OFFSHORE ENGINEERING TECHNOLOGY SERVICE PRODUCTS



CCS
CHINA CLASSIFICATION SOCIETY
中国船级社

Safety, environmental protection and creating value for clients and society



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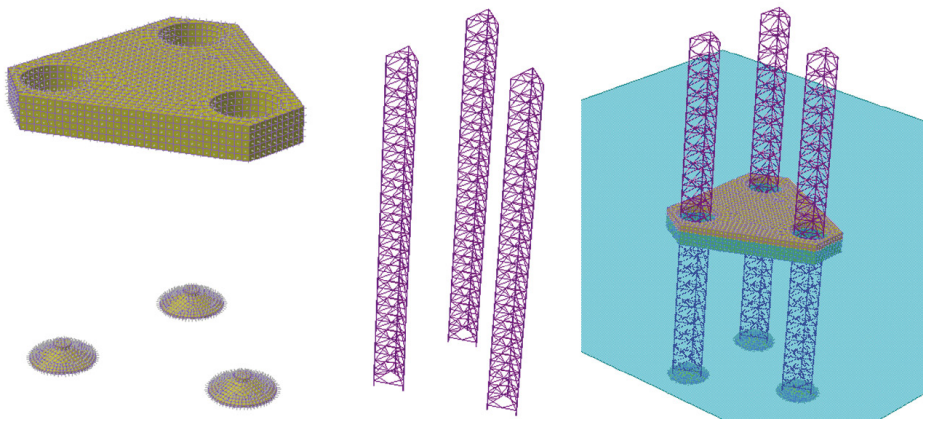
(2) Service of Risk Assessment and Control for Topside System and Equipment on Platforms

Approval in Principle (AIP) for Novel Offshore Installations

For the design of novel offshore platforms performed by shipyards or design companies who carry out R&D work, China Classification Society (CCS) will supply validation service according to the design standards/or the standard developed in progress, and provide design certification solutions for the novel offshore platform or R&D results, which would promote domestic and oversea development of offshore engineering technology.

The AIP certification service covers a wide range of facilities, such as Jack-up Platforms, Fixed Platforms, Ultra Large Floating Platforms, Floating Single Point Moorings, Tension Leg Platforms, Semi-submersible Platforms, Floating Drilling Production Storage and Offloading (FDPSO), Floating Liquefied Natural Gas (FLNG), Drilling Equipment and Subsea Production Systems etc.

(1) Deep-water Jack-up Rigs



Analysis Model of Jack-up Platform

(2) Offshore Large Floating Platforms

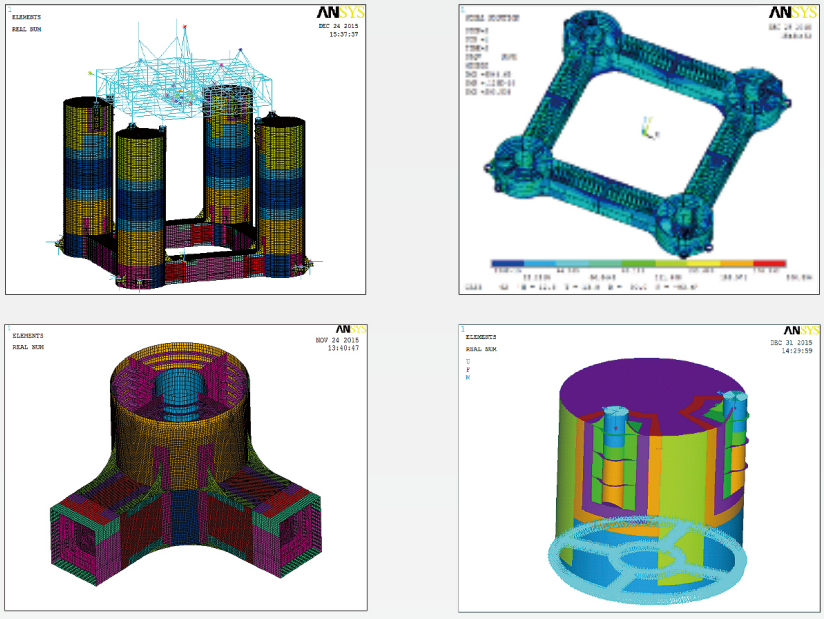


Ultra Large Floating Platform



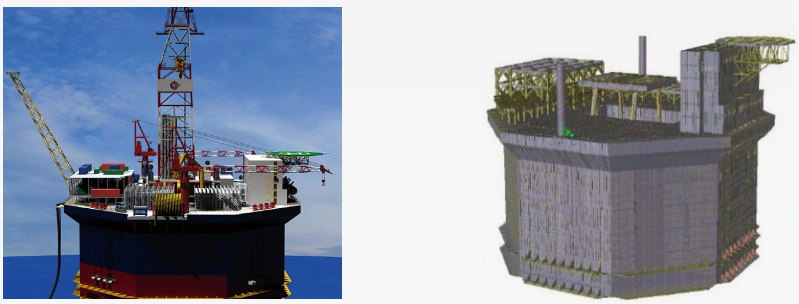
Island Reef Support Platform

(3) Deep-water Tension Leg Platforms (TLP)



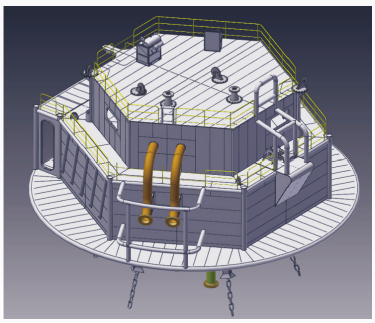
• *Analysis Model of TLP*

(4) Floating Drilling Production Storage and Offloading (FDPSO) and Floating Liquefied Natural Gas (FLNG)



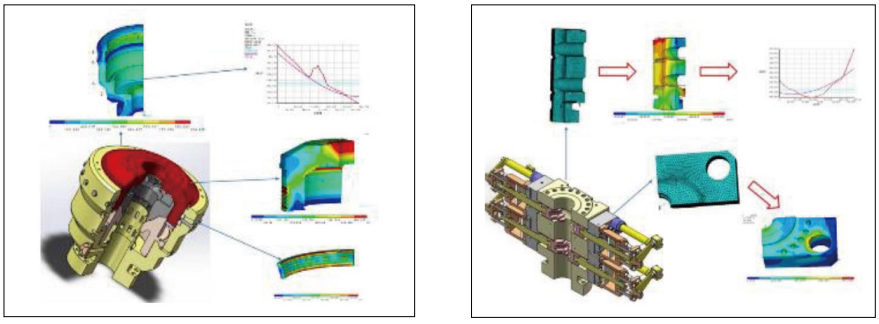
• *Octagonal FDPSO*

(5) Floating Single Point Moorings

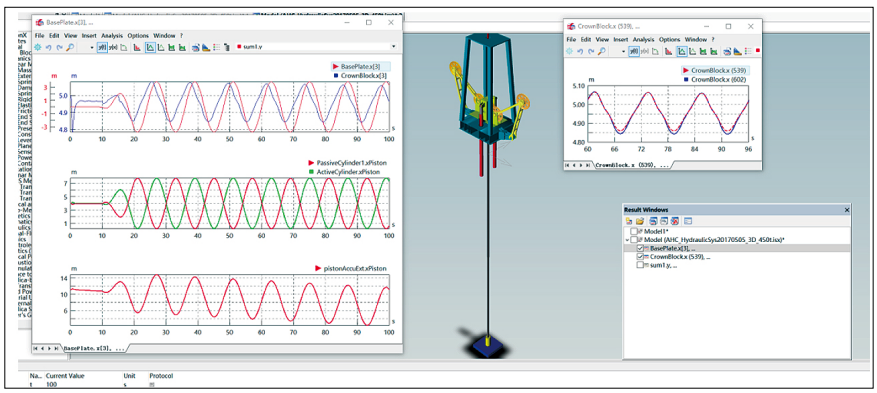


• *3D Model of Floating Single Point Mooring*

(6) Drilling Systems

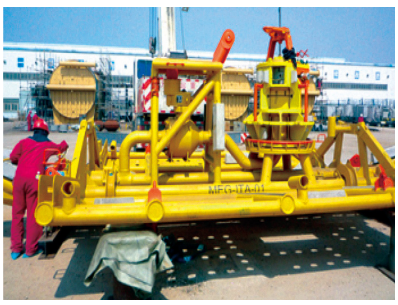


● *Strength Analysis for Well Control Equipment with Ultra High Pressure*



● *Verification of Multi-disciplinary Function Principle for Heave Compensation System*

