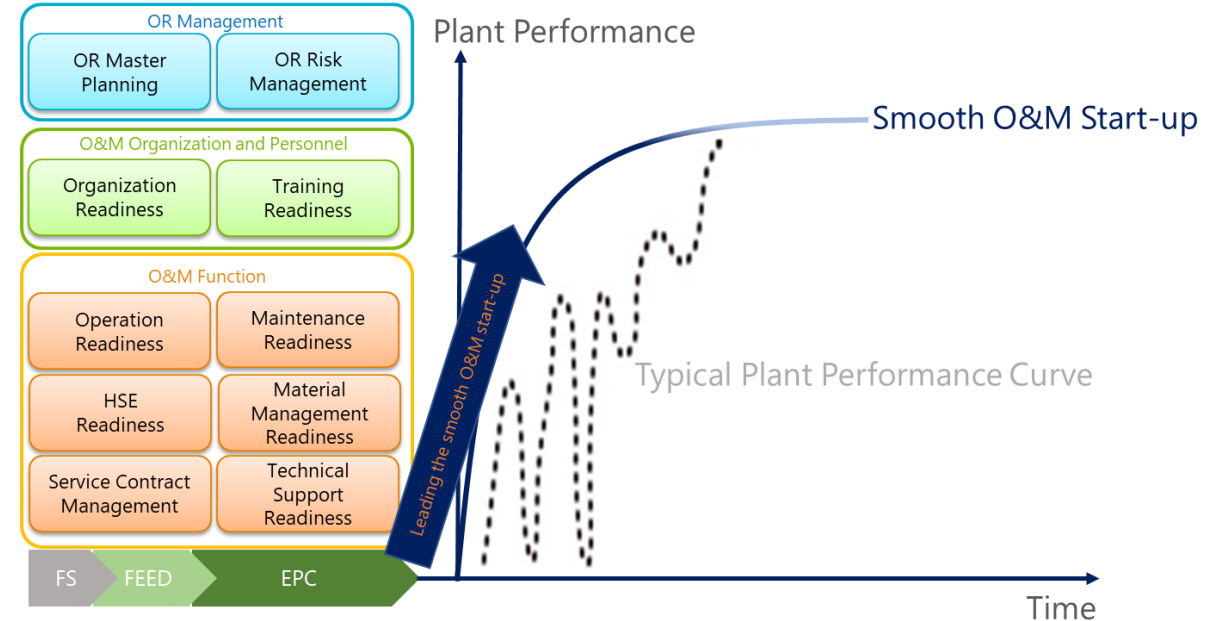
- ☹️ **Concern of safe and smooth startup of O&M**
- ☹️ **High total cost of ownership**
- ☹️ **Potential areas of concerns and its mitigations in OR^(*)**

OR&A Solution

- Execute Operations Readiness & Assurance 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

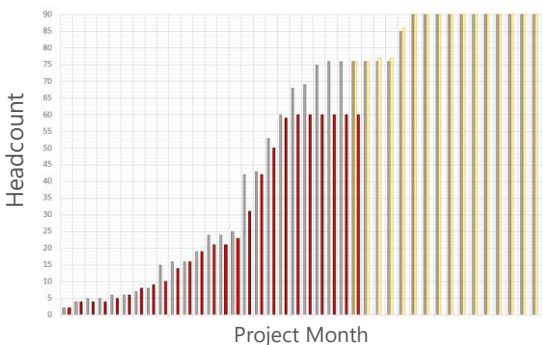
Workflow & Result

A) Operations Readiness & Assurance 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



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

Our Strengths

- Standardized Operations Readiness & Assurance 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

- Operations Readiness & Assurance 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



Operational Excellence Services

Operation Predictable Startup Program



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Predictable Startup Program

Do you have any of these issues?

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



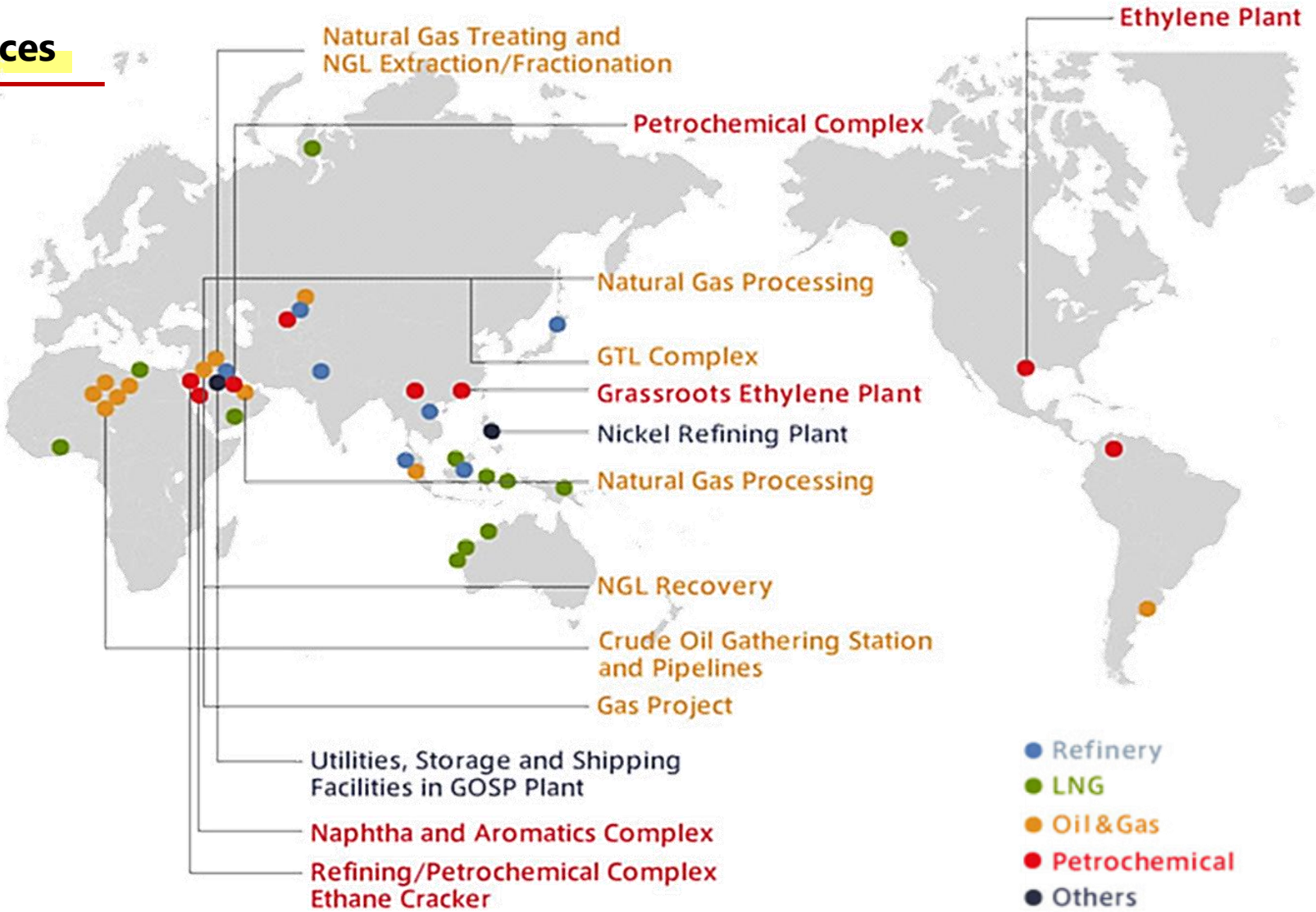
Our Solution

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 & Startup 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

Our Strengths and Experiences

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





Operational Excellence Services

Operation
CASTOR®



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

CASTOR[®] (Commissioning and Startup Transient Operability Review)

Do you have any of these issues?

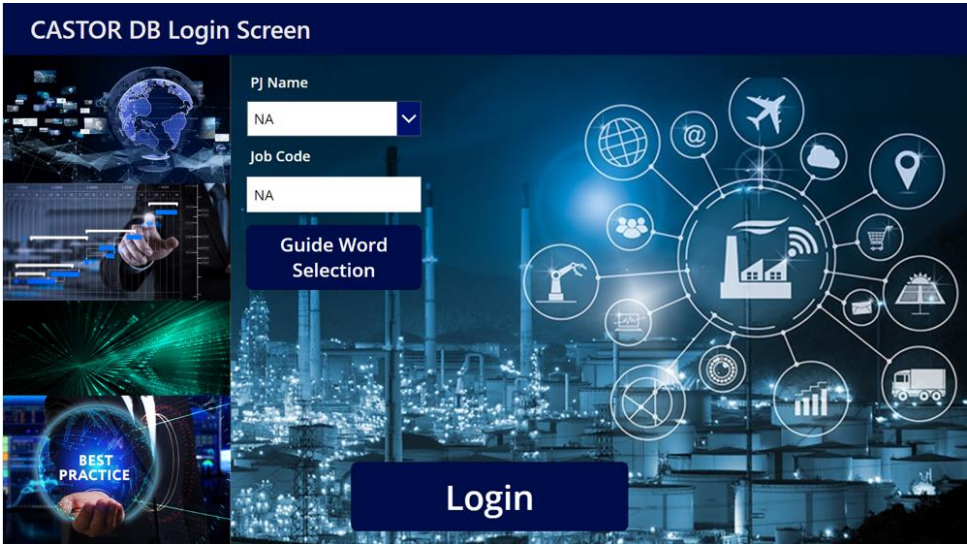
- Concerns on Commissioning and Startup Plan
- Lack of (or No) Experience in Plant Startup
- Introduction of Unfamiliar Equipment/Unit

