17 NGF Grid Concepts and Scoping Analysis (T/H related)

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Abstract

There are 3 canditates, as C-01, C-02 and C-03, to achieve design goal with the scoping analysis based on proven design. The scoping analyses include Water DNB/Heat Transfer, PIV/ Local Heat Transfer/CFD, Pressure Drop and Mass Evaporation. Mixing, heat transfer, and DNB testing with uniform axial power shape for all three vane designs give the results ; inter-channel mixing was found to be highest for the C-02, followed by the C-01 and the C-03, critical bundle power was similar for the C-01 and C-02, followed by the C-03. However, the DNB performance of the vanes is similar based on the subchannel analysis using the measured mixing factor. The heat transfer coefficient for all candidates may be equivalent at a short span of the grid. The results of the PIV tests and CFD studies showed that all the vane concepts produced similar hotspots. These hotspots were regions of locally low heat transfer, created when the impinging vortex flow separates from the cladding surface. The CFD results, however, were in conflict primarily because of their inability to correctly predict the magnitude of swirl at significant distances downstream of the grid. While the absolute value of predicted heat transfer for large distances could not be trusted, the CFD analysis was still considered acceptable for comparisons of heat transfer within 4-5 inches of the grid. The scoping analyses have provided good validation of methods to estimate the pressure drops of the grids based on specific features. Although a negative aspect of both the I-spring and the additional IFMs, the maximum increase in pressure drop is within a 10 percent relative to baseline. Peak mass is generally considered to be the best indicator of CIPS risk, although there are many other factors that come into play. An assessment was performed of the impact of additional IFMs and the C-02 vane on the mass evaporation for both nominal and extended uprated conditions. The mass evaporation was reduced 15% due to the additional IFMs, and an additional 15% due to increased heat transfer coefficient. These values are reduced to a combined 15% for extended power uprated conditions.