Bentley
Advancing Infrastructure

Project Summary

Organization:
Oil & Natural Gas Corporation Limited

Solution:
Offshore

Location:
Mumbai, Maharashtra, India

Project Objective:

- Assess structural adequacy of jacket platforms for extended use in Western Offshore oil fields off the coast of Mumbai, India.
- Study strengthening/mitigation measures necessary for platforms to meet Oil Industry Safety Directorate (OISD) requirements.
- Optimize recommended measures to requalify and recertify the platforms for 10-15 more years of service.

Products used:
SACS, SACS Collapse

Fast Facts

- ONGC implemented an iterative optioneering methodology to requalify the jacket structures for extended service.
- SACS and SACS Collapse were used to carry out design-level and non-linear ultimate strength analyses of the jacket structures.
- Mitigation measures rendered the platforms structurally adequate to ensure the safety of life, property, and the marine environment.

ROI

- Carrying out structural analyses using SACS and SACS Collapse streamlined the platform life extension/requalification process, saving at least 12 resource hours per platform.
- Bentley software enabled multiple analyses with parametric variations to optimize the strengthening/mitigation measures, which added 10-15 years to the average lifespan of a platform.

SACS Analyses Help ONGC Requalify Aging Platforms as "Fit for Use"

Indian Oil Producer Extends Life of Jacket Structures by 10-15 Years with Mitigation Measures Optioneered in SACS

Useful Design Life

Oil & Natural Gas Corporation Limited (ONGC) produces oil from the Western Offshore fields off the coast of Mumbai, India. Rather than decommission its fixed, jacket-type platforms that date to the 1970s, ONGC opted to requalify the structures as fit for extended use. The USD 150 million project involved the structural assessment of over 265 platforms, the majority of which had exceeded their 25-year design life. A foremost priority included the identification and delivery of strengthening and mitigation measures for 90 percent of these platforms, as well as the subsequent recertification necessary to meet industry safety requirements. Structural analyses carried out using SACS and SACS Collapse were integral to ONGC's methodology for platform life extension/requalification, which added 10-15 years to the structures' lifespan.

Studies conducted during the analyses included dent modeling, member/joint component strengthening, and additional pile modeling. SACS and SACS Collapse allowed multiple analyses with parametric variations to optimize the strengthening/mitigation measures, all while saving at least 12 resource hours per platform. Each requalification not only ensured uninterrupted oil production, but also avoided installation of a replacement platform at a net cost of USD 25 million.

Uninterrupted Production

A public-sector undertaking of the Government of India headquartered in Dehradun, ONGC is a multinational corporation and the country's largest oil and gas exploration and production company. It began oil exploration and production offshore of India in 1976, and today operates 265 fixed platforms in water depths ranging from 25-90 meters. Most of its jacket-type platforms—which were designed for 25 years of service—had outlived their design lives. Some platforms underwent modifications to meet changing conditions or to enhance oil recovery, while others were considered noncompliant with Oil Industry Safety Directorate (OISD) requirements.

Taking these aging platforms out of service would cause production losses of up to 1,000 barrels of oil per day per platform. Instead, ONGC sought to requalify the platforms for another 10-15 years of continuous service. The process involved assessment and mitigation of platforms that were deemed noncompliant or on the verge of noncompliance—an amount of about five platforms per year. Carrying out the structural analyses posed a significant challenge due to the excessive age of the platforms, overstressed structural components, and prior repairs or modifications that altered the original designs. Moreover, the platforms needed to be kept operational, not just to avoid oil production losses but also to accommodate offshore personnel and protect the surrounding marine environment. Safety was of paramount importance.

Iterative Optioneering

ONGC selected Bentley's flexible, interoperable offshore design and analysis applications, SACS and SACS Collapse, integrating a methodology that allowed for multiple analyses of the platforms using parametric variations. By exploring design alternatives for bringing the structures up to current safety standards, the iterative process identified structural weaknesses and optimized the proposed mitigating measures. These measures were as simple as restricting marine growth and removing redundant equipment and appurtenances, or as complex as retrofitting structural components.