Good Scenarios	Failure Scenarios	Startup modes	Over issues	Special modes	Specific Production Modes	New modes/Temporary Modes	Startup Scenarios	Commissioning Tests / Modes	Commissioning Tests / Modes	Start up Tests / Modes
Embarkment/Low temperature	Main process trips	Cut activation	Thermal expansion/contraction	Recycle modes	Product Load mode	Recycle modes	Heavy rain/snow	Equipment internal (loadings)	Steam blow	Unleaded joints tightness test
Over temperature	Main comp trips	Cut re-juvination	Controls on manual	Blank removal gas-oil shift	Product hold mode	Blank removal - H2 H2 separator	Tidal/Waves	ESD/TSD valve leak test	Safe (motor) runs	Surge tests on compressor
Overfill	Loss of containment / Leaks	Cut regen	Heavy rain/snow	Blank removal - H2 H2 separator	Other feed flow Modes	Blank removal - H2 H2 separator	Cyclone	Instrument Loop test	Chemical clean run	Pump tests not able to test on benign fluid
Over pressure	Internal leaks/fail (e.g. high pressure)	Reactor switch	Reactor switch	Distillation mode	Other feed quality Modes	Blank out mode	Distillation	Marginal test	Turbo expander tests	
Back flow	Feed equipment failure (preheating/heat exchangers/boilers)	Cut Circulation	Cyclone/best storm	Trigging & reduction mode	Equipment bypass / trickle mode	Trigging modes	Day-Night swing	Emergency	Compressor tests not able to test on benign fluid	
Vapour breakthrough	Instrument failure	Coking/Decoking	Distillation	Reactor leave heating & cooling	Batch operation	Depressure down mode	Floods (land slide)	ESD oil bath cleaning (Compt. Pack.)	Equipment test not able to test on benign fluid	
Vacuum filling/emphying	Internal failure	Stripping	Day-Night swing	Catalyst drying	Regen. Mode	Offspec modes	Lightning strike	High humidity	DM tests	
Flaming/ignition	Partial RH/Leakage	Cut make up/agent	Human error	Steam out mode	Online flushing clean modes	Pigging mode	Reactor/Smoke/Dust storm	Water bath for (de)systems	Min. filling	Melting tests
Cracking / waste issues/break through	Cracking / waste issues/break through	Off-spec Reactor modes (IC modes)	Competition	Depressure/best storm	Depressure/best storm	Vacuum unload	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
Offspec product	Partial RH/Leakage	Off-spec Reactor modes (IC modes)	Competition	Depressure/best storm	Depressure/best storm	Vacuum unload	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
Composition different	Loss of H2	Cut feed ratio	High inventory	High inventory	High inventory	High inventory	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
Hydrates/Free-outflow	Loss of heating	Coke Flare/ignition	High inventory	High inventory	High inventory	High inventory	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
Water explosion	Loss of cooling	Cut feed ratio	High inventory	High inventory	High inventory	High inventory	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
CO2 ingress (e.g. vacuum, back flow)	Loss of steam	Backflow issues	High inventory	High inventory	High inventory	High inventory	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
pH issues	Loss of FG	Incompatible components	High inventory	High inventory	High inventory	High inventory	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
(strainer) Solid/Polymer/Plugging/Signs	Loss of water	Cut plugging	High inventory	High inventory	High inventory	High inventory	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
Thermal Stress/Decomposition	Loss of chemicals	Cut Regen issues	High inventory	High inventory	High inventory	High inventory	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
Vacuum during start up (e.g. below the roof)	Loss of air/gas	Uninspected side reactions	High inventory	High inventory	High inventory	High inventory	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
Flaring	Loss of H2O2	Backflow issues	High inventory	High inventory	High inventory	High inventory	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
Overpressure (e.g. high pressure)	Loss of H2O2	Backflow issues	High inventory	High inventory	High inventory	High inventory	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
Passing RV	Loss of H2O2	Backflow issues	High inventory	High inventory	High inventory	High inventory	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
Reactor issues (degrad. conc.)	Loss of Power	RV design for upset cases	High inventory	High inventory	High inventory	High inventory	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
Foaming	Loss of Air	Catalyst within tested range	High inventory	High inventory	High inventory	High inventory	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
Leads carry over	Loss of heating	High inventory	High inventory	High inventory	High inventory	High inventory	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
Overpressure	Loss of heating	High inventory	High inventory	High inventory	High inventory	High inventory	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
Minimum noise/flow/pressure	Loss of heating	High inventory	High inventory	High inventory	High inventory	High inventory	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
Safe action / Fail	Loss of heating	High inventory	High inventory	High inventory	High inventory	High inventory	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests
Thermal expansion/contraction	Loss of heating	High inventory	High inventory	High inventory	High inventory	High inventory	Natural disasters	Drains cleaning	Refactory Dryout	ESD trip tests

CASTOR Guideword Template (General)

CASTOR[®] Solution

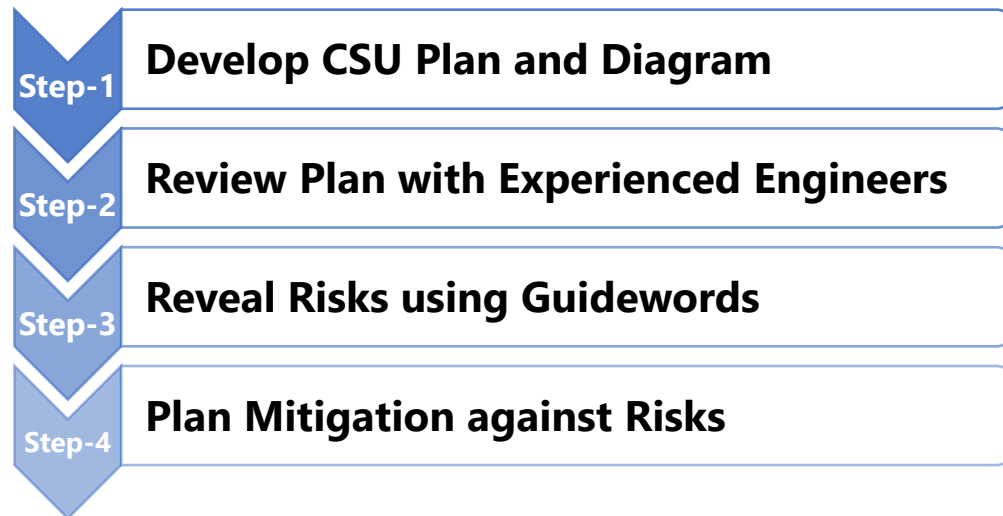
- Reveal risks during transient state operation at commissioning and initial startup phase
- Plan mitigation actions against risks
- Increase likelihood of successful commissioning and plant startup
- Minimize downtime due to trouble
- Eliminate risks of schedule delay



CASTOR Database

Workflow & Results

Workflow of CASTOR®



- Develop Commissioning and Startup (CSU) Plan and Diagram
- Review CSU Plan and Diagram with highly experienced engineers
- Reveal risks related to transient operation during Commissioning and Startup 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 Startup as an EPC Contractor
- A wealth of Lessons Learned about Commissioning and Startup
- 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 startup review as the predecessors of CASTOR®

== > **CASTOR Database**



CASTOR®
Since 2015
15 Cases



Operational Excellence Services

Operation
Commissioning Safety



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Commissioning Safety

Do you have any of these issues?

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

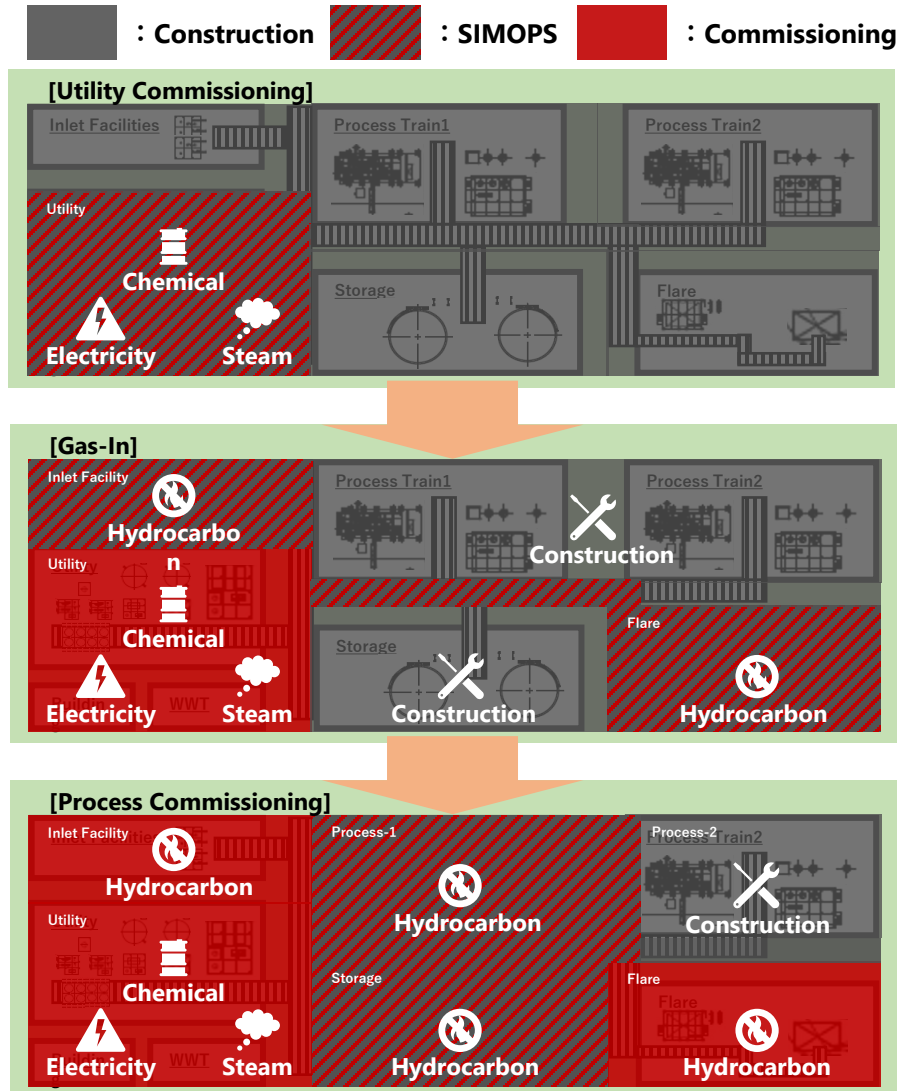
- ✓ **Electricity**
- ✓ **Chemicals**
- ✓ **Steam**
- ✓ **Hydrocarbon**

