Large Deformation Analysis

Overview

Dynamic loading occurs on pressure vessels in many cases, especially in faulted conditions such as a pipe break. Large deformation dynamic analyses can be used to evaluate structural integrity, strength of welds and fasteners, the potential for loose parts and possible flow blockage.

Severe non-linearities are normally involved in such analyses, and implicit or explicit dynamic analysis may be applied based on the degree of nonlinearity of a problem. Our modeling capabilities include:

- Intermittent contact/impact
- Different contact surface conditions
- Friction, including stick-slip conditions, and static and kinetic coefficients
- Material plasticity

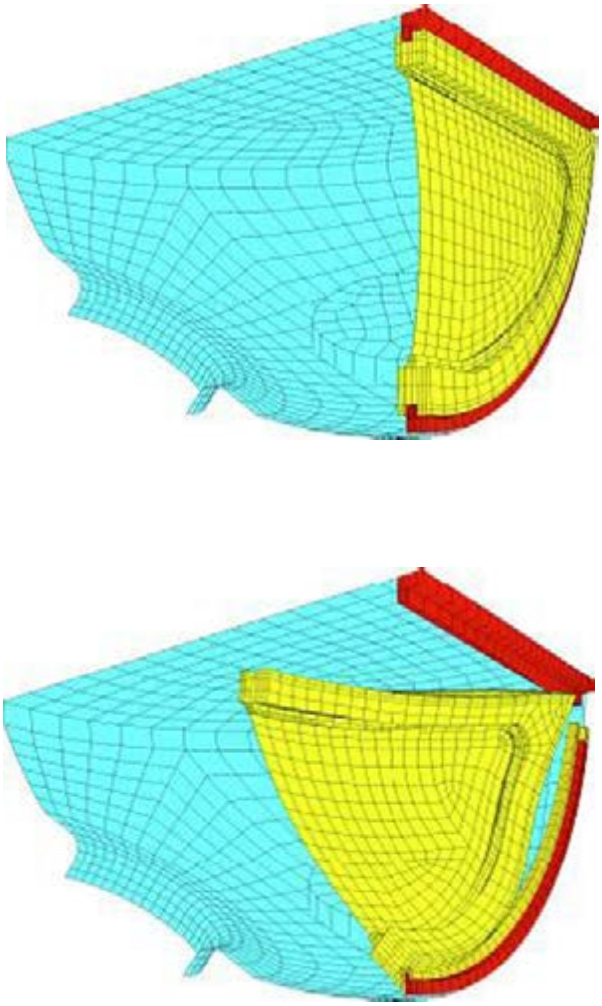
Applications

The use of large-deformation analysis can be applied to a range of applications. Typically this analysis is applied to address specific situations, and it is not used for general pressure vessel design.

An example of a large-deformation analysis performed by BWXT is a 3D non-linear dynamic analysis of a floating steam generator primary divider plate under Loss of Coolant Accident (LOCA) conditions performed by using ABAQUS™/Explicit. The model includes the divider plate, tubesheet, seatbars, primary head and manway cover. Due to an outlet side pipe break, the pressure applied to the inlet side of the divider plate increases dramatically, almost instantaneously. The analysis was used to show that the seat bar welds to the pressure boundary remain intact and to show that the detached divider plate does not fully block the outlet nozzle. Other applications include simulation of roller expansion of SG tubes, and the simulation of impacts between foreign objects and SG tubing.

Capability and Tools

Large deformation dynamic analyses have been carried out for various pressure vessels and components at BWXT by using finite element codes ABAQUS™ and ANSYS®.



Divider plate experiencing dynamic pressure differential

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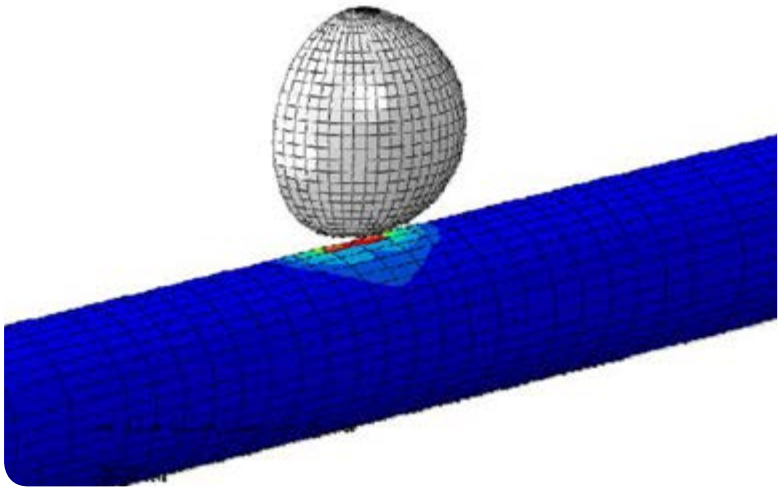
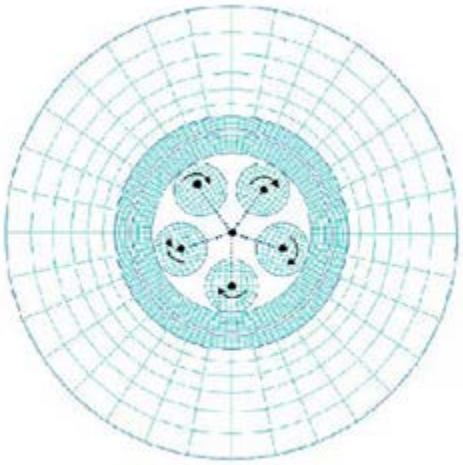
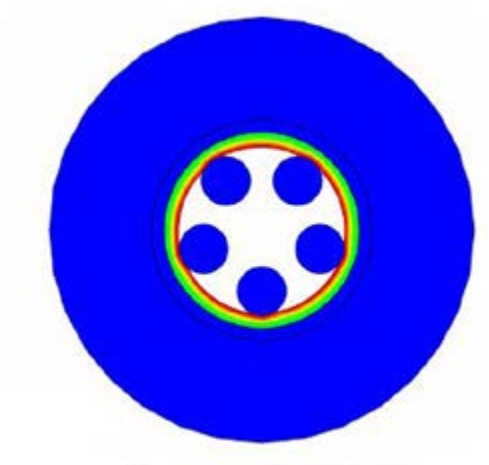


Foreign pbject colliding with a steam generator tube



Model



Plastic Strain During Rolling

NUCLEAR ENERGY GOVERNMENT SERVICES ADVANCED TECHNOLOGIES

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