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## ORNL Small-Break LOCA Heat Transfer Test Series I: Comparisons of Experimental Data with Vendor Models for Low-Flow Steam Heat Transfer

T. M. Anklam

Prepared for the U. S. Nuclear Regulatory Commission  
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COMPARISONS OF EXPERIMENTAL DATA WITH VENDOR  
MODELS FOR LOW-FLOW STEAM HEAT TRANSFER

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ABSTRACT

Comparisons are presented of data generated during the first Oak Ridge National Laboratory Small-Break Loss-of-Coolant Accident Heat Transfer Test Series with predictions of reactor vendor heat transfer correlations. Vendor correlations were found to predict experimental heat transfer coefficients relatively well. Standard errors of fit ranged from 12 to 18% for turbulent flow and were ~24% for transition-to-turbulent flow. Despite reasonable overall agreement, several of the correlations do not predict temperature ratio trends in the data.

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INTRODUCTION

Under sponsorship of the U.S. Nuclear Regulatory Commission (NRC), Oak Ridge National Laboratory (ORNL) has experimentally investigated low-flow steam heat transfer under conditions similar to those expected in a small-break loss-of-coolant accident (LOCA). This report contains comparisons of experimentally derived heat transfer coefficients with those predicted by reactor vendor heat transfer models. For a discussion of experimental procedures, methodology, and results, refer to a companion report, *ORNL Small-Break LOCA Heat Transfer Test Series I: Rod Bundle Heat Transfer Analysis*.<sup>1</sup>

## 2. COMPARISONS BETWEEN EXPERIMENTALLY DETERMINED TOTAL HEAT TRANSFER COEFFICIENTS AND VENDOR MODEL PREDICTIONS

At the request of the NRC, heat transfer coefficients computed by reactor vendor small-break LOCA heat transfer models have been compared with experimental data. The subject models are used by reactor vendors to compute total heat transfer coefficients (convection plus radiation) under conditions typical of small-break LOCAs and were supplied to ORNL by the NRC. The specific correlations for which comparisons are performed follow:

1. Westinghouse Electric Corporation (W). All W correlations are of the form

$$h_{\text{TOTAL}} = h_{\text{RAD}} + h_{\text{CONV}}, \quad (1)$$

where  $h_{\text{RAD}}$  is computed using a proprietary thermal radiation model and  $h_{\text{CONV}}$  is the convective heat transfer coefficient computed from the following correlations. For laminar flow ( $Re_v < 3000$ ),

$$h_{\text{CONV}} = \frac{3.66 k_v}{D_H} \left( \frac{T_v}{T_w} \right)^{0.25}, \quad (2)$$

where  $k_v$  is the thermal conductivity of the steam evaluated at the vapor temperature,  $D_H$  is the hydraulic diameter,  $T_v$  is the vapor temperature,  $T_w$  is the rod surface temperature, and  $Re_v$  is the vapor Reynolds number. For turbulent flow ( $Re_v > 5000$ ),

$$h_{\text{CONV}} = \frac{0.021 k_v}{D_H} Re_v^{0.8} Pr_v^{0.4} \left( \frac{T_v}{T_w} \right)^{0.5}, \quad (3)$$

where  $Pr_v$  is the vapor Prandtl number. For transition-to-turbulent flow ( $3000 \leq Re_v \leq 5000$ ),

$$h_{\text{CONV}} = h_{\text{LAM}} + (h_{\text{TUR}} - h_{\text{LAM}}) \left( \frac{Re_v - 3000}{5000 - 3000} \right), \quad (4)$$

where  $h_{\text{LAM}}$  is computed from Eq. (2) and  $h_{\text{TUR}}$  is computed from Eq. (3) with  $Re_v = 5000$ .

2. Combustion Engineering Corporation (CE). The CE model does not account for thermal radiation to steam, thus

$$h_{\text{TOTAL}} = h_{\text{CONV}} \quad (5)$$

For laminar flow,

$$h_{\text{CONV}} = \frac{1.86 k_v}{D_H} \left( \frac{\text{Re}_v \text{Pr}_v D_H}{L - Z_L} \right)^{1/3} \left( \frac{\mu_v}{\mu_w} \right)^{0.14} \quad (6)$$

where  $L$  is the bundle length,  $Z_L$  is the two-phase mixture level, and  $\mu$  is the viscosity of the steam. For turbulent flow,

$$h_{\text{CONV}} = \frac{0.023 k_v}{D_H} \text{Re}_v^{0.8} \text{Pr}_v^{0.4} \quad (7)$$

For transition to turbulence,  $h_{\text{CONV}}$  is computed from a proprietary extrapolation between Eqs. (6) and (7).

3. Babcock & Wilson Corporation (B&W). The B&W model uses the Dittus-Boelter correlation for all Reynolds numbers. Radiation to steam is not accounted for

$$h_{\text{TOTAL}} = h_{\text{CONV}} = \frac{0.023 k_v}{D_H} \text{Re}_v^{0.8} \text{Pr}_v^{0.4} \quad (8)$$

The heat transfer coefficient comparisons are presented in three ways. First, the ratios of the model computed heat transfer coefficients to the experimentally determined heat transfer coefficients are plotted vs different parameters. These plots are useful in identifying trends in the data that are not predicted by the models. Second, Tables 1-5 present statistical summaries of how well each correlation compares with the data. Finally, Appendix A contains a comprehensive listing of test conditions, experimental heat transfer coefficients, and those heat transfer coefficients predicted by vendor models.



## 2.1 Parametric Plots\*

Parametric plots aid in the identification of trends in the data not predicted by the vendor models (Figs. 1-12). The ratios of the predicted heat transfer coefficients to the experimental heat transfer coefficients are plotted against three different test parameters: system pressure (Figs. 1-4), ratio of the fuel rod simulator (FRS) surface temperature to the steam temperature (Figs. 5-8), and the vapor Reynolds number based on subchannel hydraulic diameter (Figs. 9-12). The ratio of the FRS to steam temperature is useful in that it is a measure of the importance of fluid property variations on convective heat transfer. The larger the temperature ratio the greater the effect of property variations on heat transfer.

Figures 1-4 do not indicate any well-defined trends with respect to system pressure for any of the correlations. However, note that the operating envelope of the Thermal-Hydraulic Test Facility did not allow truly parametric tests. Test parameters other than pressure were changed from test to test. Therefore, Figs. 1-4 do not imply a complete lack of a pressure trend; rather, there was no dominant pressure trend.

Figures 5-8 do indicate a temperature ratio trend, and Figs. 9-12 indicate a Reynolds number trend for all of the correlations examined. However, as discussed in Ref. 1, the actual trend in the comparison is felt to be one concerning temperature ratio, and the Reynolds number trend is considered an artifact of the manner in which the experiment was performed.

Total heat transfer under the subject test conditions was dominated by forced convection to steam with fluid property variations and thermal radiation. Of the dominant effects, the CE and B&W models account only for constant property forced convection. Thus, the fact that these models do not match the observed trends in the data is not surprising. What is somewhat surprising is the overprediction of the data at large temperature ratios. Thermal radiation accounted for 22-37% of the total heat transfer. Despite the fact that the CE and B&W models do not "take credit" for radiation, they still overpredict the total heat transfer coefficients by as much as 38% at large temperature ratios. This further serves to emphasize the importance of fluid property variations on heat transfer. As expected, the W model, which accounts for property variations and thermal radiation, matches data trends better than do the CE and B&W models.

## 2.2 Statistical Summaries

Tables 1-5 are statistical summaries for each correlation in each model. The items following are in a statistical summary:

1. Total number of points -- the number of experimental data points for which the correlation is applicable.

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\*Data from small-break LOCA Test Series I fell into the fully developed turbulent and transition-to-turbulent regimes. As such, vendor models for laminar steam flow could not be assessed.

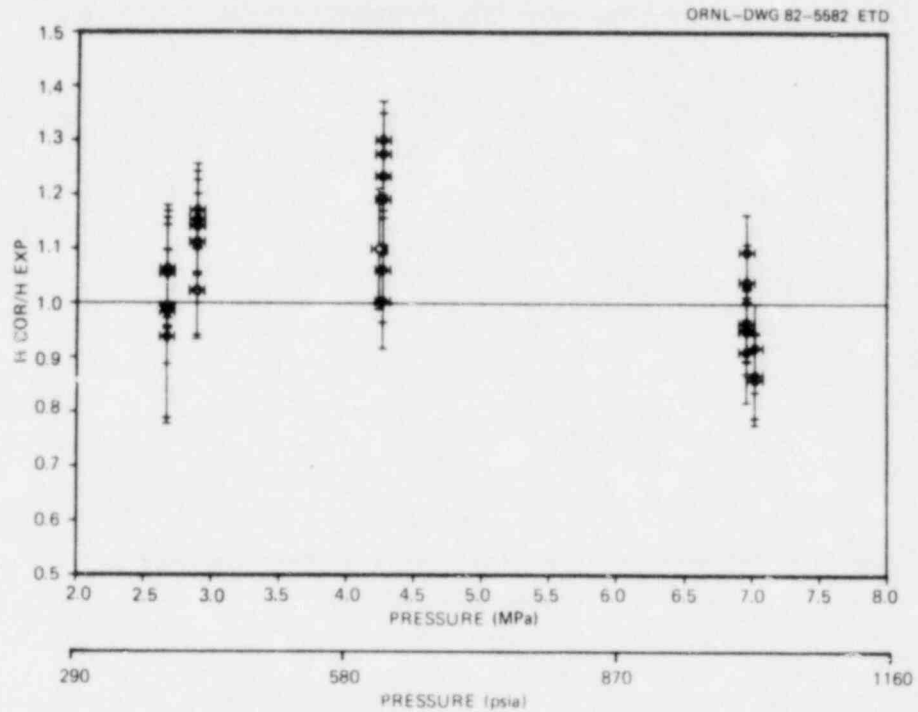


Fig. 1. Comparison between experimental heat transfer coefficients and those predicted by the W correlation for turbulent flow; comparison presented as a function of pressure.

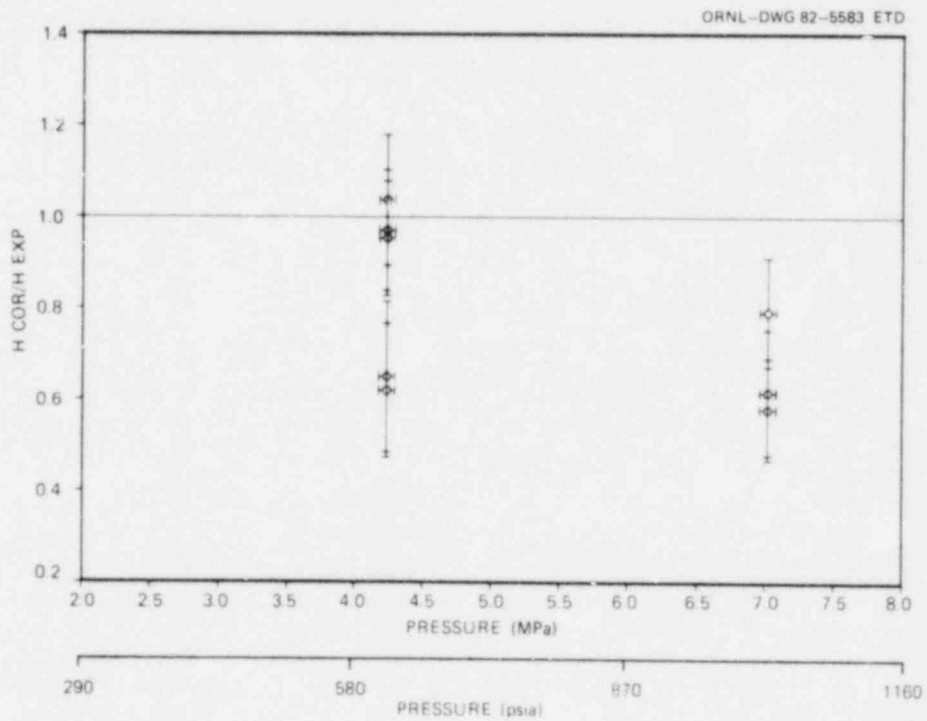


Fig. 2. Comparison between experimental heat transfer coefficients and those predicted by the W correlation for transition-to-turbulent flow; comparison presented as a function of pressure.

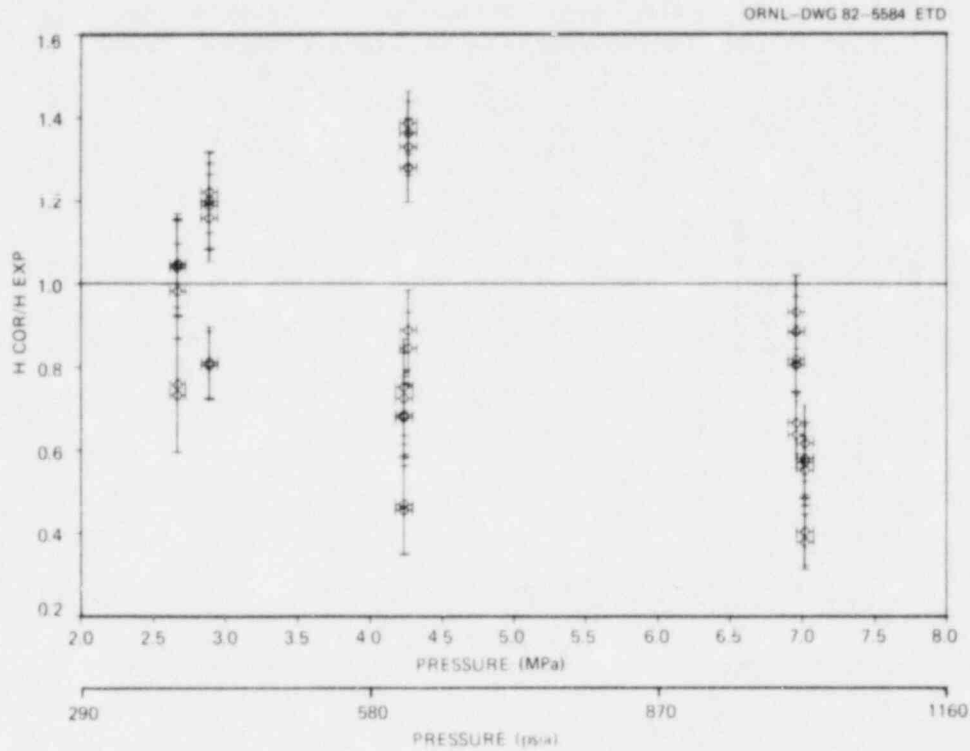


Fig. 3. Comparison between experimental heat transfer coefficients and those predicted by the CE correlations for laminar, transition, and turbulent flow; comparison presented as a function of pressure.