Our Solution

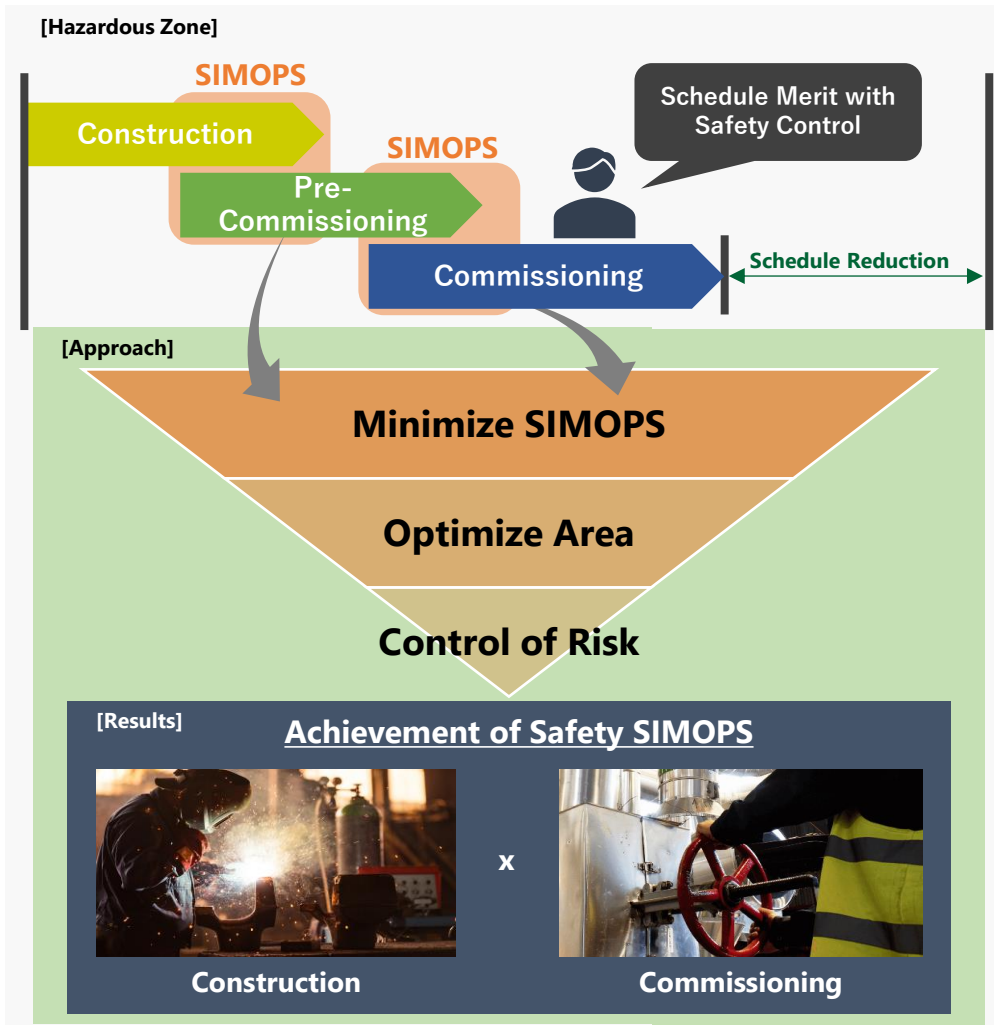
Provide consultation on the following plans/topics:

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

SIMOPS Study



Workflow & Result



Our Strengths

- Professional Process & Material Engineer Teams
- Top global results and performances on Degradation Assessment, Inspection Planning, On-site Inspection.
- Use 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 Experiences

- 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

Operation

Commissioning & Startup for FLNG/FPSO/Module



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Commissioning & Startup 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
- ✓ Startup 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
- ✓ Startup Plan, Procedure and Operator Training
- ✓ Manning including Offshore Training
- ✓ Logistics Strategy and/or Material Arrangement etc.



Commissioning & Startup for FLNG/FPSO/Module

[Return to
Operation menu](#)

Workflow & Result

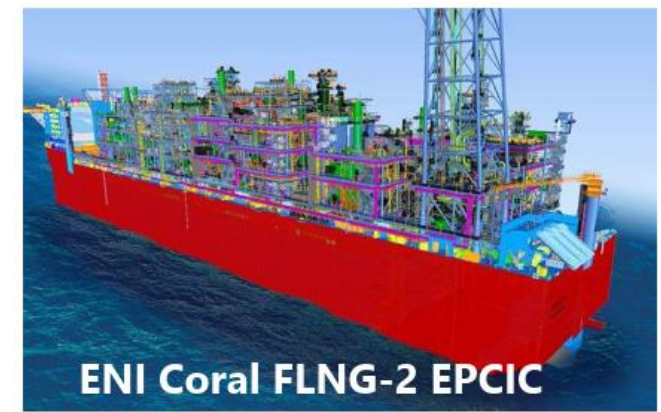


Our Strengths

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 Experiences





Operational Excellence Services

Smart O&M Solutions INTEGNANCE VR Fast Digital Twin Maintenance Viewer



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

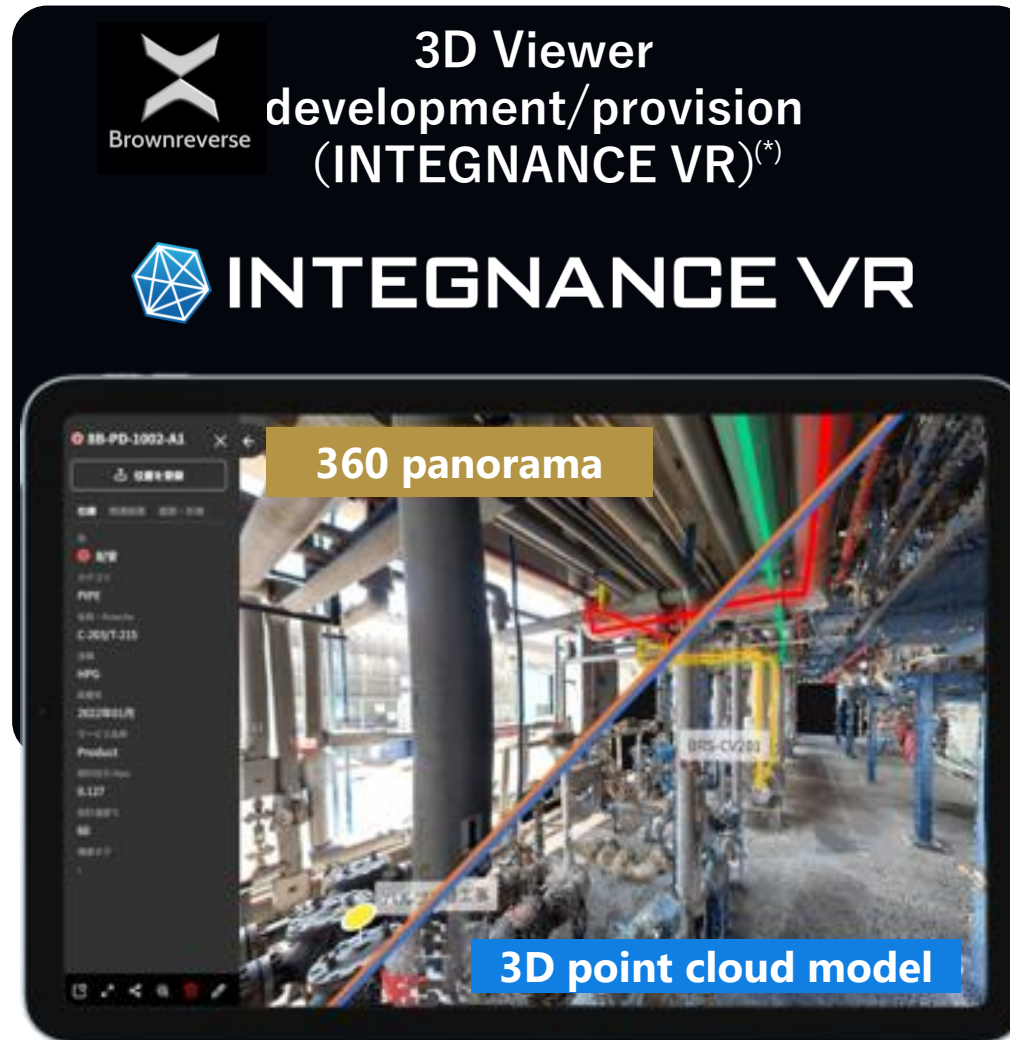
INTEGNANCE VR-Fast Digital Twin Maintenance Viewer

Do you have any of these issues?

- ☹️ **Struggling with promoting DX to aging plant which doesn't have 3D model**
- ☹️ **Wasting time on Site Visit for repair work planning, inspection planning, and daily maintenance work planning**
- ☹️ **Outdated or missing blueprints**

Our Solutions

- Our “Fast Digital Twin” replicates your plant as 3D model within 3 days at the earliest
- Without going to the site, maintenance planning can be developed via web
- Direct recording into a 3D model with tablets on-site is an efficient way to share site data without the need for blueprints



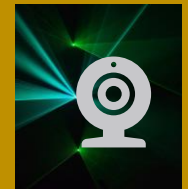
3D scanning



Wearable 3D Imaging Scanner



Drone

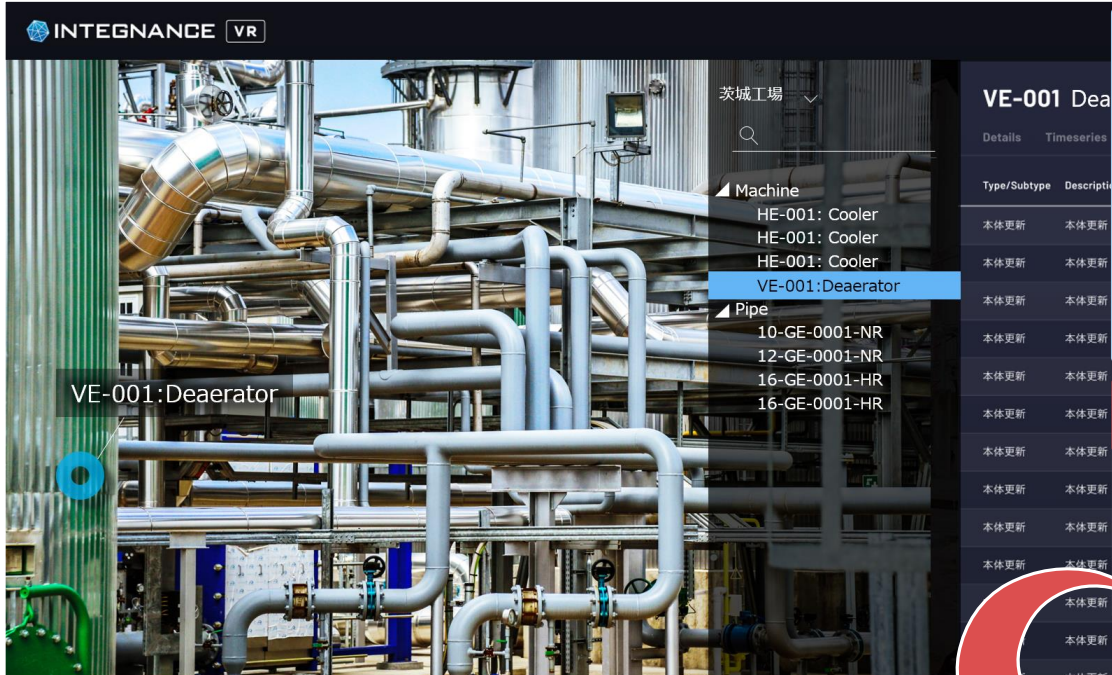


Imaging Laser Scanner

(*)INTEGNANCE VR is developed by Brownreverse which is one of JGC group companies.

