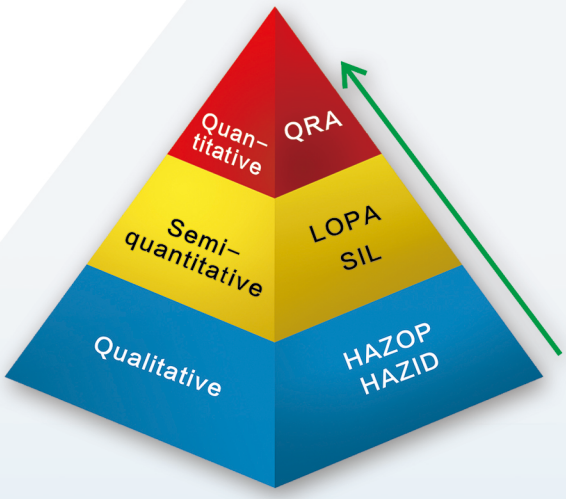


ONSHORE LNG RISK ASSESSMENT SERVICES

Risk assessments are to help our clients understand potential safety accidents and their consequences, recognize the shortcomings in risk management, and help them better understand the risks they will face and implement effective risk management. To better serve the Administration and the Industry, CCS has developed new products of risk assessments from qualitative to quantitative, including HAZID, HAZOP, LOPA, SIL and QRA.



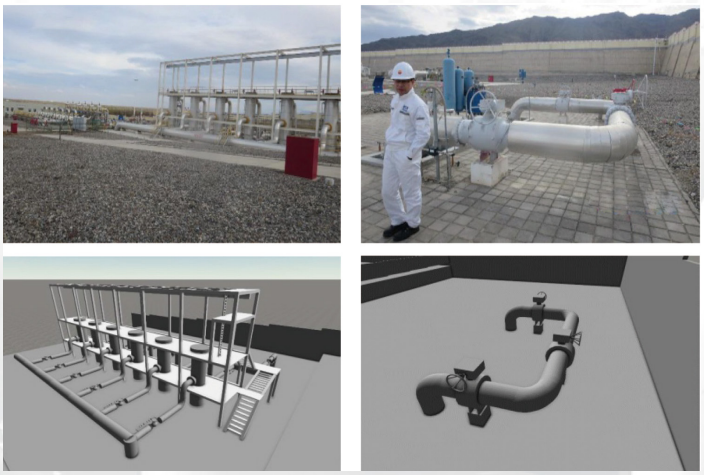


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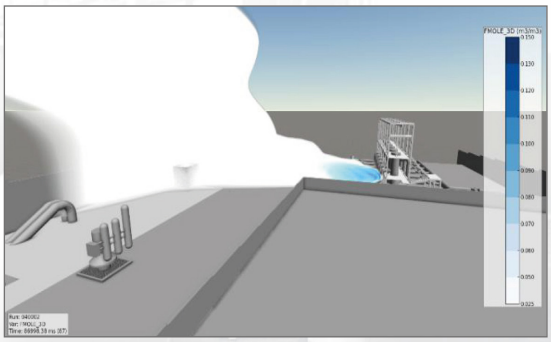
Explosion Probability Analysis for Compressor Station

The Line 3 of the West-East Pipeline Project contains 13 compressor stations with the similar arrangement. Each station is fitted with an In/Out (1/0) room which is classified as a non anti-explosive area. However, the control cabinet, front lights and switches in the 1/0 room are not explosion proof which will put the room at risk of fire or explosion. So, the Jinghe Compressor Station is selected as a representative station to analyze its explosion probability.

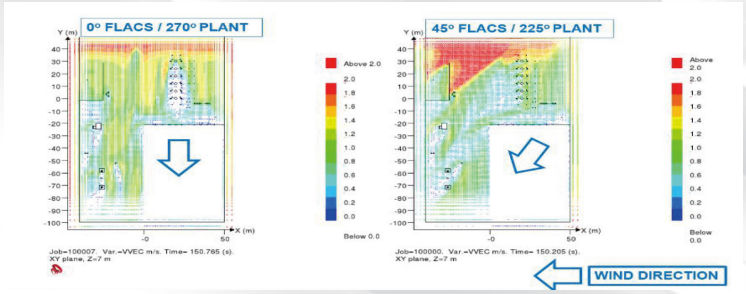
The project simulates the ventilation, calculates the probability distribution of flammable vapour clouds, analyzes the leak probability of pipes and equipment, the ignition probability and the mortality probability and carries out the fire & explosion analysis by FLACS, a 3D-CFD software, which is based on the most advanced fir & explosion probability analysis method specified in Appendix F of Norwegian National Standard Z-013. The safty impact on the whole station due to the non-explosion proof 1/0 room is assessed according to the analysis results above, and the measures are recommended for risk prevention and control.



