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Westinghouse

INFORMATION CATEGORY

Unclassified
R. F. Lee 6/15/64
Authorized Classifier Date

ASTRONUCLEAR LABORATORY

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Library (2)

No: WANL-TMI-1137

Date June 15, 1964

From A. Y. Lee, Reactor Analysis

Subject Outer Reflector Sector Thermal Shock Test Model Temperature Distribution Calculations

NE 8010 B

MASTER

PROBLEM

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To study the thermal shock problem around the web area of the outer reflector sector, a model test was run by Engineering Mechanics. In order to assist the analysis of the test data, in particular the temperature difference between the material bulk and the web temperatures, the transient temperature distributions of the test model were calculated analytically using different values of heat transfer film coefficients along the cooling surface. This is a parametric study, since the exact flow rates of the coolant in the tests are not known.

CONCLUSION

Two different geometries of the test model were calculated; one has a 0.030" thick web and the other has a 0.040" thick web. Figure 1 shows the temperature differences in the 0.030" web model for four cases at four values of heat transfer film coefficient of 3000, 5000, 9000, and 11,000 (BTU/hr-ft²-° R). The first three cases are shown in solid lines. In these three cases the coolant temperature was assumed to be a step function at 146° R for time > 0. The last case is shown in dashed line. The coolant temperature in

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this case was assumed to be variable as shown in Figure 3. The temperature difference varies from 275° R to 415° R. Figure 2 shows the same curves for the 0.040" web model for the first three cases listed above as shown in Figure 1; the fourth case with variable coolant temperature was not run. The temperature difference varies from 270° R to 395° R. The maximum temperature differences occurred between 1.2 to 2.0 seconds after the initiation of the coolant flow. In these two figures, the initial temperature of the preheated test specimen was assumed to be 710° R.

Figure 3 shows the temperature differences of the two models whose initial temperatures were 535° R, and the coolant temperature is as shown by the dashed line. These temperatures were calculated by the Stress Analysis Group using the same analytical model as used in Figures 1 and 2.

For detailed thermal stress analysis of the specimen, the complete nodal temperature distribution pattern for each case was made available to Reactor Mechanical Design. The nodal temperature distributions were in the form of computer output format on Computer Runs 8010B-AYL-015, dated May 1, 1964.

jf
Attachments

SIGNED A. Y. Lee
A. Y. Lee

REFLECTOR THERMAL SHOCK SPECIMEN
 TEMPERATURE DIFFERENCE BETWEEN
 BULK AND WEB AT VARIOUS FILM
 COEFFICIENTS VS. TIME
 $h = \text{BTU/HP FT}^2 \cdot \text{R}; \text{ FLOW (W)} = \text{LB/SEC}$
 COOLANT TEMPERATURE (T_c) = 146°R
 WEB THICKNESS = $.030''$
 SPECIMEN INITIAL TEMP = 710°R

FIGURE 1

REFLECTOR THERMAL SHOCK SPECIMEN
TEMPERATURE DIFFERENCE BETWEEN
BULK AND WEB AT VARIOUS FILM
COEFFICIENTS VS. TIME

h - BTU/HR-FT² ; FLOW(W) - LB/SEC

COOLANT TEMPERATURE (T_c) = 146°R

WEB THICKNESS = .040"

SPECIMEN INITIAL TEMP = 710°R

FIGURE 2

REFLECTOR THERMAL SHOCK SPECIMEN
 TEMPERATURE DIFFERENCE BETWEEN
 BULK AND WEB FOR DIFFERENT WEB
 THICKNESSES
 FILM COEFFICIENT = 11,000 BTU/HR-FT²-°R
 INITIAL TEMP = 535°R

$$\Delta T = T_B - T_W$$

FIGURE 3

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 COEFFICIENTS VS. TIME
 h -BTU/HR. FT². °R; FLOW (W)-LB/SEC
 COOLANT TEMPERATURE (T_c)-146°R
 WEB THICKNESS-.030"
 SPECIMEN INITIAL TEMP = 710°R

FIGURE 1

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TEMPERATURE DIFFERENCE BETWEEN
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COEFFICIENTS VS. TIME

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FIGURE 2

REFLECTOR THERMAL SHOCK SPECIMEN
TEMPERATURE DIFFERENCE BETWEEN
BULK AND WEB FOR DIFFERENT WEB
THICKNESSES

FILM COEFFICIENT = 11,000 BTU/HR-FT²-OR
INITIAL TEMP = 535°R

$$\Delta T = T_B - T_W$$

FIGURE 3