INTEGNANCE VR-Fast Digital Twin Maintenance Viewer

Key Features



3D Simulation

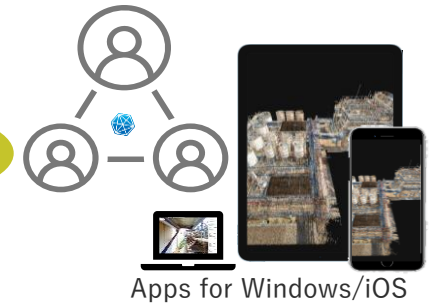
Planning of scaffolding area, Checking of material delivery routes, complicated construction, etc.

Desktop Survey

Measure the length between two points on the display without reading the drawing or measuring the actual length in the site.

Anytime Anywhere Access

- No special hardware required.
- Easy sharing thru URL.
- collaborative editing by multiple users.



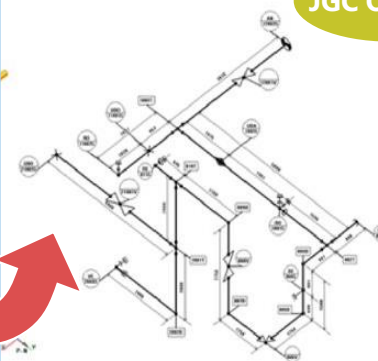
Automatic Piping Recognition

Mapping of corrosive loops and corrosion /damage focus areas on 360 panorama image

JGC Original

Automatic Isometric Output

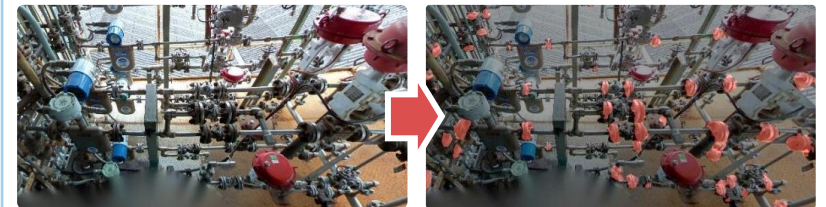
JGC Original



Automatic Flange/Valve Detection

JGC Original

Auto detection of flanges/valves positions from 360 panorama image by utilizing AI machine learning technology



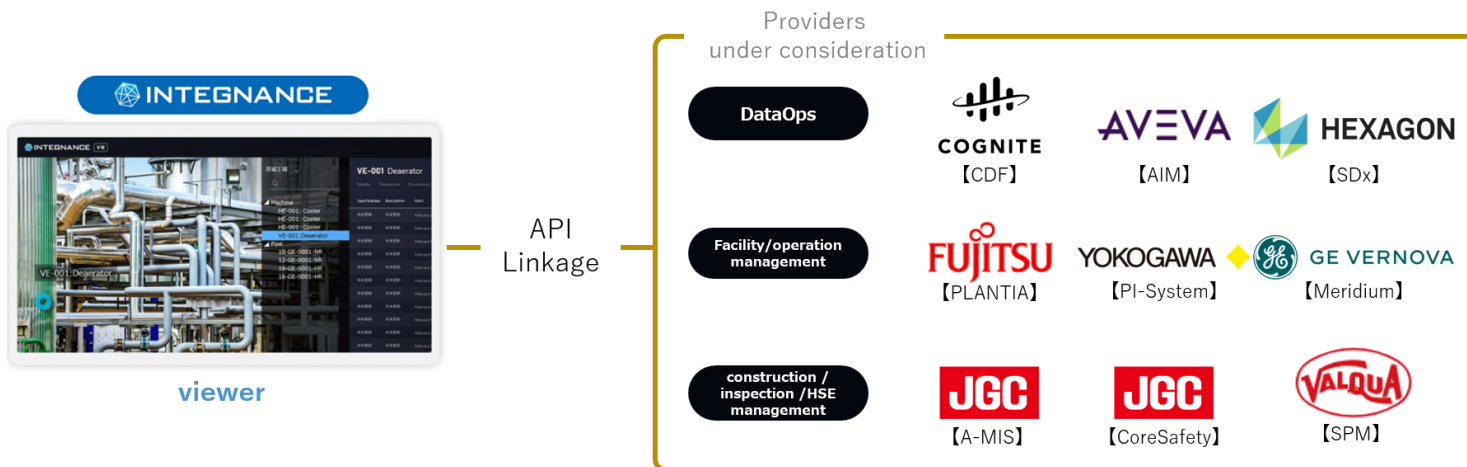
INTEGNANCE VR-Fast Digital Twin Maintenance Viewer

Use Case

Direct recording of 3D model into tablets on-site
saves 22,500hr annually. (45% reduction)

System Integration

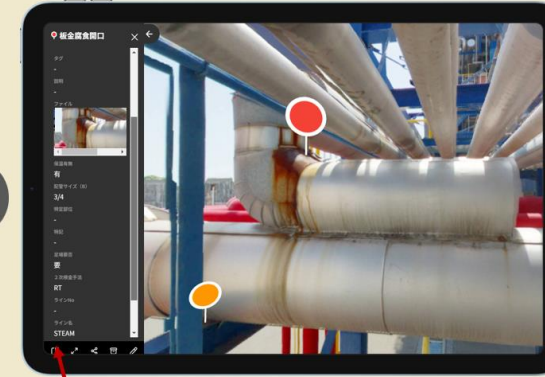
Integrating data infrastructures with WEB API makes it easier to reference
and update related information on INTEGNANCE VR.



BEFORE

- Outdated drawings
 - With sketching
 - Complicated to manage
- Difficult to identify managing location
- Field survey is essential for planning

AFTER



Photographs/details/incidental work, etc.
Record all related information together

- Direct on-site recording
⇒ Reduction of time and work for preparation and reporting
- Check information all at once
⇒ Optimized planning
- Record location information
⇒ Efficient information sharing

Our Experiences

Over 50 Sites

INTEGNANCE VR has been adopted to over 50 sites.

Recent news:

INTEGNANCE VR was adopted for an ammonia production base in Indonesia for a joint study on reducing GHG emissions.(Sep 2024)



Operational Excellence Services

Smart O&M Solutions
MODS Connect
Smart Turnaround Management



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Access to MODS Connect

 [Industrial Construction Management Software | MODS Connect | MODS](#)

MODS Connect-Smart Turnaround Management

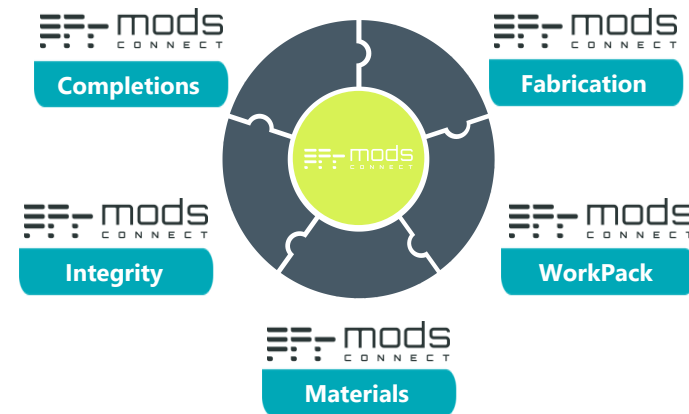
Do you have any of these issues?

- Desire efficient information sharing and status update with digital tools during turnaround
- Struggling with transitioning to paperless work management
- Need to optimize the turnaround plan effectively

Concept of MODS Connect for Turnaround

- A cloud-based solution that digitalizes, visualizes and automates Turnaround Project workflows, MODS Connect simplifies processes, improves safety, optimizes cost and time efficiencies.
- It enables remote collaboration and information sharing to help users make best decisions every day from turnaround planning to execution.

As flexible as comprehensive MODS Connect ecosystem includes 5 intelligent modules that connect in any combination.



> Completions

Facilitate a controlled, staged transfer of responsibility under each discipline via an intelligent centralized database.

> Integrity

Provide the digital intelligence to ensure leak-free startup, process safety and major hazard avoidance.

> Materials

Intelligent inventory control of materials, equipment and components to ensure delivery on time, in sequence and to the correct location.

> Fabrication

Intelligently track components throughout the upstream fabrication process to provide transparency, traceability and reliable supply-chain control.

> WorkPack

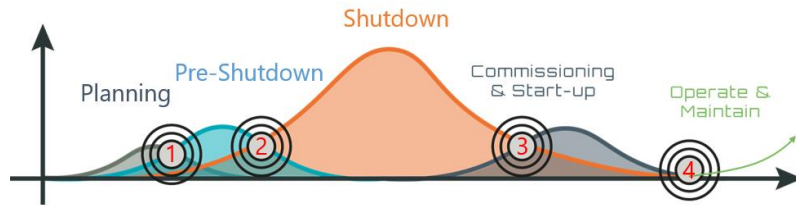
Go paperless with digital work packs for more intelligent, transparent and accountable project execution

MODS Connect-Smart Turnaround Management

Return to
Smart O&M
Solutions menu

Seamless Turnaround Management

MODS Connect achieves seamless interface management during turnaround activities



> 1.Planning to Pre-Shutdown

Manage the pre-shutdown work by assessing risks, scheduling tasks, and preparing resources based on the accumulate past experiences and knowledge in the database.