Platforms that had sustained damage were assessed using SACS' dent modeling capability. This time-saving process involved selecting a section of the dented member, then modeling that member to obtain a strength assessment. For the majority of platforms that had inherent structural weaknesses, ONGC used SACS in conjunction with SACS Collapse, a non-linear collapse analysis application, to determine the primary structural joints and/or members that required strengthening. Joints that were found to be overstressed in the design-level analysis with SACS were then assessed for ultimate strength adequacy using SACS

"[Using] the wide range of applications offered under the Bentley technology umbrella has resulted in more efficient management of offshore assets."

— Dinesh Kumar, GGM, Head Structures, Institute of Engineering and Ocean Technology, Oil & Natural Gas Corporation (IEOT-ONGC)

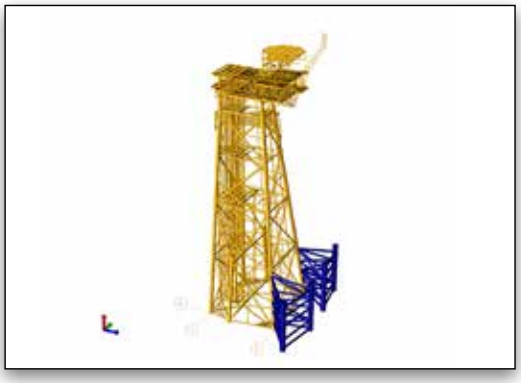
Collapse. Once the failure modes were identified, it was possible to analyze different strengthening options. For joints failing under compression, SACS verified the option of strengthening the joint using infill grout. For joints failing under tension, SACS compared strengthening options using either infill grout or metal clamps. Ease of installation was also considered in the final analysis.

Significant changes in loading also required close scrutiny of the piles, which were subject to failure due to material incapacity or soil overload. Load reduction resolved the issue for some platforms, while others required installation of additional piles. Installing piles on existing platforms had not been previously carried out in the Western Offshore field, so ONGC had to devise the technical approach to pile design, fabrication, installation, and load transference. The load distribution pattern for the new piles considered the weights of the jacket structure and the topside, as well as the effects of the pile-soil support system. Iterative SACS analyses calculated the optimal pile material, size, and distribution.

Fast, Accurate Analyses

Understanding the ultimate behavior of the structural components made it easy to ascertain and mitigate the failure modes of the jacket structures. ONGC's adoption of an iterative optioneering methodology ensured that each platform had sufficient structural support capacity. The structural analysis revealed that most of the old jacket structures did not meet OISD requirements, primarily due to recent changes in design parameters. Deploying Bentley software to carry out multiple analyses with parametric variations provided ONGC with an effective solution for optimizing the remedial measures.

The interoperability of SACS and SACS Collapse enhanced the team's ability to efficiently and effectively explore different strengthening/mitigation alternatives, resulting in significant time and cost savings. Specifically, conducting customized, simultaneous analyses in SACS and SACS Collapse saved at least 12 resource hours per platform. For this project, 10 platforms underwent non-linear ultimate strength analysis, saving a total of 120 resource hours valued at about USD 4,000.



The requalification is expected to add 10-15 years to the structures' lifespan, as well as ensure average production of around 1,000 barrels of oil per day per platform.

Averted Expenses

The structural analysis studies carried out using Bentley software ensured continued operation and revenue generation from existing platforms. Strengthening/mitigation measures were completed at considerably less expense than the cost of replacing a platform. Even those platforms that required the installation of additional piles, at an estimated cost of USD 10-15 million per platform, were requalified for less than the cost of a new USD 40 million platform. By avoiding the replacement of these platforms, ONGC realized net savings of USD 25 million per platform.

ONGC's continued domestic oil production contributes to India's 40 million metric ton (MMT) per year production supply, which feeds the country's demand for 160 MMT per year. The requalification and recertification of the offshore jacket structures added 10-15 years of service to each platform, ensuring the continued production of an average of 1,000 barrels of oil per day per platform. Equally important, the strengthening of the platform structures ensured the continued safety of the working environment for ONGC employees, protection of ONGC's investment in offshore platforms, and preservation of the Western Offshore marine environment.

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