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RECALCULATION OF SIMULATED POST-SCRAM CORE POWER DECAY CURVE FOR USE IN ROSA IV/LSTF EXPERIMENTS ON PWR SMALL-BREAK LOCAs AND TRANSIENTS

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Recalculation of Simulated Post-Scram Core Power Decay Curve for Use in ROSA-IV/LSTF Experiments on PWR Small-Break LOCAs and Transients

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Simulated post-scram core power decay curve for use in Large Scale Test Facility (LSTF) tests has been calculated on a best-estimate basis, particularly in two points, i.e. estimation of the delayed neutron fission power and consideration of the stored heat in a pressurized water reactor (PWR) fuel rod. The New Power Curve provides a LSTF heater rod with the heat transfer rate from a PWR fuel rod that was estimated for a typical pressure transient during a PWR small-break loss of coolant accident. This approach neglects conservatively the effect of stored heat release from the LSTF heater rod considering that there is large uncertainty in the thermal conductivity of outer insulator in the LSTF heater rod. When the New Power Curve is used as the LSTF core power curve, the heat transfer rate from a LSTF heater rod gives a little conservative values as compared with the heat transfer rate from a PWR fuel rod.

Keywords: PWR, LOCA, ROSA-IV, LSTF, Core Power Curve, Fuel Rod, Heater Rod, Stored Heat, Decay Power, Fission Power

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PWR小破断LOCA及び過渡変化に関するROSA－Ⅳ/LSTF実験のためのスクラム後模擬炉心出力減衰曲線

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大型非定常試験装置（LSTF）実験のためのスクラム後模擬炉心出力減衰曲線を，特に遅発中性子による核分裂出力の評価及び加圧水型原子炉（PWR）燃料棒の蓄積熱の考慮という2点において，最適評価ベースで計算した。新出力曲線により，PWR小破断冷却材喪失事故時の典型的な圧力変化に対するPWR燃料棒からの熱伝達量を，LSTFヒーターロッドにより模擬できる。本手法では，LSTFヒーターロッド中の外側絶縁材の熱伝導率の値に不確かさがあるため，LSTFヒーターロッドの蓄積熱は無視し保守的に評価している。新出力曲線をLSTF炉心出力曲線として用いた場合，LSTFヒーターロッドよりの熱伝達量は，PWR燃料棒よりの熱伝達量と比較して，少し保守的な値を与える。

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1. Introduction

The Rig-of-Safety Assessment No. 4 (ROSA-IV) Program(1) was launched in 1980 immediately following the Three Mile Island Unit 2 (TMI-2) accident, and comprises three major tasks: (1) conducting integral simulations of small-break loss-of-coolant accidents (SBLOCAs) and transients for a pressurized water reactor (PWR) using the Large Scale Test Facility (LSTF), (2) conducting separate effects tests using the Two-Phase Flow Test Facility (TPTF), and (3) developing and verifying an advanced thermal-hydraulics code for analyses of SBLOCAs and transients. The LSTF is a volumetrically scaled (1/48) Westinghouse-type PWR simulator with an electrically heated core(2). The elevation of each component in the LSTF simulates that of the actual PWR as close as possible for better simulation of the natural circulation behavior during a SBLOCA or transient.

In LSTF tests, as the core electric power curve, the JAERI Power Curve had been used until Run SB-HL-03 conducted on October 21, 1987, except for three acceptance tests (Runs AT-SB-01, 02 and 03) and a Semi-scale counterpart test (Run SB-CL-06). The JAERI Power Curve, however, was estimated conservatively in calculating the delayed neutron fission power. The New Power Curve, therefore, was calculated on best-estimate base, particularly in the above point. The difference in stored heat between a nuclear fuel rod and a LSTF electrical heater rod was also taken into account in determining the New Power Curve. This report describes the calculation method and procedure of the New Power Curve and presents a final result obtained as the New Power Curve.

LSTF 5% and 10% cold-leg break LOCA tests, Run SB-CL-13 and Run SB-CL-14, resprectively were performed by using the New Power Curve to investigate the effect of core power curve on thermal-hydraulic behavior in the primary system. The test conditions for Run SB-CL-13 and Run SB-CL-14 were the same as for Run SB-CL-08 and Run SB-CL-09, respectively, except for the core power curve: the JAERI Power Curve were used in Run SB-CL-08 and Run SB-CL-09. Test results of Run SB-CL-13 and Run SB-CL-14, and comparison with those of Run SB-CL-08 and Run SB-CL-09, respectively, are presented in References (3) and (4), respectively.

2. New Power Curve Calculation

As mentioned in the introduction, the JAERI Power Curve had been used in LSTF tests until Run SB-HL-03. The JAERI Power Curve, however, was estimated conservatively in calculating the delayed neutron fission power. The New Power Curve, therefore, was calculated on best-estimate base, particularly in calculation of the delayed neutron fission power. The difference in stored heat between a nuclear fuel rod and a LSTF electrical heater rod was also taken into account in the New Power Curve calculation.

2.1 Calculation Model and Method

(1) LSTF Calculation

The heat transfer from a LSTF electrical heater rod to core fluid was calculated with the RELAP5 / MOD2 code[5] by using a simple calculation model. Figure 2.1 shows the model used in the LSTF core heat transfer calculation.

The core was modeled with the "single volume" (SV ①), simulating two subchannels in the LSTF core and having a length equal to 1/8 of the heated region of the LSTF core. Two heater rods, one average power rod with a total peaking factor of 1.0 and one peak power rod with a total peaking factor of 2.26 were modeled with the "heat structure" and were attached to the core volume. Figure 2.2 shows details of the LSTF heater rod. The core insulator (Al_2O_3), heating element (Nichrome), outer insulator (packed MgO) and cladding (Inconel 600) were devided into 3, 1, 1 and 3 mesh intervals, respectively. There is uncertainty in the thermal conductivity of the packed MgO. Table 2.1 presents thermal conductivities of the packed MgO from two data sources: values measured by a manufacturer at low temperatures (Case A) and a value used for design of the LSTF heater rod by a manufacturer (Case B). There is a significant difference in the thermal conductivity of the packed MgO between these two data, Case A and Case B. Therefore, these two data (two cases) were tested in calculating the heat transfer from a LSTF heater rod to core fluid (Refer to Section 2.4). The lengths of the modeled heater rods were 1/8 of the heated length of the LSTF heater rod, as was the case for the core volume.

The core inlet condition was modeled with two combinations of the "time dependent volume" and "time dependent junction" (TV③ and TJ12, and TV④ and TJ13), and the "branch" (B②) and the "junction of branch" (J). As a system pressure transient, two data of lower plenum pressure transient obtained in LSTF 5% and 0.5% break LOCA tests were tested in the heat transfer calculations (Refer to Section 2.4), and these data were given in TV③ or TV④. The pressure curves obtained from LSTF 5% (Run SB-CL-08) and 0.5% (Run SB-CL-11) break tests and used in the heat transfer calculations are presented in Fig. 2.3 and Table 2.2, and Fig. 2.4 and Table 2.3, respectively. Until the pressure decreases from 15.5 MPa (a pressure under normal operating condition) to 12.5 MPa, subcooled liquid is injected from the combination of TV③ and TJ12 to the core (SV①) through the branch B②. The temperature of subcooled fluid is changed linearly from 565 K to 593 K during pressure decrease from 15.5 MPa to 12.5 MPa. After the pressure decreases below 12.5 MPa, two-phase mixture (nearly saturated liquid) with a quality of 1×10^{-10} is injected from the combination of TV④ and TJ13 to the core (SV①) in order to keep nucleate boiling condition in the core. The flow rate to the core (the core inlet flow rate) is kept at a constant value of 0.5917 kg/s, corresponding to the total flow rate for two subchannels under normal operating condition, throughout whole pressure transient. The switching from subcooled liquid flow to two-phase flow at the core inlet is done in order to prevent occurrence of DNB (departure from nucleate boiling) in the core at high pressures above 15.3 MPa corresponding to high core powers near to the power under normal operating condition.

The core outlet condition was modeled with the "single junction" (SJ14) and the "time dependent volume" (TV⑤). The pressure in TV⑤ is adjusted at a lower pressure than in TV③ or TV④ by 0.1 MPa at each time during a transient and the quality in TV⑤ is kept at 1.0 throughout a transient.

An example of the input data for LSTF heat transfer calculation (Case POLS01; Refer to Section 2.4) is presented in Appendix C.

(2) PWR Calculation

The heat transfer from a nuclear fuel rod to core fluid was also calculated with the RELAP5/MOD2 code by using the same model used for the LSTF heat transfer calculation, i.e. Fig. 2.1, except for heat structures. Two nuclear fuel rods, one average power rod with a total peaking factor of 1.0 and one peak power rod with a total peaking factor of 2.32 were modeled with the "heat structure". The fuel (UO_2), gap (He gas) and cladding (Zirconium) were devided into 5, 1 and 2 mesh intervals, respectively.

The input data for PWR heat transfer calculation (Case POPW01; Refer to Section 2.3) is presented in Appendix B.

2.2 PWR Core Power Calculation

The PWR core power was estimated by dividing into three power terms, i.e. the delayed neutron fission power term, the fission product decay power term and the actinide decay power term, which contribute much to the PWR core power after a reactor scram. (The sum of these three power terms occupy almost the whole part of the PWR core power after a reactor scram.) The major parameters and methods used for the PWR core power calculation for determining the New Power Curve are summarized in Table 2.4. For reference, those used for the PWR core power calculation for determining the JAERI Power Curve are summarized in Table 2.5.

(1) Delayed Neutron Fission Power

The delayed neutron fission power was calculated with the RELAP5/MOD2 code, i.e. by using the reactor kinetics model in the RELAP5/MOD2 code. The same model (noding) as used for the PWR heat transfer calculation, i.e. Fig. 2.1 (Refer to Subsection 2.1(2)), was also used in this calculation. The input data is also the same as used for the PWR heat transfer calculation, except a core power curve input was replaced with inputs for reactor kinetics calculation. The input data used for this calculation, i.e. the delayed neutron fission power calculation, (Case PWP000) is presented in Appendix A. The major parameters used for this calculation are summarized in Table 2.4. The reactivity feedback was not considered in this calculation.

(2) Fission Product Decay Power

The fission product decay power was taken from data in the JNDC (Japanese Nuclear Data Committee) FP (Fission Product) Nuclear Data Library[6]. (The fission product decay power for determining the JAERI

Power Curve was also from data in the JNDC Nuclear Data Library.)

(3) Actinide Decay Power

The decay powers of ^{239}U and ^{239}Np produced by neutron capture in ^{238}U were calculated by the equations

$$F_{^{239}U}(t,T) = E_{^{239}U} R[1 - \exp(-\lambda_1 T)]\exp(-\lambda_1 t), \quad (1a)$$

$$F_{^{239}Np}(t,T) = E_{^{239}Np} R\{\frac{\lambda_1}{\lambda_1-\lambda_2}[1 - \exp(-\lambda_2 T)]\exp(-\lambda_2 t) - \frac{\lambda_2}{\lambda_1-\lambda_2}[1 - \exp(-\lambda_1 T)]\exp(-\lambda_1 t)\}, \quad (1b)$$

respectively, where

F : Power (MeV/sec) per 1 fission/sec

$E_{^{239}U}$: Energy yield from ^{239}U decay = 0.474 MeV

$E_{^{239}Np}$: Energy yield from ^{239}Np decay = 0.419 MeV

R : ^{239}U yield factor (Number of ^{239}U atoms produced per fission)

λ_1 : Decay constant of $^{239}U = 4.91\times10^{-4}$ sec^{-1}

λ_2 : Decay constant of $^{239}Np = 3.41\times10^{-6}$ sec^{-1}

t : Cooling time (Time after reactor scram) (sec)

T : Irradiation time (Operating time before reactor scram) (sec)

In this calculation, the ^{239}U yield factor and the irradiation time were assumed to be 0.59 and infinitive, respectively.

Final calculated results for the three power terms and the sum of them for determining the New Power Curve are presented in normalized forms in Table 2.6. For reference, those for determining the JAERI Power Curve are presented in Table 2.7.

2.3 PWR Heat Transfer Calculation

The heat transfer from a PWR fuel rod to core fluid was calculated with the RELAP5/MOD2 code by using the model (noding) described in

Subsection 2.1(2). The input data for the PWR heat transfer calculation (Case POPW01) are presented in Appendix B. The PWR power curve, i.e. the sum of the three power terms, obtained in Section 2.2 was given as a core power curve input in this calculation. Calculation cases of heat transfer calculations including the LSTF heat transfer calculation are summarized in Table 2.8.

2.4 LSTF Heat Transfer Calculation

The heat transfer from a LSTF heater rod to core fluid was also calculated with the RELAP5/MOD2 code by using the model (noding) described in Subsection 2.1(1). An example of the input data for LSTF heat transfer calculation (Case POLS01) is presented in Appendix C. Calculation cases of the LSTF heat transfer calculation are summarized in Table 2.8.

The purpose of the LSTF heat transfer calculation is to obtain a LSTF core power curve which gives the LSTF heat transfer (the heat transfer from a LSTF heater rod to core fluid) being in best agreement with the PWR heat transfer (the heat transfer from a PWR fuel rod to core fluid) calculated in Section 2.3 (i.e. in Case POPW01).

(1) Uncertainty in Thermal Conductivity of Packed MgO

As mentioned in Subsection 2.1(1), there is uncertainty in the thermal conductivity of the packed MgO, the outer insulator in the LSTF heater rod: there is a significant difference in the thermal conductivity of the packed MgO between two data, i.e. data measured by a manufacturer at low temperatures (Case A) and data used for design of the LSTF heater rod by a manufacturer (Case B), as shown in Table 2.1. Therefore, also an mentioned in Subsection 2.1(1), these two data (Case A and Case B) were tested in the LSTF heat transfer calculation.

Figure 2.5 compares the PWR heat transfer rate from the average power rod in Case POPW01 and the LSTF heat transfer rates from the average power rod in Case POLS01 and Case POLS02. In Case POLS01 and Case POLS02, the data measured at low temperatures (i.e. Case A in Table 2.1, $\sim$4 W/mK) and the data used for design of the LSTF heater rod (i.e. Case B in Table 2.1, $\sim$1 W/mK), respectively, were given as the input for the thermal conductivity of packed MgO. The PWR core power calculated in Section 2.2, i.e. the core power presented in Table 2.6, was given as the input for the core power curve in both Case POLS01 and Case POLS02. It is considered that the stored heat in the LSTF heater rod is smaller than that in the PWR fuel rod, and therefore the LSTF heat transfer rate is smaller than the PWR heat transfer rate if the same core power, i.e. the PWR core power, is given as the input for the core power curve. Hence, the thermal conductivity of packed MgO of ∿1 W/mK (i.e. Case B in Table 2.1) is less reliable than ∿4 W/mK (i.e. Case A in Table 2.1).