> 2.Pre-Shutdown to Shutdown

Assign successors and predecessors to define the path of shutdown work, identify execution requirements to allow constraint management

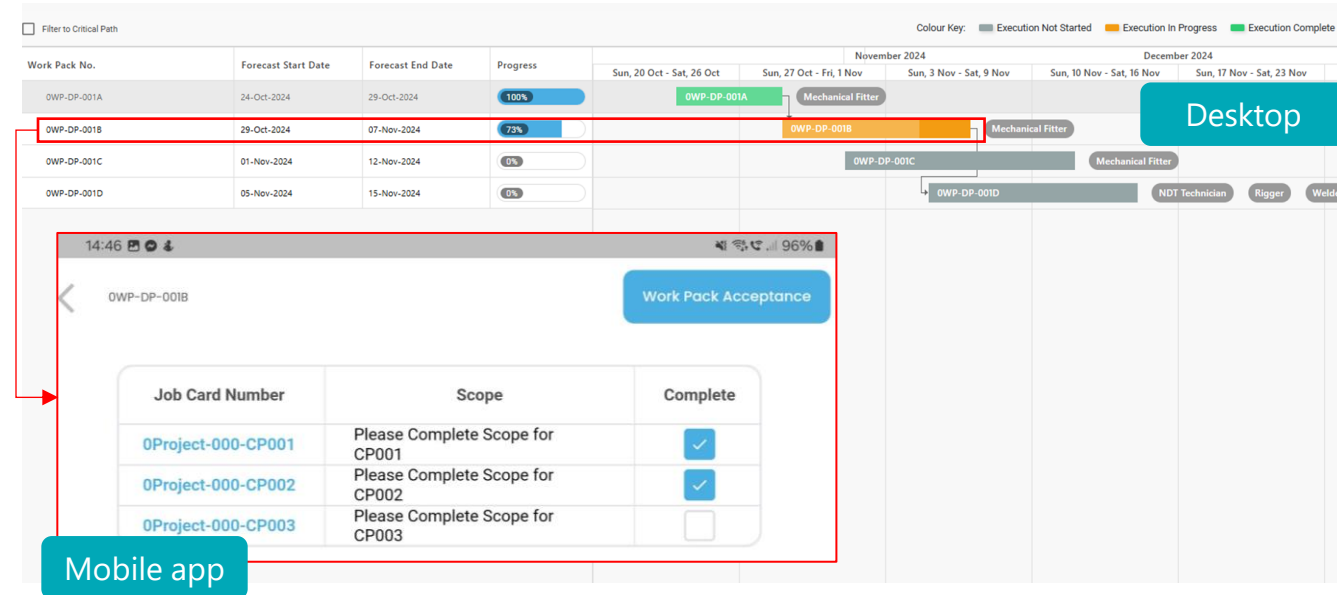
> 3.Shutdown to Start-up

Monitor shutdown work progress utilizing mobile devices, complete installation and quality records on mobile technology to provide real time tracking.

Visualize shutdown to commissioning handover.

> 4.Handover

Provide Realtime handover acceptance for operational hand over and stable operations



Gant chart monitoring and managing of activities on desktop and mobile app

Client's Benefits

- Reduces costs, for example, by reducing time spent searching for data by ~50%.
- Improves safety through transparent, streamlined workflows to minimize risk and increase the awareness of teams.
- Streamlines complex processes and maximizes resource utilization and efficiency.



Operational Excellence Services

Smart O&M Solutions Piping Remaining Life Prediction



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Piping Remaining Life AI Prediction

Do you have any of these issues?

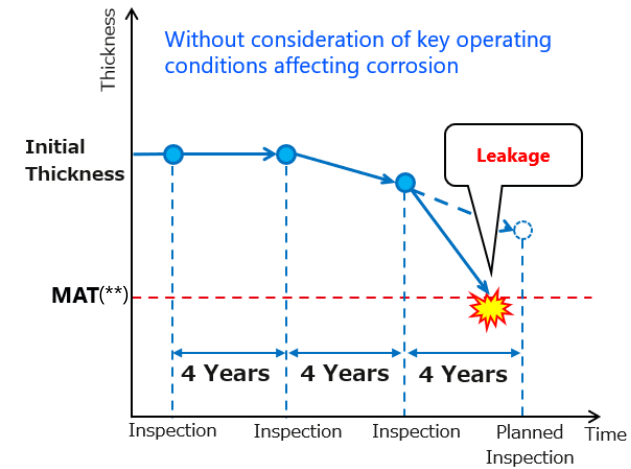
- **Unexpected incidents from piping corrosion**
- **Excessive inspection workload due to numerous TMLs (*)**
(Need to focus on critical locations)
- **Inability to reflect operating condition changes in remaining life**
- **Difficulty securing skilled personnel**

(*) Thickness Measurement Location

Conventional vs. JGC AI Method

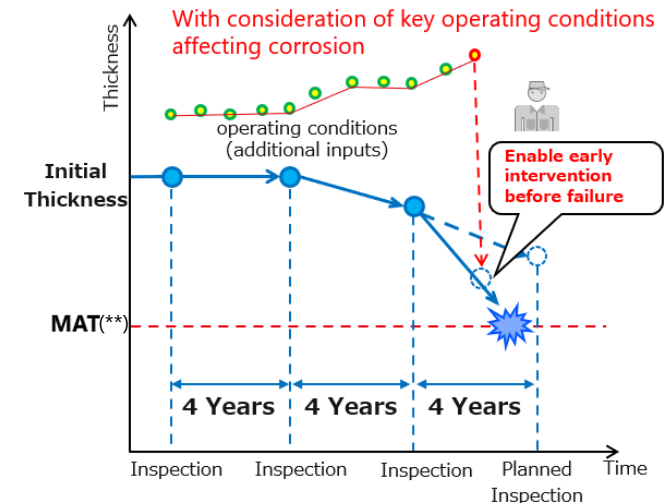
- **Conventional**
 - Based on past thickness data only
 - Static corrosion trend analysis
 - Inspection planning based on historical records
- **New AI Method (JGC solution)**
 - Combines thickness and operating data
 - Dynamic corrosion prediction
 - Data-driven, optimized inspection planning

➡ **Enabling proactive and optimized integrity management**



Conventional Prediction Methods

(**) MAT : Minimum Allowable Thickness



JGC AI-Driven Prediction Method

Piping Remaining Life AI Prediction

Continuous Improvement Through Lifecycle Operation

The system continuously improves accuracy throughout the plant lifecycle after initial development, through ongoing operation and periodic updates.

Development Phase

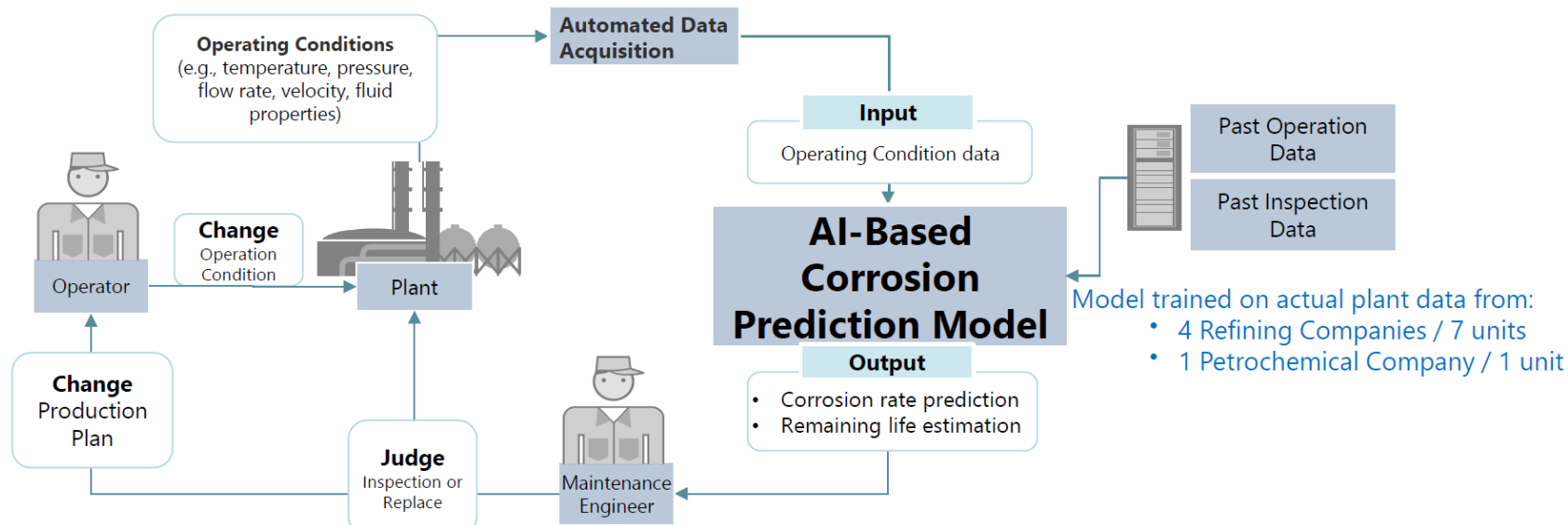
- Initial AI model training using historical thickness and process data

Operation phase

- Continuous prediction based on operating data (e.g., flow, pressure, temperature, pH)
- Model updated periodically with new inspection results (e.g., SDM)

User Benefits

- Condition-based predictions** under changing operating conditions
- Highly accurate decisions** regardless of experience
- Optimized operating conditions** based on corrosion behavior
- Preservation** and sharing of expert **knowledge**

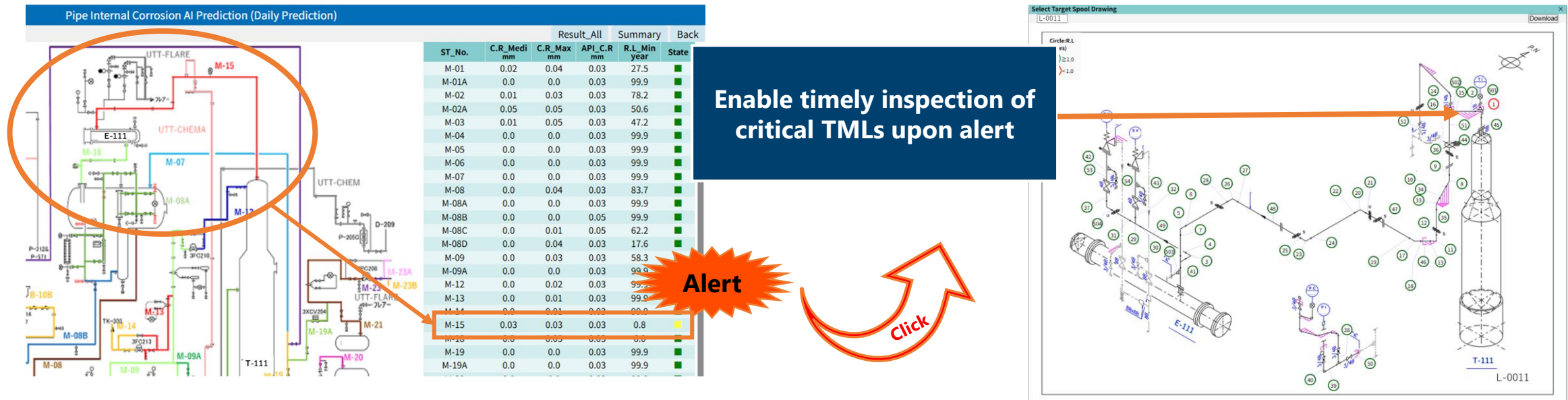


Piping Remaining Life AI Prediction

Return to
Smart O&M
Solutions menu

Key Features

- **Daily Prediction**
 - Predict remaining life based on latest operating data (up to the previous day)
- **Planning Support**
 - Predict remaining life at specific future timings (e.g., next SDM)
 - Enables optimized inspection planning
- **Simulation**
 - Simulate remaining life under planned operating conditions
 - User-defined scenarios can be evaluated in advance





Operational Excellence Services

Smart O&M Solutions AI TML Assessment



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

AI TML Assessment

Do you have any of these issues?