(7) Subsea Production Systems and Equipment



● *Subsea Pipeline Tee*

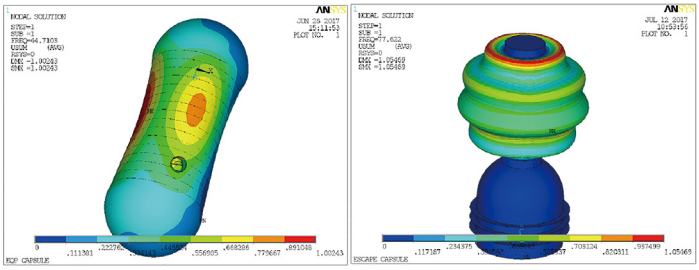


● *Subsea Oil Trees*



● *Design Certification of Subsea Connection*

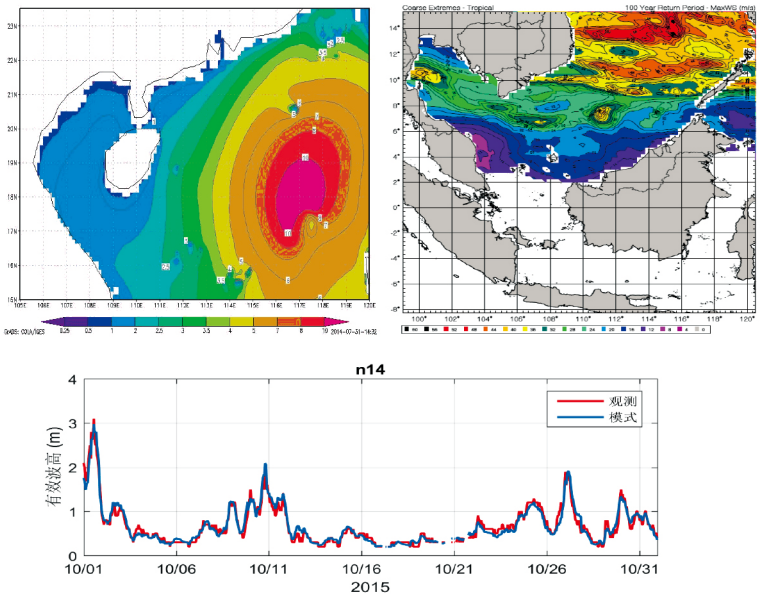
(8) Deep Sea Space Station



- *Buckling Analysis under Extreme Pressure for Structure of Manned Cabin*
- *Buckling Analysis under Extreme Pressure for Escape Cabin*

Technology Service for Marine Environmental Conditions

The R&D for the marine environmental condition has been performed by China Classification Society (CCS) from 2011. Marine environmental database was established with the data of Bohai Sea, Yellow Sea, East China Sea, South China Sea and Southeast Asia waters, and also an analysis and query software was created, which can provide clients with data of wind, wave and current for a variety of offshore platforms, sailing ships and new economic marine facilities.



- *Technology Service for Marine Environmental Condition*

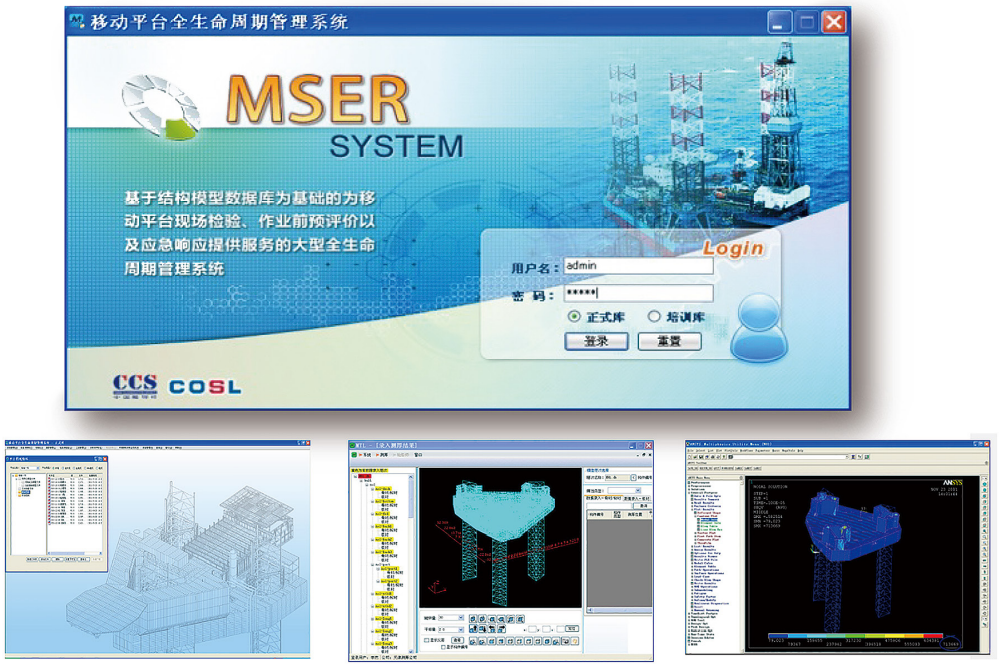
Up to now, CCS has supplied Technology services 5 times for CNOOC and 3 times for domestic other design companies.

Technology Service for Conventional Oil&Gas Offshore Platforms and Equipment

1. Mobile Offshore Units

(1) Full Lifecycle Management System of Mobile Units Structure (MSER)

Based on the urgent requirement of safety management for offshore platforms, MSER system adopts the international advanced management concept of structural integrity and can perform the fast and real-time dynamic evaluation of platform structures in full lifecycle, which covers design, construction, installation, operation and decommission of mobile offshore platforms. What's more, it can provide a complete solution for platform modification, fitness of purpose evaluation for well, incident emergency response, inspection plan, maintenance and repair.



● *Full Lifecycle Management System of Mobile Platforms Structure*

MSER system has been successfully applied on the platforms of domestic petroleum companies, such as China Offshore Oilfield Services Limited, CNPC Offshore Engineering Ltd, Sinopec Shengli Offshore Drilling Company, CNOOC Energy Development Co., Ltd, etc. More than 30 FE models of mobile offshore platforms were verified.

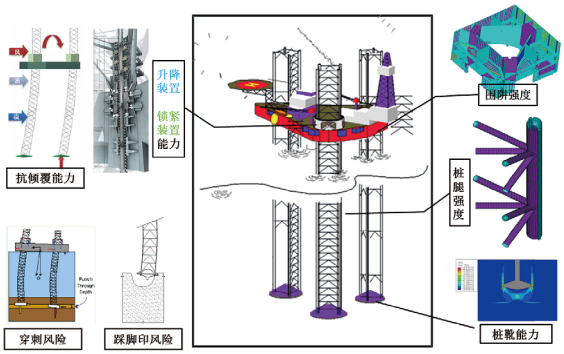
(2) Operational Safety Evaluation on the Target Waters for Mobile Offshore Units

● Operational Safety Evaluation for Well Location

Considering features of Jack-up Rigs' operation, only typical operational condition is presented in the operation manual. But during actual operation for some well location, the environmental conditions are often close to or severer than the limit stated in the operation manual. This evaluation will be performed to confirm whether or not the Jack-up Rig is suitable for the operation in the aimed location.

Up to now, 96 well location's operational safety evaluations have been completed for different clients.