Oscillation of the heat transfer rate is seen in all of the three calculations, Cases POPW01, POLS01 and POLS02, after approximately 500s. The reason may be that two-phase mixture with a constant flow rate and a constant quality is injected from the combination of time dependent volume and time dependent junction to the core not directly but through a branch component, as mentioned is Subsection 2.1(1). The oscillation of the heat transfer rate is seen in all of the calculations presented in this report.

Figure 2.6 shows the PWR heat transfer rate from the average power rod in Case POPW01 and the LSTF heat transfer rates from the average power rod in Case POLS11 and Case POLS12, together with the LSTF heat transfer rates in Case POLS01 and Case POLS02. In Case POLS11 and Case POLS12, the data measured at low temperatures (∿4 W/mK) and the data used for design of the LSTF heater rod (∿1 W/mK), respectively, were given as the input for the thermal conductivity of packed MgO. The PWR heat transfer rate from the average power rod (named "on average power rod base" in this report) calculated in Section 2.3(, i.e. in Case POPW01,) was given as the input for the core power curve in both Case POLS11 and Case POLS12. The LSTF heat transfer rates in both Case POLS11 and POLS12 are larger than the PWR heat transfer rate in Case POPW01 as expected, since there is the stored heat in the LSTF heater rod.

The final goal of the LSTF heat transfer calculation is to obtain a LSTF core power curve which gives the LSTF heat transfer rate being in best agreement with the PWR heat transfer rate in Case POPW01. However, there is uncertainty in the thermal conductivity of packed MgO, as mentioned previously. Therefore, the Case POLS11 calculation was selected as the final goal calculation: the PWR heat transfer rate on average power rod base was adopted as the LSTF core power curve, i.e. the

New Power Curve, since the LSTF heat transfer rate in Case POLS11 gives a little conservative curve comparing with the PWR heat transfer rate in Case POPW01.

(2) Average Power Rod and Peak Power Rod

Figure 2.7 compares the PWR heat transfer rate from the average power rod in Case POPW01 and the LSTF heat transfer rates from the average power rod in Case POLS11 and Case POLS21. In Case POLS21, the data measured at low temperatures (∿4 W/mK) was given as the input for the thermal conductivity of packed MgO, as in the case of Case POLS11. The PWR heat transfer rate from the peak power rod (named "on peak power rod base" in this report) calculated in Section 2.3 was given as the input for the core power curve in Case POLS21, whereas the PWR heat transfer rate from the average power rod (named "on average power rod base"), i.e. the New Power Curve, was given as the input for the core power curve in Case POLS11. In all of the LSTF heat transfer calculations, the initial total core power was the same, and the normalized PWR heat transfer rate on peak power rod base or average power rod base (normalized by each initial PWR heat transfer rate) was given as the input for the core power curve. The normalized PWR heat transfer rates on peak power rod base and average power rod base differ a little from each other, since the stored heats in the PWR peak power rod and PWR average power rod differ a little from each other due to a difference in the initial temperatures between the two rods. As shown in Fig. 2.7, while the LSTF heat transfer rate from the average power rod in Case POLS21 is a little larger than that in Case POLS11 as expected, there is almost no significant difference in the LSTF heat transfer rate from the average power rod between Case POLS21 and Case POLS11.

Figure 2.8 compares the PWR heat transfer rate from the peak power rod in Case POPW01 and the LSTF heat transfer rates from the peak power rod in Case POLS11 and Case POLS21. As shown in this figure, there is also almost no significant difference in the LSTF heat transfer rate from the peak power rod between Case POLS21 and Case POLS11.

(3) Break Area

As mentioned in Subsection 2.1(1), in order to investigate the effect of system pressure transient on the LSTF heat transfer, two pressure transient data obtained in LSTF 5% and 0.5% break LOCA tests, shown in Fig. 2.3 and Table 2.2, and Fig. 2.4 and Table 2.3, respectively, were tested in the LSTF heat transfer calculation. Figure 2.9 compares the PWR heat transfer rate from the average power rod in Case POPW01 and the LSTF heat transfer rates from the average power rod in Case POLS11 and Case POLS32, together with the LSTF heat transfer rates in Case POLS01 and Case POLS31. The data measured at low temperatures (∿4 W/mK) were given as the input for the thermal conductivity of packed MgO in Case POLS31 and Case POLS32, as in the cases of Case POLS01 and Case POLS11. The PWR heat transfer rate on average power rod base, i.e. the New Power Curve, was given as the input for the core power curve in Case POLS32 as in the case of Case POLS11, while the PWR core power was given as the input for the core power curve in Case POLS31 as in the case of Case POLS01. The pressure transient data obtained in a LSTF 0.5% break LOCA test were given as the input for the core inlet condition in Case POLS31 and Case POLS32, though the pressure transient data obtained in a LSTF 5% break LOCA test were used as the input for the core inlet condition in Case POLS01 and Case POLS11. Except for Case POLS31 and Case POLS32, the pressure transient data obtained in a LSTF 5% break LOCA test were given as the input for the core inlet condition in all of the LSTF heat transfer calculations presented in this section (, i.e. Section 2.4,) and also in the PWR delayed neutron fission power calculation described in Subsection 2.2(1).

It is obvious from comparing the LSTF heat transfer rates in Case POLS11 and Case POLS32 shown in Fig. 2.9 that there is almost no significant difference in the LSTF heat transfer rate between Case POLS11 and Case POLS32: the LSTF heat transfer rate is not affected very much by a difference in the pressure transient, i.e. the break area.

(4) BN Outer Insulator

In the LSTF heater rods in the present LSTF fuel assembly (named the "LSTF first fuel assembly"), packed MgO is used as the outer insulator. Packed BN (Boron-Nitride) will be used as the outer insulator in LSTF heater rods in a next LSTF fuel assembly (named the "LSTF second fuel assembly"). The geometries and materials used are the same between the LSTF heater rods in the LSTF first fuel assembly and in the LSTF second fuel assembly, except packed MgO in the outer insulator is replaced by packed BN. The LSTF first fuel assembly will be replaced by the LSTF second fuel assembly in March, 1989. A difference in the LSTF heat transfer between the LSTF heater rod in the LSTF first fuel assembly (packed MgO outer insulator) and that in the LSTF second fuel assembly (packed BN outer insulator) will be examined in this subsection.

Figure 2.10 shows the PWR heat transfer rate from the average power rod in Case POPW01 and the LSTF heat transfer rates from the average power rod in Case POLS01 and Case POLS81, together with the LSTF heat transfer rate in Case POLS02. In Case POLS81, data for the packed BN were given as the input for physical properties of the outer insulator, and the PWR core power was given as the input for the core power curve as in the cases of Case POLS01 and Case POLS02.

Figure 2.11 compares the PWR heat transfer rate from the average power rod in Case POPW01 and the LSTF heat transfer rates from the average power rod in Case POLS11 and Case POLS82, together with the LSTF heat transfer rate in Case POLS12. In Case POLS82, data for the packed BN were given as the input for physical properties of the outer insulator, and the PWR heat transfer rate on average power rod base, i.e. the New Power Curve, was given as the input for the core power curve as in the cases of Case POLS11 and Case POLS12.

It is seen from comparing the PWR heat transfer rate in Case POPW01 and the LSTF heat transfer rates in Case POLS11 and Case POLS82 shown in Fig. 2.11 that while the LSTF heat transfer rate in Case POLS82 (the LSTF heater rod in the LSTF second fuel assembly) is a little smaller than the LSTF heat transfer rate in Case POLS11 (the LSTF heater rod in the LSTF first fuel assembly), the LSTF heat transfer rate in Case POLS82 gives a little conservative curve comparing with the PWR heat transfer rate in Case POPW01. This means that the LSTF heat transfer rate from the heater rod in the LSTF second fuel assembly is a little conservative comparing with the PWR heat transfer rate and is also in approximately agreement with the LSTF heat transfer rate from the heater rod in the LSTF first fuel assembly, if the New Power Curve is used as the core power curve.

(5) JAERI Power Curve

A difference between the PWR heat transfer rate and the LSTF heat transfer rate in the case where the JAERI Power Curve is used as the core power curve is examined in this subsection. Figure 2.12 compares the PWR heat transfer rate from the average power rod in Case POPW01 and the LSTF heat transfer rate from the average power rod in Case POLS91, together with the LSTF heat transfer rates in Case POLS01, Case POLS02 and Case POLS92. The data measured at low temperature (~4 W/mK) were given as the input for the thermal conductivity of packed MgO in Case POLS91 as in the case of Case POLS01, while the data used for design of the LSTF heater rod (~1 W/mK) were used as the input for the thermal conductivity of packed MgO in Case POLS92 as in the case of Case POLS02. The JAERI Power Curve was given as the input for the core power curve in Case POLS91 and Case POLS92. It is seen from comparing the PWR heat transfer rate in Case POPW01 and the LSTF heat transfer rate in Case POLS91 shown in Fig. 2.12 that the LSTF heat transfer rate in the case where the JAERI Power Curve is used as the core power curve is considerably lower until approximately 15s and considerably larger between approximately 15s and 400s than the PWR heat transfer rate. The reason of this disagreement may be that the PWR delayed neutron fission power was estimated approximately using one delayed neutron group in determining the JAERI Power Curve.

As mentioned in Subsection 2.4(1), finally, the PWR heat transfer rate on average power rod base was selected as the New Power Curve. The PWR power, the New Power Curve and the JAERI Power Curve are compared in Fig. 2.13. In a LSTF LOCA test, the LSTF core power is kept at 10 MW for approximately 18s and 29s after a reactor scram due to limitation of electric power supply, when the New Power Curve and JAERI Power Curve are used as the LSTF core power, respectively. Digital values of the New Power Curve and JAERI Power Curve are presented in Tables 2.9 and 2.10, respectively. As shown in Fig. 2.13, the New Power Curve used in a LSTF test is considerably lower between approximately 20s and 300s and a little higher after approximately 300s than the JAERI Power Curve used in a LSTF test. The reason of this discrepancy may be that the PWR delayed neutron fission power was estimated using 6 delayed neutron groups and the stored heat in a PWR fuel rod was considered in determing the New Power Curve, though the former was estimated approximately using 1 delayed neutron group and the latter was not considered in determining the JAERI Power Curve.

The times in Tables 2.2 and 2.3 and Figs. 2.3 and 2.4 are the time after a break, and the times in the other tables (i.e. Tables 2.6, 2.7, 2.9 and 2.10) and in the other figures (i.e. Figs. 2.5 through 2.13) are the time after a reactor scram.

3. Concluding Remarks

The New Power Curve for LSTF tests was calculated on best-estimate base, particularly in two points, i.e. estimation of the delayed neutron fission power and consideration of the stored heat in a PWR fuel rod. Finally, the PWR heat transfer rate on average power rod base was adopted as the New Power Curve, neglecting the stored heat in a LSTF heater rod since there is uncertainty in the thermal conductivity of outer insulator in the LSTF heater rod. When the New Power Curve is used as the LSTF core power curve, the LSTF heat transfer rate gives a little conservative values comparing with the PWR heat transfer rate.

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The times in Tables 2.2 and 2.3 and Figs. 2.3 and 2.4 are the time after a break, and the times in the other tables (i.e. Tables 2.6, 2.7, 2.9 and 2.10) and in the other figures (i.e. Figs. 2.5 through 2.13) are the time after a reactor scram.

3. Concluding Remarks

The New Power Curve for LSTF tests was calculated on best-estimate base, particularly in two points, i.e. estimation of the delayed neutron fission power and consideration of the stored heat in a PWR fuel rod. Finally, the PWR heat transfer rate on average power rod base was adopted as the New Power Curve, neglecting the stored heat in a LSTF heater rod since there is uncertainty in the thermal conductivity of outer insulator in the LSTF heater rod. When the New Power Curve is used as the LSTF core power curve, the LSTF heat transfer rate gives a little conservative values comparing with the PWR heat transfer rate.

Acknowledgements

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(2) ROSA-IV Group, ROSA-IV Large Scale Test Facility (LSTF) System Description, JAERI-M 84-237 (1985).

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(6) K. Tasaka, et al., JNDC Nuclear Data Library of Fission Products, JAERI 1287 (1983).

Table 2.1 Thermal Conductivity of MgO

(a) Case A; Values measured by manufacturer at low temperatures, ∿4 W/mK

Temperature (K)	Thermal Conductivity (W/mK)
334.15	1.3142
443.15	2.3493
554.15	3.9309
3473.15*	3.9309*

* Extrapolation of measured value at 554.15K

(b) Case B; Value used for design of heater rod by manufacturer, ∿1 W/mK

Temperature (K)	Thermal Conductivity (W/mK)
273.15	1.1049
3473.15	1.1049

Table 2.2 Pressure Curve for 5% Break (SB-CL-08) used in Calculations

	Time (s)	Pressure (MPa)
1	0.0	15.50
2	(15.3)	(12.50)
3	25.0	10.60
4	60.0	9.25
5	77.0	8.95
6	124.0	8.45
7	148.0	8.40
8	167.0	8.15
9	207.0	7.75
10	239.0	7.25
11	400.0	5.10
12	486.0	3.95
13	549.0	3.30
14	557.0	3.05
15	582.0	2.60
16	609.0	2.40
17	627.0	2.30
18	774.0	2.20
19	810.0	2.05
20	910.0	2.00
21	938.0	1.85
22	969.0	1.65
23	1000.0	1.55

Table 2.3 Pressure Curve for 0.5% Break (SB-CL-11) used in Calculations

	Time (s)	Pressure (MPa)
1	0.0	15.50
2	20.0	14.25
3	90.0	12.70
4	130.0	13.50
5	(167.5)	(12.50)
6	190.0	11.90
7	390.0	8.75
8	430.0	8.45
9	520.0	8.30
10	2600.0	8.00

Table 2.4 PWR Power Curve Calculation for Determining New Power Curve

1. Delayed Neutron Fission Power
   Used Code : RELAP5/MOD2 (Point Reactor Kinetics Model)
   6 Delayed Neutron Groups
   Control Rod Worth : -4%
   Control Rod Drop Time : 3s
   Delayed Neutron Fraction : 0.75%

2. Fission Product Decay Power
   JNDC (Japanese Nuclear Data Committee), Ref. (6)

3. Actinide Decay Power
   Eq. (1)
   Energy Yield from U^{239} Decay : 0.474 MeV
   Energy Yield from Np^{239} Decay : 0.419 MeV
   Decay Constant of U^{239} : $4.91\times10^{-4}\ s^{-1}$
   Decay Constant of Np^{239} : $3.41\times10^{-6}\ s^{-1}$
   U^{239} Production Factor : 0.59

Table 2.5 PWR Power Curve Calculation for Determining JAERI Power Curve

1. Delayed Neutron Fission Power

   Used Code : — (Hand Calculation)