- Experience with unexpected leaks in non-TML (*) piping.
- Concerns about adequacy and sufficiency of existing TMLs.
- Need for efficient allocation of TMLs for new piping in accordance with standards and regulations.

(*)TML: Thickness Monitoring Location

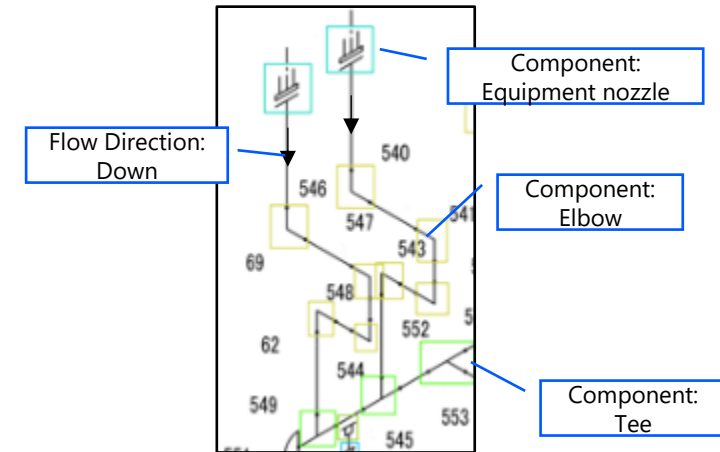
What our solution is

1. Automated Identification of Component & Flow Direction

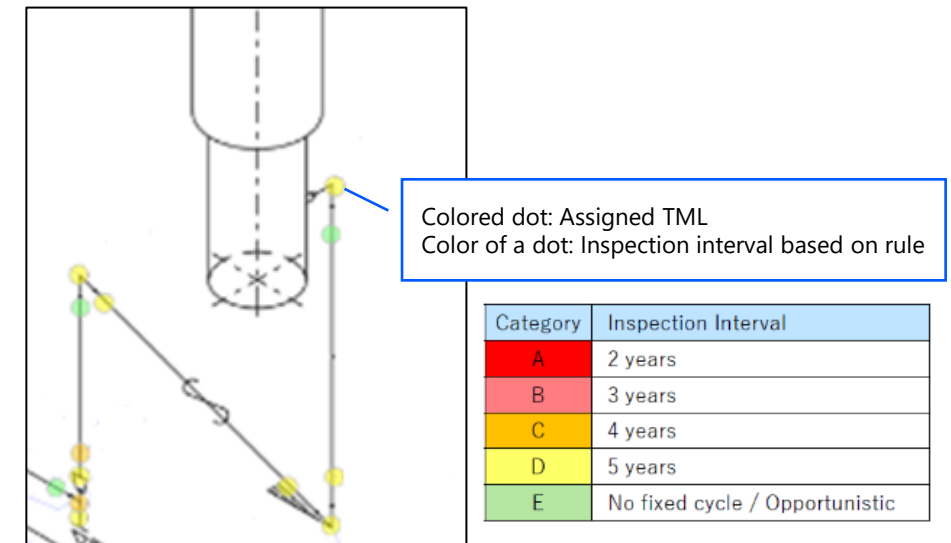
- Reads spool drawings to automatically extract and structure piping components, flow directions, and other related information.

2. Rule-Based TML Assignment

- Client-specific TML assignment rules can be pre-set. (e.g., place TML on piping at every 50 ft.)
- Then, TMLs are automatically assigned based on pre-defined rules.



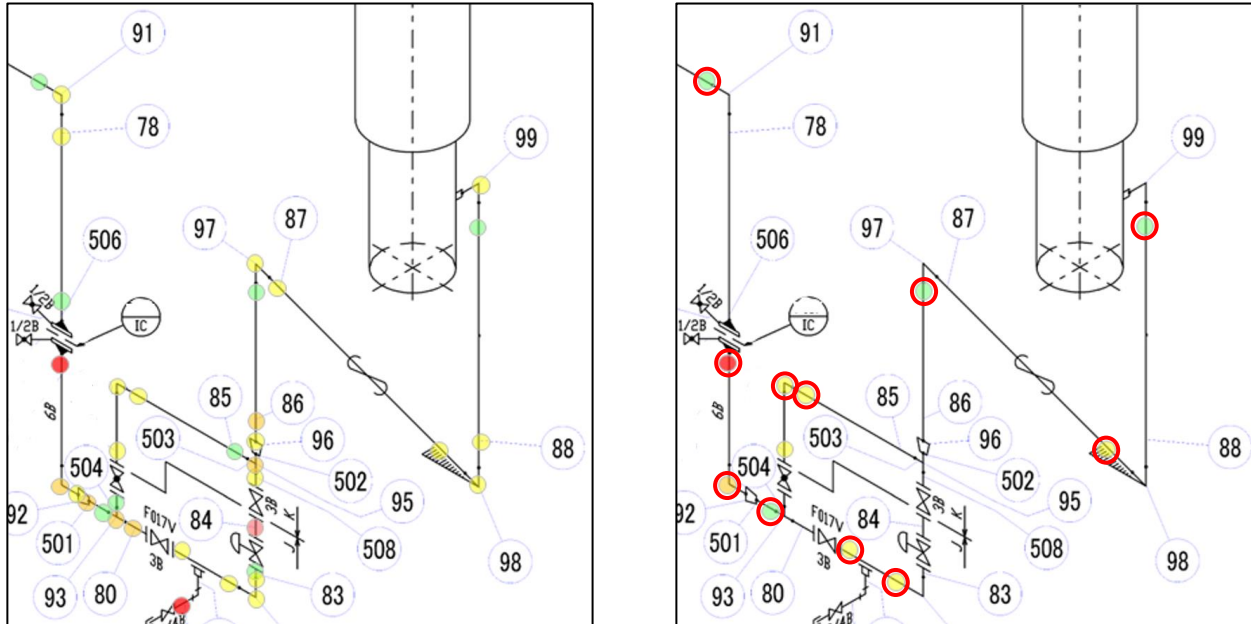
1. Automated Identification of Component & Flow Direction



2. Rule-Based TML assignment

Identify Gaps in TML Coverage

- The system can compare existing TMLs with AI-recommended TMLs to identify gaps.
- The user can evaluate whether existing TML coverage is sufficient.





Operational Excellence Services

Smart O&M Solutions

INTEGNANCE TR

Predicting Failure of Rotating Machinery



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

INTEGNANCE TR-Predicting Failure of Rotating Machinery

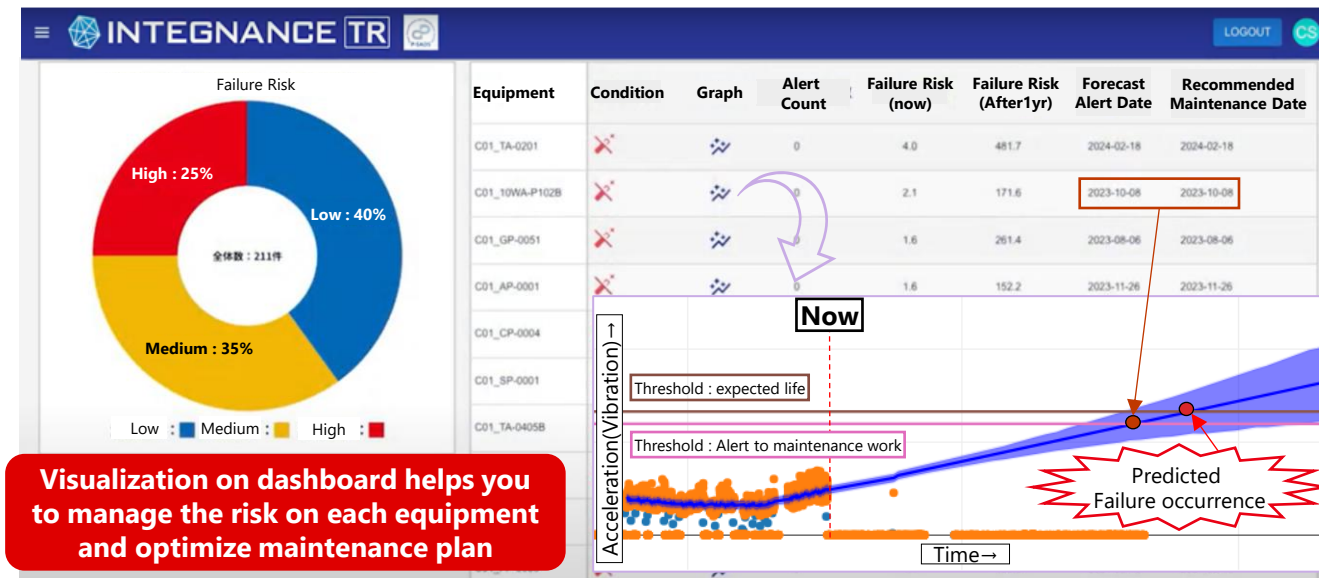
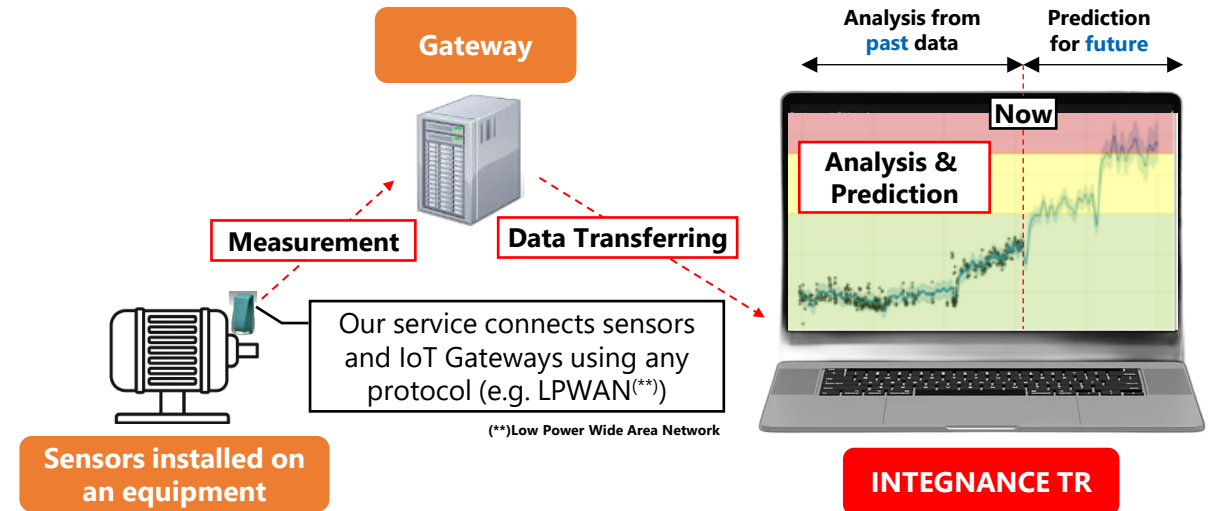
Do you have any of these issues?