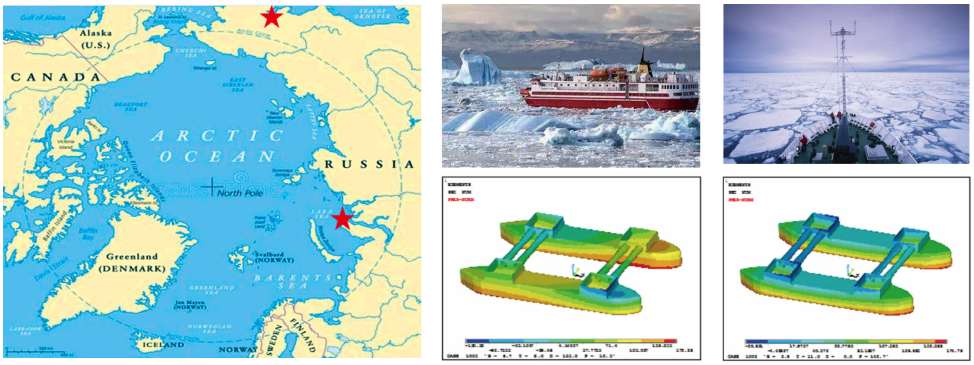


● *Operational Safety Evaluation for Well Location*

● Fitness for Purpose Evaluation for Polar Operation

Because of the severe weather condition and special environmental protection requirement, specific professional analyses are needed to evaluate the fitness for purpose for Mobile Offshore Units polar operation, such as low temperature resistance, severe ice resistance, environmental protection, and so on. China Classification Society (CCS) will perform professional analysis to evaluate the capacity of structure, equipment, stability and mooring according to the requirements of *"International Code for Ships Operating in Polar Waters"*, to ensure the platform's safety for polar operation.

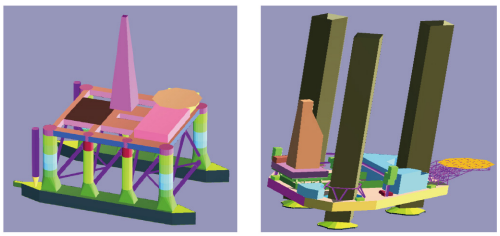
Up to now, the fitness for purpose evaluations for the platforms including "HYSY 982", "Nanhai 8" etc. have been completed, which would operate in polar region.



● *Evaluation of Polar Region Operation for the "Nanhai 8" MODU*

(3) Analysis and Verification Service for Floating Stability of Mobile Offshore Units

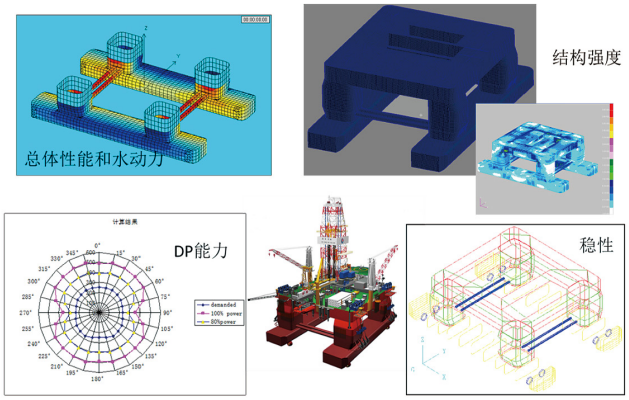
China Classification Society (CCS) can provide the analysis and verification service for mobile offshore platforms stability performance, which is based on the affluent experience from plan approvals, surveys, evaluations and R&D projects. Detailed and accurate stability analysis for mobile offshore platforms in specified condition can improve the quality of the plan approval and site inspection. CCS also can provide stability analysis and verification service for clients whose platform need modification or life extension.



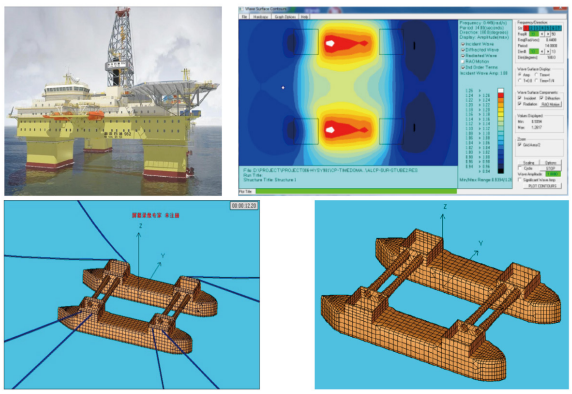
• *Floating Stability Analysis and Verification for Mobile Offshore Units*

(4) Statistics of Hydrodynamic Load, Motion and Air Gap for Semi-submersible Platforms

With advanced theory and analysis method, China Classification Society (CCS) can perform the accurate forecast for the hydrodynamic load and motion response of Semi-submersible Platform, and can do verification for air gap calculation of the platform, which can ensure the design meets the requirement of standards. CCS can also provide technical support for clients during type selection, modification, capacity improvement of Semi-submersible platform.



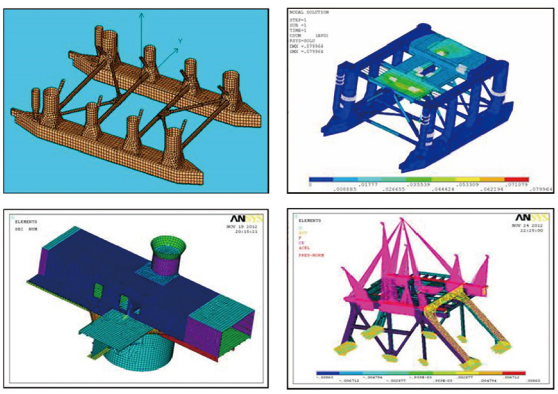
• *Motion Response and Hydrodynamic Analysis for Semi-submersible Platform*



• *Hydrodynamic Load Analysis for Semi-submersible Platform*

(5) Evaluation of Global Strength, Local Strength, and Fatigue Strength for Semi-submersible Platforms

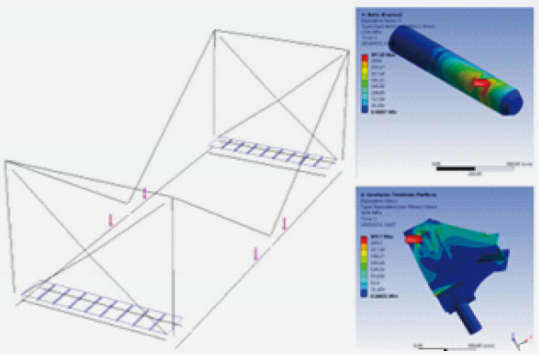
With advanced theory and analysis methods, based on statistics for the hydrodynamic load and motion response of Semi-submersible platform, China Classification Society (CCS) can perform evaluation of platform's the global strength, local strength and fatigue strength of Semi-submersible, which makes sure the Semi-submersible platform structure and functionality safe.



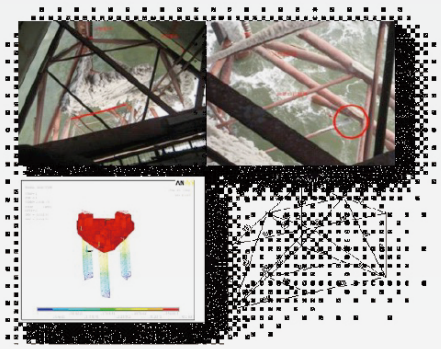
• *Global and Local Strength Analysis for Semi-submersible Platform*

(6) Technical Support for Emergency Response of Mobile Offshore Units

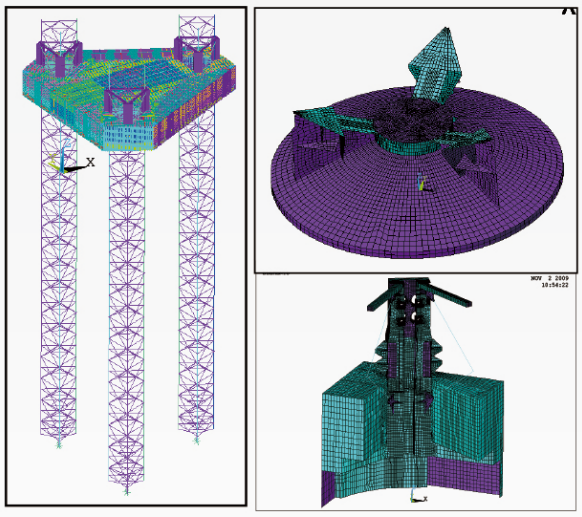
After accumulation of model database and emergency response handling technology for years, China Classification Society (CCS) forms the capacity of technical support service for emergency response. When accidental damage occurs to the Mobile offshore platform, the emergency response system would be launched quickly, which make sure that the analysis of emergency accident and the evaluation of surplus capacity be performed accurately and efficiently, leading to reasonable operation suggestion, which can guide the scientific operation and make reasonable follow-up working plan after the accident, ensuring the safe operation and risk management for the structure of Mobile offshore platform.

