EGR Cooler Thermal Assessment by Implicitly Coupled Complex MultiPhysics Modeling

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Thermal stress is one of the major failure modes of EGR Coolers due to high temperature gradients at shell and tube heat exchanging regions. For adequate risk assessment highly accurate temperature field determination is required to be able to run further durability analyses for detection and prevention of several thermally induced failure modes. The most practical and accurate way of providing detailed temperature filed is including and solving several physical processes all together by implicitly coupling them using STAR-CCM+.

The physical processes that are incorporated are gas and coolant flows, heat transfer between these two regions over tubes that are modeled as thin shell regions, boiling as a result of high heat flux and resulting temperature field of solid components due heat transfer. Incorporation of several physics into the domain and maintaining accuracy requires detailed modeling of highly resolved flow fields resulting in solution domains that are consisting of up to 20 million cells depending on the size of the coolers analyzed. By STAR-CCM+, such detailed and highly loaded domain are efficiently solved and accurate detailed information are gathered regarding both flow and temperature fields which provides feedback for necessary design actions to be taken for detection and prevention of failure modes detected.

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