- Need to predict failure event to minimize production loss
- Need to optimize maintenance plan and cost for rotating machinery with or without existing sensors
- Struggling to accumulate maintenance knowledge

What is INTEGNANCE TR^(*)

- **Web-Based Analysis Tool:**
INTEGNANCE TR, one of JGC in-house software, analyzes and visualizes the predicted condition of rotating machines by modeling time series data from sensors (e.g., vibration, temperature).
- **One-Stop Service:**
Provides comprehensive services, including the installation of sensors and gateway devices to connect equipment to the cloud, AI modeling, and cloud-based visualization, all with secure data transfer protocols.

(*)Time series regression forecast for Rotating machinery



INTEGNANCE TR-Predicting Failure of Rotating Machinery

Linkage with Virtual Reality

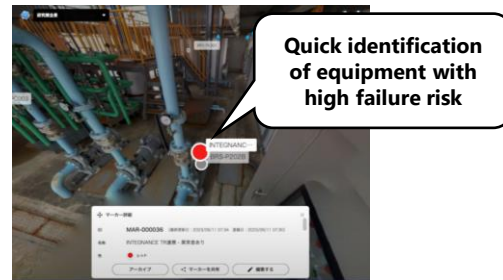
- **VR-Based Visualization (INTEGNANCE VR)**
Visualize equipment and failure risks from INTEGNANCE TR in a 3D plant.
- **Faster Anomaly Response**
Technical staff can quickly identify issues and take action using 3D visualization.



INTEGNANCE TR



INTEGNANCE VR [See Details](#)



INTEGNANCE VR
(Fast Digital Twin Maintenance Viewer)

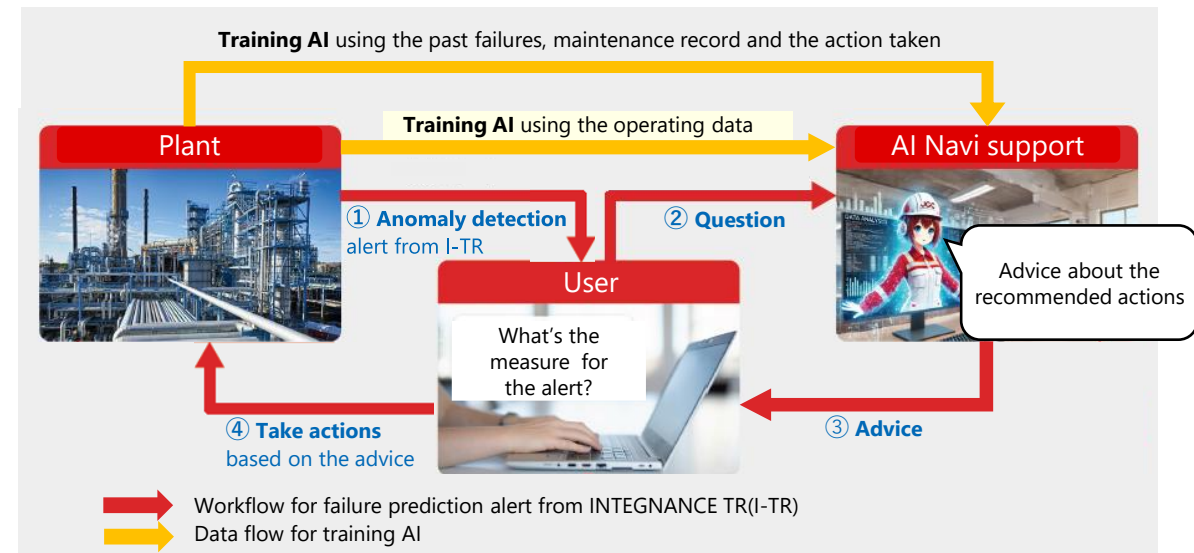
Our Strengths

- **Customized AI Algorithms:**
Leveraging extensive plant engineering expertise, we develop tailored AI algorithms for specific equipment and situations.
- **Flexible Integration:**
Our system seamlessly connects with sensors from any vendor.
- **Cost-Effective:**
We offer low implementation and licensing costs.

Future Features of INTEGNANCE TR

- **AI Navi (*) Integration:**
Get advice based on past failures, actions taken, and operating data.
- **Prescriptive Maintenance:**
Combining INTEGNANCE TR and AI Navi for proactive solutions.
- **Knowledge Standardization:**
AI Navi captures and standardizes expert knowledge for sustainable transitions.

(*)AI Navi is under development by JGC



INTEGNANCE TR-Predicting Failure of Rotating Machinery

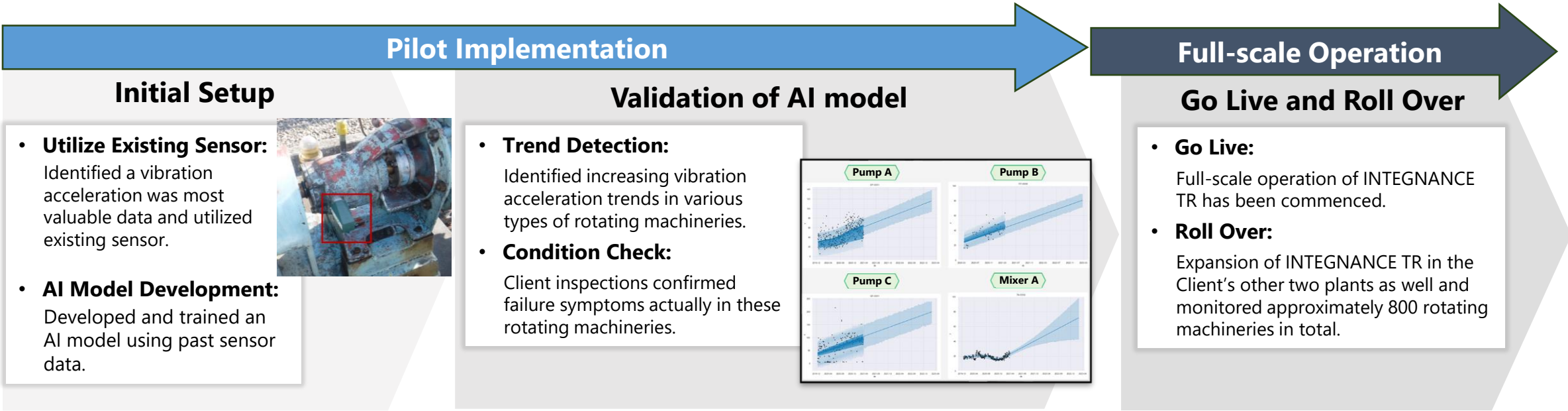
Use Case : Failure Prediction in Oil Refineries

Client: Japanese oil refinery

- Requires a maintenance for the equipment in offsite area
- Approximately 300 rotating machinery with a sensors which cause alarms when their value is over the threshold.
- The alarms included non-critical alarms such as spike noise, false alarms.

Client benefit

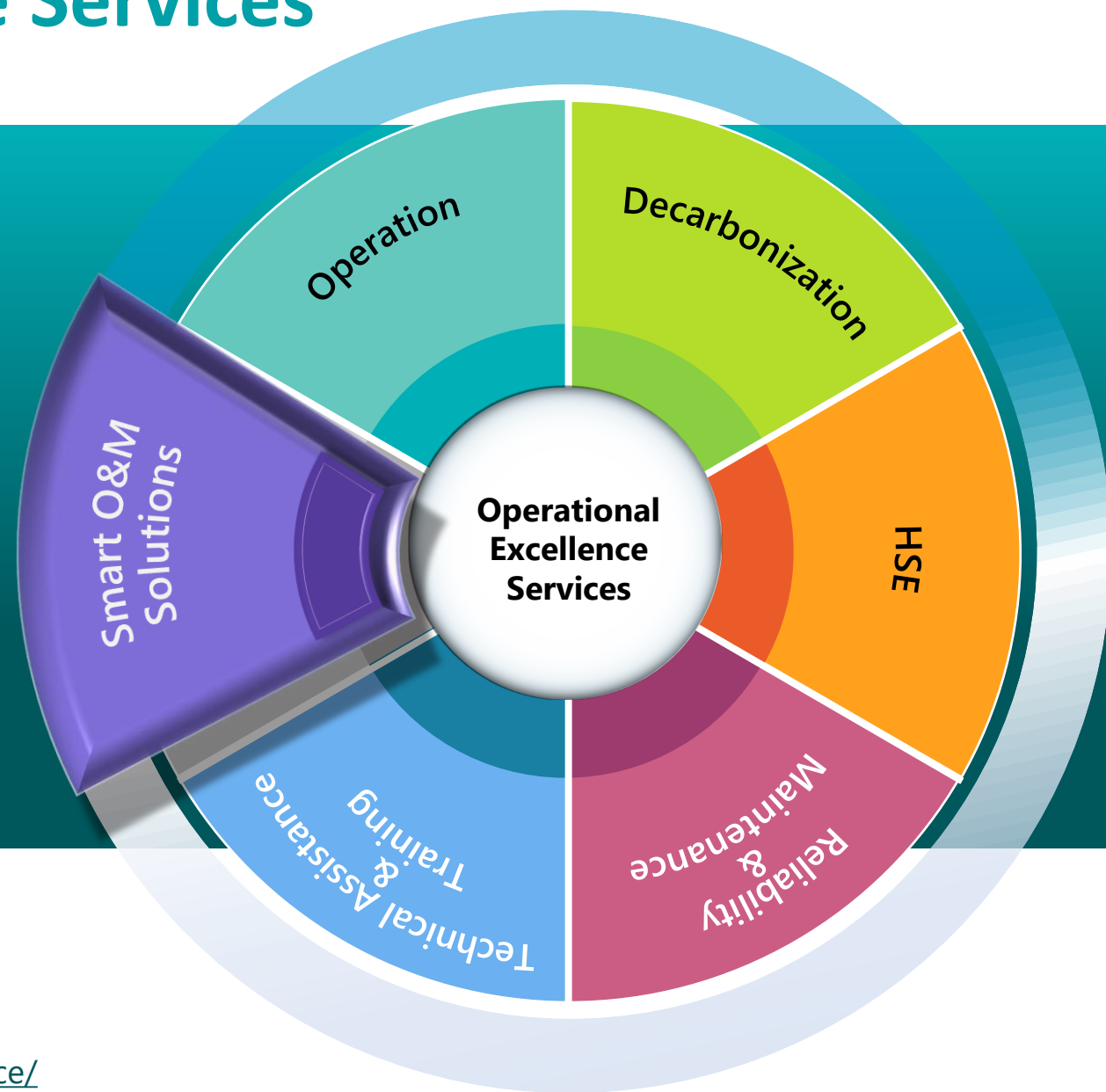
- **Prevent Unexpected Shutdowns:**
Timely maintenance prevents unexpected equipment failures.
- **Remote Monitoring:**
Expanded from 300 to 800 rotating machines monitored remotely.
- **Reduced Maintenance Costs:**
Optimize maintenance schedules to reduce costs.