   1 Delayed Neutron Group with Average Neutron Life Time of 80s

   Control Rod Worth : -4%

   Control Rod Drop Time : 3s

   Delayed Neutron Fraction : 0.7%

2. Fission Product Decay Power

   JNDC (Japanese Nuclear Data Committee), Ref. (6)

3. Actinide Decay Power

   Eq. (1)

   Energy Yield from U^{239} Decay : 0.474 MeV

   Energy Yield from Np^{239} Decay : 0.419 MeV

   Decay Constant of U^{239} : 4.91×10^{-4} s^{-1}

   Decay Constant of Np^{239} : 3.41×10^{-6} s^{-1}

   U^{239} Production Factor : 0.59

Table 2.6 Normalized Delayed Neutron Fission Power, and Fission Product and Actinide Decay Powers for determining New Power Curve

Time (s)	DN Fission Power	FP Decay Power	Actinides Decay Power	Total
0	0.933498	0.0639013	2.60028×10^{-3}	1.00000
1	0.813366	0.0590464	2.59960×10^{-3}	0.875012
1.5	0.636461	0.0573887	2.59926×10^{-3}	0.696449
2	0.361606	0.0559959	2.59892×10^{-3}	0.420201
3	0.107936	0.0537360	2.59825×10^{-3}	0.164270
4	0.0924713	0.0519435	2.59757×10^{-3}	0.147012
5	0.0814024	0.0504658	2.59689×10^{-3}	0.134465
6	0.0727933	0.0492146	2.59621×10^{-3}	0.124604
8	0.0601687	0.0471896	2.59487×10^{-3}	0.109953
10	0.0514425	0.0455997	2.59352×10^{-3}	0.0996357
15	0.0382506	0.0427264	2.59015×10^{-3}	0.0835672
20	0.0306565	0.0407292	2.58679×10^{-3}	0.0739725
30	0.0216180	0.0379898	2.58010×10^{-3}	0.0621879
40	0.0161113	0.0360901	2.57343×10^{-3}	0.0547748
50	0.0123328	0.0346322	2.56680×10^{-3}	0.0495318
60	9.59011×10^{-3}	0.0334497	2.56020×10^{-3}	0.0456000
80	5.98466×10^{-3}	0.0316091	2.54711×10^{-3}	0.0401409
100	3.86642×10^{-3}	0.0302191	2.53413×10^{-3}	0.0366196
150	1.48610×10^{-3}	0.0278325	2.50226×10^{-3}	0.0318209
200	6.66549×10^{-4}	0.0262741	2.47114×10^{-3}	0.0294117
300	1.68548×10^{-4}	0.0242586	2.41115×10^{-3}	0.0268382
400	4.68085×10^{-5}	0.0229210	2.35401×10^{-3}	0.0253218
500	1.32219×10^{-5}	0.0219114	2.29959×10^{-3}	0.0242242
600	3.74563×10^{-6}	0.0210933	2.24775×10^{-3}	0.0233447
800	3.00913×10^{-7}	0.0198010	2.15136×10^{-3}	0.0219527
1000	$\sim3.7\times10^{-8}$	0.0187908	2.06390×10^{-3}	0.0208547
1500		0.0169359	1.87907×10^{-3}	0.0188150
2000		0.0156228	1.73402×10^{-3}	0.0173568
3000		0.0138385	1.53053×10^{-3}	0.0153690
4000		0.0126595	1.40439×10^{-3}	0.0140639
5000		0.0118064	1.32560×10^{-3}	0.0131320
6000		0.0111501	1.27579×10^{-3}	0.0124259
8000		0.0101867	1.22253×10^{-3}	0.0114092
1×10^{4}		9.49787×10^{-3}	1.19751×10^{-3}	0.0106954
2×10^{4}		7.67865×10^{-3}	1.14767×10^{-3}	8.82632×10^{-3}
5×10^{4}		5.85228×10^{-3}	1.03600×10^{-3}	6.88828×10^{-3}

Table 2.6 (Continued)

Time (s)	DN Fission Power	FP Decay Power	Actinides Decay Power	Total
1×10^{5}		4.80086×10^{-3}	8.73605×10^{-4}	5.67446×10^{-3}
2×10^{5}		4.02849×10^{-3}	6.21182×10^{-4}	4.64967×10^{-3}
5×10^{5}		3.26068×10^{-3}	2.23323×10^{-4}	3.48400×10^{-3}
1×10^{6}		2.70896×10^{-3}	4.05942×10^{-5}	2.74955×10^{-3}
2×10^{6}		2.17399×10^{-3}	1.34128×10^{-6}	2.17533×10^{-3}
5×10^{6}		1.56445×10^{-3}	4.83824×10^{-11}	1.56445×10^{-3}
1×10^{7}		1.20688×10^{-3}	1.90530×10^{-18}	1.20688×10^{-3}
2×10^{7}		9.11667×10^{-4}		9.11667×10^{-4}
5×10^{7}		6.85618×10^{-4}		6.85618×10^{-4}
1×10^{8}		5.86748×10^{-4}		5.86748×10^{-4}
2×10^{8}		5.22337×10^{-4}		5.22337×10^{-4}
5×10^{8}		4.19465×10^{-4}		4.19465×10^{-4}
1×10^{9}		2.96290×10^{-4}		2.96290×10^{-4}
1×10^{10}		2.79366×10^{-5}		2.79366×10^{-5}
1×10^{11}		2.72816×10^{-5}		2.72816×10^{-5}
1×10^{12}		2.44637×10^{-5}		2.44637×10^{-5}
1×10^{13}		9.90464×10^{-6}		9.90464×10^{-6}

Table 2.7 Normalized Delayed Neutron Fission Power, and Fission Product and Actinide Decay Powers for determining JAERI Power Curve

Time (s)	DN Fission Power	FP Decay Power	Actinide Decay Power	Total
0	0.9333	0.064	0.00270	1.0
1	0.8129	0.059	0.00270	0.874
1.5	0.6505	0.058	0.00270	0.710
2	0.3845	0.056	0.00270	0.441
3	0.1391	0.054	0.00270	0.193
4	0.1391	0.052	0.00270	0.191
5				
6	0.1335	0.050	0.00270	0.183
8	0.1307	0.048	0.00270	0.179
10	0.1269	0.046	0.00263	0.173
15	0.1195	0.043		0.163
20	0.1120	0.041	0.00262	0.153
30				
40	0.08773	0.037	0.00261	0.125
50				
60	0.06813	0.034	0.00259	0.103
80	0.05320	0.032	0.00258	0.086
100	0.04107	0.031	0.00257	0.073
150	0.02240	0.028		0.051
200	0.01213	0.027	0.00250	0.040
300				
400	9.333×10^{-4}	0.023		0.025
500			0.00233	
600	∿0	0.021		0.022
800		0.020		0.021
1000		0.019	0.00209	0.020
1500		0.017		0.018
2000		0.016	0.00176	0.017
3000				
4000		0.013		0.014
5000			0.00134	
6000		0.011		0.012
8000		0.010		0.011
1×10^{4}		0.010	0.00121	0.011
2×10^{4}		0.0077	0.00116	0.0083
5×10^{4}		0.0059	0.00105	0.0065

Table 2.7 (Continued)

Time (s)	DN Fission Power	FP Decay Power	Actinide Decay Power	Total
1×10^{5}		0.0048	0.000885	0.0053
2×10^{5}				
5×10^{5}				
1×10^{6}				
2×10^{6}				
5×10^{6}				
1×10^{7}				
2×10^{7}				
5×10^{7}				
1×10^{8}				
2×10^{8}				
5×10^{8}				
1×10^{9}				
1×10^{10}				
1×10^{11}				
1×10^{12}				
1×10^{13}				

Table 2.8 Cases of Heat Transfer Calculations

Case	Contents
POPW01	PWR Case
POLS01	Power = Power of PWR Case $\lambda(MgO) \fallingdotseq 4\ W/m^2K$ 5% Break
POLS02	Power = Power of PWR Case $\lambda(MgO) \fallingdotseq 1\ W/m^2K$ 5% Break
POLS11	Power = Heat Transfer Rate of PWR Case $\lambda(MgO) \fallingdotseq 4\ W/m^2K$ 5% Break
POLS12	Power = Heat Transfer Rate of PWR Case $\lambda(MgO) \fallingdotseq 1\ W/m^2K$ 5% Break
POLS21	Power = Heat Transfer Rate of PWR Case (Peak Power Rod Base) $\lambda(MgO) \fallingdotseq 4\ W/m^2K$ 5% Break
POLS22	Power = Heat Transfer Rate of PWR Case (Peak Power Rod Base) $\lambda(MgO) \fallingdotseq 1\ W/m^2K$ 5% Break
POLS31	Power = Power of PWR Case $\lambda(MgO) \fallingdotseq 4\ W/m^2K$ 0.5% Break
POLS32	Power = Heat Transfer Rate of PWR Case $\lambda(MgO) \fallingdotseq 4\ W/m^2K$ 0.5% Break
POLS81	Power = Power of PWR Case Outer Insulator = BN 5% Break
POLS82	Power = Heat Transfer Rate of PWR Case Outer Insulator = BN 5% Break
POLS91	Power = JAERI Power Curve $\lambda(MgO) \fallingdotseq 4\ W/m^2K$ 5% Break
POLS92	Power = JAERI Power Curve $\lambda(MgO) \fallingdotseq 1\ W/m^2K$ 5% Break

Table 2.9 New Power Curve

Time (s)	Power (MW)	Normalized Power (-)	Power used in Test (MW)
0	71.313	1.0	10.000
1	70.324	0.98614	10.000
1.5	68.688	0.96320	10.000
2	65.300	0.91568	10.000
3	56.428	0.79128	10.000
4	48.645	0.68214	10.000
5	42.614	0.59757	10.000
6	37.472	0.52546	10.000
8	29.133	0.40853	10.000
10	22.820	0.32000	10.000
15	12.503	0.17533	10.000
17.87			10.000
20	8.1497	0.11428	8.1497
30	5.3662	0.075249	5.3662
40	4.5044	0.063164	4.5044
50	3.9056	0.054767	3.9056
60	3.5384	0.049619	3.5384
80	3.0425	0.042664	3.0425
100	2.7633	0.038749	2.7633
150	2.4228	0.033974	2.4228
200	2.2631	0.031735	2.2631
300	2.0795	0.029160	2.0795
400	2.0000	0.028045	2.0000
500	1.9127	0.026821	1.9127
600	1.8317	0.025685	1.8317
800	1.5768	0.022111	1.5768
1000	1.4872	0.020855	1.4872
1500	1.3417	0.018815	1.3417
2000	1.2378	0.017357	1.2378
3000	1.0960	0.015369	1.0960
4000	1.0029	0.014064	1.0029
5000	0.93648	0.013132	0.93648
6000	0.88612	0.012426	0.88612
8000	0.81362	0.011409	0.81362
1×10^4	0.76272	0.010695	0.76272
2×10^4	0.62943	8.8263×10^{-3}	0.62943
5×10^4	0.49122	6.8883×10^{-3}	0.49122
1×10^5	0.40466	5.6745×10^{-3}	0.40466

Table 2.10 JAERI Power Curve

Time (s)	Power (MW)	Normalized Power (-)	Power used in Test (MW)
0	71.313	1.0	10.000
1	62.327	0.874	10.000
1.5	50.632	0.710	10.000
2	31.449	0.441	10.000
3	13.763	0.193	10.000
4	13.621	0.191	10.000
5			
6	13.050	0.183	10.000
8	12.765	0.179	10.000
10	12.337	0.173	10.000
15	11.624	0.163	10.000
20	10.911	0.153	10.000
29.12			10.000
30			
40	8.9141	0.125	8.9141
50			
60	7.3452	0.103	7.3452
80	6.1329	0.086	6.1329
100	5.2058	0.073	5.2058
150	3.6369	0.051	3.6369
200	2.8525	0.040	2.8525
300			
400	1.7828	0.025	1.7828
500			
600	1.5689	0.022	1.5689
800	1.4976	0.021	1.4976
1000	1.4263	0.020	1.4263
1500	1.2836	0.018	1.2836
2000	1.2123	0.017	1.2123
3000			
4000	0.99838	0.014	0.99838
5000			
6000	0.85575	0.012	0.85575
8000	0.78444	0.011	0.78444
1×10^4	0.78444	0.011	0.78444
2×10^4	0.59189	0.0083	0.59189
5×10^4	0.46353	0.0065	0.46353
1×10^5	0.37796	0.0053	0.37796

