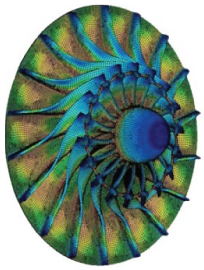

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Internal Brick Arch Collapse – Chemical Reactors
(Computational Fluid Dynamics and Finite Element Analysis)

Project Description: Chemical reactors operating at high temperatures require adequate flexibility for thermal expansion growth. Many times these reactors are designed straight from ASME Section VIII Div. 1, without consideration to low cycle fatigue. A major flaw with this approach is that Div. 1 is a cookie cutter approach to design and often over-designs components. This can create rigid tubesheets and perforated plates and rigid tubesheet joints to the channel and/or shell. Resultantly, high cyclic plastic strains are generated, that in some cases, can cause early cracking of components in a year or less, even only months or weeks. FEA models are generated, used in conjunction with either FEA heat transfer models or CFD models. ASME Section VIII Div. 2 cyclic rules (elastic-plastic for base metal and smooth full-pen welded joints and the linear-elastic equivalent structural stress method for fillet-welded joints) are used to replicate problem areas. Then, the reactor is redesigned and re-tested to prove it is acceptable for the required number of cycles.

FEA and CFD Results: Below are various results images of reactor fatigue troubleshooting, starting with a couple CFD images and finishing with a visible crack and the FEA matching hot spot.