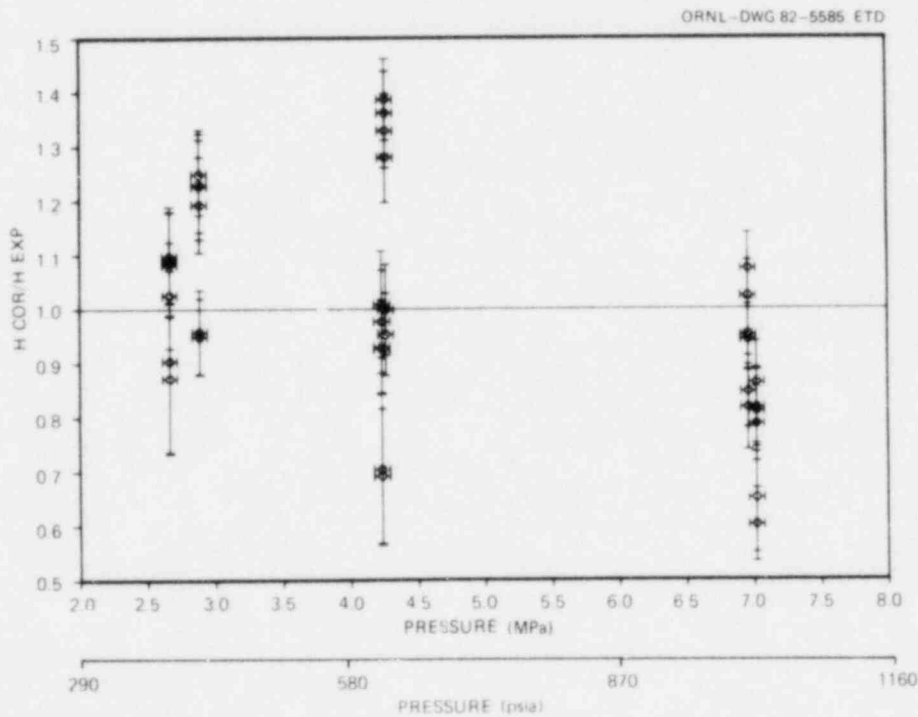


Fig. 4. Comparison between experimental heat transfer coefficients and those predicted by the B&W correlation for laminar, transition, and turbulent flow; comparison presented as a function of pressure.

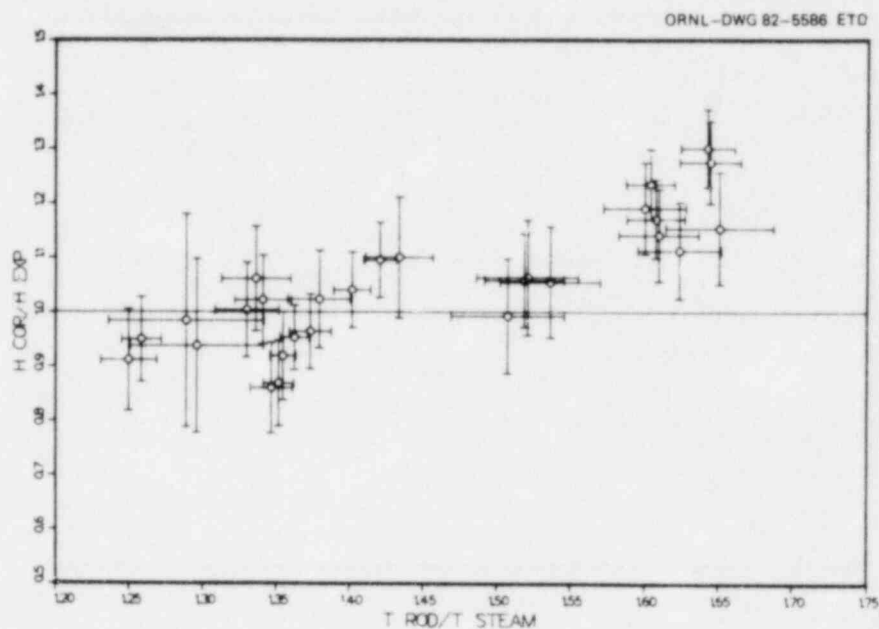


Fig. 5. Comparison between experimental heat transfer coefficients and those predicted by the  $\underline{W}$  correlation for turbulent flow; comparison presented as a function of temperature ratio.

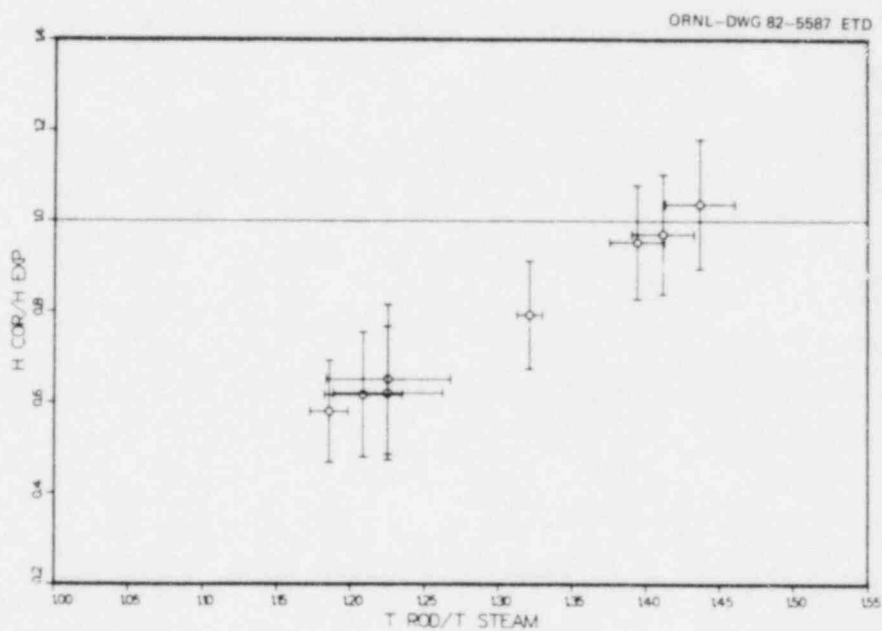


Fig. 6. Comparison between experimental heat transfer coefficients and those predicted by the  $\underline{W}$  correlation for transition-to-turbulent flow; comparison presented as a function of temperature ratio.

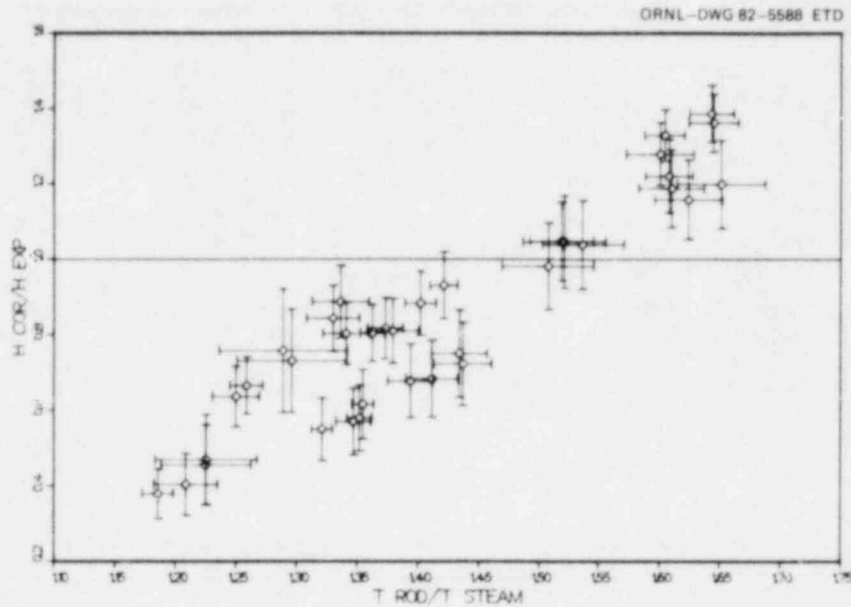


Fig. 7. Comparison between experimental heat transfer coefficients and those predicted by the CE correlations for laminar, transition, and turbulent flow; comparison presented as a function of temperature ratio.

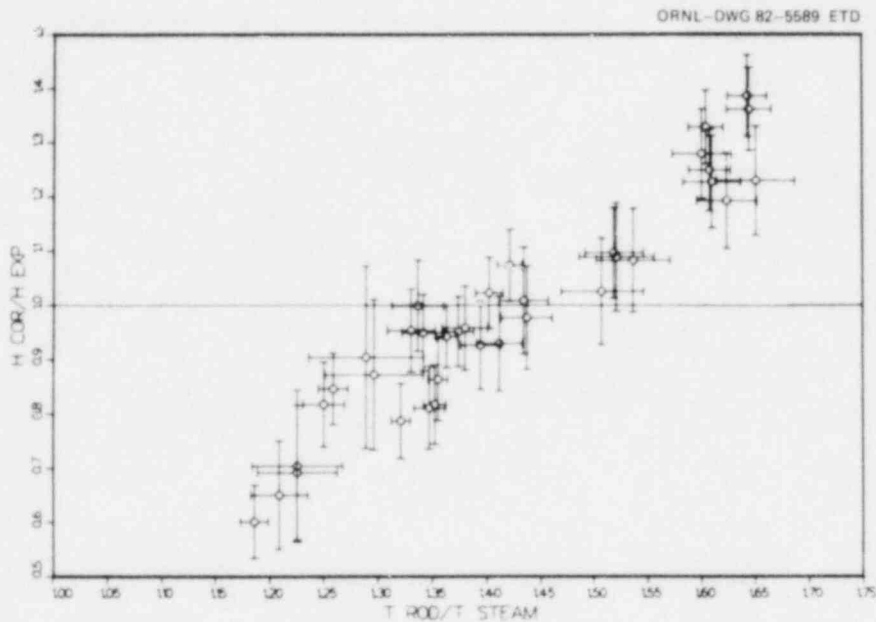


Fig. 8. Comparison between experimental heat transfer coefficients and those predicted by the B&W correlation for laminar, transition, and turbulent flow; comparison presented as a function of temperature ratio.

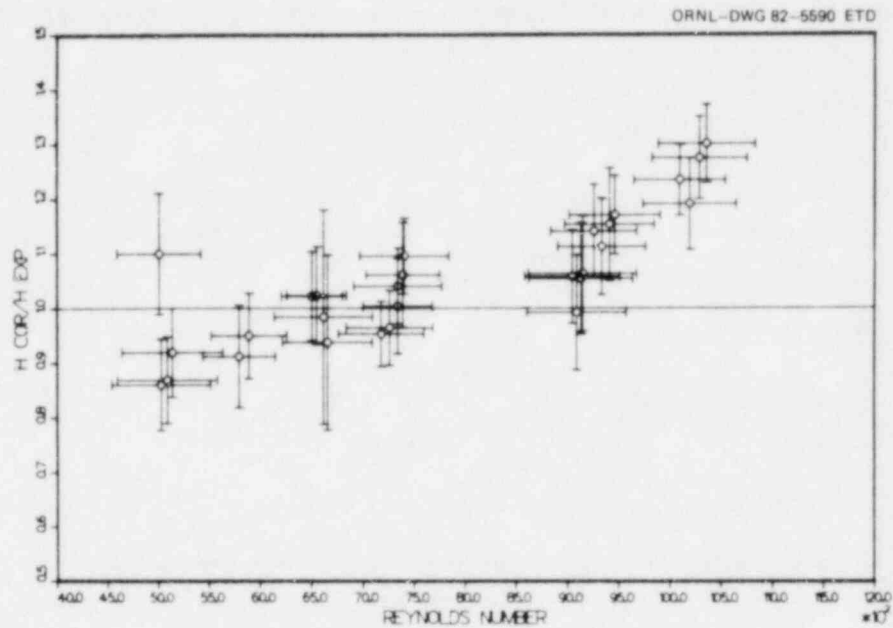


Fig. 9. Comparison between experimental heat transfer coefficients and those predicted by the W correlation for turbulent flow; comparison presented as a function of Reynolds number.

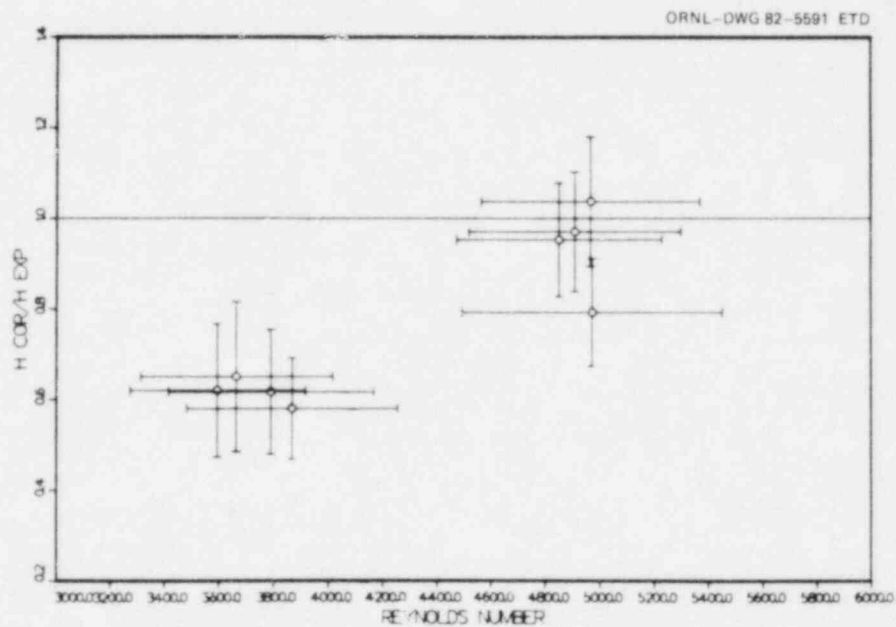


Fig. 10. Comparison between experimental heat transfer coefficients and those predicted by the W correlation for transition-to-turbulent flow; comparison presented as a function of Reynolds number.