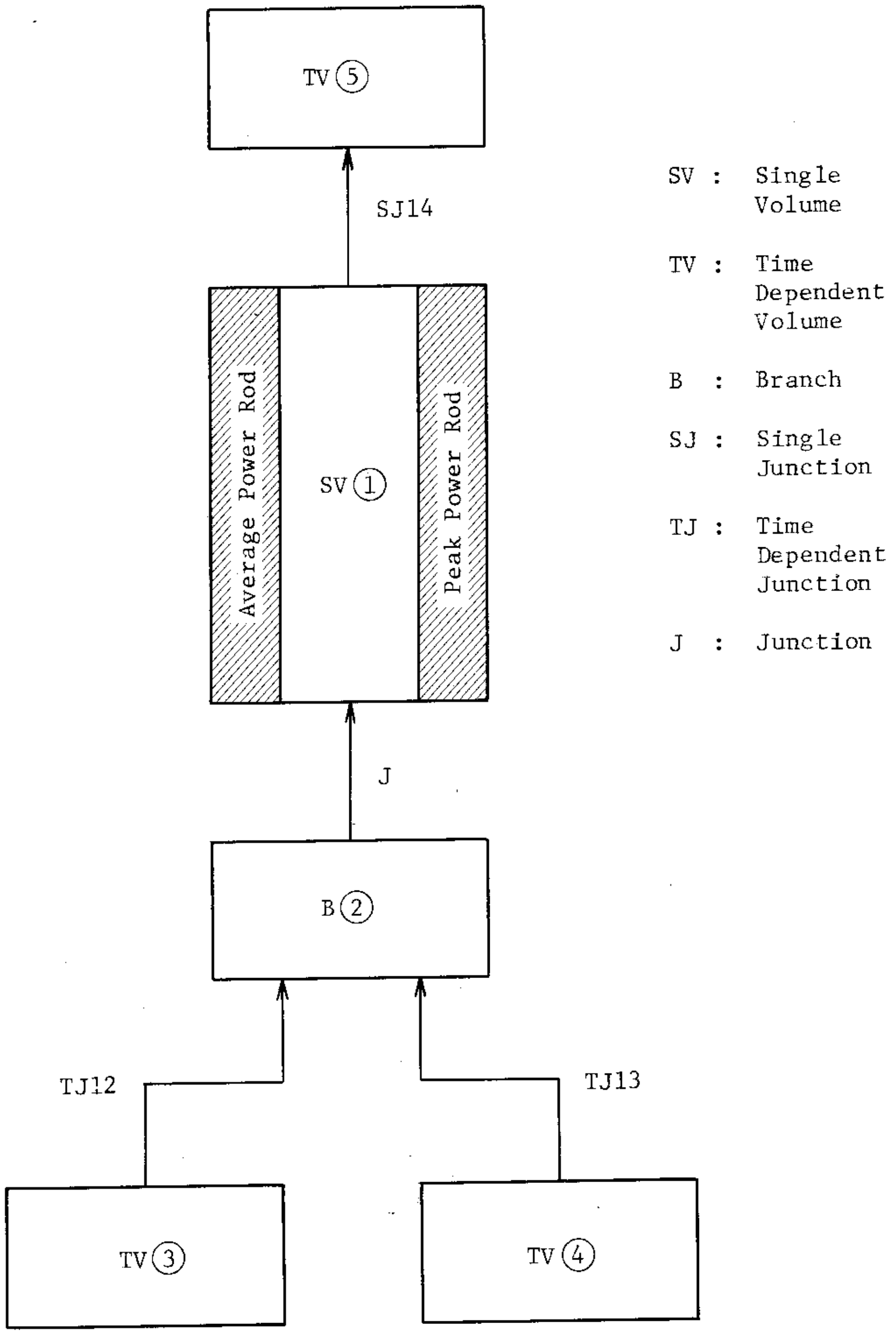
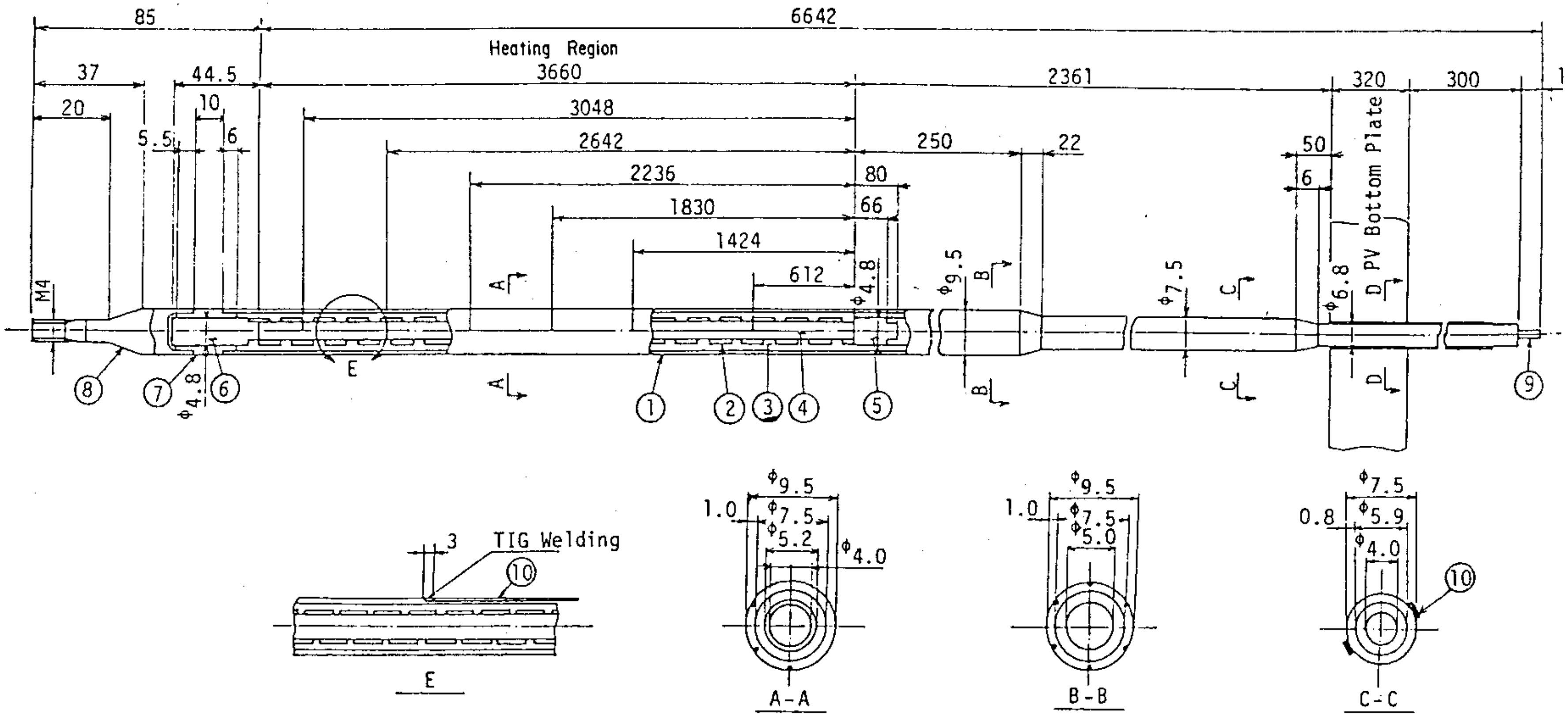
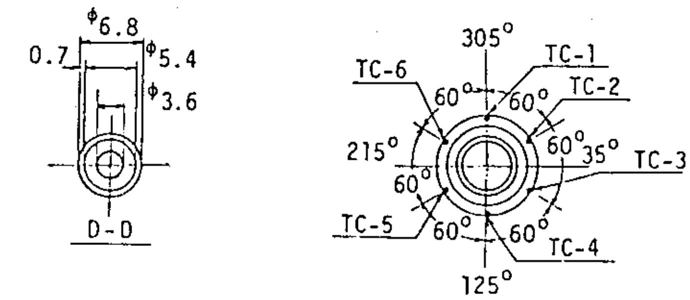


Fig. 2.1 Model used in LSTF and PWR Core Heat Transfer Calculations





Mark	Description	Material
1	Cladding	Inconel 600
2	Heating Element	Nichrome
3	Insulator	MgO
4	Core	Al_2O_3
5	Lower Conductor	Ni/Cu
6	Upper Conductor	Ni
7	End Cap	SUS 316
8	Connector	Ni
9	Plug	Cu
10	Thermocouple	C/A

Fig. 2.2 LSTF Heater Rod

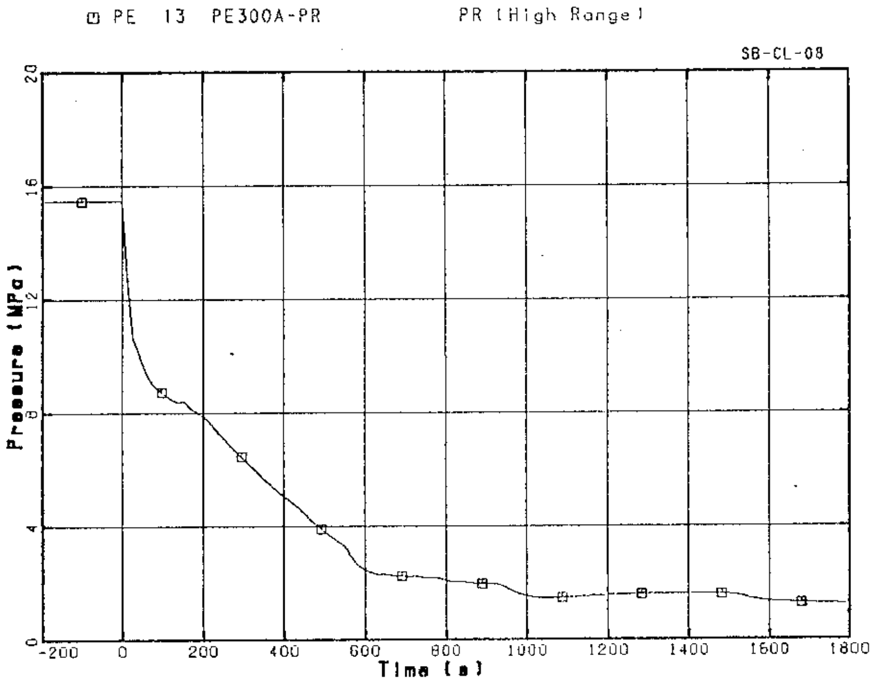


Fig. 2.3 Pressure Curve for 5% Break (SB-CL-08) used in Calculations

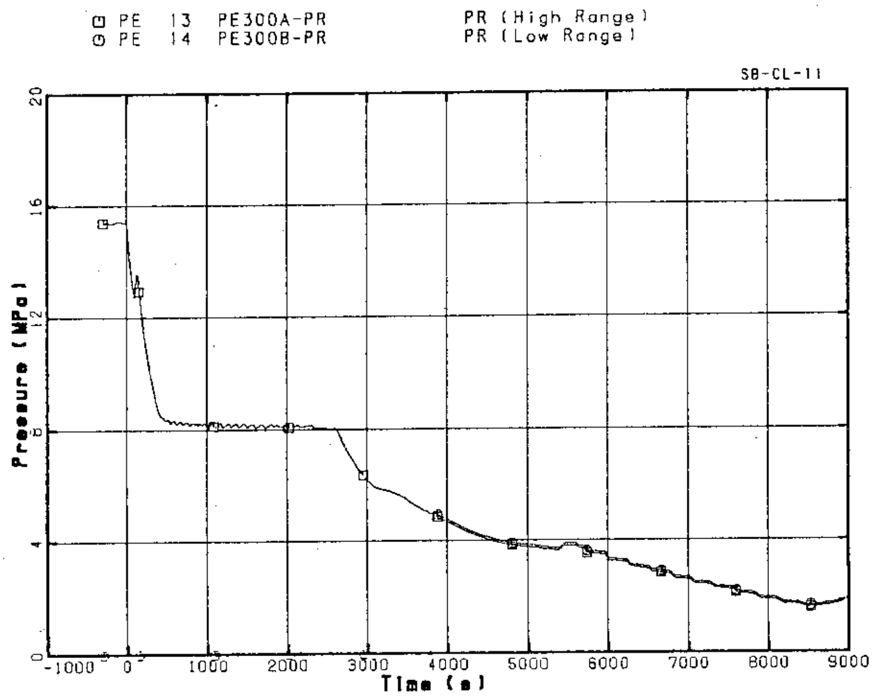


Fig. 2.4 Pressure Curve for 0.5% Break (SB-CL-11) used in Calculations

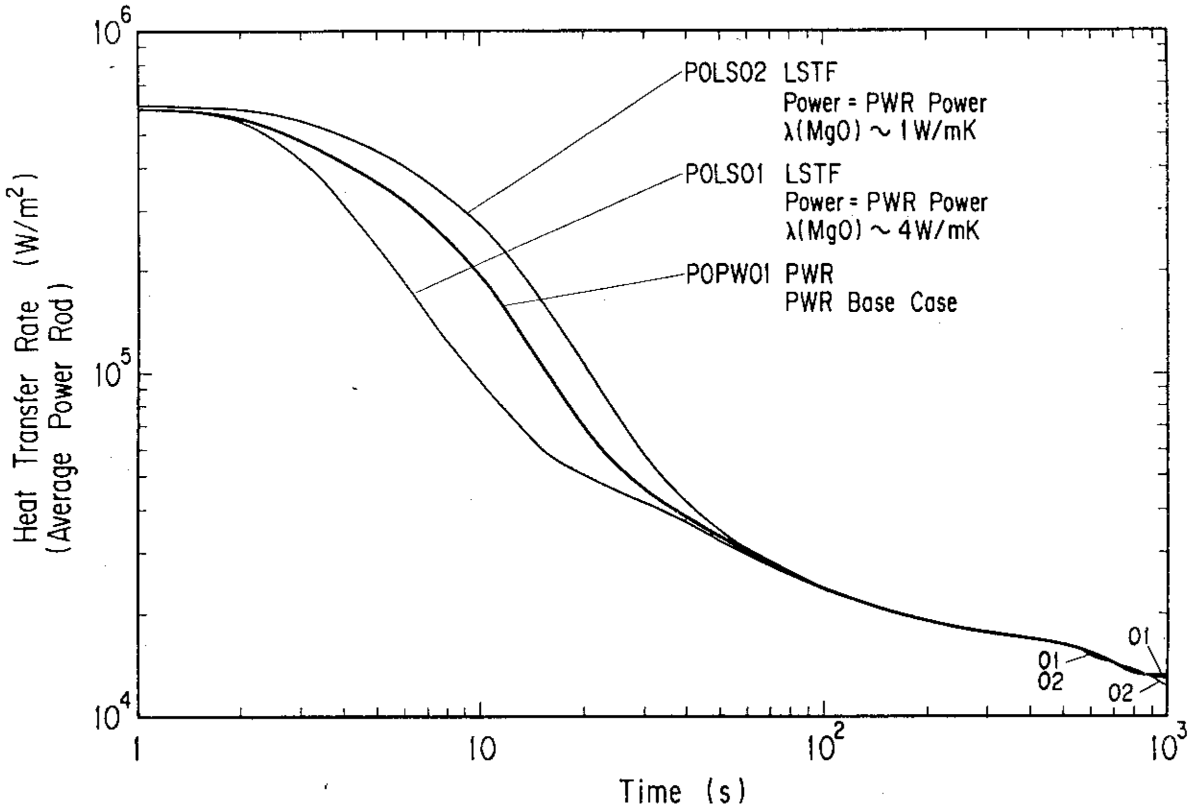


Fig. 2.5 Comparison of Heat Transfer Rates in Case POPW01 and Cases POLS01 and POLS02