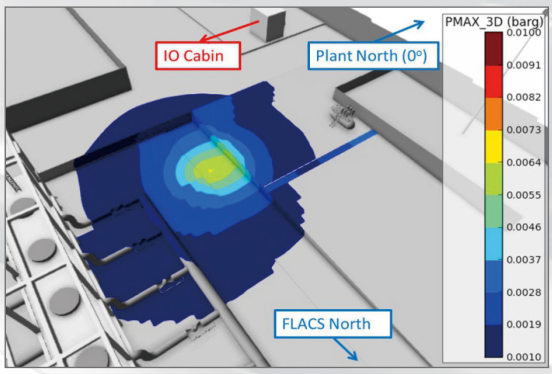
Simulation Models



Natural Gas Leakage



Ventilation Simulation for the Compressor Station

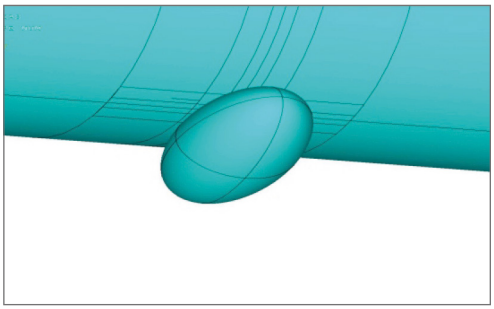


Explosion Overpressure Distribution

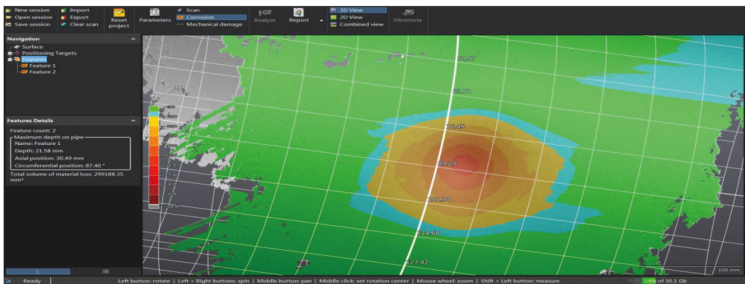
Analysis of Crude Oil Pipeline with Dents

The crude oil pipeline is 56.6 km in length. Due to improper backfill, dents are formed on the pipeline by the surrounding fieldstones.

Based on the charts of laser 3D scanning, the depth and strain of denst are evaluated and calculated according to 'SY/T 6996-2014 Assessment of Steel Oil & Gas Pipeline with Dents'. At the same time, the dents strain on the pipe is calculated by ANSYS, and suggestions about the use of evaluating stress are given by the method of the combination with surface stress and mid plane stress. Based on LS-DYNA, the simulation of soil settlement in the process of concave forming is carried out.



Finite Element Calculation Model



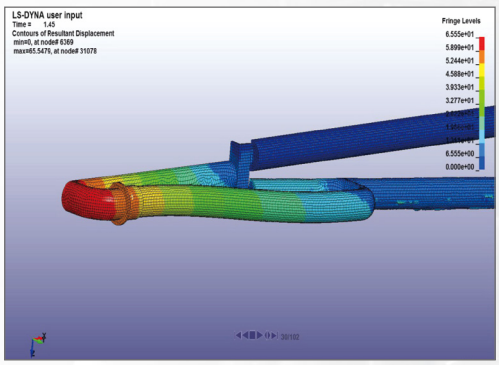
Laser 3D Scan Depth



Scene Picture

Analysis for Drainage Hoses in a Crude Oil Tank

The crude oil tank is of steel dual-disk floating roof type with a volume of 100,000m^3 The composite hose of its central drainage system is damaged. A SRJ (Submerged Rotary Jet) system is set inside the tank, which is believed to cause the damage to the hose. The analysis focuses on the influence from the SRJ system. Because the speed of water-jet from the SRJ is up to 25m/s, and the nozzle is very close to the hose connection flange. The simulation software LS-DYNA and the ALE algorithm are adopted to analyze the jet impact. Based on the simulation results, we analyze the pipe damage cause, and give the lowest allowable liquid level. We also optimize the position of the drainage pipe and the SRJ.