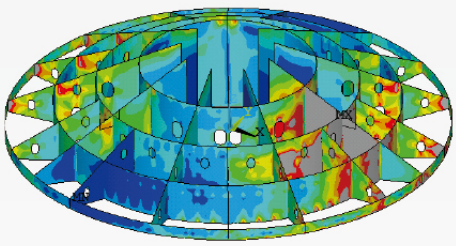


• *Technical Support of Emergency Response for the Failure of Tensioner on Cantilever Beam of "HYSY 942"*



• *Technical Support of Emergency Response for the Leg Damage of "Nanhai 1"*



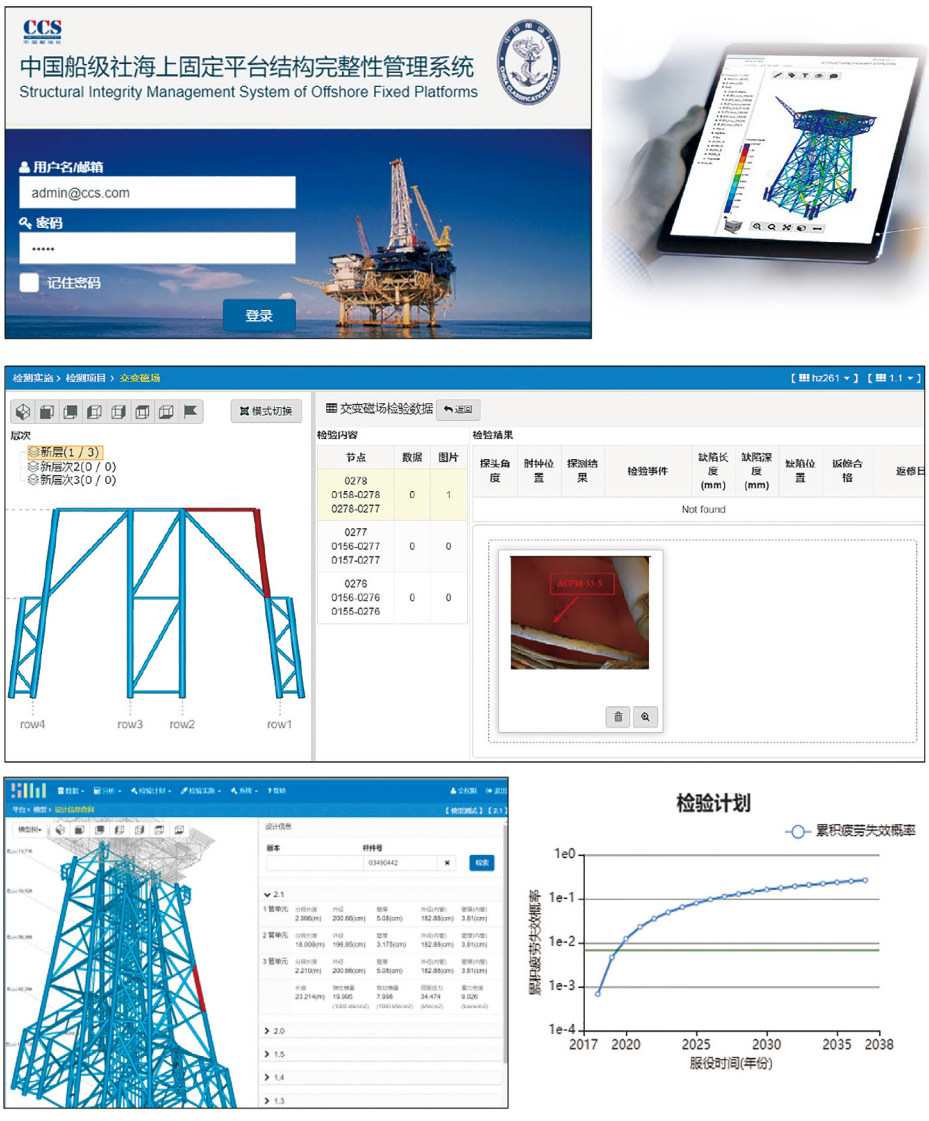


• *Technical Support of Emergency Response for "HYSY 941" Punch-through*

2. Fixed Offshore Jacket Platforms

(1) Fixed Structures Integrity Management (FSIM)

Fixed Structures Integrity Management (FSIM) system, developed independently by CCS, is an overall management system with integration of data management, safety evaluation, risk control and inspection planning. With full quantitative RBI (Risk-Based Inspection) and semi quantitative analysis method applied, this system's efficient data manage capacity and 3D display function ensure that it can conduct continuous and dynamic follow-up evaluation, identify the critical components and nodes of the platform automatically, optimize the scope and period of inspection, which guarantee the safety and reliability of platform structures.



● *Management System of Structural Integrity for Fixed Platform*

(2) Evaluation Service for Structural Strength of Jacket Platforms

Structural evaluation analysis, such as static analysis, earthquake analysis, dynamic analysis, fatigue and ultimate limit analysis, can be performed with the latest status data, including inspection information, deck equipment load. It can provide not only technical support for plan approval and site inspection internally, also independent verification analysis of new build platform and structural status evaluation of jacket in service for clients.



• *Independent Verification by Third Party for Platform LW3-1 DPP*

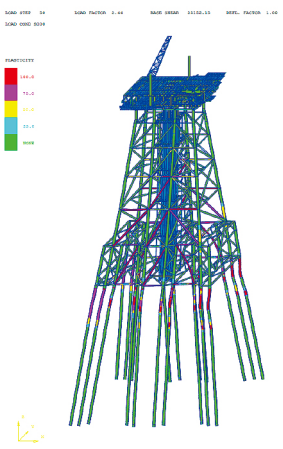


• *Evaluation of Annual Inspection for Platform Pinghu Bajiaoting*

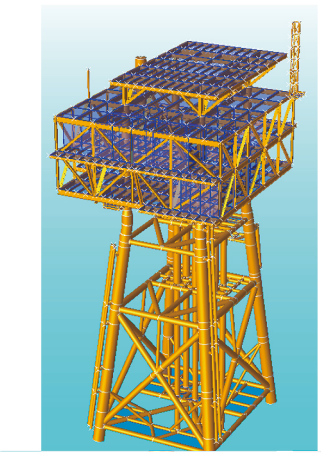
(3) Evaluation of Feasibility for Life Extension for Platform Exceeding the Design Life

This service can meet the standardized requirement of evaluation technology for the aged platforms which are beyond design life. It fully consider the risk presented in the aged platforms, and also controls the risk of platforms within an acceptable level by evaluation and reinforcement measures, which ensures that the platforms will work safely even after the period exceeding design life. CCS forms a complete flow for the evaluation for life extension of aged platforms and determines the evaluation basis and methods for the life extension of aged platforms. Scientific and reasonable inspection plan and maintenance strategy can be determined when the main risk for platforms are identified. Eventually, the operational risk and accidents rate will be reduced and the economic efficiency of platforms will be improved.

About 30 Jacket platforms of domestic oil companies have been evaluated for life extension, which makes delayed service platforms with fundamental technical support.



• *Evaluation of Life Extension for Pinghu DDP platform*



• *Evaluation of Life Extension for BZ34 platform*

(4) Technical Support for the Emergency Response of Jacket Platforms

The purpose of emergency response is that when platform encounters an accident, emergency response will be started rapidly to provide effective measures by fast calculation and evaluation, and to provide technical support for the decision-making from client/operator.

Several emergency response have been completed for Jackets of CNOOC, such as the cause of deformation and evaluation of consequence for the walkway with cable on a platform in East China Sea, safety evaluation for large deflection of topside beams on a platform in South China Sea, evaluation of tilting accident for a platform in Bohai bay etc.



• *Deformation of Walkway with Cable for a Platform*

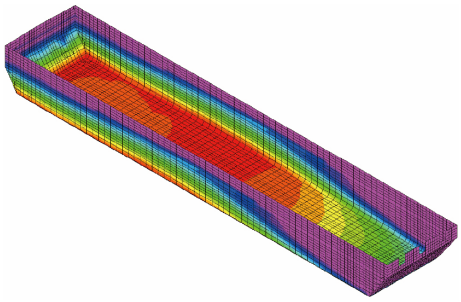


• *Large deflection of Topside Beams*

3. Offshore Floating Installations

(1) Global Performance Analysis Service for FPSOs

Based on the comprehensive rules and guidelines, together with the advanced technology and methodology, CCS has accomplished or has been carrying out the third-party independent analysis/ safety evaluation service for the global performance and mooring system of several FPSOs.