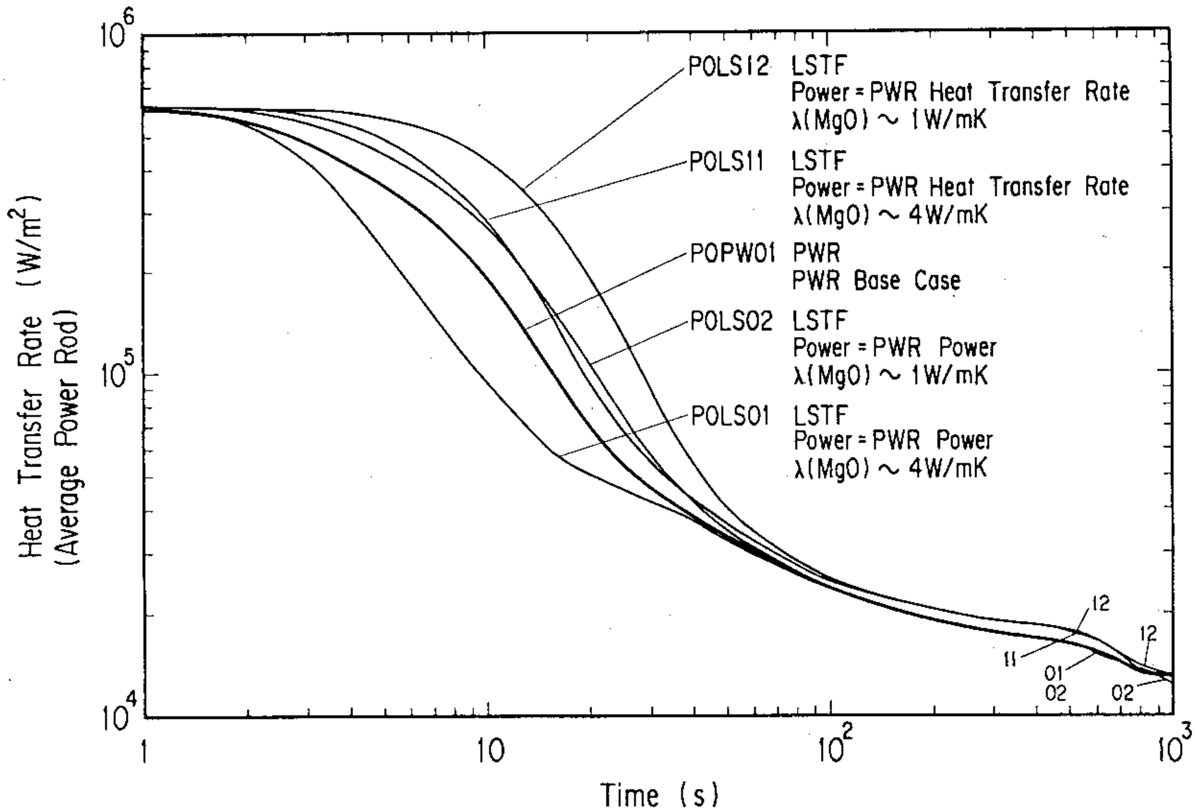


Fig. 2.6 Comparison of Heat Transfer Rates in Case POPW01 and Cases POLS11 and POLS12

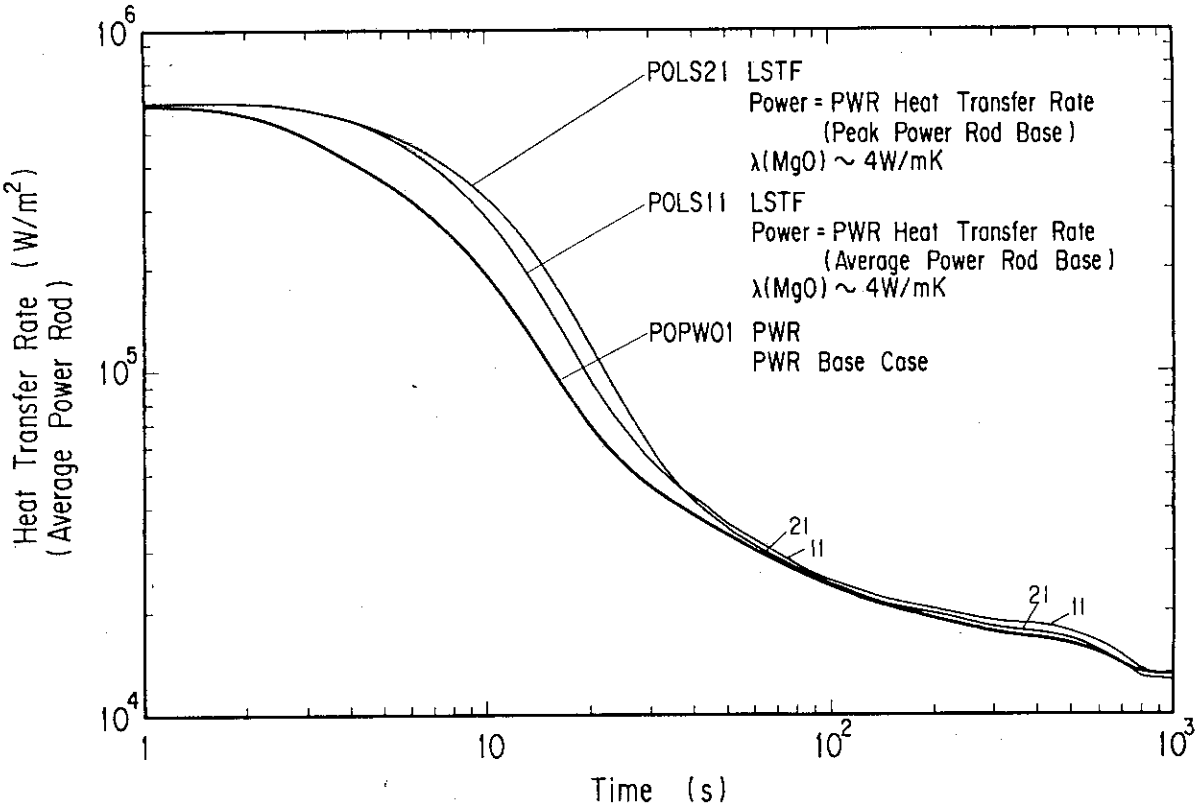


Fig. 2.7 Comparison of Heat Transfer Rates in Case POPW01 and Cases POLS11 and POLS21; Average Power Rod

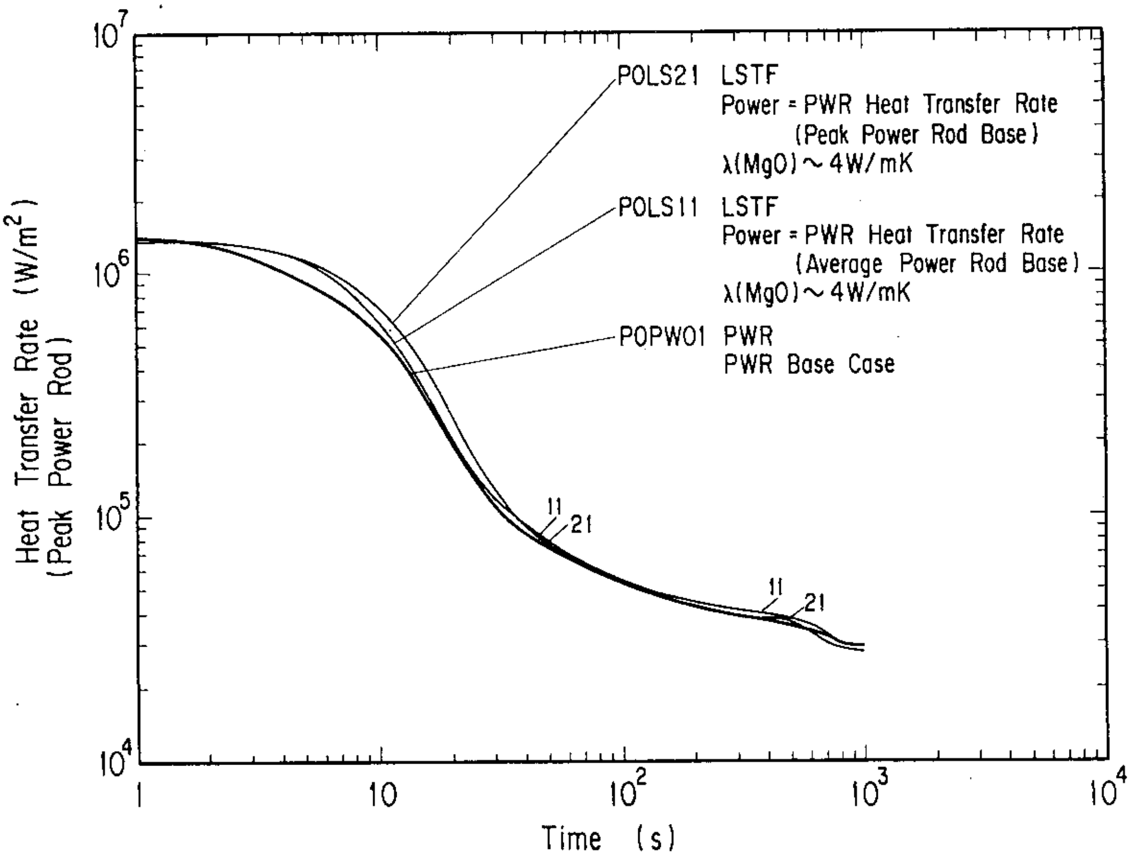


Fig. 2.8 Comparison of Heat Transfer Rates in Case POPW01 and POLS11 and POLS21; Peak Power Rod

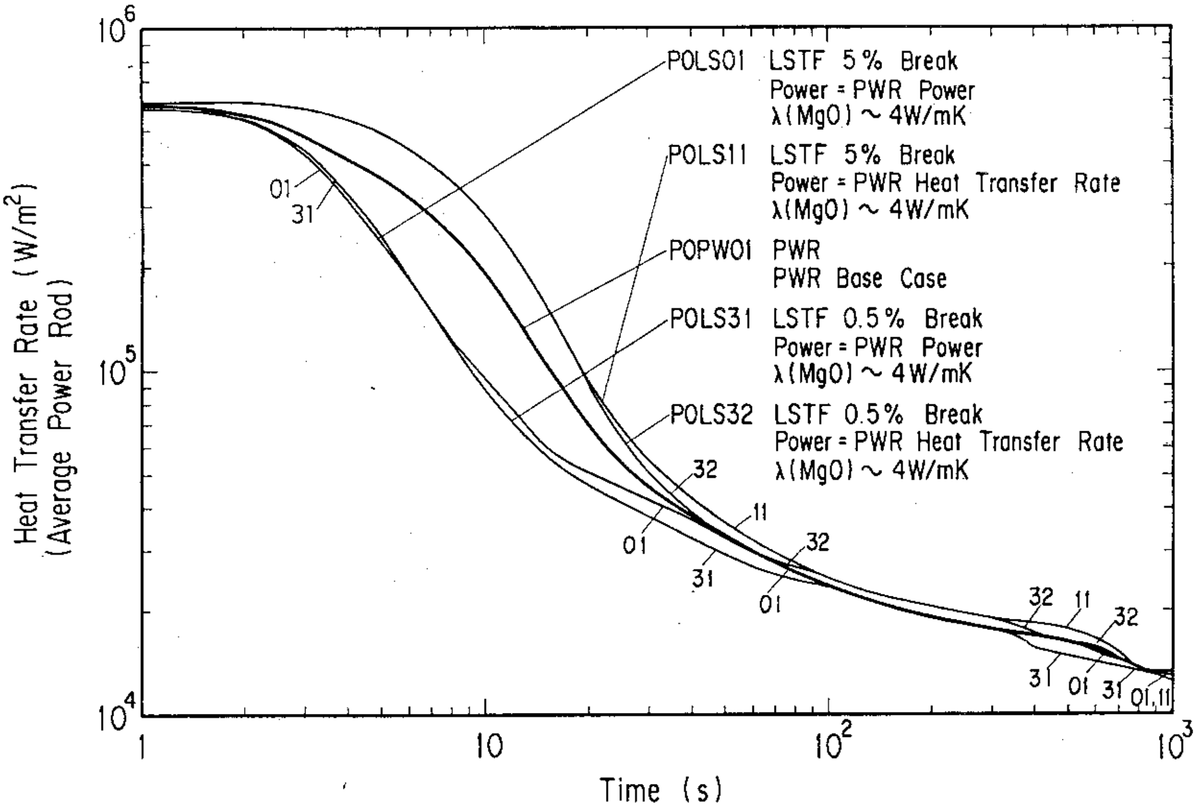


Fig. 2.9 Comparison of Heat Transfer Rates in Case POPW01 and Cases POLS11 and POLS32

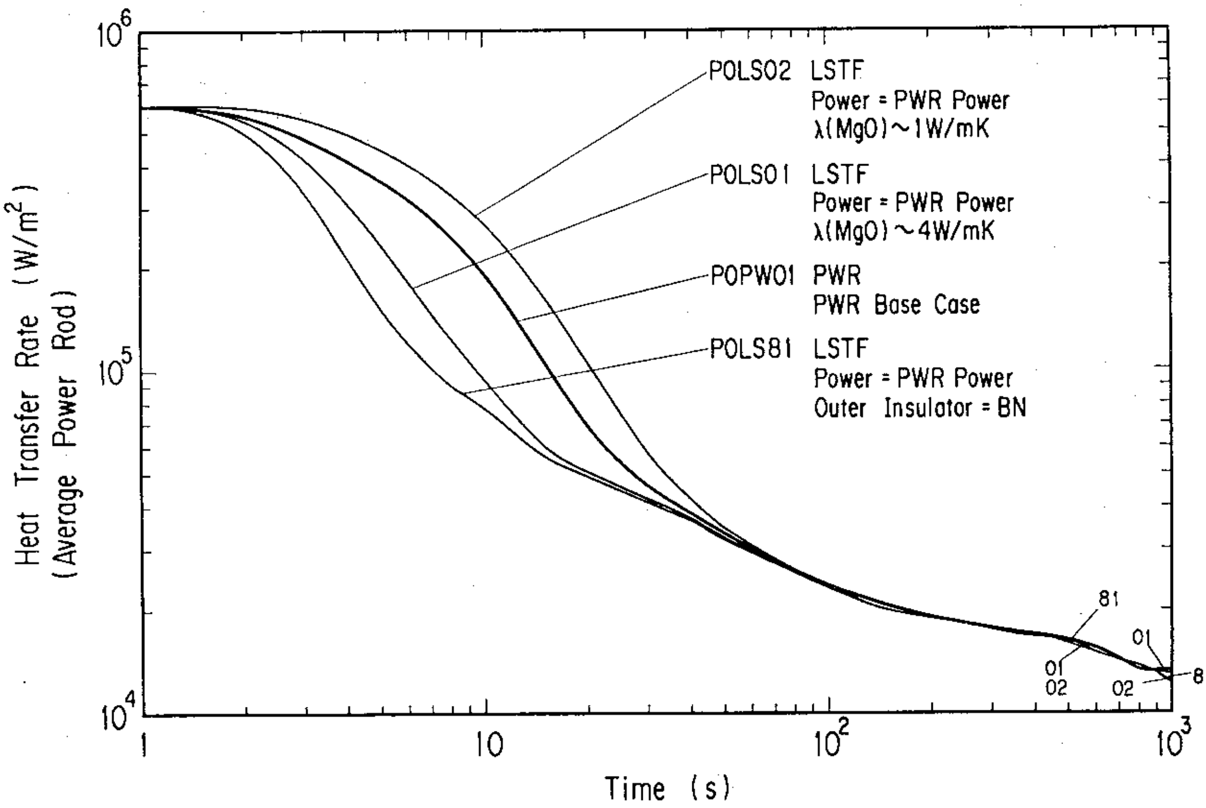


Fig. 2.10 Comparison of Heat Transfer Rates in Case POPW01 and Cases POLS01 and POLS81