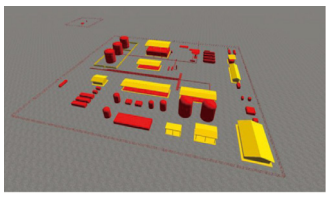
Pipeline Displacement Fringe

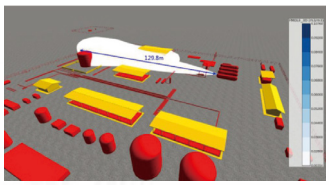
Risk Assessments for Oil-Gas Field Production Facilities

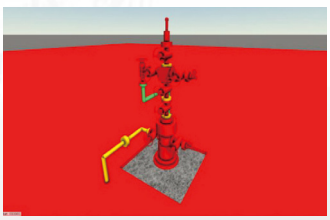
The Oil-Gas field is located in Western Africa. CCS is responsible for its risk assessment and provides suggestions on its safety management, by carrying carried out the risk assessments including QRA, HAZOP, LOPA SIL and calculation of the personal risk individual risk and social risk.

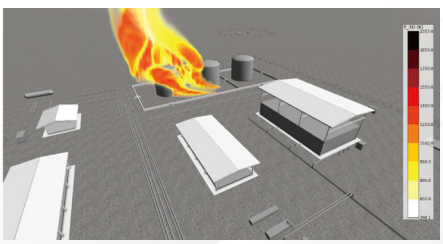
The facilities of the project include

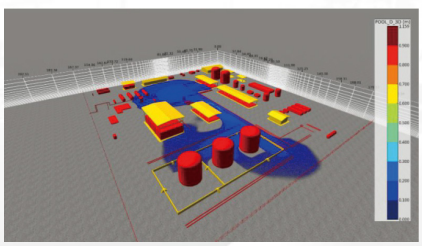
- 7 well sites
- 1 centralized processing field (CPF)
- 1 cross matelote station (CMS)
- 1 production management field (PMF)
- Transporting, gas-lift and water injection lines from well sites to CPF
- 1 crude oil line of DN200 from CPF to CMS
- 1 cross matelote line of DN150 from CMS to TOTAL M'BoumBaOil Gathering Station









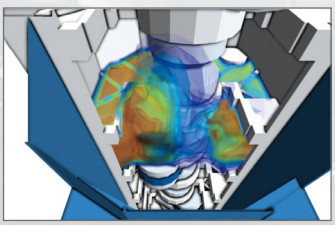


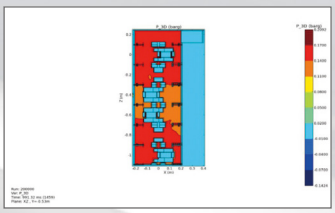
Explosion Simulation and Strength Evaluation of Gas Fuel Engine Crankcase

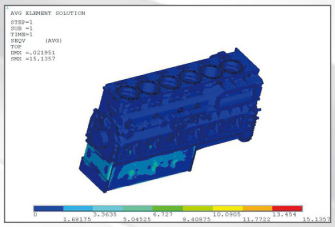
This evaluation is intended to evaluate whether the gas fuel engine satisfies the requirements of 11.1.2. 7 of CCS Rules for Natural Gas Fuelled Ship, 2013: "The crankcase of gas fuel engines is to be provided with an explosion relief valve of sufficient relief area unless documentation demonstrating that the system has sufficient strength to contain the worst-case explosion."

The project mainly includes simulation and strength evaluation of gas fuel engine crankcase explosion. The following is about the method of the analysis: the worst explosion consequence in the engine crankcase is simulated by FLACS. Then the simulating results are applied on finite element model of crankcase, and the stress of crankcase under severe explosion is analyzed to evaluate the strength of crankcase and accessories by ANSYS.

According to the calculation results, stress condition of crankcase is analyzed and corresponding suggestions are given.

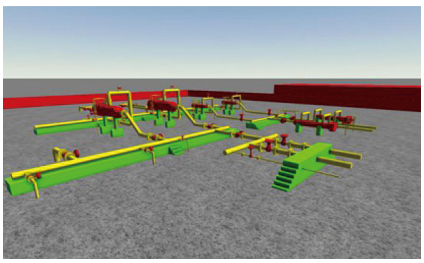


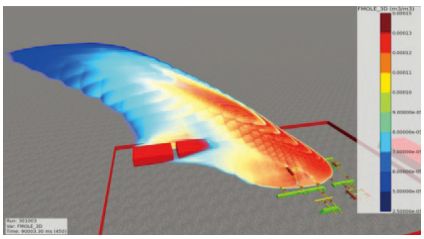




Quantitative Risk Assessments on LNG Terminals, Bunkering Stations and Connecting Pipes

A quantitative risk assessment is conducted on a gas distributing station and an urban duct with a length of 4 km based on the given dangerous scenes, such as shutdown of emergency shutdown valve of inlet and outlet pipes, blow down of high level blow-down pipes, cracking of pipeling welding seams and leakage of filter separators. According to the standard process of TNO (Holland Institute of Applied Sciences), the individual risk and social risk are analyzed, the frequency calculation is based on the equipment failure database of the International Oil and Gas Producers Association. And the result calculation using a three-dimensional computational fluid dynamics method.