Operational Excellence Services

Smart O&M Solutions Plant Smartification with AI Technology



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Plant Smartification with AI Technology

Do you have any of these issues?

- ☹ Lack of specific expertise for O&M improvement
- ☹ Decline in productivity due to plant aging
- ☹ Accumulated large amount of data but not being used
- ☹ Knowledge gained through the experience of senior O&M personnel is not shared well with other members of the team.

Why choose an AI Solution with JGC

Know your Process Design

Extensive achievement in process engineering for various types of EPC project

Longstanding O&M Service

Our team has wide knowledge and experience in O&M service

Multi-field Engineers

Our engineers can propose AI solution with multiple fields including process, pressure vessels, rotating equipment, static equipment, electrical, instrumentation, HSE, etc.



Excellent AI experts

Extensive successful experience in providing AI solutions and well-developed implementation methodology.

30+ Cases

Prediction of catalyst degradation, Digital systemization of O&M, Equipment Failure Prediction System...etc.

Various Types of Facilities

Oil Producing, Power Plant, LNG Plant, Chemical plant, Space station, Waste treatment plant...etc.

Plant Smartification with AI Technology

Our Solution



**Operation
Visualization**

Visualize plant operation data to intuitively determine operating conditions



**Anomaly
Detection**

Quickly detect abnormalities and analyze causes to prevent any unforeseen events and trouble



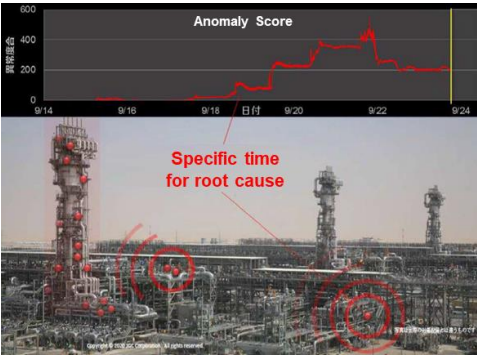
**Prediction of
age-related
deterioration.**

Predicts age-related deterioration of catalysts, solvents, etc., and suggests optimal replacement times.

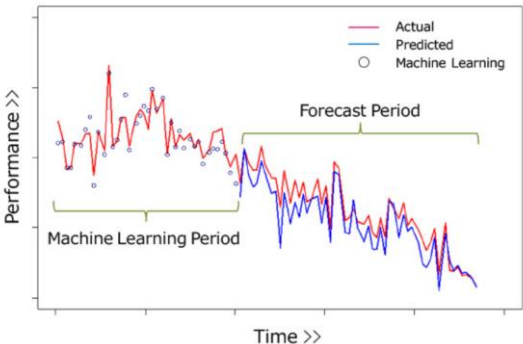


**Productivity
Improvement**

Incorporating external factor such as climate data into operational data analysis to improve productivity

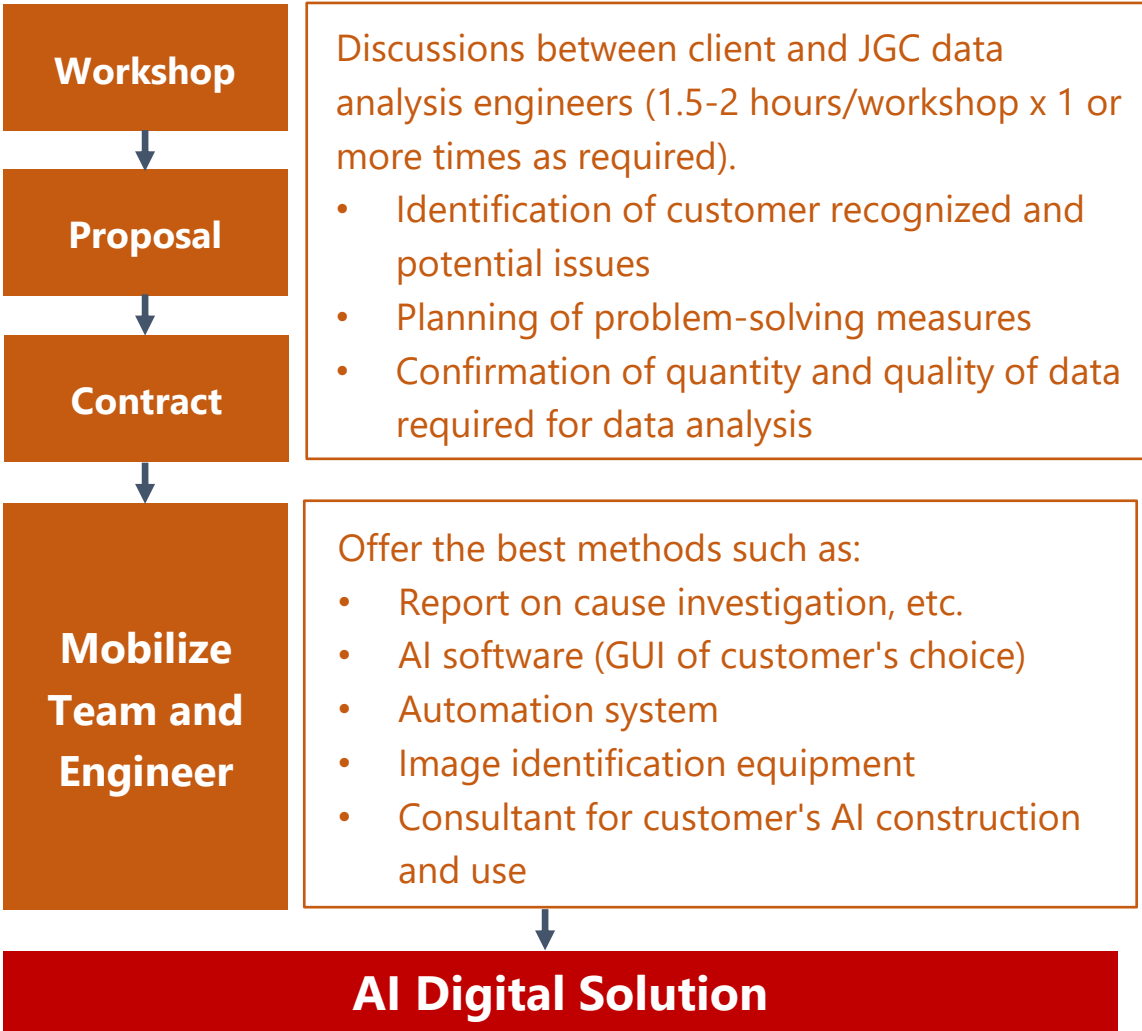


Trace the process determine the cause



Time-dependent catalyst deterioration

Our Approach



Case Study: Analysis equipment clogging factors in Chemical plant

Return to
Smart O&M
Solutions menu

(1) Issue

- ☹️ **Equipment clogging occurs frequently**
- ☹️ To clean the clogging, the plant had to be shutdown and resulting in a **significant loss of production.**
- ☹️ Difficult to analyze **the large number of operating conditions** under which clogging occurs.

(2) Our Solution

- Step-1** To develop AI model based on algorithms for LightGBM Classifier model to investigate operating conditions during clogging for the past 10 years
- Step-2** The model calculates clogging in real time during operation and extracts operational factors (e.g., sensor values) related to blockages sequentially.
- Step-3** Approximately 20 factors representing operating conditions that contribute to blockage were found. The top three factors were visualized as a three-dimensional plot. **(Fig. 1)**
- Step-4** The result allows engineers to properly analyze the elements causing the clogging and develop an efficient solution.

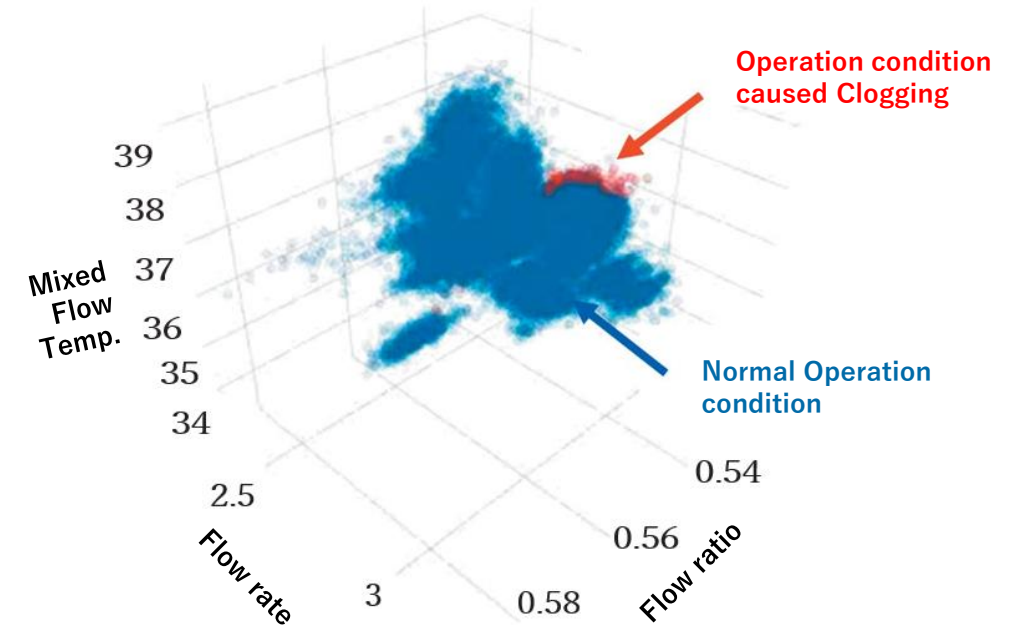


Fig.1 3D visualization of elements causing clogging

(3) Client's Benefit

Improved productivity was achieved by operating to prevent clogging