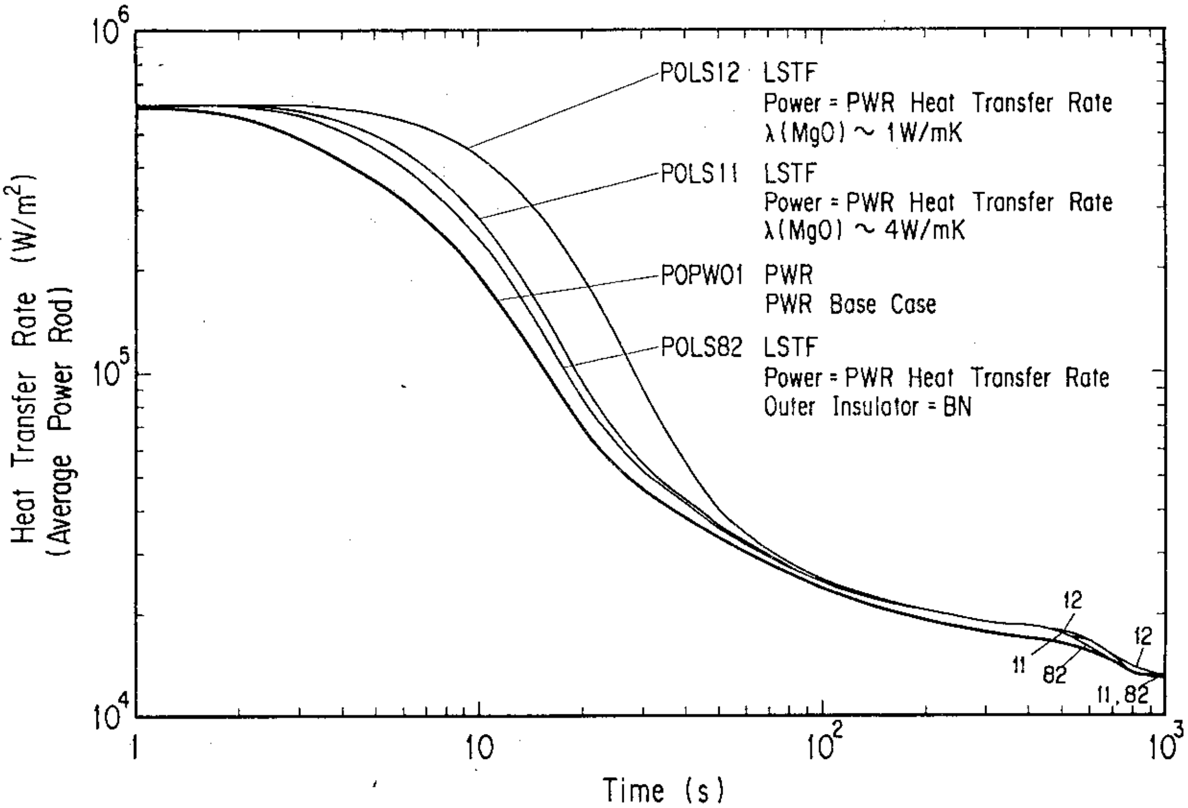


Fig. 2.11 Comparison of Heat Transfer Rates in Case POPW01 and Cases POLS11 and POLS82

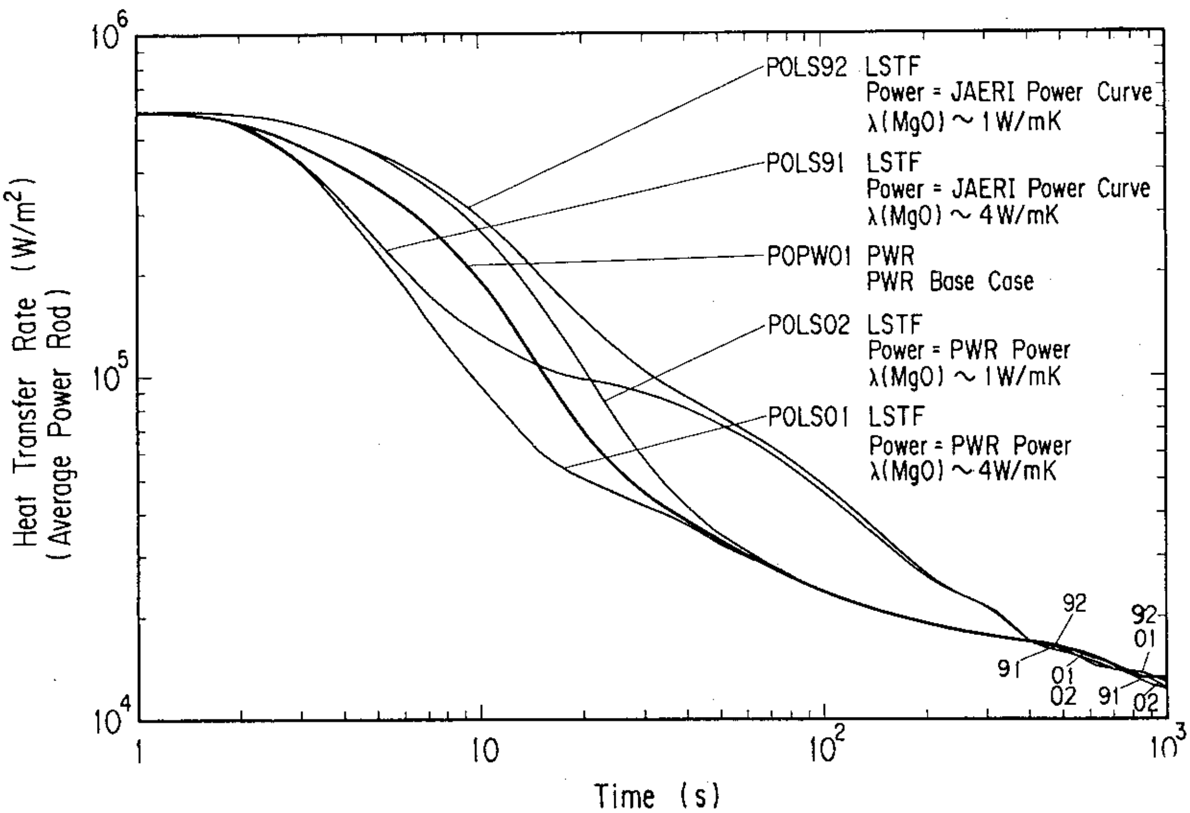


Fig. 2.12 Comparison of Heat Transfer Rates in Case POPW01 and Cases POLS91

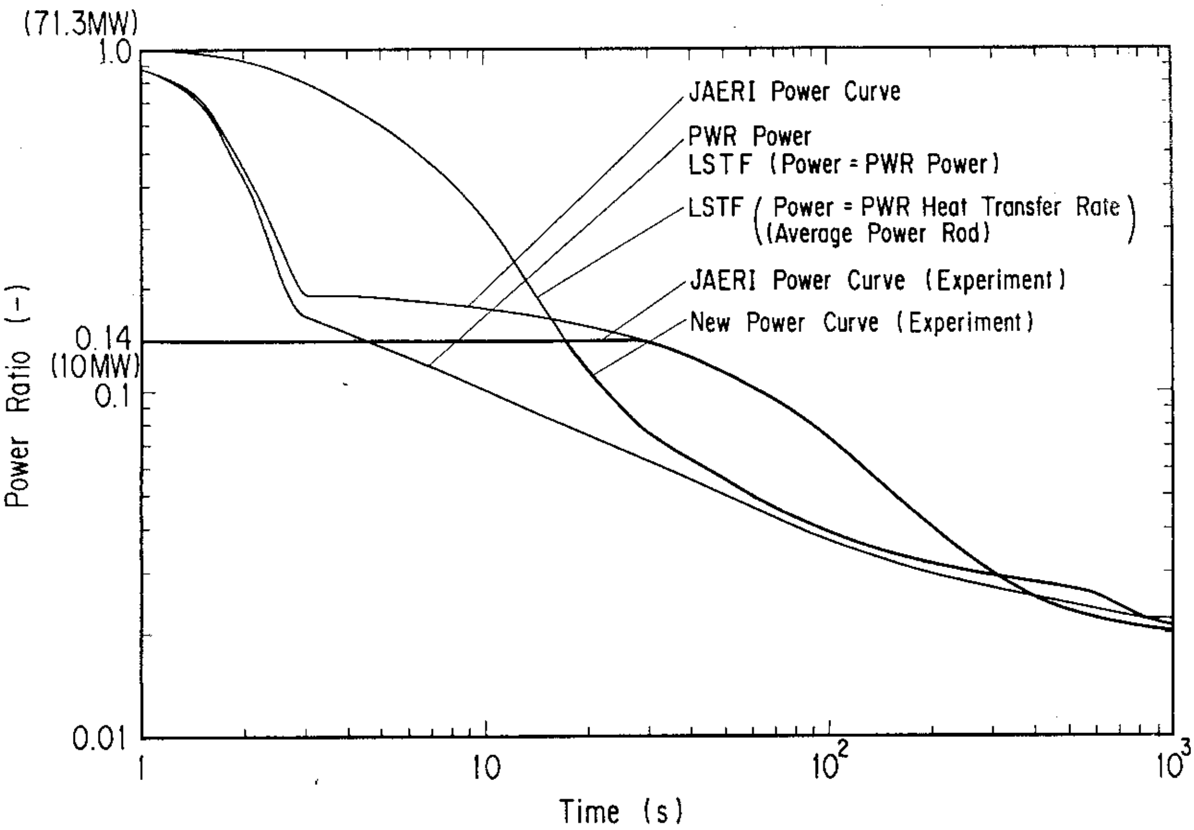


Fig. 2.13 Comparison of PWR Power, New Power Curve and JAERI Power Curve

Appendix A Input Data used for Delayed Neutron Fission Power Calculation (Case PWP000)

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FILE = J3491.LSR5P2.DATA                    DATE    88/08/05(FRIDAY)    TIME 17:41:39  PAGE 0001  *VIVAPO*

**************
** PWP000   **
**************

= PWR POWER CURVE                                                                        * 00010000  PWP013
*    RELAP5/MOD2 INPUT DATA                                                              *00020000  PWP013
*************************************************************************************00030000  PWP013
**************  MODULE NAME = PWP000            **************************00040012  PWP013
**************  87/6/16 BY KUMAMARU             **************************00050000  PWP013
**************  - INLET QUALITY = 0.05          **************************00060000  PWP013
**************  - CORE FLOW RATE = 0.59170 KG/S **************************00070000  PWP013
**************  - POWER = 26.886 KW             **************************00080000  PWP013
*************************************************************************************00090000  PWP013
*                                                                                        *00100000  PWP013
*          TYPE      OPTION                                                              *00110000  PWP013
0000100     NEW       TRANSNT                                                            *00120000  PWP013
*                                                                                        *00130000  PWP013
*          INPUT CHECK                                                                   *00140000  PWP013
0000101     RUN                                                                          *00150000  PWP013
*                                                                                        *00160000  PWP013
*          INPUT     OUTPUT                                                              *00170000  PWP013
0000102     SI        SI                                                                 *00180000  PWP013
*                                                                                        *00190000  PWP013
*         T END      MIN      MAX     CON    MIE     MAE     MR                          *00200000  PWP013
0000201      20.0   1.0-10   0.005    1      20     1000    1000                         *00210000  PWP013
0000202      50.0   1.0-10   0.005    1     100     4000    1000                         *00220000  PWP013
0000203    1000.0   1.0-10   0.010    1     500     4000    1000                         *00230000  PWP013
*                                                                                        *00240000  PWP013
*************************************************************************************00240111  PWP013
*  TRIP ; REACTOR SCRAM                                                                  *00240211  PWP013
*                                                                                        *00240311  PWP013
0000501    TIME   0   GE    NULL   0   15.0   L                                          *00241011  PWP013
*                                                                                        *00242011  PWP013
*************************************************************************************00250000  PWP013
*  MINOR EDIT REQUESTS                                                                   *00260000  PWP013
*                                                                                        *00270000  PWP013
0000301     P               005010000                                                    *00280006  PWP013
0000302     TEMPF           005010000                                                    *00290006  PWP013
0000303     P               003010000                                                    *00300006  PWP013
0000304     TEMPF           003010000                                                    *00310006  PWP013
0000305     TEMPG           003010000                                                    *00320006  PWP013
0000306     QUALS           003010000                                                    *00330006  PWP013
0000307     P               004010000                                                    *00331006  PWP013
0000308     TEMPF           004010000                                                    *00332006  PWP013
0000309     TEMPG           004010000                                                    *00333006  PWP013
0000310     QUALS           004010000                                                    *00334006  PWP013
0000311     P               001010000                                                    *00340006  PWP013
0000312     TEMPF           001010000                                                    *00350006  PWP013
0000313     TEMPG           001010000                                                    *00360006  PWP013
0000314     QUALS           001010000                                                    *00370006  PWP013
0000315     VOIDF           001010000                                                    *00380006  PWP013
0000316     VOIDG           001010000                                                    *00390006  PWP013
0000317     P               002010000                                                    *00391006  PWP013
0000318     TEMPF           002010000                                                    *00392006  PWP013

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0000319     TEMPG          002010000                                          *00393006  PWP013
0000320     QUALS          002010000                                          *00394006  PWP013
0000321     VOIDF          002010000                                          *00395006  PWP013
0000322     VOIDG          002010000                                          *00396006  PWP013
0000323     MFLOWJ         012000000                                          *00400006  PWP013
0000324     MFLOWJ         013000000                                          *00410006  PWP013
0000325     MFLOWJ         014000000                                          *00410107  PWP013
0000326     MFLOWJ         002010000                                          *00411007  PWP013
0000327     HTTEMP         001000101                                          *00420007  PWP013
0000328     HTTEMP         001000102                                          *00430007  PWP013
0000329     HTTEMP         001000103                                          *00440007  PWP013
0000330     HTTEMP         001000104                                          *00450007  PWP013
0000331     HTTEMP         001000105                                          *00460007  PWP013
0000332     HTTEMP         001000106                                          *00470007  PWP013
0000333     HTTEMP         001000107                                          *00480007  PWP013
0000334     HTTEMP         001000108                                          *00490007  PWP013
0000335     HTTEMP         001000109                                          *00500007  PWP013
0000336     HTTEMP         002000101                                          *00510007  PWP013
0000337     HTTEMP         002000102                                          *00520007  PWP013
0000338     HTTEMP         002000103                                          *00530007  PWP013
0000339     HTTEMP         002000104                                          *00540007  PWP013
0000340     HTTEMP         002000105                                          *00550007  PWP013
0000341     HTTEMP         002000106                                          *00560007  PWP013
0000342     HTTEMP         002000107                                          *00570007  PWP013
0000343     HTTEMP         002000108                                          *00580007  PWP013
0000344     HTTEMP         002000109                                          *00590007  PWP013
0000345     HTRNR          001000101                                          *00600007  PWP013
0000346     HTRNR          002000101                                          *00610007  PWP013
0000347     RKTPOW         000000000                                          *00630007  PWP013
0000348     RKFIPOW        000000000                                          *00640007  PWP013
0000349     RKGAPOW        000000000                                          *00641007  PWP013
0000350     RKREAC         000000000                                          *00642007  PWP013
0000351     RKRECPER       000000000                                          *00643007  PWP013
*                                                                             *00644000  PWP013
******************************************************************************00650000  PWP013
******************************************************************************00660000  PWP013
*                                                                             *00670000  PWP013
*           CORE  ( VOLUME 1 )                                                *00680000  PWP013
*                                                                             *00690000  PWP013
*           NAME         TYPE                                                 *00700000  PWP013
0010000     C001         SNGLVOL                                              *00710000  PWP013
*                                                                             *00720000  PWP013
*         AREA       LEN      VOL  HZ    VR     ELV     ROUGH  HYD       FE   *00730000  PWP013
0010101   1.7576-4  0.4575   0.0  0.0  90.0   0.4575   0.0  1.1778-2   00    *00740000  PWP013
*                                                                             *00750000  PWP013
*          CTL   PRESSURE     TEMP                                            *00760006  PWP013
0010200     3    15.45+6      582.0                                           *00770006  PWP013
*                                                                             *00780000  PWP013
******************************************************************************00781008  PWP013
*                                                                             *00782008  PWP013
*           CORE INLET ( BRANCH 2 )                                           *00783008  PWP013
*                                                                             *00784008  PWP013
*           NAME         TYPE                                                 *00785008  PWP013
0020000     C002         BRANCH                                               *00786008  PWP013
*                                                                             *00786108  PWP013

