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New High Temperature Heat Exchanger Bridge Impact Damage Fitness-for-Service (Finite Element Analysis, Explicit Analysis, Forming, Impact, Cyclic-Creep)

Project Description: A new high temperature heat exchanger impacted a bridge during delivery to the site. The impact occurred on the top shell expansion joint. An FEA model was created of the heat exchanger, with two initial analyses evaluating the forming stresses of the EJ and the impact with the bridge, using the explicit solver. The impact damage was replicated by iteratively comparing the dent size and depth to provided 3D laser scanning data. Strain-rate hardening material properties were used. Forming and impact stresses/strains are carried over to a cyclic-creep cyclic-by-cycle analysis model by use of an initial state function. Both damaged and undamaged versions of the heat exchanger were evaluated. It was determined that after a couple cycles, the damaged area goes into elastic shakedown, and the ultimate cycle life, based on both creep and plasticity, was still within original design specifications. Adjacent welds were only exposed to elastic stresses; however, it was recommended to perform both surface and volumetric non-destructive examination of the welds in the impact vicinity.

FEA Results: Pertinent images or this fitness-for-service study are shown below:

