NSTX CALCULATION

TITLE Integrated Thermal Analysis, Bakeout

CALC. NO. NSTX-CALC-13-10 DATE 5/11/98

ORIGINATOR A Brooks CHECKER Rev. 1

PURPOSE:

This calculation describes heat flows and temperature rise expected during bakeout.

REFERENCES:

See attached.

ASSUMPTIONS:

See attached.

CALCULATION:

See attached.

CONCLUSION:

See attached.

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13-980511-AWB-01

TO: R. Parsells
FROM: A Brooks, HM Fan
DATE: 11 May 1998
SUBJECT: Update of VV Bakeout Heating Requirements

Ref: 1) Memo 13-970214-AWB-01, dated 14 February 1997
"Bakeout of Vacuum Vessel and Internals" by A Brooks
2) E-Mail to R. Parsells, dated 9 April 1998, by HM Fan

This memo updates the heating requirements for the Bakeout of the Vacuum Vessel and internal components provided in reference 1 based on the more detailed analysis reported in reference 2.

For background info, the inital requirements presented in reference 1 were based on analysis using an axisymmetric radiation exchange model. The recent analysis presented in ref 2 is a 3-D model of 1/4 of the vacuum vessel. Radiations loads were derived from the axisymmetric model and imposed on the 3-D model in a conservative manner to primarily address structural issues. This model was then also used to provide information regarding the distribution of heating and cooiln requirements for various portions of the vessel: ie ports, domes, cylindrical section, etc. This lead to a much higher heat load requirement than previously stated (from 50 KW to over 80 KW) for the Dowtherm system (the ohmic heating of the center stack remains unchanged at 5.3).

While some of this is real due such as higher heat losses due to much larger surface area of the vessel with appendages (the surface area with ports and ribs is actually 66% higher than the axisymentric vessel), a review of the model reveals several areas where heat loads applied are conservative (ports walls and cover plates , as well as necks are at least partial shaded).

Taking credit for the port shading as well as the shading of the necks provided by the divertors, reduces the revised total heating required by the Dowtherm System to 68.7 KW and the 150 C cooling requirements of the Vessel to 60 KW, the balance being lost thru the vessel insulation.

There is still some conservatism built into the analysis , since we are not running a full 3-D radiation model. The heating of the Vessel assumes radiation exchange based only on the vessel emissivity and doesn't take credit for the less than unity emissivity of the PFC's. However since the 70 KW of heating seems to represents only a modest impact on the Dowtherm heating design, we recommend proceeding with this number.

The table below summaries the revised heating and cooling requirments compared to the inital estimates.

	Previous	Revised
Dowtherm 350+ PP& Div heating	49.8	68.7
Center Stack Ohmic Heating	5.3	5.3
Total	55.1	74.0
Dowtherm Vessel Cooling (at 150 C)	-45.6	-60.0
Losses to Center Stack	-5.3	-5.3
Losses thru VV insulation and uninsulated Port Cover	-5.2	-8.7
Total	-55.1	-74.0

cc:

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M Ono	L Dudek	J Chrzanowski

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