Checks for Calculation No: <u>NSTXU-CALC-11-21-00</u>

Revision No: 0

Title: Calculations of Plasma Facing Components: Center Stack Angular Section (CSA) Tiles Assembly Transient Thermal and Structural Analysis

Component was checked against latest design Yes.

All required load cases are included and current Yes.

Discuss method used in the calculation

The calculation form reports the thermal and structural analysis of baseline and variant tiles for center stack angular rows 5 and 6. The Workbench is used to do the transient thermal simulations based on the system required heat flux cases 1 and 2. The thermal results at the end of pulse are input into the static structural model as the imported body temperature load. The halo force load and eddy current moments are taken from Wassee Syed's calculation form NSTXU-CALC-11-11-00. The different stresses of variant CSA tile assemblies with thermocouple and gas injection under the combined thermal and mechanical loads are much below the allowable values by big margins.

Discuss how the calculation was checked (*)

Based on my experience with the similar transient thermal and structural analysis of NSTX-U OBD12 tiles, all the thermal and stress results look reasonable.

List issue identified and how they were resolved

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Technical Authority:

(sign and date)

(*) independent calculations can be appended

Minimum Requirements for Checking Calculations

- 1. Assure that inputs were correctly selected and incorporated into the design.
- 2. Calculation considers, as appropriate:
 - Performance Requirements (capacity, rating, system output)
 - Design Conditions (pressure, temperature, voltage, etc.)
 - Load Conditions (Electromagnetic (Lorentz Force), seismic, wind, thermal, dynamic)
 - Environmental Conditions (radiation zone, hazardous material, etc.)
 - Material Requirements
 - Structural Requirements (foundations, pipe supports, etc.)
 - Hydraulic Requirements (NPSH, pressure drops, etc.)
 - Chemistry Requirements
 - Electrical Requirements (power source, volts, raceway, and insulation)
 - Equipment Reliability (FMEA)
 - Failure Effects on Surrounding Equipment
 - Tolerance Buildup
- 3. Assumptions necessary to perform the design activity are adequately described and reasonable.
- 4. An appropriate calculation method was used.
- 5. The results are reasonable compared to the inputs.
- 6. Error bars (range) for inputs used, results / conclusions, assumptions, have been considered and are acceptable.

NOTE: IT IS THE RESPONSIBILITY OF THE CHECKER TO USE METHODS THAT WILL SUBSTANTIATE TO HIS/HER PROFESSIONAL SATISFACTION THAT THE CALCULATION IS CORRECT.

BY SIGNING CALCULATION, CHECKER ACKNOWLEDGES THAT THE CALCULATION HAS BEEN APPROPRIATELY CHECKED AND THAT THE APPLICABLE ITEMS LISTED ABOVE HAVE BEEN INCLUDED AS PART OF THE CHECK.