FILE = J3491.LSR5P2.DATA                     DATE     88/08/05(FRIDAY)     TIME 17:41:39  PAGE 0002
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*          NO.J        CTL                                                           *00786208  PWP013
0020001    1           1                                                             *00786308  PWP013
*                                                                                    *00787008  PWP013
*          AREA      LEN     VOL  HZ   VR    ELV    ROUGH  HYD     FE                *00788008  PWP013
0020101    1.7576-4  0.05    0.0  0.0  90.0  0.05   0.0    0.0     10                *00789008  PWP013
*                                                                                    *00789108  PWP013
*           CTL    PRESSURE     TEMP                                                 *00789208  PWP013
0020200     3      15.49+6      565.0                                                *00789308  PWP013
*                                                                                    *00789408  PWP013
*          FROM       TO           AREA       FLOS    RLOS    CAHS                   *00789508  PWP013
0021101    002010000  001000000    1.7576-4   0.0     0.0     0000                   *00789608  PWP013
*                                                                                    *00789708  PWP013
*          FLOW-F     FLOW-G       VEL-G                                             *00789808  PWP013
0021201    0.59170    0.0          0.0                                               *00789908  PWP013
*                                                                                    *00790208  PWP013
***********************************************************************************  *00790308  PWP013
*                                                                                    *00800000  PWP013
*           VOLUME 3                                                                 *00810006  PWP013
*                                                                                    *00820000  PWP013
*           NAME         TYPE                                                        *00830000  PWP013
0030000     C003         TMDPVOL                                                     *00840006  PWP013
*                                                                                    *00850000  PWP013
*          AREA      LEN    VOL       HZ   VR    ELV   ROUGH  HYD     FE             *00860000  PWP013
0030101    1.7576-4  1.0    1.7576-4  0.0  90.0  1.0   0.0    0.0     11             *00870006  PWP013
*                                                                                    *00880000  PWP013
*           CTL    TRIP   ALPH    NUME                                               *00890000  PWP013
0030200     3                                                                        *00900006  PWP013
*                                                                                    *00910000  PWP013
*           TIME     PRESSURE     TEMP                                               *00920007  PWP013
0030201     0.0      15.50+6      565.0                                              *00930007  PWP013
0030202     15.3     12.50+6      593.1                                              *00940007  PWP013
0030203  1000.0      12.50+6      593.1                                              *00950007  PWP013
*                                                                                    *01150000  PWP013
***********************************************************************************  *01151006  PWP013
*                                                                                    *01152006  PWP013
*           VOLUME 4                                                                 *01153007  PWP013
*                                                                                    *01154006  PWP013
*           NAME         TYPE                                                        *01155006  PWP013
0040000     C004         TMDPVOL                                                     *01156007  PWP013
*                                                                                    *01157006  PWP013
*          AREA      LEN    VOL       HZ   VR    ELV   ROUGH  HYD     FE             *01158006  PWP013
0040101    1.7576-4  1.0    1.7576-4  0.0  90.0  1.0   0.0    0.0     11             *01159007  PWP013
*                                                                                    *01159106  PWP013
*           CTL    TRIP   ALPH    NUME                                               *01159206  PWP013
0040200     2                                                                        *01159307  PWP013
*                                                                                    *01159406  PWP013
*           TIME     PRESSURE     QUALITY                                            *01159506  PWP013
0040201     0.0      15.50+6      0.05                                               *01159607  PWP013
0040202     15.3     12.50+6      0.05                                               *01159707  PWP013
0040203     25.0     10.60+6      0.05                                               *01159807  PWP013
0040204     60.0      9.25+6      0.05                                               *01159907  PWP013
0040205     77.0      8.95+6      0.05                                               *01160007  PWP013
0040206    124.0      8.45+6      0.05                                               *01160107  PWP013
0040207    148.0      8.40+6      0.05                                               *01160207  PWP013
0040208    167.0      8.15+6      0.05                                               *01160307  PWP013

FILE = J3491.LSR5P2.DATA                    DATE    88/08/05(FRIDAY)    TIME 17:41:39  PAGE 0003
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0040209   207.0      7.75+6      0.05                                          *01160407  PWP013
0040210   239.0      7.25+6      0.05                                          *01160507  PWP013
0040211   400.0      5.10+6      0.05                                          *01160607  PWP013
0040212   486.0      3.95+6      0.05                                          *01160707  PWP013
0040213   549.0      3.30+6      0.05                                          *01160807  PWP013
0040214   557.0      3.05+6      0.05                                          *01160907  PWP013
0040215   582.0      2.60+6      0.05                                          *01161007  PWP013
0040216   609.0      2.40+6      0.05                                          *01161107  PWP013
0040217   627.0      2.30+6      0.05                                          *01161207  PWP013
0040218   774.0      2.20+6      0.05                                          *01161307  PWP013
0040219   810.0      2.05+6      0.05                                          *01161407  PWP013
0040220   910.0      2.00+6      0.05                                          *01161507  PWP013
0040221   938.0      1.85+6      0.05                                          *01161607  PWP013
0040222   969.0      1.65+6      0.05                                          *01161707  PWP013
0040223  1000.0      1.55+6      0.05                                          *01161807  PWP013
*                                                                              *01161907  PWP013
*******************************************************************************01162007  PWP013
*                                                                              *01170000  PWP013
*           VOLUME 5                                                           *01180007  PWP013
*                                                                              *01190000  PWP013
*           NAME         TYPE                                                  *01200000  PWP013
0050000     C005         TMDPVOL                                               *01210007  PWP013
*                                                                              *01220000  PWP013
*         AREA       LEN      VOL   HZ    VR     ELV    ROUGH  HYD      FE     *01230000  PWP013
0050101   1.7576-4  1.0  1.7576-4  0.0  90.0  1.0  0.0    0.0      11          *01240007  PWP013
*                                                                              *01250000  PWP013
*          CTL     TRIP   ALPH    NUME                                         *01260000  PWP013
0050200     2                                                                  *01270007  PWP013
*                                                                              *01280000  PWP013
*          TIME     PRESSURE     QUALITY                                       *01290000  PWP013
0050201     0.0     15.40+6      1.0                                           *01300007  PWP013
0050202    15.3     12.40+6      1.0                                           *01310007  PWP013
0050203    25.0     10.50+6      1.0                                           *01311007  PWP013
0050204    60.0      9.15+6      1.0                                           *01320007  PWP013
0050205    77.0      8.85+6      1.0                                           *01330007  PWP013
0050206   124.0      8.35+6      1.0                                           *01340007  PWP013
0050207   148.0      8.30+6      1.0                                           *01350007  PWP013
0050208   167.0      8.05+6      1.0                                           *01360007  PWP013
0050209   207.0      7.65+6      1.0                                           *01370007  PWP013
0050210   239.0      7.15+6      1.0                                           *01380007  PWP013
0050211   400.0      5.00+6      1.0                                           *01390007  PWP013
0050212   486.0      3.85+6      1.0                                           *01400007  PWP013
0050213   549.0      3.20+6      1.0                                           *01410007  PWP013
0050214   557.0      2.95+6      1.0                                           *01420007  PWP013
0050215   582.0      2.50+6      1.0                                           *01430007  PWP013
0050216   609.0      2.30+6      1.0                                           *01440007  PWP013
0050217   627.0      2.20+6      1.0                                           *01450007  PWP013
0050218   774.0      2.10+6      1.0                                           *01460007  PWP013
0050219   810.0      1.95+6      1.0                                           *01470007  PWP013
0050220   910.0      1.90+6      1.0                                           *01480007  PWP013
0050221   938.0      1.75+6      1.0                                           *01490007  PWP013
0050222   969.0      1.55+6      1.0                                           *01500007  PWP013
0050223  1000.0      1.45+6      1.0                                           *01510007  PWP013
*                                                                              *01520000  PWP013
*******************************************************************************01530000  PWP013
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*                                                                          *01540000  PWP013
*     JUNCTION BETWEEN VOLUME 3 AND BRANCH 2  ( JUNCTION 12 )              *01550007  PWP013
*                                                                          *01560000  PWP013
*           NAME         TYPE                                              *01570000  PWP013
0120000     C012         TMDPJUN                                           *01580007  PWP013
*                                                                          *01590000  PWP013
*         FROM         TO             AREA                                 *01600000  PWP013
0120101   003000000    002000000      1.7576-4                             *01610007  PWP013
*                                                                          *01620000  PWP013
*          CTL                                                             *01630000  PWP013
0120200     1                                                              *01640007  PWP013
*                                                                          *01650000  PWP013
*           TIME       FLOW-F       FLOW-G       VEL-J                     *01660000  PWP013
0120201     0.0        0.59170      0.0          0.0                       *01670007  PWP013
0120202    15.3        0.59170      0.0          0.0                       *01671007  PWP013
0120203    15.4        0.0          0.0          0.0                       *01672007  PWP013
0120204  1000.0        0.0          0.0          0.0                       *01673007  PWP013
*                                                                          *01680000  PWP013
***************************************************************************01681007  PWP013
*                                                                          *01682007  PWP013
*     JUNCTION BETWEEN VOLUME 4 AND BRANCH 2  ( JUNCTION 13 )              *01683007  PWP013
*                                                                          *01684007  PWP013
*           NAME         TYPE                                              *01685007  PWP013
0130000     C013         TMDPJUN                                           *01686007  PWP013
*                                                                          *01687007  PWP013
*         FROM         TO             AREA                                 *01688007  PWP013
0130101   004000000    002000000      1.7576-4                             *01689007  PWP013
*                                                                          *01689107  PWP013
*          CTL                                                             *01689207  PWP013
0130200     1                                                              *01689307  PWP013
*                                                                          *01689407  PWP013
*           TIME       FLOW-F       FLOW-G       VEL-J                     *01689507  PWP013
0130201     0.0        0.0          0.0          0.0                       *01689607  PWP013
0130202    15.2        0.0          0.0          0.0                       *01689707  PWP013
0130203    15.3        0.56211      0.029585     0.0                       *01689807  PWP013
0130204  1000.0        0.56211      0.029585     0.0                       *01689907  PWP013
*                                                                          *01690007  PWP013
***************************************************************************01690107  PWP013
*                                                                          *01700000  PWP013
*     JUNCTION BETWEEN VOLUME 1 AND VOLUME 5  ( JUNCTION 14 )              *01710007  PWP013
*                                                                          *01720000  PWP013
*           NAME         TYPE                                              *01730000  PWP013
0140000     C014         SNGLJUN                                           *01740007  PWP013
*                                                                          *01750000  PWP013
*         FROM         TO          AREA      FLOS RLOS CAHS  SUBC TWOC     *01760000  PWP013
0140101   005000000    001010000 1.7576-4    0.0  0.0  0000  1.0  1.0      *01770007  PWP013
*                                                                          *01780000  PWP013
*           CTL        FLOW-F       FLOW-G       VEL-J                     *01790000  PWP013
0140201     1         -0.59170      0.0          0.0                       *01800007  PWP013
*                                                                          *01810000  PWP013
***************************************************************************01820000  PWP013
***************************************************************************01830000  PWP013
*****                    HEAT SLAB                                    *****01840000  PWP013
***************************************************************************01850000  PWP013
*****                                                                 *****01860000  PWP013

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*************************************************************************01870000  PWP013
*****         AVERAGE POWER CHANNEL HEAT STRUCTURE                  *****01880000  PWP013
*************************************************************************01890000  PWP013
*                                                                       *01900000  PWP013
*           NH     NP     TYPE    S-FLG   L-COR                         *01910000  PWP013
10010000    1      9      2       1       0.0                           *01920000  PWP013
*                                                                       *01930000  PWP013
*           LOC-F  MESH-F                                               *01940000  PWP013
10010100    0      1                                                    *01950000  PWP013
*                                                                       *01960000  PWP013
*          NO ITV   R-COR       NO ITV   R-COR       NO ITV   R-COR     *01970000  PWP013
10010101    5       0.00410 ,   1        0.00414 ,   2        0.00475   *01980000  PWP013
*                                                                       *01990000  PWP013
*           CMP    NO      CMP    NO      CMP    NO                     *02000000  PWP013
10010201    1      5 ,     2      6 ,     3      8                      *02010000  PWP013
*                                                                       *02020000  PWP013
*           SOURCE                                                      *02030000  PWP013
10010301    1.0    5 ,     0.0    6 ,     0.0    8                      *02040000  PWP013
*                                                                       *02050000  PWP013
*           FLG                                                         *02060000  PWP013
10010400    0                                                           *02070000  PWP013
*                                                                       *02080000  PWP013
*           TEMP         NP                                             *02090000  PWP013
10010401    617.7        9                                              *02100000  PWP013
*                                                                       *02110000  PWP013
******  LEFT   *****                                                    *02120000  PWP013
*                                                                       *02130000  PWP013
*            B.V.          INC  BCT   A-C      AREA       NH            *02140000  PWP013
10010501     0             0    0     0        0.0        1             *02150000  PWP013
*                                                                       *02160000  PWP013
******  RIGHT  *****                                                    *02170000  PWP013
*                                                                       *02180000  PWP013
*            B.V.          INC  BCT   A-C      AREA       NH            *02190000  PWP013
10010601     001010000     0    1     0      1.3654-2   1               *02200000  PWP013
*                                                                       *02210000  PWP013
*            TYPE     IS MULTI    L-D-H    R-D-H   NH                   *02220000  PWP013
*0010701    1000      0.30699      0.0      0.0     1                   *02230004  PWP013
10010701    1000      0.30145      0.0      0.0     1                   *02231004  PWP013
*                                                                       *02240000  PWP013
******  LEFT   *****                                                    *02250000  PWP013
*                                                                       *02260000  PWP013
*            CHF   HYD         HEQ         CHAN-L     NH                *02270000  PWP013
10010801     0     0.0         0.0         0.0        1                 *02280000  PWP013
*                                                                       *02290000  PWP013
******  RIGHT  *****                                                    *02300000  PWP013
*                                                                       *02310000  PWP013
*            CHF   HYD         HEQ         CHAN-L     NH                *02320000  PWP013
10010901     0     0.011778    0.011778    0.4575     1                 *02330000  PWP013
*                                                                       *02340000  PWP013
*************************************************************************02350000  PWP013
*****             HIGH POWER CHANNEL HEAT STRUCTURE                 *****02360000  PWP013
*************************************************************************02370000  PWP013
*                                                                       *02380000  PWP013
*           NH     NP     TYPE    S-FLG   L-COR                         *02390000  PWP013
10020000    1      9      2       1       0.0                           *02400000  PWP013