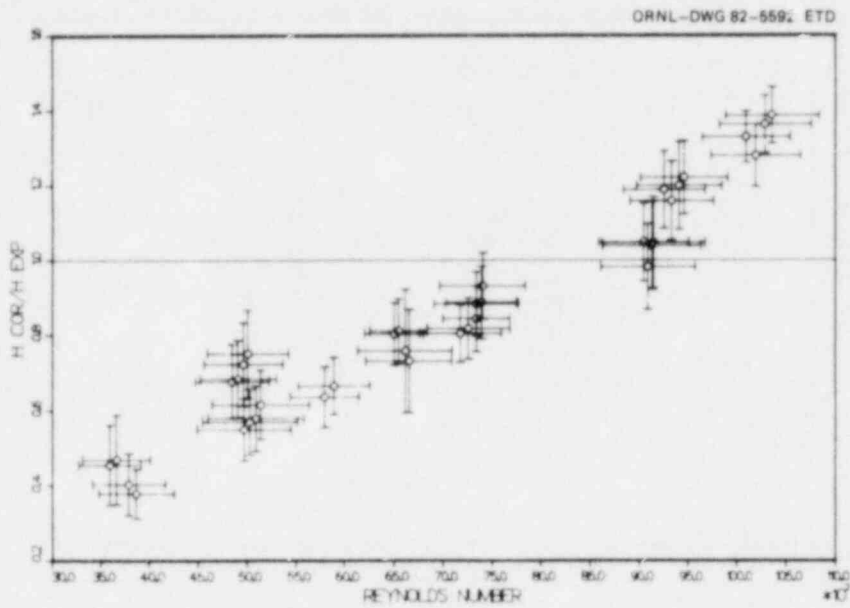


Fig. 11. Comparison between experimental heat transfer coefficients and those predicted by the CE correlations for laminar, transition, and turbulent flow; comparison presented as a function of Reynolds number.

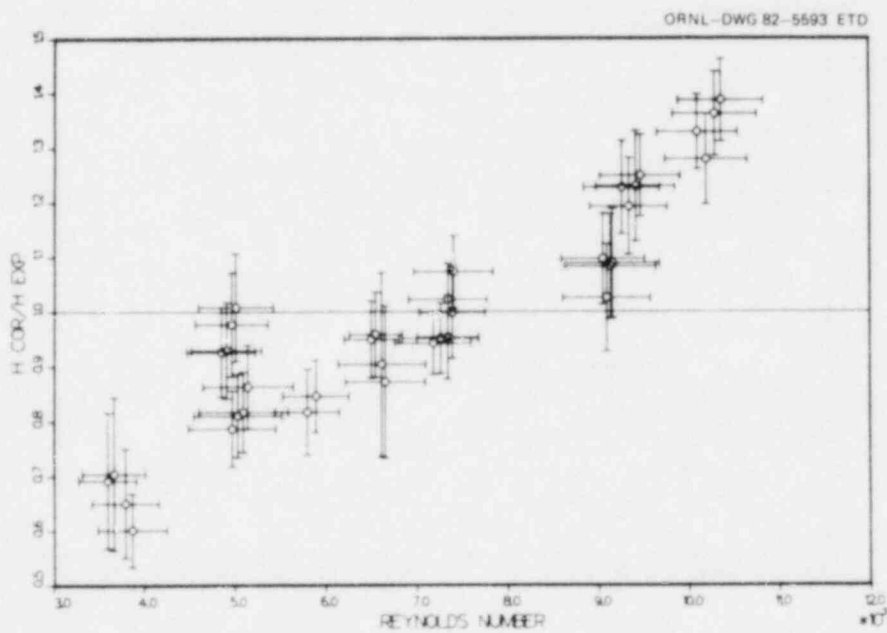


Fig. 12. Comparison between experimental heat transfer coefficients and those predicted by the B&W correlation for laminar, transition, and turbulent flow; comparison presented as a function of Reynolds number.

Table 1. Statistical summary for the  $\underline{W}$  correlation for fully developed turbulent flow

Item	Value
Total number of points	25
Standard error	0.126
Points too high, %	72
Maximum overprediction, %	30
Standard error of high points	0.145
Points too low, %	28
Maximum underprediction, %	8.8
Standard error of low points	0.051
Slope of data (bulk Reynolds number $\times 10^3$ )	5.03
Slope of data ( $T_w/T_v$ )	0.665
Slope of data (system pressure), 1.0/MPa (1.0/psia)	-0.016 (-0.00011)

Table 2. Statistical summary for the C-E correlation for fully developed turbulent flow

Item	Value
Total number of points <sup>a</sup>	4
Standard error	0.341
Points too high, %	100
Maximum overprediction, %	38.5
Standard error of high points	0.341
Points too low, %	0.0
Maximum underprediction	N.A. <sup>b</sup>
Standard error of low points	N.A.
Slope of data (bulk Reynolds number)	Not statistically significant
Slope of data ( $T_w/T_v$ )	Not statistically significant
Slope of data (system pressure)	Not statistically significant

<sup>a</sup>Total number of points is only 4 because C-E assumes that most of the data are transition to turbulence.

<sup>b</sup>N.A. = not applicable.



Table 3. Statistical summary for the B&W correlation for fully developed turbulent and transition-to-turbulent flow

Item	Value
Total number of points	30
Standard error	0.181
Points too high, %	50
Maximum overprediction, %	38.6
Standard error of high points	0.216
Points too low, %	50
Maximum underprediction, %	30.8
Standard error of low points	0.139
Slope of data (bulk Reynolds number $\times 10^4$ )	7.98
Slope of data ( $T_w/T_v$ )	1.24
Slope of data (system pressure), 1.0/MPa (1.0/psia)	-0.03 (-0.00021)

Table 4. Statistical summary for the W correlation for transition-to-turbulent flow

Item	Value
Total number of points	5
Standard error	0.233
Points too high, %	20.0
Maximum overprediction, %	3.7
Standard error of high points	0.037
Points too low, %	80
Maximum underprediction, %	38
Standard error of low points	0.260
Slope of data (bulk Reynolds number)	Not statistically significant
Slope of data ( $T_w/T_v$ )	Not statistically significant
Slope of data (system pressure)	Not statistically significant

Table 5. Statistical summary for CE  
correlation for transition-  
to-turbulent flow

Item	Value
Total number of points	26
Standard error	0.242
Points too high, %	26.9
Maximum overprediction, %	22.3
Standard error of high points	0.151
Points too low, %	73.1
Maximum underprediction, %	52.8
Standard error of low points	0.268
Slope of data (bulk Reynolds number $\times 10^3$ )	10.6
Slope of data ( $T_w/T_v$ )	1.48
Slope of data (system pres- sure), 1.0/MPa (1.0/psia)	-0.05 (-0.00034)

2. Standard error - a relative standard error defined as

$$SE = \sqrt{\frac{\sum_{i=1}^N \frac{h_{COR} - h_{EX}}{h_{EX}}^2}{N}}$$

where  $h_{COR}$  is the correlation-predicted total heat transfer coefficient and  $h_{EX}$  is the experimentally determined heat transfer coefficient.

3. Percentage of points too high - the percentage of data points over-predicted by the correlation.
4. Maximum overprediction.
5. Standard error of high points.
6. Percentage of points too low - the percentage of data points under-predicted by the correlation.
7. Maximum underprediction.
8. Standard error of low points.
9. Slope with respect to vapor Reynolds number - the slope of a line that represents the least squares fit of the points in the Reynolds number parametric plots (Figs. 9-12). Test 3.02.10F data are not included in the statistical summary because of heat loss problems (see Ref. 1, Appendix D). If the slope is 0.0 then no discernible trend for bulk Reynolds number has been observed. If this quantity

is not shown, then the statistical sample has been deemed too small for a meaningful least squares fit.

10. Slope with respect to temperature ratio - same as item 9 except that temperature ratio is the parameter of interest.
11. Slope with respect to system pressure - same as item 9 except that system pressure is the parameter of interest.

### 3. CONCLUSIONS

Vendor heat transfer models predict experimental heat transfer coefficients relatively well. The standard error for transition region correlations is ~24%. Standard errors for turbulent region correlations vary between 12.6 and 18.1%. The statistical sample for the CE correlation was too small to draw conclusions.

Despite good overall agreement, however, these models have several shortcomings. The models have substantial maximum deviations from data: maximum overpredictions for turbulent flow correlations varied between 30.0 and 38.6%, and maximum underpredictions varied between 38.0 and 52.8%. The CE and B&W correlations do not match trends in data with respect to temperature ratio. These shortcomings can be mitigated, however, by properly accounting for fluid property variations and thermal radiation.<sup>1</sup>

Although the models were quite successful at predicting data, further verification is needed. The vapor Reynolds number range should be extended, and the correlations should be compared with other independent data.

## REFERENCE

1. T. M. Anklam, *ORNL Small-Break LOCA Heat Transfer Test Series I: Rod Bundle Heat Transfer Analysis*, NUREG/CR-2052 (ORNL/NUREG/TM-445) (August 1981).

## Appendix A

## HEAT TRANSFER RESULTS

This appendix contains the results of the heat transfer and local fluid condition calculations. Rod and subchannel types are specified in Ref. 1 in the section on treatment of experimental data.<sup>1</sup> Note that although some heat transfer calculations have been done for rod types 5 and 6, these calculations do not account for radiation to the bundle shroud. Because rod types 5 and 6 are directly adjacent to the bundle shroud, radiation to the shroud may be significant. Therefore, the user is advised to follow the convention used in Ref. 1 and only use results that pertain to rod types 1-4, which are not adjacent to the shroud.

A.1 Key for Appendix A

Appendix A results are grouped by test and thermocouple level. Results for a test are first presented for thermocouple G - 3.62 m (11.9 ft) above the beginning of the heated length - and then for level F - 3.02 m (9.9 ft) above the beginning of the heated length. Uncertainties in a calculated or measured quantity appear adjacent to the quantity and are denoted by the symbol +OR- or the word DELTA. An example of the latter would be a column of numbers under the heading DELTA STEAM TEMPERATURE; the column represents the uncertainty in the steam temperature. Definitions for abbreviations and terms not commonly understood are

ANN MASS INV	Mass of water and steam present in the test section annulus during the data scan.
H EXP	Experimentally determined total heat transfer coefficient.
MODIFIED WALL RE	Reynolds number based on subchannel hydraulic diameter with all vapor properties evaluated at the heated surface temperature.
PR BULK TEMP	Prandtl number based on vapor temperature.
PR FILM	Prandtl number based on film temperature.
RE BULK/BUDI	Reynolds number based on bundle hydraulic diameter with all vapor properties evaluated at vapor temperature.
RE BULK/SCDI	Reynolds number based on subchannel hydraulic diameter with all vapor properties evaluated at vapor temperature.
RE FILM/BUDI	Reynolds number based on bundle hydraulic diameter with all vapor properties evaluated at the film temperature.
RE FILM/SCDI	Reynolds number based on subchannel hydraulic diameter with all vapor properties evaluated at film temperature.
TS MASS INV	Mass of water and steam in test section proper during data scan.
TSURF/TSHE	Fuel rod surface temperature based on FRS sheath thermocouple reading.

A.2 Key for Vendor Model Results

H/B&W	Total heat transfer coefficient calculated from <u>B&amp;W</u> heat transfer model.
HCE	Total heat transfer coefficient calculated from <u>CE</u> heat transfer model.
HLAM/W	Total heat transfer coefficient calculated from the <u>W</u> heat transfer model for laminar forced convection.
HTRAN/W	Total heat transfer coefficient calculated from <u>W</u> heat transfer model for transition-to-turbulent forced convection.
HTUR/W	Total heat transfer coefficient calculated from <u>W</u> heat transfer model for fully developed turbulent forced convection.

Note that a heat transfer coefficient of 0.0 implies that the local fluid conditions are out of the range for which the correlation is applicable.

