OUR WORK

ITER

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October 2014

PDL ENGINEERS WERE RESPONSIBLE FOR ASSESSING THE STRUCTURAL INTEGRITY OF THE PEDESTAL RING.

PDL is a global provider of exemplary engineering design and analysis consultancy services. Our engineering capabilities will mitigate your risk, shorten your development timescales and reduce your development costs.

The ITER project is an international project with the aim of proving that nuclear fusion is a viable source of energy in the future.

PDL engineers spent a number of months on site at Caderache, France as part of the Tokamak team. The engineers were primarily involved in the structural assessment of the Cryostat. The Cryostat provides a super cool environment in which the toroidal vacuum vessel is supported. At the base of the Cryostat is the pedestal ring which provides structural support to the entire machine. PDL engineers were responsible for assessing the structural integrity of the pedestal ring, which is approximately 30m in diameter. The ring is made from a fabricated box section (1200 mm x 1200 mm) with plate thicknesses up to 250mm and supports the full 23,000 tons of the machine.

FULL NON-LINEAR ELASTIC PLASTIC ANALYSIS WAS PERFORMED FOR A NUMBER OF OPERATIONAL LOAD CASES

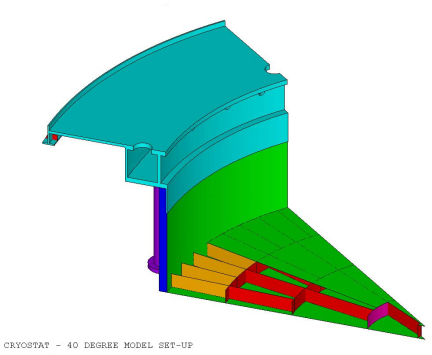

Figure 1: Shell and Solid FE Model of Cryostat base and Pedestal Ring

Full non-linear elastic plastic analysis was performed for a number of operational load cases. The structure was also assessed for a number of additional load cases including full seismic assessment and also fault conditions, which could be seen in the operation of the reactor. These VDE (Vertical Displacement Events) occur when the plasma within the reactor is disturbed, potentially causing large forces to occur on the structure.

In order to generate efficient solutions, where possible, symmetry models were used. Additionally the models were generated using a combination of shell and solid elements. Shell elements were used in regions where detailed stresses were not required, but the stiffness of the components needed to be fully captured. Solid elements with a suitable mesh density were used

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in regions where the stress in the structure needed to be fully resolved. All models were parametrized and created using Ansys APDL (Ansys Parametric Design Language) scripts. This allowed changes to the model geometry, materials and boundary conditions to be implemented extremely quickly and efficiently. For load cases where symmetry was not applicable, a full 3D model of the cryostat was created and solved.

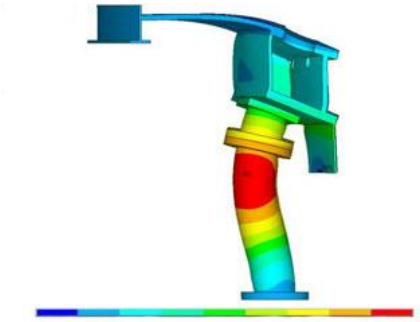

Figure 2: Radial Displacement of Pedestal Ring under seismic loading

Comprehensive fatigue analysis on the cryostat was also performed considering structural and thermal loading. Detailed calculation of the thermal stresses was required as the cryostat supported components super cooled to 4 K (-269°C). In order to ensure the peak stresses were properly captured, a sub-modelling routine was developed in order to avoid significantly increased solve times.

PDL Engineers delivered the project on time and schedule, working to particularly onerous deadlines throughout the project.

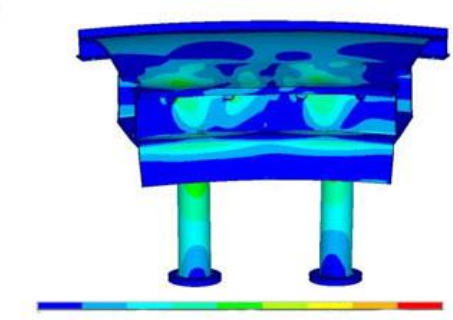

Figure 3: Elastic Stress in the Pedestal Ring under VDE

For further information regarding PDL's engineering capabilities please email: solutions@pdl-group.com or telephone our head office.