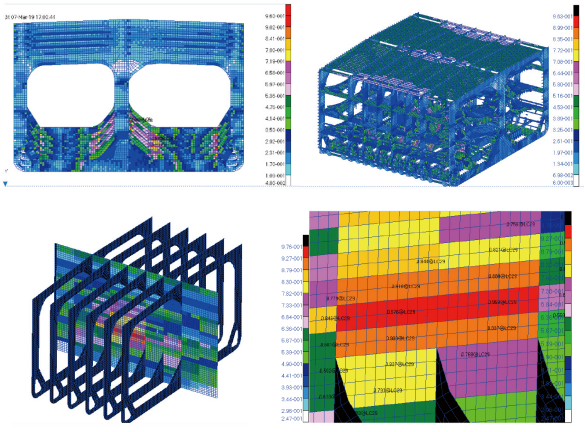


• *Analysis of Hydrodynamic Performance and Wave Loads*

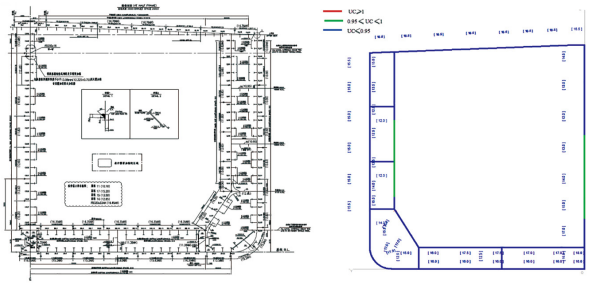
(2) Structural Strength Analysis of FPSOs

With the commercial FEM software and in-house tools, CCS can carry out the rule scantling rule check and the FEM analysis of 3-Cargo compartments, the full-length ship for several FPSOs.

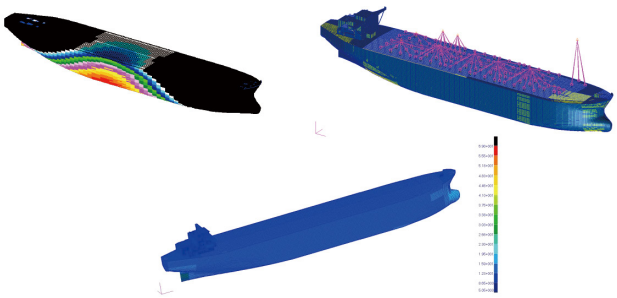
CCS has accomplished the independent analysis of hull strength for FPSOs, including "HYSY118" FPSO, "AVANT1" FPSO, "HYSY121" FSO converted with oil tanker, etc. These independent analyses provide technical support for the plan approval and class survey in projects.



• *Finite Element Analysis for Compartments*



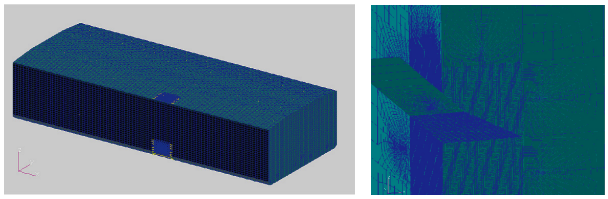
• *Scantling Rule Check*



• *Finite Element Analysis of the Full-length Ship*

(3) Analysis for Fatigue Strength of Floating Structures

CCS can provide the service of simplified or spectral fatigue analysis for the floating structures by using hydrodynamic and structural software, as well as the in-house tools.

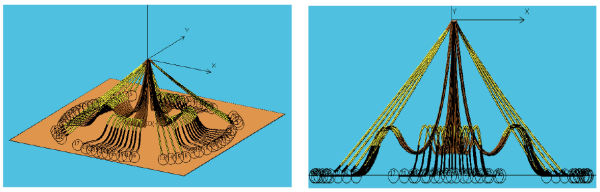


• *Analysis for Structural Fatigue Strength*

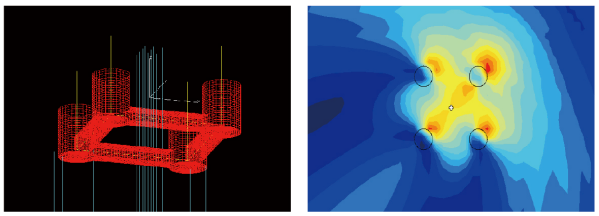
4. Positioning Mooring System

(1) Analysis and Verification of Mooring System for Offshore Floating Installations

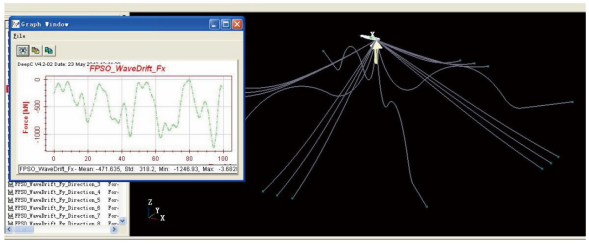
This service provides the reasonable evaluation for the performance of mooring system and strength of mooring lines through the accurate forecast of motion response for Offshore Floating Installations under the wind, wave and current, which ensure the design is in full compliance with the requirement of codes and class rules. Currently, it is widely applied to the Semi-submersible Platforms and FPSOs of Chinese companies, such as China Oilfield Services Co., Ltd, China National Offshore Oil Corporation, etc. It is also applied to FEED design review of TLPs.



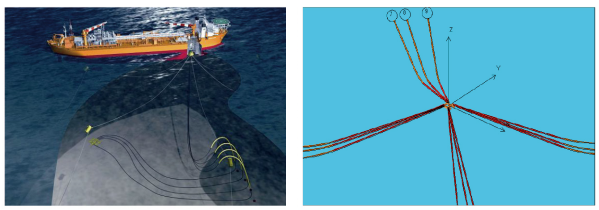
• *Analysis of Mooring System for Semi-submersible Platform in Deep Sea*



• *Analysis of Tendon System for Tension Leg Platform*



• *Analysis Result of Mooring System for FPSO*



• *Analysis of Mooring System for FPSO*

New Marine Economic Facilities and Equipment

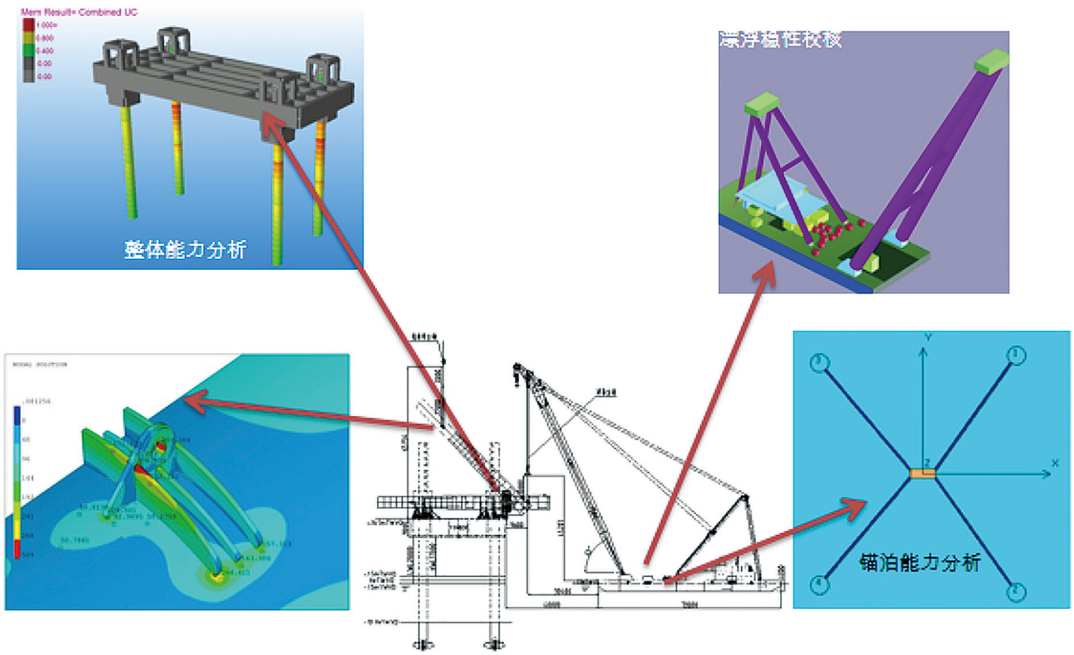
1. Full Lifecycle Technical Service for Fixed Offshore Wind Farm Facilities

(1) Structural Design Review and Technical Service for Offshore Substation

For the foundation structure of fixed offshore substations, especially for Jacket and Tripod, CCS provides technical service for clients, including design review, independent verification calculation, technical Review and design optimization.