## OUTPUT RESULTS FOR TEST 3.02.10C

## SYSTEM PARAMETER SUMMARY

SYSTEM PRESSURE	0.41925318E+03	+OR-	0.81505825E+01	PSIA
INLET FLOW	0.16898413E+01	+OR-	0.80000000E-01	GPM
	0.74029685E+03	+OR-	0.35047707E+02	LBH/HR
OUTLET FLOW	0.15411243E+03	+OR-	0.35000000E+01	GPM
	0.72065945E+03	+OR-	0.21905124E+02	LBH/HR
BUNDLE MASS FLUX	0.10836984E+05	+OR-	0.32940037E+03	LBH/HR*FT**2
INLET TEMPERATURE	0.38100293E+03	+OR-	0.43285745E+00	DEG F
OUTLET TEMPERATURE	0.79382520E+03	+OR-	0.13337479E+01	DEG F
COLLAPSED IL	0.52207521E+01	+OR-	0.33552357E+00	FEET
TS MASS INV.	0.22302229E+02	DELTA	-0.57452170E-01	LBH OVER SCAN
ANN MASS INV.	0.33855479E+02	DELTA	-0.32651035E-01	LBH OVER SCAN

## SUBCHANNEL TEMPERATURES FOR LEVEL G (DEG F)

INTERNAL SUBCHANNEL TEMP	0.88061488E+03	+CR-	0.18694332E+02
COLD ROD SUBCHANNEL TEMP	0.80899654E+03	+CR-	0.14013849E+02
CORNER SUBCHANNEL TEMP	0.68555388E+03	+CR-	0.17274214E+02
WALL SUBCHANNEL TEMP	0.80827676E+03	+CR-	0.25176738E+02

## SUBCHANNEL TEMPERATURES FOR LEVEL P (DEG F)

INTERNAL SUBCHANNEL TEMP	0.52648483E+03	+CR-	0.11607437E+02
COLD ROD SUBCHANNEL TEMP	0.51364203E+03	+CR-	0.96030409E+01
CORNER SUBCHANNEL TEMP	0.49150597E+03	+CR-	0.68319489E+01
WALL SUBCHANNEL TEMP	0.51351296E+03	+CR-	0.10292862E+02



## RADIATION FLOI SUMMARY - LEVEL G (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLOI	+OR-
1	0.27085638+04	0.1250922E+04
3	0.3813027E+04	0.1283474E+04

## RADIATION FLOI SUMMARY - LEVEL F (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLOI	+OR-
1	0.2310010E+04	0.7640836E+03
2	0.2898841E+04	0.8816456E+03
3	0.2987037E+04	0.8161103E+03
4	0.2991082E+04	0.7934631E+03

## RADIATION FLOI SUMMARY - LEVEL G (DEG F)

HOT ROD TEMPS	0.1339942E+04	
COLD ROD TEMPS	0.1000218E+04	+OR- 0.6085161E+02

## RADIATION FLOI SUMMARY - LEVEL F (DEG F)

HOT ROD TEMPS	0.1146934E+04	
COLD ROD TEMPS	0.6999232E+03	+OR- 0.6653621E+02

## RADIATION TO COLD RODS - LEVEL G (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLOI	+OR-
3	0.8535547E+03	0.2724261E+03

## RADIATION TO COLD RODS - LEVEL F (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLOI	+OR-
2	0.3603618E+03	0.1028992E+03
3	0.6344012E+03	0.1810464E+03
4	0.7428359E+03	0.2158924E+03

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL G

ROD TYPE	STEAM TEMP. DEG F	DELTA STEAM TEMP.	TS09P/TS0E DEG F	DELTA TS09P/TS0E	SURFACE Q" BTU/HR FT2	DELTA SURFACE Q"
1	0.88061E+03	0.18694E+02	0.13380E+04	0.59647E+01	0.11558E+05	0.21657E+03
3	0.84481E+03	0.16354E+02	0.13399E+04	0.16041E+02	0.12322E+05	0.46687E+03
5	0.84445E+03	0.21916E+02	0.13687E+04	0.22710E+02	0.12418E+05	0.35048E+03
6	0.79568E+03	0.21581E+02	0.12780E+04	0.58963E+01	0.11587E+05	0.28274E+03

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL G

ROD TYPE	H EXP BTU/HR FT2 F	DELTA H EXP	FILM TEMP. DEG F	DELTA FILM TEMP.
1	0.25271E+02	0.11831E+01	0.11093E+04	0.12330E+02
3	0.24887E+02	0.14882E+01	0.10924E+04	0.16197E+02
5	0.23488E+02	0.15757E+01	0.11066E+04	0.22327E+02
6	0.24025E+02	0.12228E+01	0.10368E+04	0.13738E+02

## DIMENSIONLESS PARAMETERS FOR LEVEL G

ROD TYPE	RE BULK/SCDI	DELTA RE BULK/SCDI	RE BULK/RODI	DELTA RE BULK/RODI	PR BULK TEMP	DELTA PR BULK TEMP.
1	0.65070E+04	0.29654E+03	0.56611E+04	0.25799E+03	0.92406E+00	0.38120E-02
3	0.65509E+04	0.28862E+03	0.58305E+04	0.25688E+03	0.93242E+00	0.40088E-02
5	0.56981E+04	0.27766E+03	0.58322E+04	0.28419E+03	0.93251E+00	0.53115E-02
6	0.51888E+04	0.25514E+03	0.60798E+04	0.24896E+03	0.94684E+00	0.68214E-02

## DIMENSIONLESS PARAMETERS FOR LEVEL G

ROD TYPE	RE FILM/SCDI	DELTA RE FILM/SCDI	RE FILM/RODI	DELTA RE FILM/RODI	PR FILM TEMP	DELTA PR FILM TEMP.
1	0.54886E+04	0.21324E+03	0.47733E+04	0.18552E+03	0.89276E+00	0.10569E-02
3	0.54262E+04	0.22601E+03	0.48295E+04	0.20115E+03	0.89428E+00	0.14589E-02
5	0.46724E+04	0.21381E+03	0.47823E+04	0.21884E+03	0.89308E+00	0.19000E-02
6	0.42671E+04	0.17285E+03	0.50233E+04	0.20253E+03	0.89994E+00	0.15006E-02

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL G  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRAM/W	DELTA HTRAM/W	HLAM/W	DELTA HLAM/W	HTOR/W	DELTA HTOR/W
1	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.25025E+02	0.16736E+01
3	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.25462E+02	0.16244E+01
5	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.26085E+02	0.20248E+01
6	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.25687E+02	0.18891E+01

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL G  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRAM/CE	DELTA HTRAM/CE	HLAM/CE	DELTA HLAM/CE	HTOR/CE	DELTA HTOR/CE
1	0.20302E+02	0.18456E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
3	0.20163E+02	0.17567E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
5	0.19289E+02	0.20439E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
6	0.18453E+02	0.20681E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL G  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	H/SGW	DELTA H/SGW
1	0.23989E+02	0.13863E+01
3	0.23840E+02	0.13006E+01
5	0.24513E+02	0.15907E+01
6	0.24845E+02	0.16425E+01

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL F

ROD TYPE	STEAM TEMP. DEG F	DELTA STEAM TEMP.	TSURF/TSHE DEG F	DELTA TSURF/TSHE	SURFACE Q" BTU/HR FT2	DELTA SURFACE Q"
1	0.52648E+03	0.11607E+02	0.11256E+04	0.51270E+01	0.11575E+05	0.21681E+03
2	0.52327E+03	0.11106E+02	0.11629E+04	0.30947E+02	0.12612E+05	0.48181E+03
3	0.52006E+03	0.10605E+02	0.11310E+04	0.21699E+02	0.12493E+05	0.47333E+03
4	0.51685E+03	0.10104E+02	0.11121E+04	0.20842E+02	0.11894E+05	0.36712E+03
5	0.52000E+03	0.10950E+02	0.11416E+04	0.23190E+02	0.12427E+05	0.39009E+03
6	0.51125E+03	0.97563E+01	0.10937E+04	0.61775E+01	0.11747E+05	0.24610E+03

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL F

ROD TYPE	H EIP BTU/HR FT2 F	DELTA H EIP	FILM TEMP. DEG F	DELTA FILM TEMP.
1	0.19321E+02	0.54629E+00	0.82603E+03	0.83672E+01
2	0.19718E+02	0.12628E+01	0.84309E+03	0.21027E+02
3	0.20450E+02	0.11198E+01	0.82552E+03	0.16152E+02
4	0.19982E+02	0.99249E+00	0.81446E+03	0.15473E+02
5	0.19991E+02	0.10363E+01	0.83061E+03	0.17070E+02
6	0.20167E+02	0.58167E+00	0.80250E+03	0.79669E+01

## DIMENSIONLESS PARAMETERS FOR LEVEL F

ROD TYPE	RE BULK/SCDI	DELTA RE BULK/SCDI	RE BULK/BUDI	DELTA RE BULK/BUDI	PR BULK TEMP	DELTA PR BULK TEMP.
1	0.94597E+04	0.44475E+03	0.82299E+04	0.38693E+03	0.11485E+01	0.16714E-01
2	0.94086E+04	0.43672E+03	0.82682E+04	0.38378E+03	0.11533E+01	0.16246E-01
3	0.93333E+04	0.42757E+03	0.83069E+04	0.38055E+03	0.11581E+01	0.15747E-01
4	0.92575E+04	0.41842E+03	0.83461E+04	0.37723E+03	0.11630E+01	0.15217E-01
5	0.81167E+04	0.37591E+03	0.83777E+04	0.38475E+03	0.11582E+01	0.16251E-01
6	0.71823E+04	0.32242E+03	0.84157E+04	0.37778E+03	0.11717E+01	0.15014E-01

## DIMENSIONLESS PARAMETERS FOR LEVEL F

ROD TYPE	FI FILM/SCDI	DELTA RE FILM/SCDI	RE FILM/BUDI	DELTA RE FILM/BUDI	PR FILM TEMP	DELTA PR FILM TEMP
1	0.68084E+04	0.25527E+03	0.59233E+04	0.22208E+03	0.93747E+00	0.23144E-02
2	0.66442E+04	0.31884E+03	0.58388E+04	0.28019E+03	0.93286E+00	0.51391E-02
3	0.66581E+04	0.29365E+03	0.59259E+04	0.26135E+03	0.93762E+00	0.43880E-02
4	0.66352E+04	0.28961E+03	0.59820E+04	0.26110E+03	0.94085E+00	0.44743E-02
5	0.57638E+04	0.25833E+03	0.58994E+04	0.26441E+03	0.93614E+00	0.44963E-02
6	0.51582E+04	0.19233E+03	0.60479E+04	0.22538E+03	0.94459E+00	0.25163E-02

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL F  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRAN/W	DELTA HTRAN/W	HLAM/W	DELTA HLAM/W	HTUR/W	DELTA HTUR/W
1	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.22620E+02	0.12346E+01
2	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.22745E+02	0.14078E+01
3	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.22755E+02	0.13057E+01
4	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.22799E+02	0.12714E+01
5	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.23267E+02	0.13655E+01
6	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.23789E+02	0.11811E+01

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL F  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRAN/CE	DELTA HTRAN/CE	HLAM/CE	DELTA HLAM/CE	HTUR/CE	DELTA HTUR/CE
1	0.23574E+02	0.17564E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
2	0.23631E+02	0.17328E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
3	0.23681E+02	0.17065E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
4	0.23731E+02	0.16810E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
5	0.22813E+02	0.18125E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
6	0.22179E+02	0.17970E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL F  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	H/BSW	DELTA H/BSW
1	0.24130E+02	0.12759E+01
2	0.24249E+02	0.12496E+01
3	0.24386E+02	0.12238E+01
4	0.24527E+02	0.11976E+01
5	0.25078E+02	0.12798E+01
6	0.25999E+02	0.12410E+01

## OUTPUT RESULTS FOR TEST 3.02.100

## SYSTEM PARAMETER SUMMARY

SYSTEM PRESSURE	0.61421045E+03	+OR-	0.84393942E+01	PSIA
INLET FLOW	0.12607574E+01	+OR-	0.80000000E-01	GPM
	0.54859545E+03	+OR-	0.34812438E+02	LBM/HR
OUTLET FLOW	0.61082932E+02	+OR-	0.35000000E+01	GPM
	0.44928567E+03	+OR-	0.26667582E+02	LBM/HR
BUNDLE MASS FLOW	0.67561755E+04	+OR-	0.40101627E+03	LBM/HR*FT**2
INLET TEMPERATURE	0.39172974E+03	+OR-	0.88353670E+00	DEG F
OUTLET TEMPERATURE	0.74053418E+03	+OR-	0.46851978E+01	DEG F
COLLAPSED LL	0.63112673E+01	+OR-	0.34878787E+00	FEET
TS MASS INV.	0.24629187E+02	DELTA	0.48262848E+00	LBM OVER SCAN
ANN MASS INV.	0.10583625E+03	DELTA	-0.32641372E-01	LBM OVER SCAN

## SUBCHANNEL TEMPERATURES FOR LEVEL G (DEG F)

INTERNAL SUBCHANNEL TEMP	0.10059907E+04	+OR-	0.49889952E+02
COLD ROD SUBCHANNEL TEMP	0.99584777E+03	+OR-	0.32112550E+02
CORNER SUBCHANNEL TEMP	0.59469482E+03	+OR-	0.85796457E+02
WALL SUBCHANNEL TEMP	0.78244621E+03	+OR-	0.76103715E+02

## SUBCHANNEL TEMPERATURES FOR LEVEL F (DEG F)

INTERNAL SUBCHANNEL TEMP	0.64852305E+03	+OR-	0.17426663E+02
COLD ROD SUBCHANNEL TEMP	0.64538929E+03	+OR-	0.12726604E+02
CORNER SUBCHANNEL TEMP	0.52144900E+03	+OR-	0.26559982E+02
WALL SUBCHANNEL TEMP	0.57958028E+03	+OR-	0.23963171E+02

## RADIATION FLUX SUMMARY - LEVEL G (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
1	0.2544616E+04	0.1516320E+04
3	0.3094922E+04	0.1534954E+04

## RADIATION FLUX SUMMARY - LEVEL F (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
1	0.2375171E+04	0.8968653E+03
2	0.2731649E+04	0.9148386E+03
3	0.2686476E+04	0.8713669E+03
4	0.2819851E+04	0.8643041E+03

## RADIATION FLUX SUMMARY - LEVEL G (DEG F)

HOT ROD TEMPS	0.1330187E+04	
COLD ROD TEMPS	0.1129715E+04	+OR- 0.5375132E+02

## RADIATION FLUX SUMMARY - LEVEL F (DEG F)

HOT ROD TEMPS	0.1116926E+04	
COLD ROD TEMPS	0.8007079E+03	+OR- 0.5501792E+02

## RADIATION TO COLD RODS - LEVEL G (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
3	0.5841938E+03	0.3029712E+03

## RADIATION TO COLD RODS - LEVEL F (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
2	0.3406599E+03	0.1180139E+03
3	0.4921382E+03	0.1801768E+03
4	0.7573660E+03	0.2895904E+03

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL G

ROD TYPE	STEAM TEMP. DEG F	DELTA STEAM TEMP.	TSURF/TSHE DEG F	DELTA TSURF/TSHE	SURFACE Q" BTU/HR FT2	DELTA SURFACE Q"
1	0.10060E+04	0.49890E+02	0.13366E+04	0.64081E+01	0.81570E+04	0.96882E+02
3	0.10009E+04	0.41001E+02	0.13302E+04	0.20113E+02	0.82912E+04	0.15830E+03
5	0.89442E+03	0.62997E+02	0.12951E+04	0.18607E+02	0.83466E+04	0.16657E+03
6	0.79159E+03	0.71973E+02	0.12202E+04	0.53115E-01	0.81570E+04	0.92598E+02