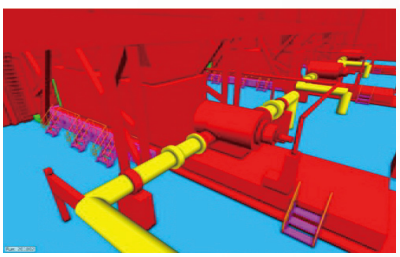
Taking into account the impact of the domino effect according to the requirements of the owners, the individual risk curve, individual risk contour and social risk curve are drawn in the report. It provides data support to assess the risk level and determining the pipe routing scheme.

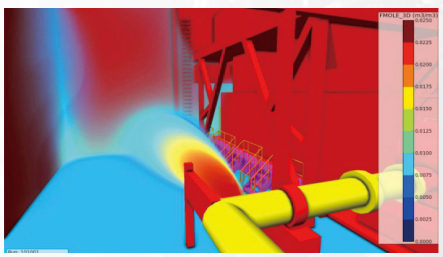
Explosion Consequences Assessment of Compressor Station

The compressor station is located at 1945 km in the Line 3 of the West-Bast Pipeline Project, in which the compressor plant has a representative arrangement. Three compressors are placed parallelly in the plant, which may be the source of natural gas leakage. Because the control boxes of the compressors are not explosion proof and the plant is enclosed, an explosion will occur in the case of large leaks of natural gas.

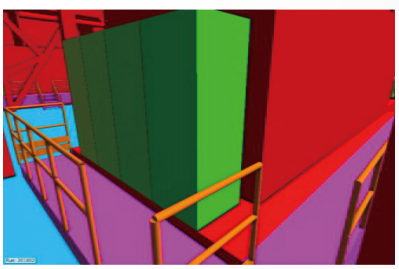
The project assesses the risk of leakage in the compressor plant and the risk that the control boxes of compressors will ignite natural gas, and based on the internationally renowned oil and gas leakage simulation software FLACS, natural gas leakage consequences and overpressure distribution after ignition and explosion in the plant is quantitatively calculated, based on the calculation results, the degree of accident consequence is evaluated and the risk prevention and control measures are proposed.

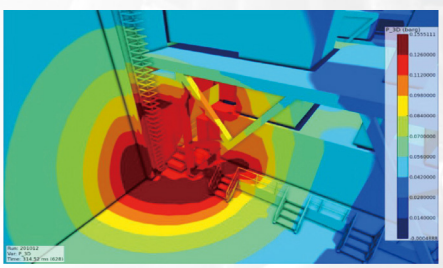










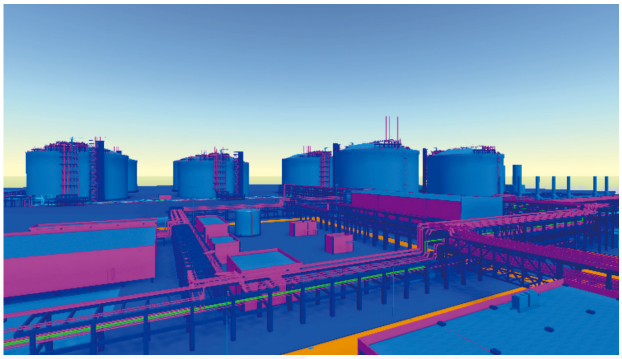


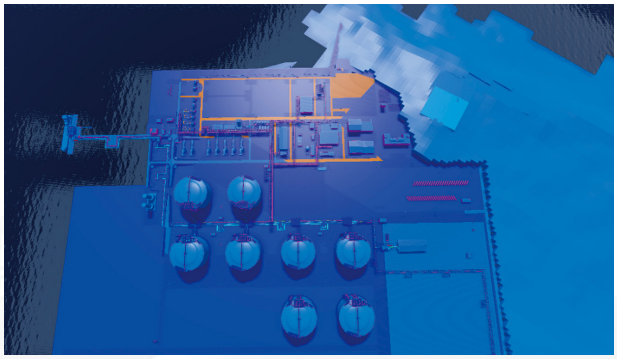
LNG/Oil&gas terminal

CCS carried out the risk assessment of LNG/Oil&gas terminal. The evaluation includes the module layout and process flow.

Our services

- HAZOP
- SIL
- QRA
- Fire and explosion analysis（FEA）





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