(2) Technical Service for Installation of Offshore Wind Farm Facilities

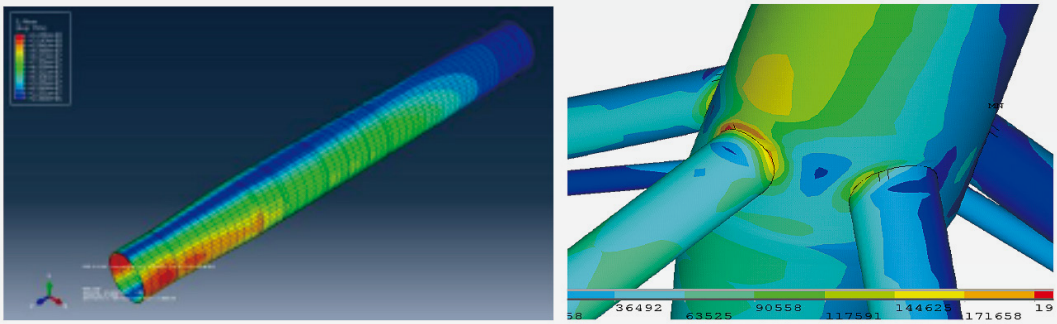
For offshore wind farm facilities installation process, such as load out, transportation and lifting, etc. CCS provides technical service for clients, including vessel/installation unit capacity evaluation, special equipment/instrument design review, installation evaluation, etc.



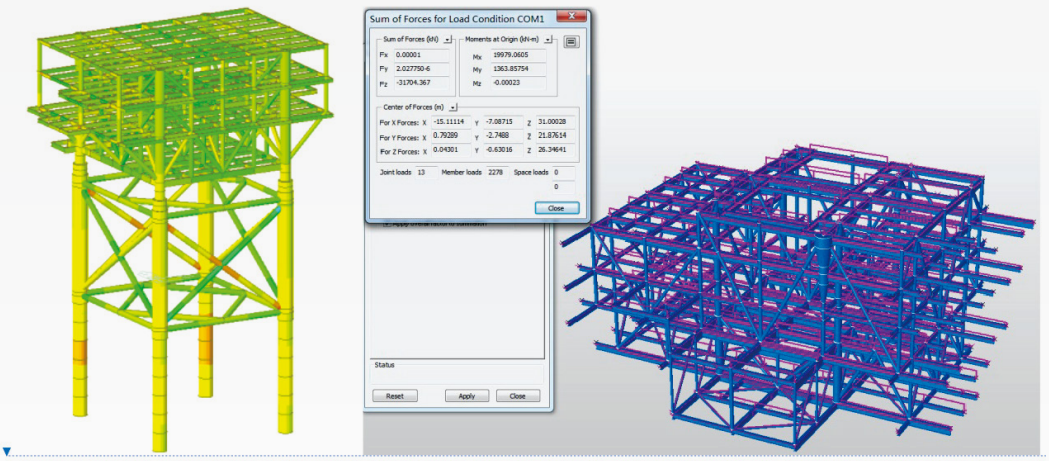
Independent Third Party Technical Support for the Installation of Offshore Wind Farm Facilities

(3) Evaluation of Integrity for the Offshore Wind Power Facilities in Service

For fixed offshore wind farm facilities in service, CCS provides clients with the technical service for the structure integrity issue, such as structural damage evaluation and crack Engineering Critical Assessment (ECA) caused by fatigue, etc.



• *Structural Strength Verification and Optimization for a Monopile of Offshore Wind Turbine*

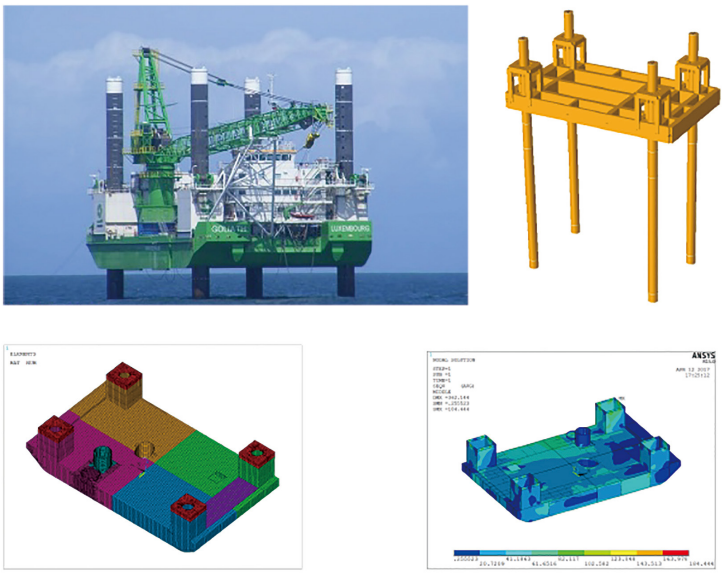


• *Authentication Inspection, Design Review, Independent Verification for Offshore Substation*

2. Design Validation and Evaluation Service for Offshore Wind Installation Units

In line with *"Statutory Inspection Code for Mobile Offshore Platforms"*, CCS provides technology service for clients, including verification of main hull strength, stability capacity, leg strength, jacking system and spudcan capacity for Wind Installation Units, which ensures that the structural capacity complies with requirements for the installation of offshore wind turbine.

Up to now, CCS has completed the structural evaluation for several Jack-up Wind Installation Units, such as TORBEN, TEARA Sunrise and GOLITAH, which are imported from foreign countries by domestic new energy engineering companies.



• *Independent Verification for Jack-up Wind Installation Units*

3. R&D for Floating Offshore Wind Farm Facilities

(1) Third Party Design Review Service for Floating Offshore Wind Farm Facilities

With regard to the floating offshore wind turbine foundation, CCS can provide third party design review according to corresponding code/standard and provide design review service for other floating systems. With respect to novel floating offshore wind power facilities, CCS conducts the third party validation such as Approval in Principle (AIP).

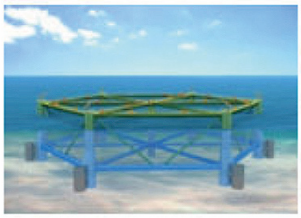
(2) Independent Verification for Floating Offshore Wind Farm Facilities

Based on accumulated design experience of offshore floating unit in oil & gas industry and the knowledge of technical difference between floating offshore wind systems and conventional floating units, CCS can conduct independent verification for floating offshore wind facilities, such as hydrodynamic global performance, structural strength, mooring analysis, etc.

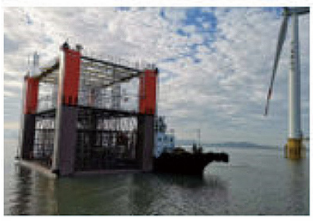
4. Offshore Fish Farm

(1) Third-party Technology Service for Design of Offshore Fish Farm

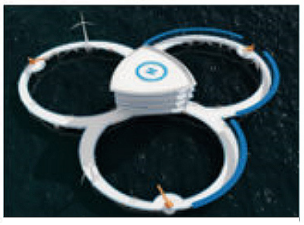
With regard to the offshore fish farm, CCS can provide third party design review according to corresponding code/ standard and provide design technology service. For those novel designs of offshore fish farm, CCS can provide the Approval in Principal (AIP) for the design.