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL G

ROD TYPE	H EXP BTU/HR FT2 F	DELTA H EXP	FILM TEMP. DEG F	DELTA FILM TEMP.
1	0.24669E+02	0.37641E+01	0.11713E+04	0.28149E+02
3	0.25181E+02	0.35255E+01	0.11656E+04	0.30557E+02
5	0.20831E+02	0.33877E+01	0.10948E+04	0.38802E+02
6	0.19033E+02	0.32144E+01	0.10059E+04	0.38944E+02

## DIMENSIONLESS PARAMETERS FOR LEVEL G

ROD TYPE	RE BULK/SCDI	DELTA RE BULK/SCDI	RE BULK/BUDI	DELTA RE BULK/BUDI	PR BULK TEMP	DELTA PR BULK TEMP.
1	0.36650E+04	0.35131E+03	0.31886E+04	0.30564E+03	0.90896E+00	0.70402E-02
3	0.35959E+04	0.32168E+03	0.32004E+04	0.28630E+03	0.90977E+00	0.60122E-02
5	0.33915E+04	0.37097E+03	0.34713E+04	0.37970E+03	0.93188E+00	0.14442E-01
6	0.32251E+04	0.39132E+03	0.37789E+04	0.45851E+03	0.97004E+00	0.2907.E-01

## DIMENSIONLESS PARAMETERS FOR LEVEL G

ROD TYPE	RE FILM/SCDI	DELTA RE FILM/SCDI	RE FILM/BUDI	DELTA RE FILM/BUDI	PR FILM TEMP	DELTA PR FILM TEMP
1	0.32691E+04	0.25427E+03	0.28442E+04	0.22122E+03	0.88992E+00	0.22667E-02
3	0.32077E+04	0.25479E+03	0.28549E+04	0.22677E+03	0.89042E+00	0.24989E-02
5	0.29252E+04	0.25174E+03	0.29941E+04	0.25766E+03	0.89732E+00	0.39919E-02
6	0.27215E+04	0.23907E+03	0.31888E+04	0.28012E+03	0.90898E+00	0.56172E-02



HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL G  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRAW/W	DELTA HTRAW/W	HLAW/W	DELTA HLAW/W	HTOR/W	DELTA HTOR/W
1	0.16040E+02	0.32443E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
3	0.15609E+02	0.29758E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
5	0.13820E+02	0.34954E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
6	0.12010E+02	0.36543E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL G  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRAW/CE	DELTA HTRAW/CE	HLAW/CE	DELTA HLAW/CE	HTOR/CE	DELTA HTOR/CE
1	0.11573E+02	0.23486E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
3	0.11465E+02	0.21438E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
5	0.10763E+02	0.26613E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
6	0.10197E+02	0.29285E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL G  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	H/BEW	DELTA H/BEW
1	0.17370E+02	0.22104E+01
3	0.17423E+02	0.19741E+01
5	0.17397E+02	0.27490E+01
6	0.17490E+02	0.32580E+01

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL F

ROD TYPE	STEAM TEMP. DEG F	DELTA STEAM TEMP.	TSUBP/TSHE DEG F	DELTA TSUBP/TSHE	SURFACE Q" BTU/HR FT2	DELTA SURFACE Q"
1	0.64852E+03	0.17427E+02	0.11295E+04	0.38854E+01	0.79495E+04	0.14252E+03
2	0.64774E+03	0.16252E+02	0.11315E+04	0.12344E+02	0.82718E+04	0.15809E+03
3	0.64696E+03	0.15077E+02	0.11024E+04	0.10162E+02	0.82092E+04	0.15674E+03
4	0.64617E+03	0.13902E+02	0.10820E+04	0.63927E+01	0.79030E+04	0.67628E+02
5	0.61405E+03	0.20695E+02	0.10874E+04	0.74994E+01	0.82438E+04	0.14256E+03
6	0.58228E+03	0.22978E+02	0.10455E+04	0.62812E+01	0.80764E+04	0.91682E+02

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL F

ROD TYPE	H EXP BTU/HR FT2 F	DELTA H EXP	FILM TEMP. DEG F	DELTA FILM TEMP.
1	0.16526E+02	0.68123E+00	0.88903E+03	0.10656E+02
2	0.17100E+02	0.79202E+00	0.88961E+03	0.14298E+02
3	0.18025E+02	0.79767E+00	0.87467E+03	0.12619E+02
4	0.18158E+02	0.65540E+00	0.86406E+03	0.10147E+02
5	0.17415E+02	0.86394E+00	0.85074E+03	0.14097E+02
6	0.17437E+02	0.91798E+00	0.81387E+03	0.14610E+02

## DIMENSIONLESS PARAMETERS FOR LEVEL F

ROD TYPE	RE BULK/SCDI	DELTA RE BULK/SCDI	RE BULK/BODI	DELTA RE BULK/BODI	PR BULK TEMP	DELTA PR BULK TEMP
1	0.50112E+04	0.41385E+03	0.43597E+04	0.36005E+03	0.10788E+01	0.15299E-01
2	0.49662E+04	0.40223E+03	0.43642E+04	0.35348E+03	0.10796E+01	0.14473E-01
3	0.49086E+04	0.38978E+03	0.43687E+04	0.34692E+03	0.10804E+01	0.13617E-01
4	0.48508E+04	0.37753E+03	0.43732E+04	0.34036E+03	0.10811E+01	0.12731E-01
5	0.44589E+04	0.38933E+03	0.45638E+04	0.39849E+03	0.11174E+01	0.24457E-01
6	0.40687E+04	0.37274E+03	0.47673E+04	0.43674E+03	0.11629E+01	0.33873E-01

## DIMENSIONLESS PARAMETERS FOR LEVEL F

ROD TYPE	RE FILM/SCDI	DELTA RE FILM/SCDI	RE FILM/BODI	DELTA RE FILM/BODI	PR FILM TEMP	DELTA PR FILM TEMP
1	0.40071E+04	0.27186E+03	0.34862E+04	0.23652E+03	0.93335E+00	0.28735E-02
2	0.39652E+04	0.28051E+03	0.34846E+04	0.24651E+03	0.93319E+00	0.38057E-02
3	0.39623E+04	0.27546E+03	0.35265E+04	0.24517E+03	0.93751E+00	0.36681E-02
4	0.39453E+04	0.26669E+03	0.35569E+04	0.24043E+03	0.94080E+00	0.31569E-02
5	0.35131E+04	0.24916E+03	0.35958E+04	0.25502E+03	0.94524E+00	0.46889E-02
6	0.31644E+04	0.22688E+03	0.37078E+04	0.26584E+03	0.95960E+00	0.60829E-02

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL F  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRAN/W	DELTA HTRAN/W	HLAM/W	DELTA HLAM/W	HTUR/W	DELTA HTUR/W
1	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.18177E+02	0.16713E+01
2	0.17729E+02	0.23025E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
3	0.17490E+02	0.22537E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
4	0.17278E+02	0.21918E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
5	0.16188E+02	0.24818E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
6	0.14780E+02	0.25868E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL F  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRAN/CE	DELTA HTRAN/CE	HLAM/CE	DELTA HLAM/CE	HTUR/CE	DELTA HTUR/CE
1	0.12402E+02	0.18396E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
2	0.12364E+02	0.17956E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
3	0.12329E+02	0.17531E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
4	0.12289E+02	0.17106E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
5	0.12078E+02	0.20009E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
6	0.11894E+02	0.21237E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL F  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	H/BEW	DELTA H/BEW
1	0.16644E+02	0.14752E+01
2	0.16704E+02	0.14324E+01
3	0.16752E+02	0.13902E+01
4	0.16802E+02	0.13477E+01
5	0.17566E+02	0.16961E+01
6	0.18552E+02	0.18800E+01

## OUTPUT RESULTS FOR TEST 3.02.10E

## SYSTEM PARAMETER SUMMARY

SYSTEM PRESSURE	0.61842493E+03	+OR-	0.81581032E+01	PSIA
INLET FLOW	0.20318861E+01	+OR-	0.80000000E-01	GPM
	0.87345348E+03	+OR-	0.34391828E+02	LBR/HR
OUTLET FLOW	0.13231888E+03	+OR-	0.35000000E+01	GPM
	0.86426206E+03	+OR-	0.25813610E+02	LBR/HR
BUNDLE MASS FLOW	0.12996434E+05	+OR-	0.38817458E+03	LBR/HR*FT**2
INLET TEMPERATURE	0.40751782E+03	+OR-	0.53024310E+00	DEG F
OUTLET TEMPERATURE	0.87238379E+03	+OR-	0.19273090E+01	DEG F
COLLAPSED LL	0.54988515E+01	+OR-	0.34906037E+00	FEET
TS MASS INV.	0.22083865E+02	DELTA	0.17277977E-01	LBR OVER SCA1
AWR MASS INV.	0.92739913E+02	DELTA	-0.27759231E+00	LBR OVER SCA1

## SUBCHANNEL TEMPERATURES FOR LEVEL G (DEG F)

INTERNAL SUBCHANNEL TEMP	0.94275453E+03	+OR-	0.24410285E+02
COLD ROD SUBCHANNEL TEMP	0.90154352E+03	+OR-	0.17582341E+02
CORNER SUBCHANNEL TEMP	0.76554718E+03	+OR-	0.20202235E+02
WALL SUBCHANNEL TEMP	0.87022315E+03	+OR-	0.23541087E+02

## SUBCHANNEL TEMPERATURES FOR LEVEL F (DEG F)

INTERNAL SUBCHANNEL TEMP	0.59497118E+03	+OR-	0.11481225E+02
COLD ROD SUBCHANNEL TEMP	0.58537644E+03	+OR-	0.99501485E+01
CORNER SUBCHANNEL TEMP	0.55371550E+03	+OR-	0.76839382E+01
WALL SUBCHANNEL TEMP	0.57808514E+03	+OR-	0.10012995E+02

## RADIATION FLUX SUMMARY - LEVEL G (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
1	0.3723568E+04	0.1649023E+04
3	0.4396716E+04	0.1583559E+04

## RADIATION FLUX SUMMARY - LEVEL F (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
1	0.3678139E+04	0.1191005E+04
2	0.4306320E+04	0.1208193E+04
3	0.4085832E+04	0.1138912E+04
4	0.4853358E+04	0.1179412E+04

## RADIATION FLUX SUMMARY - LEVEL G (DEG F)

HOT ROD TEMPS	0.1378555E+04	
COLD ROD TEMPS	0.1052887E+04	+OR- 0.5494658E+02

## RADIATION FLUX SUMMARY - LEVEL F (DEG F)

HOT ROD TEMPS	0.1245421E+04	
COLD ROD TEMPS	0.7672559E+03	+OR- 0.6694253E+02

## RADIATION TO COLD RODS - LEVEL G (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
3	0.9389219E+03	0.3345518E+03

## RADIATION TO COLD RODS - LEVEL F (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
2	0.6436828E+03	0.1835559E+03
3	0.8339508E+03	0.2552404E+03
4	0.1633172E+04	0.4848902E+03

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL G

ROD TYPE	STEAM TEMP. DEG F	DELTA STEAM TEMP.	TSURF/TSHE DEG F	DELTA TSURF/TSHE	SURFACE Q" BTU/HR FT2	DELTA SURFACE Q"
1	0.94275E+03	0.24410E+02	0.14146E+04	0.60136E+01	0.13609E+05	0.00000E+00
3	0.92215E+03	0.20996E+02	0.13786E+04	0.11187E+02	0.13773E+05	0.13020E+03
5	0.90649E+03	0.23976E+02	0.14113E+04	0.16676E+02	0.13990E+05	0.12253E+03
6	0.86219E+03	0.22924E+02	0.13623E+04	0.59047E+01	0.13605E+05	0.34277E+02

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL G

ROD TYPE	H EXP BTU/HR FT2 F	DELTA H EXP	FILM TEMP. DEG F	DELTA FILM TEMP.
1	0.28840E+02	0.15365E+01	0.11787E+04	0.15212E+02
3	0.30178E+02	0.15987E+01	0.11504E+04	0.16092E+02
5	0.27715E+02	0.16218E+01	0.11589E+04	0.20326E+02
6	0.27210E+02	0.12896E+01	0.11123E+04	0.14414E+02

## DIMENSIONLESS PARAMETERS FOR LEVEL G

ROD TYPE	RE BULK/SCDI	DELTA RE BULK/SCDI	RE BULK/BODI	DELTA RE BULK/BODI	PR BULK TEMP	DELTA PR BULK TEMP.
1	0.73908E+04	0.35882E+03	0.64300E+04	0.31217E+03	0.92057E+00	0.48401E-02
3	0.73402E+04	0.33899E+03	0.65330E+04	0.30171E+03	0.92514E+00	0.46500E-02
5	0.64614E+04	0.31478E+03	0.66134E+04	0.32219E+03	0.92896E+00	0.57152E-02
6	0.58476E+04	0.28367E+03	0.68517E+04	0.33238E+03	0.94171E+00	0.69980E-02

## DIMENSIONLESS PARAMETERS FOR LEVEL G

ROD TYPE	RE FILM/SCDI	DELTA RE FILM/SCDI	RE FILM/BODI	DELTA RE FILM/BODI	PR FILM TEMP	DELTA PR FILM TEMP
1	0.62580E+04	0.24891E+03	0.54444E+04	0.21655E+03	0.88935E+00	0.12250E-02
3	0.62321E+04	0.25265E+03	0.55468E+04	0.22487E+03	0.89181E+00	0.14239E-02
5	0.53888E+04	0.23320E+03	0.55156E+04	0.23849E+03	0.89105E+00	0.17350E-02
6	0.48565E+04	0.19265E+03	0.56904E+04	0.22573E+03	0.89551E+00	0.14593E-02

