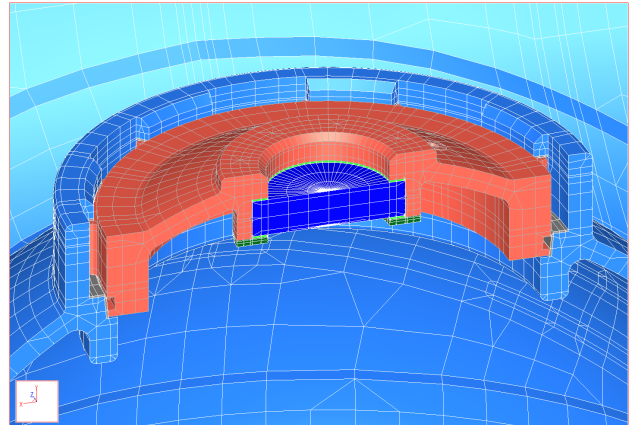


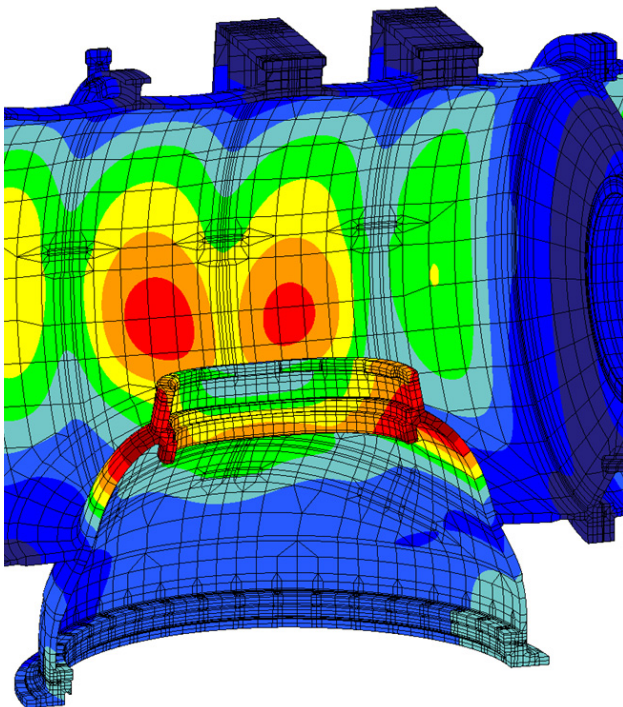
SUBMERSIBLE HATCH DESIGN

FCL have, for many years, undertaken project work involving the mechanical design of submarines, rescue submersibles and related ancillary equipment. One specific project, carried out for a major UK supplier of rescue submersibles, included the detailed design of the hatch located at the upper end of the integral dry mating skirt used for subsea docking with distressed submarines.

Design of the hatch, which was principally undertaken using Pro/MECHANICA (now CREO/Simulate) finite element software, was complicated by the need to cater for external pressures in excess of 50 bar g (500 metres of sea water) and internal pressure conditions of up to 5.0 bar g during surface transfer-under-pressure while also ensuring that relative distortions arising between the hatch and its seating did not either cause leakage, or prevent the free opening of the hatch during rescue operations at maximum depth.



Due to the way in which the dry mating skirt was integrated with the hull of the submersible, it was found to be necessary to include detailed representation of the entire central section of the hull to obtain an accurate prediction of structural behaviour.



Careful attention was given to the design of the reinforcing stiffeners running into the junction between the hull and the skirt in order to minimise overall distortion, before further optimisation, involving the use of contact analysis methods, was carried out to achieve a design for the hatch and seating ring that maintained levels of both stress and displacement within acceptable values.

Confirmation of the accuracy of the results obtained was provided firstly, by excellent correlation with measured distortions around the hatch seal obtained from tests carried out on a mock-up hatch assembly, and secondly, by the subsequent trouble-free operation of the hatch in sea trials and finally in service.