• *Column-stabilized Offshore Fish Farm with On-bottom Condition*



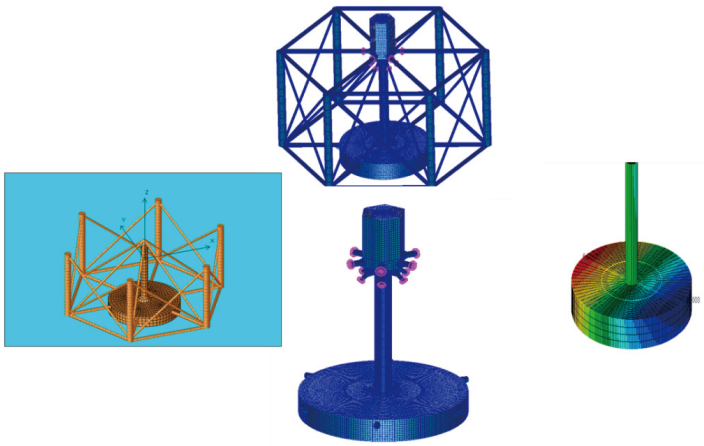
• *Column-stabilized Offshore Fish Farm for Abalone*



• *Fish Farm and Leisure Facilities with On-bottom Condition*

(2) Service of Independent Verification for Offshore Fish Farm

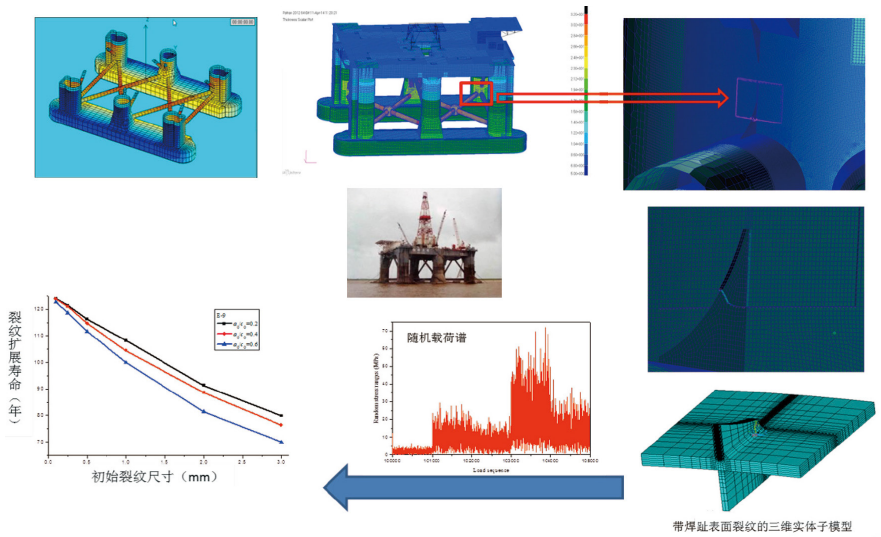
Based on the specific environmental conditions and functionality of offshore fish farm, together with the accumulated experiences from R&D, plan approval and inspection, CCS provides independent verification for the key calculation in the design of the facilities. For example, CCS can carry out the independent verification for global performance, global strength, and strength of mooring system for the facilities.



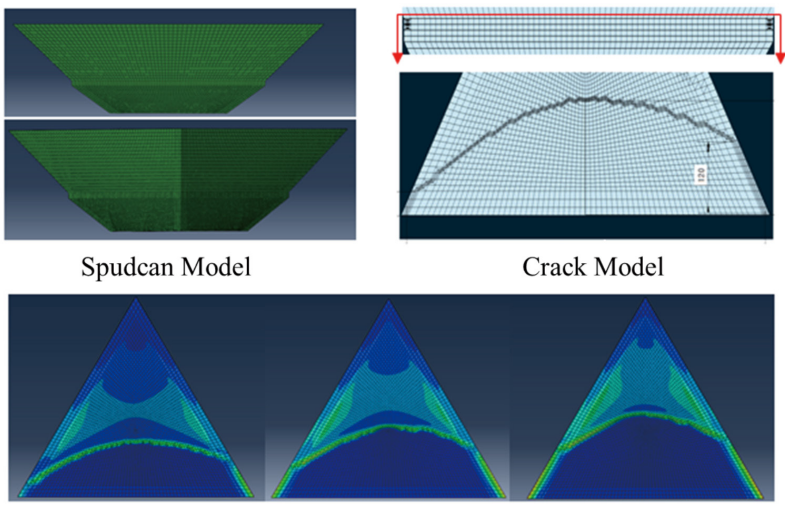
• *Evaluation of Global Strength for Column-stabilized Fish Farm*

Evaluation Service of Engineering Critical Assessment (ECA) for Offshore Facilities

Under the proper condition, CCS can provide the evaluation service of Engineering Critical Assessment (ECA) for the offshore facilities. By the evaluation of expansion for the cracks in the remaining service period or the next inspection cycle, the structural safety state can be determined and effective action can be taken. This service can effectively accelerate the building cycle, reduce the engineering cost, and develop reasonable inspection plan, which would ensure the operational safety and the scientific management of the platforms.



● *ECA of Cracks for Semi-submersible Drilling Platform " KANTAN 3"*

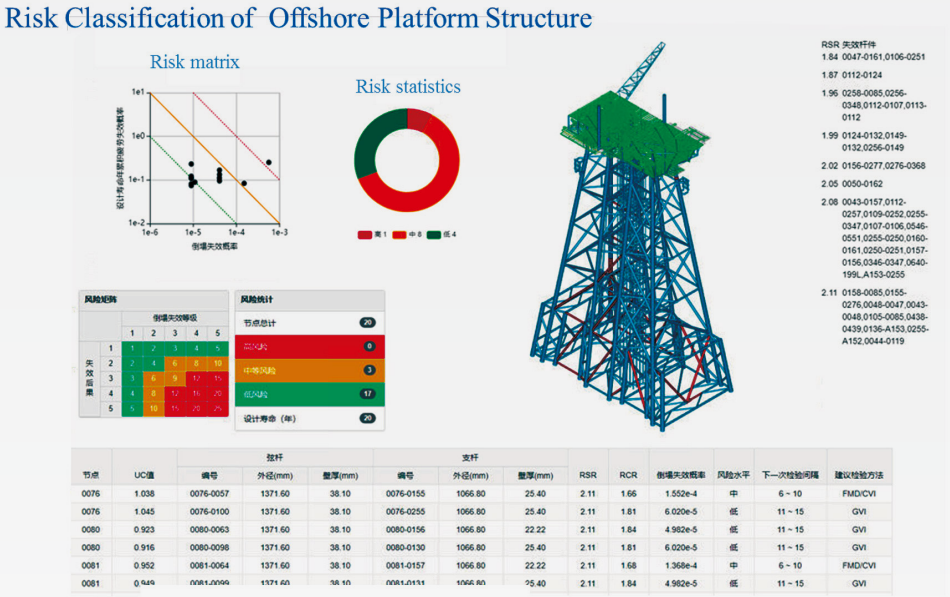


● *ECA of Cracks for the Spudcan of Jack-up Platform "GRAFT"*

Risk-Based Inspection Service

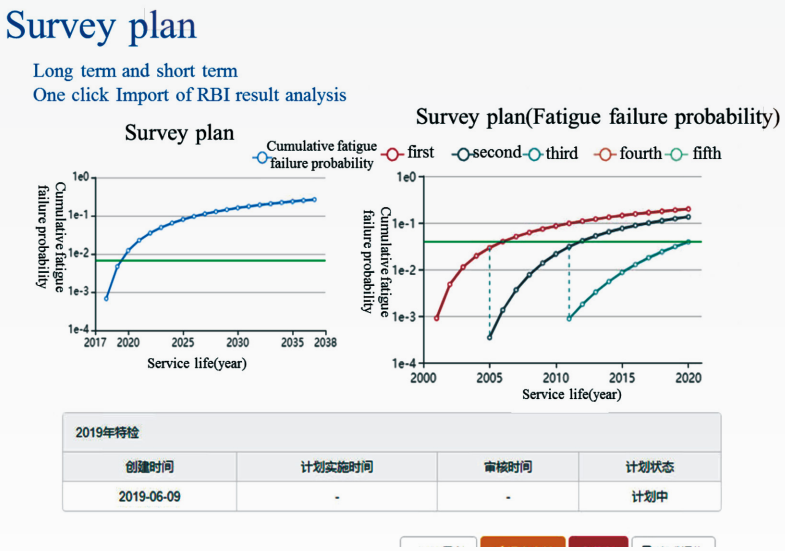
(1) Dynamic Management Service for Fixed Platform Structures

CCS's offshore Fixed Structures Integrity Management (FSIM) can provide continuous service of dynamic management to the fixed structures for clients, which also has the function of data storage, quick access, rapidly emergency response, reasonable inspection plan development and the risk control more effectively.