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL G  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRAN/W	DELTA HTRAN/W	HLAR/W	DELTA HLAR/W	HTUR/W	DELTA HTUR/W
1	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.30592E+02	0.22394E+01
3	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.30286E+02	0.20767E+01
5	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.30892E+02	0.23551E+01
6	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.30688E+02	0.22268E+01

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL G  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRAN/CE	DELTA HTRAN/CE	HLAR/CE	DELTA HLAR/CE	HTUR/CE	DELTA HTUR/CE
1	0.25584E+02	0.24135E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
3	0.25453E+02	0.22569E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
5	0.24443E+02	0.24759E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
6	0.23435E+02	0.24788E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL G  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	H/SGF	DELTA H/SGF
1	0.28802E+02	0.18715E+01
3	0.28772E+02	0.17222E+01
5	0.29465E+02	0.19306E+01
6	0.29943E+02	0.19558E+01

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL F

ROD TYPE	STEAM TEMP. DEG F	DELTA STEAM TEMP.	TSUPP/TSHE DEG F	DELTA TSUPP/TSHE	SURFACE Q" BTU/HR FT2	DELTA SURFACE Q"
1	0.59497E+03	0.11481E+02	0.12728E+04	0.19671E+01	0.14276E+05	0.64613E+02
2	0.59257E+03	0.11098E+02	0.12706E+04	0.11980E+02	0.14601E+05	0.14429E+03
3	0.59017E+03	0.10716E+02	0.12202E+04	0.23692E+02	0.14514E+05	0.13720E+03
4	0.58778E+03	0.10333E+02	0.12204E+04	0.48482E+01	0.14100E+05	0.30128E+02
5	0.58653E+03	0.10747E+02	0.12264E+04	0.12911E+02	0.14736E+05	0.16588E+03
6	0.57621E+03	0.97978E+01	0.11737E+04	0.58857E+01	0.14341E+05	0.36120E+02

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL F

ROD TYPE	H EXP BTU/HR FT2 F	DELTA H EXP	FILM TEMP. DEG F	DELTA FILM TEMP.
1	0.21061E+02	0.38926E+00	0.93390E+03	0.77242E+01
2	0.1534E+02	0.56061E+00	0.93159E+03	0.11539E+02
3	0.21036E+02	0.97531E+00	0.90520E+03	0.17204E+02
4	0.22286E+02	0.40488E+00	0.90410E+03	0.75905E+01
5	0.23029E+02	0.65527E+00	0.90647E+03	0.11779E+02
6	0.24002E+02	0.46313E+00	0.87495E+03	0.78418E+01

## DIMENSIONLESS PARAMETERS FOR LEVEL F

ROD TYPE	RE BULK/SCDI	DELTA RE BULK/SCDI	RE BULK/RODI	DELTA RE BULK/RODI	PR BULK TEMP	DELTA PR BULK TEMP.
1	0.10357E+05	0.47350E+03	0.90104E+04	0.41195E+03	0.11453E+01	0.16268E-01
2	0.10287E+05	0.46542E+03	0.90403E+04	0.40901E+03	0.11489E+01	0.16095E-01
3	0.10191E+05	0.45620E+03	0.90705E+04	0.40603E+03	0.11525E+01	0.15723E-01
4	0.10095E+05	0.44704E+03	0.91009E+04	0.40303E+03	0.11562E+01	0.15421E-01
5	0.89072E+04	0.39985E+03	0.91168E+04	0.40926E+03	0.11581E+01	0.16148E-01
6	0.78948E+04	0.34582E+03	0.92505E+04	0.40521E+03	0.11746E+01	0.15747E-01

## DIMENSIONLESS PARAMETERS FOR LEVEL F

ROD TYPE	RE FILM/SCDI	DELTA RE FILM/SCDI	RE FILM/RODI	DELTA RE FILM/RODI	PR FILM TEMP	DELTA PR FILM TEMP
1	0.74412E+04	0.26652E+03	0.64738E+04	0.23187E+03	0.92248E+00	0.16659E-02
2	0.73799E+04	0.28612E+03	0.64854E+04	0.25184E+03	0.92299E+00	0.24941E-02
3	0.74381E+04	0.32285E+03	0.66201E+04	0.28735E+03	0.92928E+00	0.42016E-02
4	0.73493E+04	0.26343E+03	0.66258E+04	0.23750E+03	0.92957E+00	0.19125E-02
5	0.64615E+04	0.25282E+03	0.66135E+04	0.25876E+03	0.92896E+00	0.28981E-02
6	0.57876E+04	0.20940E+03	0.67814E+04	0.24535E+03	0.93770E+00	0.23211E-02



HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL 2  
 (HTG/HR FT<sup>2</sup> F)

ROD TYPE	H/MSL	DELTA	H/MSL
1	0.29198E+02	0.14837E+01	0.29198E+02
2	0.29322E+02	0.14622E+01	0.29322E+02
3	0.29463E+02	0.14413E+01	0.29463E+02
4	0.29608E+02	0.14203E+01	0.29608E+02
5	0.29807E+02	0.14073E+01	0.29807E+02
6	0.31587E+02	0.14656E+01	0.31587E+02

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL 2  
 (HTG/HR FT<sup>2</sup> F)

ROD TYPE	H/MSL/CR	DELTA	H/MSL/CR	DELTA	H/MSL/CR	DELTA	H/MSL/CR
1	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.29198E+02	0.14837E+01	0.0000E+00
2	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.29322E+02	0.14622E+01	0.0000E+00
3	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.29463E+02	0.14413E+01	0.0000E+00
4	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.29608E+02	0.14203E+01	0.0000E+00
5	0.28845E+02	0.21122E+01	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
6	0.28185E+02	0.21255E+01	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL 2  
 (HTG/HR FT<sup>2</sup> F)

ROD TYPE	H/MSL/A	DELTA	H/MSL/A	DELTA	H/MSL/A	DELTA	H/MSL/A
1	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.27388E+02	0.14169E+01	0.0000E+00
2	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.27447E+02	0.14585E+01	0.0000E+00
3	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.27428E+02	0.15369E+01	0.0000E+00
4	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.27509E+02	0.13887E+01	0.0000E+00
5	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.28080E+02	0.14712E+01	0.0000E+00
6	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.28770E+02	0.13642E+01	0.0000E+00

## OUTPUT RESULTS FOR TEST 3.02.10F

## SYSTEM PARAMETER SUMMARY

SYSTEM PRESSURE	0.10178751E+04	+OR-	0.85016453E+01	PSIA
INLET FLOW	0.11250935E+01	+OR-	0.80000000E-01	GPM
	0.46142232E+03	+OR-	0.32809538E+02	LBH/HR
OUTLET FLOW	0.39616806E+02	+OR-	0.35000000E+01	GPM
	0.49414262E+03	+OR-	0.43935786E+02	LBH/HR
BUNDLE MASS FLOW	0.74307161E+04	+OR-	0.66068851E+03	LBH/HR*FT**2
INLET TEMPERATURE	0.46448218E+03	+OR-	0.61267626E-01	DEG F
OUTLET TEMPERATURE	0.76092407E+03	+OR-	0.30290556E+01	DEG F
COLLAPSED LL	0.70471944E+01	+OR-	0.37418391E+00	FEET
TS MASS INV.	0.25174994E+02	DELTA	-0.11214497E+00	LBH OVER SCAN
ANN MASS INV.	0.10348879E+03	DELTA	-0.27760761E+00	LBH OVER SCAN

## SUBCHANNEL TEMPERATURES FOR LEVEL G (DEG F)

INTERNAL SUBCHANNEL TEMP	0.10500115E+04	+OR-	0.15678640E+02
COLD BCD SUBCHANNEL TEMP	0.10425720E+04	+OR-	0.12688935E+02
CORNER SUBCHANNEL TEMP	0.66613396E+03	+OR-	0.44379981E+02
WALL SUBCHANNEL TEMP	0.85956062E+03	+OR-	0.27099476E+02

## SUBCHANNEL TEMPERATURES FOR LEVEL F (DEG F)

INTERNAL SUBCHANNEL TEMP	0.68942821E+03	+OR-	0.70271963E+01
COLD BCD SUBCHANNEL TEMP	0.68731754E+03	+OR-	0.64565171E+01
CORNER SUBCHANNEL TEMP	0.58051763E+03	+OR-	0.12657206E+02
WALL SUBCHANNEL TEMP	0.63539506E+03	+OR-	0.83995309E+01

## RADIATION FLUX SUMMARY - LEVEL G (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
1	0.2423306E+04	0.1718032E+04
3	0.3382022E+04	0.1910233E+04

## RADIATION FLUX SUMMARY - LEVEL F (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
1	0.2225653E+04	0.9477512E+03
2	0.2500954E+04	0.9506458E+03
3	0.2594237E+04	0.9562471E+03
4	0.2733214E+04	0.9449057E+03

## RADIATION FLUX SUMMARY - LEVEL G (DEG F)

HOT ROD TEMPS	0.1360815E+04	
COLD ROD TEMPS	0.1161248E+04	+OR- 0.5161988E+02

## RADIATION FLUX SUMMARY - LEVEL F (DEG F)

HOT ROD TEMPS	0.1089980E+04	
COLD ROD TEMPS	0.7988999E+03	+OR- 0.4624936E+02

## RADIATION TO COLD RODS - LEVEL G (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
3	0.6012306E+03	0.3628528E+03

## RADIATION TO COLD RODS - LEVEL F (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
2	0.3024966E+03	0.1235040E+03
3	0.4397554E+03	0.1836268E+03
4	0.7890045E+03	0.3553994E+03

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL G

ROD TYPE	STEAM TEMP. DEG F	DELTA STEAM TEMP.	TSURF/TSHE DEG F	DELTA TSURF/TSHE	SURFACE Q" BTU/HR FT2	DELTA SURFACE Q"
1	0.10500E+04	0.15679E+02	0.13303E+04	0.58912E+01	0.91254E+04	0.00000E+00
3	0.10463E+04	0.14184E+02	0.13608E+04	0.25892E+02	0.94967E+04	0.90643E+02
5	0.95479E+03	0.21389E+02	0.12568E+04	0.12447E+02	0.95759E+04	0.17517E+03
6	0.85882E+03	0.28565E+02	0.12080E+04	0.58996E+01	0.91254E+04	0.00000E+00

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL G

ROD TYPE	H EXP BTU/HR FT2 F	DELTA H EXP	FILM TEMP. DEG F	DELTA FILM TEMP.
1	0.32554E+02	0.19451E+01	0.11902E+04	0.10785E+02
3	0.30194E+02	0.37152E+01	0.12036E+04	0.25033E+02
5	0.31703E+02	0.26614E+01	0.11058E+04	0.16918E+02
6	0.26133E+02	0.21828E+01	0.10334E+04	0.17232E+02

## DIMENSIONLESS PARAMETERS FOR LEVEL G

ROD TYPE	RE BULK/SCDI	DELTA RE BULK/SCDI	RE BULK/BODI	DELTA RE BULK/BODI	PR BULK TEMP	DELTA PR BULK TEMP
1	0.38699E+04	0.38624E+03	0.33668E+04	0.33603E+03	0.91213E+00	0.28448E-02
3	0.37926E+04	0.37468E+03	0.33755E+04	0.33348E+03	0.91284E+00	0.26281E-02
5	0.35218E+04	0.36889E+03	0.36046E+04	0.37757E+03	0.93526E+00	0.62788E-02
6	0.33105E+04	0.36912E+03	0.38790E+04	0.43250E+03	0.97613E+00	0.14870E-01

## DIMENSIONLESS PARAMETERS FOR LEVEL G

ROD TYPE	RE FILM/SCDI	DELTA RE FILM/SCDI	RE FILM/BODI	DELTA RE FILM/BODI	PR FILM TEMP	DELTA PR FILM TEMP
1	0.35256E+04	0.33767E+03	0.30673E+04	0.29378E+03	0.89235E+00	0.11187E-02
3	0.34172E+04	0.35785E+03	0.30414E+04	0.31849E+03	0.89097E+00	0.28154E-02
5	0.31665E+04	0.31747E+03	0.32410E+04	0.32494E+03	0.90286E+00	0.23960E-02
6	0.29069E+04	0.29365E+03	0.34061E+04	0.34407E+03	0.91539E+00	0.33719E-02

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL G  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRAN/W	DELTA HTRAN/W	HLAN/W	DELTA HLAN/W	HTUR/W	DELTA HTUR/W
1	0.18870E+02	0.34575E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
3	0.18619E+02	0.34522E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
5	0.15924E+02	0.35541E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
6	0.13878E+02	0.36414E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL G  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRAN/CE	DELTA HTRAN/CE	HLAN/CE	DELTA HLAN/CE	HTUR/CE	DELTA HTUR/CE
1	0.12332E+02	0.20146E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
3	0.12180E+02	0.19691E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
5	0.11479E+02	0.21014E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
6	0.10876E+02	0.22584E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL G  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	H/BSW	DELTA H/BSW
1	0.19566E+02	0.18552E+01
3	0.19638E+02	0.18189E+01
5	0.19807E+02	0.20998E+01
6	0.20109E+02	0.24488E+01

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL F

ROD TYPE	STEAM TEMP. DEG F	DELTA STEAM TEMP.	TSURF/TSHE DEG F	DELTA TSURF/TSHE	SURFACE Q" BTU/HR FT2	DELTA SURFACE Q"
1	0.68943E+03	0.70272E+01	0.10972E+04	0.35347E+01	0.93549E+04	0.52704E+02
2	0.68890E+03	0.68845E+01	0.10932E+04	0.72515E+01	0.98264E+04	0.90914E+02
3	0.66837E+03	0.67419E+01	0.10868E+04	0.13513E+02	0.97904E+04	0.93446E+02
4	0.66785E+03	0.65992E+01	0.10563E+04	0.47594E+01	0.93549E+04	0.54692E+02
5	0.66241E+03	0.77134E+01	0.10484E+04	0.66748E+01	0.98976E+04	0.13793E+03
6	0.63518E+03	0.91209E+01	0.10150E+04	0.58934E+01	0.93857E+04	0.00000E+00

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL F

ROD TYPE	H EXP BTU/HR FT2 F	DELTA H EXP	FILM TEMP. DEG F	DELTA FILM TEMP.
1	0.22943E+02	0.46108E+00	0.89331E+03	0.52809E+01
2	0.24306E+02	0.64187E+00	0.89104E+03	0.70680E+01
3	0.24574E+02	0.96049E+00	0.88758E+03	0.10127E+02
4	0.25390E+02	0.57999E+00	0.87207E+03	0.56793E+01
5	0.25442E+02	0.76607E+00	0.85541E+03	0.71941E+01
6	0.24714E+02	0.70668E+00	0.82507E+03	0.75071E+01

## DIMENSIONLESS PARAMETERS FOR LEVEL F

ROD TYPE	RE BULK/SCDI	DELTA RE BULK/SCDI	RE BULK/BODI	DELTA RE BULK/BODI	PR BULK TEMP	DELTA PR BULK TEMP
1	0.51427E+04	0.49761E+03	0.44741E+04	0.43292E+03	0.11586E+01	0.10881E-01
2	0.50944E+04	0.49250E+03	0.44769E+04	0.43280E+03	0.11594E+01	0.10631E-01
3	0.50332E+04	0.48612E+03	0.44797E+04	0.43266E+03	0.11602E+01	0.10385E-01
4	0.49720E+04	0.47973E+03	0.44825E+04	0.43250E+03	0.11610E+01	0.10140E-01
5	0.45344E+04	0.45972E+03	0.46411E+04	0.47054E+03	0.11991E+01	0.10327E-01
6	0.41367E+04	0.42826E+03	0.48471E+04	0.50179E+03	0.12436E+01	0.16393E-01

## DIMENSIONLESS PARAMETERS FOR LEVEL F

ROD TYPE	RE FILM/SCDI	DELTA RE FILM/SCDI	RE FILM/BODI	DELTA RE FILM/BODI	PR FILM TEMP	DELTA PR FILM TEMP
1	0.43402E+04	0.40358E+03	0.37760E+04	0.35111E+03	0.95851E+00	0.23657E-02
2	0.43043E+04	0.40621E+03	0.37826E+04	0.35698E+03	0.95955E+00	0.31945E-02
3	0.42613E+04	0.41231E+03	0.37927E+04	0.36697E+03	0.96117E+00	0.46348E-02
4	0.42579E+04	0.39751E+03	0.38387E+04	0.35838E+03	0.96888E+00	0.29167E-02
5	0.38000E+04	0.35951E+03	0.38894E+04	0.36797E+03	0.97810E+00	0.41053E-02
6	0.34009E+04	0.32303E+03	0.39849E+04	0.37850E+03	0.99778E+00	0.52524E-02

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL F  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRAM/W	DELTA HTRAM/W	HLAM/W	DELTA HLAM/W	HTOR/W	DELTA HTOR/W
1	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.21086E+02	0.18099E+01
2	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.21113E+02	0.18330E+01
3	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.21143E+02	0.18752E+01
4	0.20114E+02	0.29883E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
5	0.18817E+02	0.31678E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
6	0.17442E+02	0.33143E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL F  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRAM/CE	DELTA HTRAM/CE	HLAM/CE	DELTA HLAM/CE	HTOR/CE	DELTA HTOR/CE
1	0.14131E+02	0.20947E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
2	0.14090E+02	0.20881E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
3	0.14013E+02	0.20804E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
4	0.13959E+02	0.20727E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
5	0.13720E+02	0.21888E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
6	0.13609E+02	0.22814E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL F  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	H/BSW	DELTA H/BSW
1	0.19813E+02	0.16918E+01
2	0.19862E+02	0.16907E+01
3	0.19922E+02	0.16904E+01
4	0.19983E+02	0.16902E+01
5	0.21083E+02	0.18523E+01
6	0.22592E+02	0.20256E+01

## OUTPUT RESULTS FOR TEST 3.02.100

## SYSTEM PARAMETER SUMMARY

SYSTEM PRESSURE	0.10089921E+04	+OR-	0.82287269E+01	PSIA
INLET FLOW	0.18746128E+01	+OR-	0.80000000E-01	GPM
	0.76754489E+03	+OR-	0.32756109E+02	LBM/HR
OUTLET FLOW	0.69217758E+02	+OR-	0.35000000E+01	GPM
	0.75085228E+03	+OR-	0.38599797E+02	LBM/HR
BUNDLE MASS FLOW	0.11291012E+05	+OR-	0.58088807E+03	LBM/HR**2
INLET TEMPERATURE	0.46609204E+03	+OR-	0.29963517E+00	DEG F
OUTLET TEMPERATURE	0.88312876E+03	+OR-	0.32344894E+01	DEG F
COLLAPSED LL	0.61730891E+01	+OR-	0.37364065E+00	FEET
TS MASS INV.	0.22394137E+02	DELTA	0.80447976E-01	LBM OVER SCAN
ANN MASS INV.	0.99549365E+02	DELTA	-0.81656165E-01	LBM OVE. SCAN

## SUBCHANNEL TEMPERATURES FOR LEVEL G (DEG F)

INTERNAL SUBCHANNEL TEMP	0.10469948E+04	+CR-	0.15467229E+02
COLD ROD SUBCHANNEL TEMP	0.10286394E+04	+CR-	0.12358889E+02
CORNER SUBCHANNEL TEMP	0.79678143E+03	+CR-	0.17635913E+02
WALL SUBCHANNEL TEMP	0.92140510E+03	+CR-	0.18665748E+02

## SUBCHANNEL TEMPERATURES FOR LEVEL F (DEG F)

INTERNAL SUBCHANNEL TEMP	0.75095651E+03	+CR-	0.87159007E+01
COLD ROD SUBCHANNEL TEMP	0.74343871E+03	+CR-	0.76734766E+01
CORNER SUBCHANNEL TEMP	0.64847705E+03	+CR-	0.78209268E+01
WALL SUBCHANNEL TEMP	0.69951894E+03	+CR-	0.88643327E+01



## RADIATION FLUX SUMMARY - LEVEL G (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
1	0.3657979E+04	0.1997876E+04
3	0.4234321E+04	0.1991775E+04

## RADIATION FLUX SUMMARY - LEVEL F (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
1	0.3261117E+04	0.1324447E+04
2	0.3613917E+04	0.1278015E+04
3	0.3422761E+04	0.1208772E+04
4	0.3938799E+04	0.1243381E+04

## RADIATION FLUX SUMMARY - LEVEL G (DEG F)

HOT ROD TEMPS	0.1412280E+04	
COLD ROD TEMPS	0.1155145E+04	+OR- 0.5117240E+02

## RADIATION FLUX SUMMARY - LEVEL F (DEG F)

HOT ROD TEMPS	0.1216446E+04	
COLD ROD TEMPS	0.8689958E+03	+OR- 0.5001570E+02

## RADIATION TO COLD RODS - LEVEL G (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
3	0.8097364E+03	0.3843654E+03

## RADIATION TO COLD RODS - LEVEL F (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
2	0.4888459E+03	0.1741755E+03
3	0.6252131E+03	0.2386700E+03
4	0.1265254E+04	0.4949921E+03

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL G

ROD TYPE	STEAM TEMP. DEG C	DELTA STEAM TEMP.	TSUBF/TSHE DEG F	DELTA TSUBF/TSHE	SURFACE Q" BTU/HR FT2	DELTA SURFACE Q"
1	0.10470E+04	0.15467E+02	0.14368E+04	0.62792E+01	0.12578E+05	0.29047E+02
3	0.10378E+04	0.13913E+02	0.14123E+04	0.22813E+02	0.12539E+05	0.15897E+03
5	0.98420E+03	0.17066E+02	0.13831E+04	0.15638E+02	0.12686E+05	0.89775E+02
6	0.92165E+03	0.17609E+02	0.13287E+04	0.61059E+01	0.12607E+05	0.64305E+02

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL G

ROD TYPE	H EXP BTU/HR FT2 F	DELTA H EXP	FILM TEMP. DEG F	DELTA FILM TEMP.
1	0.32267E+02	0.13838E+01	0.12419E+04	0.10873E+02
3	0.33486E+02	0.24269E+01	0.12250E+04	0.18363E+02
5	0.31805E+02	0.18594E+01	0.11836E+04	0.16352E+02
6	0.30970E+02	0.14267E+01	0.11252E+04	0.11857E+02

## DIMENSIONLESS PARAMETERS FOR LEVEL G

ROD TYPE	RE BULK/SCDI	DELTA RE BULK/SCDI	RE BULK/BODI	DELTA RE BULK/BODI	PR BULK TEMP	DELTA PR BULK TEMP.
1	0.58939E+04	0.36649E+03	0.51277E+04	0.31885E+03	0.91248E+00	0.28266E-02
3	0.57983E+04	0.35461E+03	0.51606E+04	0.31561E+03	0.91426E+00	0.26656E-02
5	0.52385E+04	0.33421E+03	0.53617E+04	0.34207E+03	0.92647E+00	0.42652E-02
6	0.47931E+04	0.31033E+03	0.56162E+04	0.36362E+03	0.94617E+00	0.62979E-02

## DIMENSIONLESS PARAMETERS FOR LEVEL G

ROD TYPE	RE FILM/SCDI	DELTA RE FILM/SCDI	RE FILM/BODI	DELTA RE FILM/BODI	PR FILM TEMP	DELTA PR FILM TEMP
1	0.51872E+04	0.30147E+03	0.45129E+04	0.26228E+03	0.88729E+00	0.93602E-03
3	0.51238E+04	0.32206E+03	0.45603E+04	0.28664E+03	0.88881E+00	0.16538E-02
5	0.45734E+04	0.28291E+03	0.46810E+04	0.28957E+03	0.89296E+00	0.17094E-02
6	0.41899E+04	0.24598E+03	0.48625E+04	0.28817E+03	0.89999E+00	0.15581E-02

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL G  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRM/W	DELTA HTRM/W	HLAM/W	DELTA HLAM/W	HTUR/W	DELTA HTUR/W
1	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.30638E+02	0.21889E+01
3	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.30530E+02	0.22069E+01
5	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.30382E+02	0.23323E+01
6	0.29411E+02	0.34952E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL G  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRM/CE	DELTA HTRM/CE	HLAM/CE	DELTA HLAM/CE	HTUR/CE	DELTA HTUR/CE
1	0.21468E+02	0.22475E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
3	0.21312E+02	0.21865E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
5	0.20261E+02	0.23120E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
6	0.19276E+02	0.23303E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL G  
(BTU/HR FT<sup>2</sup> F)

ROD TYPE	H/SEW	DELTA H/SEW
1	0.27307E+02	0.17629E+01
3	0.27372E+02	0.17069E+01
5	0.27818E+02	0.19001E+01
6	0.28257E+02	0.19976E+01

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL F

ROD TYPE	STEAM TEMP. DEG F	DELTA STEAM TEMP.	TSURF/TSHE DEG F	DELTA TSURF/TSHE	SURFACE Q" BTU/HR FT2	DELTA SURFACE Q"
1	0.75096E+03	0.87159E+01	0.12608E+04	0.58046E+01	0.12707E+05	0.82751E+02
2	0.74908E+03	0.84553E+01	0.12351E+04	0.97276E+01	0.12742E+05	0.12815E+03
3	0.74720E+03	0.81947E+01	0.11978E+04	0.13074E+02	0.12743E+05	0.16155E+03
4	0.74532E+03	0.79341E+01	0.11823E+04	0.51901E+01	0.12515E+05	0.96559E+02
5	0.72524E+03	0.87901E+01	0.11725E+04	0.12000E+02	0.12881E+05	0.14709E+03
6	0.69962E+03	0.85664E+01	0.11269E+04	0.61269E+01	0.12812E+05	0.65348E+02

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL F

ROD TYPE	H EXP BTU/HR FT2 F	DELTA H EXP	FILM TEMP. DEG F	DELTA FILM TEMP.
1	0.24924E+02	0.52695E+00	0.10059E+04	0.70603E+01
2	0.26220E+02	0.74370E+00	0.99207E+03	0.90914E+01
3	0.28277E+02	0.10325E+01	0.97252E+03	0.10635E+02
4	0.28636E+02	0.65938E+00	0.96383E+03	0.65621E+01
5	0.28800E+02	0.10128E+01	0.94886E+03	0.10395E+02
6	0.29989E+02	0.75490E+00	0.91323E+03	0.73466E+01

## DIMENSIONLESS PARAMETERS FOR LEVEL F

ROD TYPE	RE BULK/SCDI	DELTA RE BULK/SCDI	RE BULK/BODI	DELTA RE BULK/BODI	PR BULK TEMP	DELTA PR BULK TEMP.
1	0.74035E+04	0.43549E+03	0.64410E+04	0.37887E+03	0.10655E+01	0.10046E-01
2	0.73412E+04	0.43026E+03	0.64513E+04	0.37811E+03	0.10677E+01	0.9880E-02
3	0.72601E+04	0.42396E+03	0.64616E+04	0.37733E+03	0.10700E+01	0.97156E-02
4	0.71787E+04	0.41767E+03	0.64720E+04	0.37655E+03	0.10723E+01	0.95405E-02
5	0.64332E+04	0.37962E+03	0.65845E+04	0.38855E+03	0.10990E+01	0.12145E-01
6	0.57410E+04	0.33915E+03	0.67268E+04	0.39738E+03	0.11401E+01	0.14080E-01

## DIMENSIONLESS PARAMETERS FOR LEVEL F

ROD TYPE	RE FILM/SCDI	DELTA RE FILM/SCDI	RE FILM/BODI	DELTA RE FILM/BODI	PR FILM TEMP	DELTA PR FILM TEMP
1	0.60674E+04	0.34256E+03	0.52786E+04	0.29803E+03	0.92112E+00	0.16143E-02
2	0.60666E+04	0.35170E+03	0.53313E+04	0.30907E+03	0.92446E+00	0.22244E-02
3	0.60757E+04	0.35961E+03	0.54076E+04	0.32006E+03	0.92963E+00	0.28834E-02
4	0.60364E+04	0.33946E+03	0.54421E+04	0.30604E+03	0.93211E+00	0.18898E-02
5	0.53762E+04	0.31792E+03	0.55027E+04	0.32540E+03	0.93670E+00	0.32282E-02
6	0.48238E+04	0.27497E+03	0.56521E+04	0.32219E+03	0.94942E+00	0.28545E-02