节点	UC值	拍杆			支杆			RSR	RCR	倒塌失效概率	风险水平	下一次检验间隔	建议检验方法
		编号	外径(mm)	壁厚(mm)	编号	外径(mm)	壁厚(mm)						
0076	1.038	0076-0057	1371.60	38.10	0076-0155	1066.80	25.40	2.11	1.66	1.552e-4	中	6 ~ 10	FMD/CVI
0076	1.045	0076-0100	1371.60	38.10	0076-0255	1066.80	25.40	2.11	1.81	6.020e-5	低	11 ~ 15	GVI
0080	0.923	0080-0063	1371.60	38.10	0080-0156	1066.80	22.22	2.11	1.84	4.982e-5	低	11 ~ 15	GVI
0080	0.916	0080-0098	1371.60	38.10	0080-0130	1066.80	25.40	2.11	1.81	6.020e-5	低	11 ~ 15	GVI
0081	0.952	0081-0064	1371.60	38.10	0081-0157	1066.80	22.22	2.11	1.68	1.368e-4	中	6 ~ 10	FMD/CVI
0081	0.949	0081-0099	1371.60	38.10	0081-0131	1066.80	25.40	2.11	1.84	4.982e-5	低	11 ~ 15	GVI

● *Classification of Risk Level for Platform Structure*



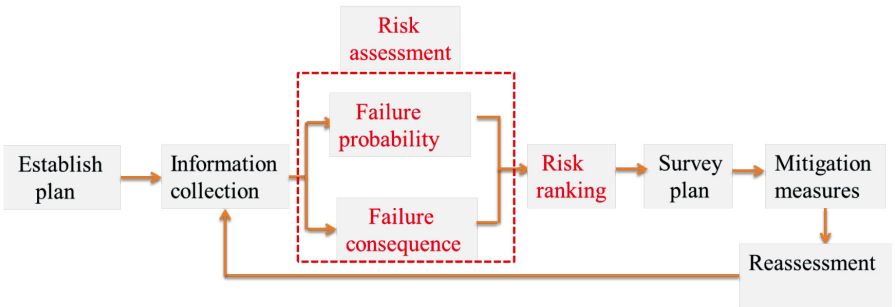
2019年特检			
创建时间	计划实施时间	审核时间	计划状态
2019-06-09	-	-	计划中

● *Development of Inspection Plan*

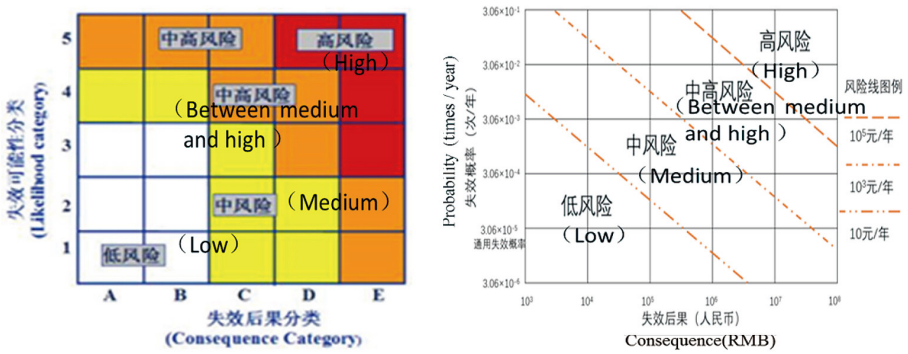
(2) Service of Risk Assessment and Control for Topside System and Equipment on Platforms

This service can identify damage, failure consequence and risks level of topside equipment and system on platforms, followed by providing risk management with inspection strategy, which would reduce risk of the platform. Through the development of scientific and reasonable inspection strategy, accurate and focused inspection will be realized, which would enable the offshore engineering inspection service is focused on the equipment and parts with high risk and effectively control the whole risk for the platforms.

In addition to the Jacket platforms, this service also applied to system and equipment like FPSOs, artificial island and onshore/offshore terminal.



• *Assessment Process*

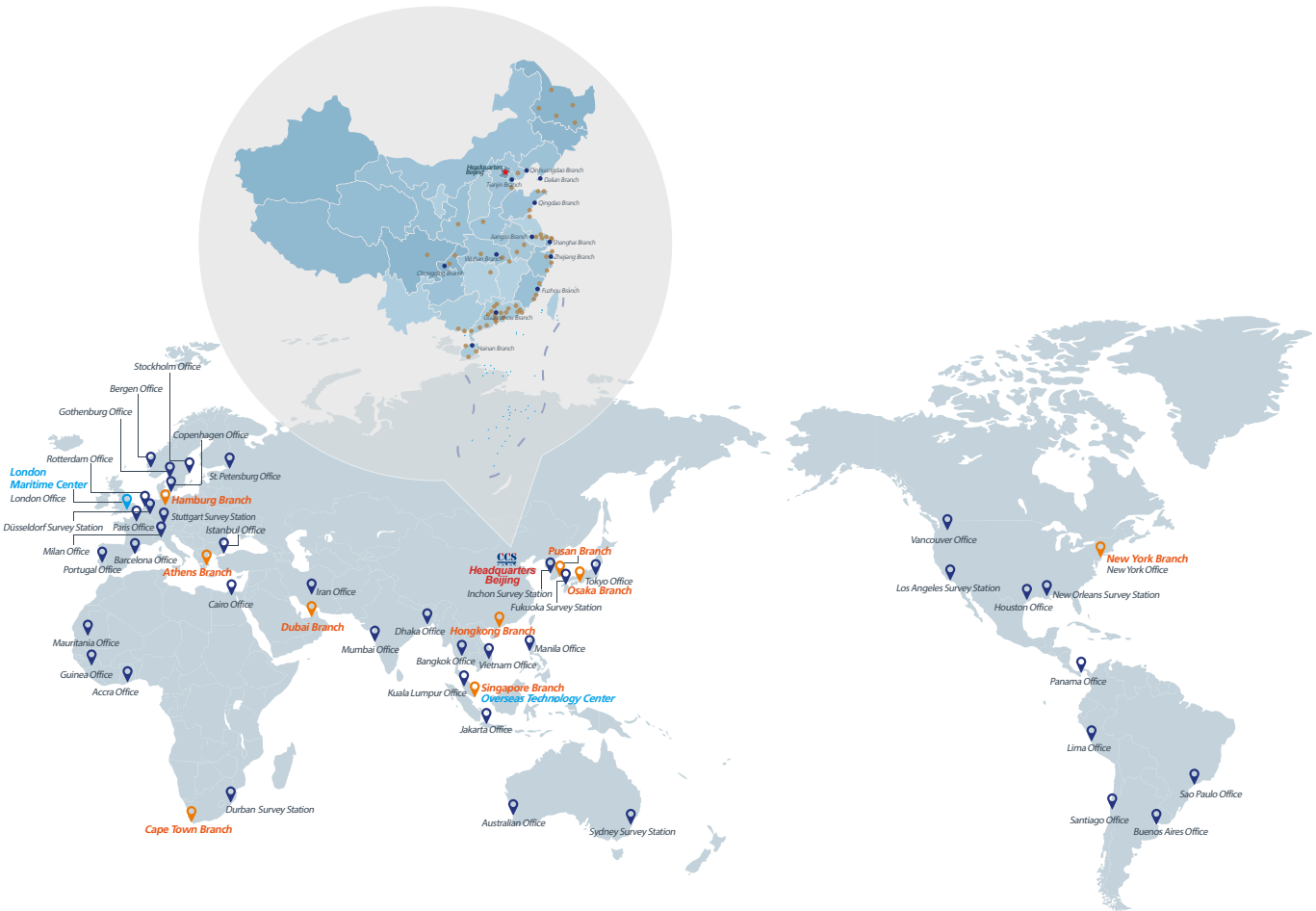


• *Risk Assessment Criteria*

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To meet the demand of our customers, we have set up branches and offices in major port cities in China as well as in Asia, Europe, America, Middle East, Australia and many other countries or regions worldwide, forming a global survey network.



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