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL F  
 (BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRAM/W	DELTA HTRAM/W	HLAM/W	DELTA HLAM/W	HTOR/W	DELTA HTOR/W
1	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.27298E+02	0.16220E+01
2	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.27277E+02	0.16633E+01
3	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.27258E+02	0.16584E+01
4	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.27266E+02	0.15767E+01
5	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.27812E+02	0.17063E+01
6	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.28449E+02	0.16671E+01

 HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL F  
 (BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRAM/CE	DELTA HTRAM/CE	HLAM/CE	DELTA HLAM/CE	HTOR/CE	DELTA HTOR/CE
1	0.23204E+02	0.21429E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
2	0.23166E+02	0.21311E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
3	0.23111E+02	0.21190E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
4	0.23047E+02	0.21077E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
5	0.22342E+02	0.21818E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
6	0.21634E+02	0.21943E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

 HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL F  
 (BTU/HR FT<sup>2</sup> F)

ROD TYPE	S/BSW	DELTA H/BSW
1	0.26746E+02	0.15512E+01
2	0.26816E+02	0.15422E+01
3	0.26901E+02	0.15339E+01
4	0.26988E+02	0.15255E+01
5	0.27907E+02	0.16269E+01
6	0.29075E+02	0.16833E+01

## OUTPUT RESULTS FOR TEST 3.02.10H

## SYSTEM PARAMETER SUMMARY

SYSTEM PRESSURE	0.38746119E+03	+OR-	0.78240378E+01	PSIA
INLET FLOW	0.17336559E+01	+OR-	0.80000000E-01	GPM
	0.76282204E+03	+OR-	0.35202684E+02	LBM/HR
OUTLET FLOW	0.19230611E+03	+OR-	0.35000000E+01	GPM
	0.81333987E+03	+OR-	0.22645538E+02	LBM/HR
BUNDLE MASS FLOW	0.12230675E+05	+OR-	0.34053441E+03	LBM/HR*FT**2
INLET TEMPERATURE	0.37467847E+03	+OR-	0.69960713E+00	DEG F
OUTLET TEMPERATURE	0.81500513E+03	+OR-	0.35626554E+01	DEG F
COLLAPSED LL	0.42702236E+01	+OR-	0.33320972E+00	FEET
TS MASS INV.	0.19257062E+02	DELTA	-0.18387165E+00	LBM OVER SCAN
AWW MASS INV.	0.29598897E+01	DELTA	-0.55523362E+00	LBM OVER SCAN

## SUBCHANNEL TEMPERATURES FOR LEVEL G (DEG F)

INTERNAL SUBCHANNEL TEMP	0.10164313E+04	+OR-	0.60244169E+02
COLD ROD SUBCHANNEL TEMP	0.94012223E+03	+OR-	0.39117773E+02
CORNER SUBCHANNEL TEMP	0.69573369E+03	+OR-	0.45067426E+02
WALL SUBCHANNEL TEMP	0.83737929E+03	+OR-	0.51993124E+02

## SUBCHANNEL TEMPERATURES FOR LEVEL F (DEG F)

INTERNAL SUBCHANNEL TEMP	0.64666257E+03	+OR-	0.28305180E+02
COLD ROD SUBCHANNEL TEMP	0.61942082E+03	+OR-	0.17071919E+02
CORNER SUBCHANNEL TEMP	0.53217597E+03	+OR-	0.16850229E+02
WALL SUBCHANNEL TEMP	0.58274237E+03	+OR-	0.20132390E+02

## RADIATION FLOW SUMMARY - LEVEL G (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
1	0.303139E+04	0.1559909E+04
3	0.3776602E+04	0.1471219E+04

## RADIATION FLOW SUMMARY - LEVEL F (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
1	0.2617821E+04	0.9328095E+03
2	0.3295957E+04	0.9635691E+03
3	0.2804765E+04	0.9518884E+03
4	0.4184501E+04	0.9922375E+03

## RADIATION FLOW SUMMARY - LEVEL G (DEG F)

HOT ROD TEMPS	0.1404311E+04	
COLD ROD TEMPS	0.1108640E+04	+OR- 0.6C52704E+02

## RADIATION FLOW SUMMARY - LEVEL F (DEG F)

HOT ROD TEMPS	0.1188837E+04	
COLD ROD TEMPS	0.7847247E+03	+OR- 0.6C20894E+02

## RADIATION TO COLD RODS - LEVEL G (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
3	0.9090876E+03	0.3105615E+03

## RADIATION TO COLD RODS - LEVEL F (BTU/HR FT\*\*2)

ROD TYPE	RADIATION HEAT FLUX	+OR-
2	0.6166058E+03	0.1577398E+03
3	0.6233835E+03	0.2168438E+03
4	0.1744303E+04	0.4869551E+03

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL G

ROD TYPE	STEAM TEMP. DEG F	DELTA STEAM TEMP.	TSURF/TSHE DEG F	DELTA TSURF/TSHE	SURFACE Q" BTU/HR FT2	DELTA SURFACE Q"
1	0.10164E+04	0.60244E+02	0.14432E+04	0.84813E+01	0.12991E+05	0.00000E+00
3	0.97828E+03	0.49681E+02	0.14043E+04	0.10053E+02	0.13342E+05	0.13713E+03
5	0.92691E+03	0.56119E+02	0.14157E+04	0.97695E+01	0.13431E+05	0.22977E+03
6	0.84673E+03	0.52324E+02	0.13482E+04	0.71088E+01	0.13078E+05	0.48331E+02

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL G

ROD TYPE	H EXP BTU/HR FT2 F	DELTA H EXP	FILM TEMP. DEG F	DELTA FILM TEMP.
1	0.30445E+02	0.43405E+01	0.12298E+04	0.34363E+02
3	0.31317E+02	0.37398E+01	0.11913E+04	0.29867E+02
5	0.27478E+02	0.32367E+01	0.11713E+04	0.32944E+02
6	0.26079E+02	0.27476E+01	0.10975E+04	0.29717E+02

## DIMENSIONLESS PARAMETERS FOR LEVEL G

ROD TYPE	RE BULK/SCDI	DELTA RE BULK/SCDI	RE BULK/RODI	DELTA RE BULK/RODI	PR BULK TEMP	DELTA PR BULK TEMP.
1	0.66185E+04	0.47698E+03	0.57581E+04	0.44497E+03	0.90150E+00	0.63054E-02
3	0.66559E+04	0.43491E+03	0.59239E+04	0.38708E+03	0.90625E+00	0.60573E-02
5	0.60211E+04	0.43278E+03	0.61627E+04	0.44296E+03	0.91385E+00	0.82289E-02
6	0.56122E+04	0.40178E+03	0.65759E+04	0.47077E+03	0.92570E+00	0.10996E-01

## DIMENSIONLESS PARAMETERS FOR LEVEL G

ROD TYPE	RE FILM/SCDI	DELTA RE FILM/SCDI	RE FILM/RODI	DELTA RE FILM/RODI	PR FILM TEMP	DELTA PR FILM TEMP.
1	0.57216E+04	0.28432E+03	0.49778E+04	0.24736E+03	0.88382E+00	0.18529E-02
3	0.57332E+04	0.27120E+03	0.51027E+04	0.24138E+03	0.88617E+00	0.18482E-02
5	0.50512E+04	0.25048E+03	0.51701E+04	0.25638E+03	0.88751E+00	0.21666E-02
6	0.46383E+04	0.22471E+03	0.54347E+04	0.26330E+03	0.89330E+00	0.24956E-02



HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL G  
 (BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRAM/W	DELTA HTRAM/W	HLAM/W	DELTA HLAM/W	HTOR/W	DELTA HTOR/W
1	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.29957E+02	0.41573E+01
3	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.29360E+02	0.35744E+01
5	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.29247E+02	0.40459E+01
6	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.28429E+02	0.38736E+01

 HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL G  
 (BTU/HR FT<sup>2</sup> F)

ROD TYPE	HTRAM/CE	DELTA HTRAM/CE	HLAM/CE	DELTA HLAM/CE	HTOR/CE	DELTA HTOR/CE
1	0.23081E+02	0.37310E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
3	0.22904E+02	0.33036E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
5	0.21813E+02	0.36469E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
6	0.20776E+02	0.35552E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

 HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL G  
 (BTU/HR FT<sup>2</sup> F)

ROD TYPE	H/BSW	DELTA H/BSW
1	0.27523E+02	0.32730E+01
3	0.27308E+02	0.28513E+01
5	0.27617E+02	0.32882E+01
6	0.27663E+02	0.32914E+01

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL F

ROD TYPE	STEAM TEMP. DEG F	DELTA S <sup>2</sup> MAN TEMP.	TSORF/TSHE DEG F	DELTA TSORF/TSHE	SURFACE Q <sup>m</sup> BTU/HR FT <sup>2</sup>	DELTA SURFACE Q <sup>m</sup>
1	0.64666E+03	0.24305E+02	0.12221E+04	0.10045E+02	0.13260E+05	0.72131E+01
2	0.63985E+03	0.22497E+02	0.12287E+04	0.14118E+02	0.13677E+05	0.14931E+03
3	0.63304E+03	0.20689E+02	0.11490E+04	0.50504E+02	0.13469E+05	0.28384E+03
4	0.62623E+03	0.18880E+02	0.11887E+04	0.54656E+01	0.12980E+05	0.78268E+02
5	0.61470E+03	0.22219E+02	0.12084E+04	0.86207E+01	0.13734E+05	0.20302E+03
6	0.58608E+03	0.20355E+02	0.11587E+04	0.70106E+01	0.13348E+05	0.49128E+02

## RESULTS OF HEAT TRANSFER COMPUTATIONS FOR LEVEL F

ROD TYPE	H EXP BTU/HR FT <sup>2</sup> F	DELTA H EXP	FILM TEMP. DEG F	DELTA FILM TEMP.
1	0.23041E+02	0.10531E+01	0.93439E+03	0.17175E+02
2	0.23229E+02	0.10781E+01	0.93425E+03	0.18307E+02
3	0.26104E+02	0.28154E+01	0.89103E+03	0.35596E+02
4	0.23078E+02	0.81844E+00	0.90745E+03	0.12173E+02
5	0.23132E+02	0.98954E+00	0.91155E+03	0.15420E+02
6	0.23111E+02	0.88065E+00	0.87239E+03	0.13683E+02

## DIMENSIONLESS PARAMETERS FOR LEVEL F

ROD TYPE	RE BULK/SCDI	DELTA RE BULK/SCDI	RE BULK/BODI	DELTA RE BULK/BODI	PR BULK TEMP	DELTA PR BULK TEMP.
1	0.91413E+04	0.52614E+03	0.79530E+04	0.45774E+03	0.10126E+01	0.12662E-01
2	0.91243E+04	0.50417E+03	0.80183E+04	0.44306E+03	0.10168E+01	0.12786E-01
3	0.90833E+04	0.48174E+03	0.80844E+04	0.42876E+03	0.10177E+01	0.12722E-01
4	0.90414E+04	0.45993E+03	0.81513E+04	0.41466E+03	0.10260E+01	0.12481E-01
5	0.80766E+04	0.44560E+03	0.82666E+04	0.41388E+03	0.10347E+01	0.16000E-01
6	0.73113E+04	0.39234E+03	0.85667E+04	0.45971E+03	0.10598E+01	0.18392E-01

## DIMENSIONLESS PARAMETERS FOR LEVEL F

ROD TYPE	RE FILM/SCDI	DELTA RE FILM/SCDI	RE FILM/BODI	DELTA RE FILM/BODI	PR FILM TEMP	DELTA PR FILM TEMP
1	0.70422E+04	0.29041E+03	0.61267E+04	0.25266E+03	0.91264E+00	0.26359E-02
2	0.69726E+04	0.29371E+03	0.61274E+04	0.25811E+03	0.91266E+00	0.28048E-02
3	0.71246E+04	0.40297E+03	0.63411E+04	0.35866E+03	0.92022E+00	0.63247E-02
4	0.69416E+04	0.26056E+03	0.62582E+04	0.23491E+03	0.91718E+00	0.21157E-02
5	0.60944E+04	0.24428E+03	0.62378E+04	0.25003E+03	0.91645E+00	0.26144E-02
6	0.54944E+04	0.21452E+03	0.64379E+04	0.25136E+03	0.92396E+00	0.27797E-02

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL F  
(STD/HR FT2 F)

ROD TYPE	HTRAN/W	DELTA HTRAN/W	HLAN/W	DELTA HLAN/W	HTUR/W	DELTA HTUR/W
1	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.24478E+02	0.21652E+01
2	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.24480E+02	0.20792E+01
3	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.24333E+02	0.22567E+01
4	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.24398E+02	0.17784E+01
5	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.24843E+02	0.20542E+01
6	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.25150E+02	0.19511E+01

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL F  
(STD/HR FT2 F)

ROD TYPE	HTRAN/CE	DELTA HTRAN/CE	HLAN/CE	DELTA HLAN/CE	HTUR/CE	DELTA HTUR/CE
1	0.24071E+02	0.25921E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
2	0.24102E+02	0.24795E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
3	0.24129E+02	0.23626E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
4	0.24143E+02	0.22527E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
5	0.23414E+02	0.25398E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
6	0.22861E+02	0.24835E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

HEAT TRANSFER CORRELATION CALCULATION FOR LEVEL F  
(STD/HR FT2 F)

ROD TYPE	H/BSW	DELTA H/BSW
1	0.25060E+02	0.19906E+01
2	0.25121E+02	0.18951E+01
3	0.25198E+02	0.17998E+01
4	0.25280E+02	0.17035E+01
5	0.25970E+02	0.19713E+01
6	0.26852E+02	0.19494E+01

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