FILE = J3491.LSR5P2.DATA                    DATE     88/08/05(FRIDAY)      TIME 17:41:39  PAGE 0006
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*                                                                           *02410000  PWP013
*          LOC-F  MESH-F                                                    *02420000  PWP013
10020100   0010                                                             *02430000  PWP013
*                                                                           *02440000  PWP013
*          FLG                                                              *02450000  PWP013
10020400   0010                                                             *02460000  PWP013
*                                                                           *02470000  PWP013
******  LEFT   *****                                                        *02480000  PWP013
*                                                                           *02490000  PWP013
*           B.V.         INC  BCT   A-C      AREA      NH                   *02500000  PWP013
10020501    0            0    0     0        0.0        1                   *02510000  PWP013
*                                                                           *02520000  PWP013
******  RIGHT  *****                                                        *02530000  PWP013
*                                                                           *02540000  PWP013
*           B.V.         INC  BCT   A-C      AREA      NH                   *02550000  PWP013
10020601    001010000    0    1     0      1.3654-2     1                   *02560000  PWP013
*                                                                           *02570000  PWP013
*           TYPE     IS MULTI    L-D-H   R-D-H   NH                         *02580000  PWP013
*0020701   1000      0.69301      0.0     0.0     1                         *02590004  PWP013
10020701   1000      0.69855      0.0     0.0     1                         *02591004  PWP013
*                                                                           *02600000  PWP013
******  LEFT   *****                                                        *02610000  PWP013
*                                                                           *02620000  PWP013
*           CHF    HYD        HEQ         CHAN-L    NH                      *02630000  PWP013
10020801     0     0.0        0.0         0.0       1                       *02640000  PWP013
*                                                                           *02650000  PWP013
******  RIGHT  *****                                                        *02660000  PWP013
*                                                                           *02670000  PWP013
*           CHF    HYD        HEQ         CHAN-L    NH                      *02680000  PWP013
10020901     0     0.011778   0.011778    0.4575    1                       *02690000  PWP013
*                                                                           *02700000  PWP013
****************************************************************************02710000  PWP013
*                                                                           *02720000  PWP013
*****      HEAT STRUCTURE THERMAL PROPERTY DATA                        *****02730000  PWP013
*                                                                           *02740000  PWP013
****************************************************************************02750000  PWP013
*                                                                           *02760000  PWP013
*               TYPE       K-FLAG    CV-FLAG                                *02770000  PWP013
*UO2                                                                        *02780000  PWP013
20100100        TBL/FCTN     1          1                                   *02790000  PWP013
*HE GAS                                                                     *02800000  PWP013
20100200        TBL/FCTN     1          1                                   *02810000  PWP013
*ZIRCONIUM                                                                  *02820000  PWP013
20100300        ZR                                                          *02830000  PWP013
*                                                                           *02840000  PWP013
*********        THERMAL CONDUCTIVITY (W/MK)                      **********02850000  PWP013
*                                                                           *02860000  PWP013
*          TEMP      COND        TEMP      COND       TEMP      COND        *02870000  PWP013
*UO2                                                                        *02880000  PWP013
20100101    311.1    8.657       422.1     6.915      533.2     5.759       *02890000  PWP013
20100102    644.3    4.939       755.4     4.329      866.5     3.858       *02900000  PWP013
20100103    977.6    3.488      1088.8     3.190     1199.9     2.947       *02910000  PWP013
20100104   1311.0    2.683      1421.2     2.553     1533.2     2.396       *02920000  PWP013
*0100105   1644.2    2.309      1927.2     2.197                            *02930002  PWP013
20100105   1644.2    2.309      1927.2     2.197     3927.2     2.197       *02931002  PWP013
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*                                                                            *02940000  PWP013
*                                                                            *02950000  PWP013
*HE GAS                                                                      *02960000  PWP013
20100201    0.221                                                            *02970000  PWP013
*                                                                            *02980000  PWP013
*                                                                            *02990000  PWP013
*********        VOLUMETRIC HEAT CAPACITY (J/M3K)                  *********03000000  PWP013
*                                                                            *03010000  PWP013
*             TEMP     COND        TEMP     COND        TEMP     COND       *03020000  PWP013
*U02                                                                         *03030000  PWP013
*0100151     311.0    1076.0      422.1    1217.7      533.2    1287.4      *03040001  PWP013
*0100152     644.3    1330.0      755.4    1360.4      866.5    1384.4      *03050001  PWP013
*0100153     977.6    1404.5     1088.8    1422.4     1199.9    1439.0      *03060001  PWP013
*0100154    1644.3    1484.0                                                 *03070001  PWP013
20100151     311.0  3.8736+6      422.1  4.3837+6      533.2  4.6346+6      *03071001  PWP013
20100152     644.3  4.7880+6      755.4  4.8974+6      866.5  4.9838+6      *03072001  PWP013
20100153     977.6  5.0562+6     1088.8  5.1206+6     1199.9  5.1804+6      *03073001  PWP013
*0100154    1644.3  5.3424+6                                                 *03074002  PWP013
20100154    1644.3  5.3424+6     3644.3  5.3424+6                            *03075002  PWP013
*                                                                            *03080000  PWP013
*                                                                            *03090000  PWP013
*HE GAS                                                                      *03100000  PWP013
*0100251    0.245                                                            *03110001  PWP013
20100251    882.0                                                            *03111001  PWP013
*                                                                            *03120000  PWP013
*                                                                            *03130000  PWP013
*****************************************************************************03140000  PWP013
*****                                                                  *****03150000  PWP013
*****       REACTOR KINETICS                                           *****03160000  PWP013
*****                                                                  *****03170000  PWP013
*****************************************************************************03180000  PWP013
*                                                                            *03190000  PWP013
*           TYPE          FEEDBACK                                           *03200000  PWP013
30000000    POINT         SEPARABL                                           *03210000  PWP013
*                                                                            *03220000  PWP013
*           DECAY      T. POWER    I.R.   DNF/PNGT   FP YF   U239 YF        *03230010  PWP013
*0000001    GAMMA-AC   26.886+3    0.0    375.0                              *03240004  PWP013
*0000001    GAMMA-AC   27.380+3    0.0    375.0                              *03241010  PWP013
30000001    GAMMA-AC   27.380+3    0.0    375.0      1.0     0.59            *03242010  PWP013
*                                                                            *03250000  PWP013
*           F.P. TYPE                                                        *03260000  PWP013
30000002    ANS79-1                                                          *03270000  PWP013
*                                                                            *03280000  PWP013
*           TABLE                                                            *03290000  PWP013
30000011    111                                                              *03300000  PWP013
*                                                                            *03310000  PWP013
*****************************************************************************03320000  PWP013
*                                                                            *03330000  PWP013
*    REACTIVITY TABLE                                                        *03340000  PWP013
*                                                                            *03350000  PWP013
*           T TYPE     TRIP    F1       F2                                 *  03360011  PWP013
20211100    REAC-T     501     1.0      -0.04                                *03370011  PWP013
*                                                                            *03380000  PWP013
*           TIME              REACTIVITY                                     *03390000  PWP013
20211101      0.0                0.0                                         *03400011  PWP013
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FILE = J3491.LSR5P2.DATA                    DATE    88/08/05(FRIDAY)     TIME 17:41:39  PAGE 0009  *VIVAPO*

           20211102      0.5          0.53333                                       *03410011  PWP013
           20211103      1.0           3.3333                                       *03420011  PWP013
           20211104      1.4           8.2667                                       *03430011  PWP013
           20211105      1.6          12.000                                        *03440011  PWP013
           20211106      1.8          18.667                                        *03450011  PWP013
           20211107      2.0          33.333                                        *03460011  PWP013
           20211108      2.2          75.333                                        *03470011  PWP013
           20211109      2.4         116.00                                         *03480011  PWP013
           20211110      2.6         127.20                                         *03490011  PWP013
           20211111      2.8         131.47                                         *03500011  PWP013
           20211112      3.0         133.33                                         *03510011  PWP013
           20211113   1000.0         133.33                                         *03520011  PWP013
           *                                                                        *03530000  PWP013
           ************************************************************************ *03540000  PWP013
           .                                                                        *03550000  PWP013
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Appendix B Input Data used for PWR Heat Transfer Calculation (Case POPW01)

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FILE = J3491.LSR5P2.DATA                    DATE     87/10/13(TUESDAY)     TIME 20:03:49  PAGE 0001  *VIVAPO*

      **************
      ** POPW01    **
      **************

              = PWR POWER CURVE                                                          *00010020  POPW01
              *    RELAP5/MOD2 INPUT DATA                                                *00020000  POPW01
              ************************************************************************00030000  POPW01
              **************  MODULE NAME = POPW01              ************************00040019  POPW01
              **************  87/6/16 BY KUMAMARU               ************************00050000  POPW01
              **************  - INLET CONDITION :               ************************00060020  POPW01
              **************         SUBCOOLED TO SATURATED     ************************00061020  POPW01
              **************  - CORE FLOW RATE = 0.59170 KG/S   ************************00070000  POPW01
              **************  - POWER = 26.886 KW               ************************00080000  POPW01
              ************************************************************************00090000  POPW01
              *                                                                          *00100000  POPW01
              *          TYPE      OPTION                                                *00110000  POPW01
              0000100     NEW      TRANSNT                                               *00120000  POPW01
              *                                                                          *00130000  POPW01
              *          INPUT CHECK                                                     *00140000  POPW01
              0000101     RUN                                                            *00150000  POPW01
              *                                                                          *00160000  POPW01
              *          INPUT     OUTPUT                                                *00170000  POPW01
              0000102     SI        SI                                                   *00180000  POPW01
              *                                                                          *00190000  POPW01
              *         T END     MIN      MAX    CON    MIE     MAE     MR              *00200000  POPW01
              0000201      20.0   1.0-10   0.005   1     100     4000    1000            *00210017  POPW01
              0000202      50.0   1.0-10   0.005   1     200     4000    1000            *00220017  POPW01
              0000203     200.0   1.0-10   0.01    1     250     4000    1000            *00221017  POPW01
              0000204     500.0   1.0-10   0.02    1     250     4000    1000            *00230016  POPW01
              0000205    1050.0   1.0-10   0.04    1     125     4000    1000            *00231017  POPW01
              *                                                                          *00240000  POPW01
              ************************************************************************00240111  POPW01
              *  TRIP ; REACTOR SCRAM                                                    *00240211  POPW01
              *                                                                          *00240311  POPW01
              0000501     TIME    0   GE    NULL    0    15.0    L                       *00241011  POPW01
              *                                                                          *00242011  POPW01
              ************************************************************************00250000  POPW01
              *  MINOR EDIT REQUESTS                                                     *00260000  POPW01
              *                                                                          *00270000  POPW01
              0000301     P                 005010000                                    *00280006  POPW01
              0000302     TEMPF             005010000                                    *00290006  POPW01
              0000303     P                 003010000                                    *00300006  POPW01
              0000304     TEMPF             003010000                                    *00310006  POPW01
              0000305     TEMPG             003010000                                    *00320006  POPW01
              0000306     QUALS             003010000                                    *00330006  POPW01
              0000307     P                 004010000                                    *00331006  POPW01
              0000308     TEMPF             004010000                                    *00332006  POPW01
              0000309     TEMPG             004010000                                    *00333006  POPW01
              0000310     QUALS             004010000                                    *00334006  POPW01
              0000311     P                 001010000                                    *00340006  POPW01
              0000312     TEMPF             001010000                                    *00350006  POPW01
              0000313     TEMPG             001010000                                    *00360006  POPW01
              0000314     QUALS             001010000                                    *00370006  POPW01
              0000315     VOIDF             001010000                                    *00380006  POPW01

FILE = J3491.LSR5P2.DATA                    DATE     87/10/13(TUESDAY)     TIME 20:03:49  PAGE 0001
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FILE = J3491.LSR5P2.DATA                    DATE    87/10/13(TUESDAY)     TIME 20:03:49  PAGE 0002  *VIVAPO*

                   0000316     VOIDG          001010000                                       *00390006  POPW01
                   0000317     P              002010000                                       *00391006  POPW01
                   0000318     TEMPF          002010000                                       *00392006  POPW01
                   0000319     TEMPG          002010000                                       *00393006  POPW01
                   0000320     QUALS          002010000                                       *00394006  POPW01
                   0000321     VOIDF          002010000                                       *00395006  POPW01
                   0000322     VOIDG          002010000                                       *00396006  POPW01
                   0000323     MFLOWJ         012000000                                       *00400006  POPW01
                   0000324     MFLOWJ         013000000                                       *00410006  POPW01
                   0000325     MFLOWJ         014000000                                       *00410107  POPW01
                   0000326     MFLOWJ         002010000                                       *00411007  POPW01
                   0000327     HTTEMP         001000101                                       *00420007  POPW01
                   0000328     HTTEMP         001000102                                       *00430007  POPW01
                   0000329     HTTEMP         001000103                                       *00440007  POPW01
                   0000330     HTTEMP         001000104                                       *00450007  POPW01
                   0000331     HTTEMP         001000105                                       *00460007  POPW01
                   0000332     HTTEMP         001000106                                       *00470007  POPW01
                   0000333     HTTEMP         001000107                                       *00480007  POPW01
                   0000334     HTTEMP         001000108                                       *00490007  POPW01
                   0000335     HTTEMP         001000109                                       *00500007  POPW01
                   0000336     HTTEMP         002000101                                       *00510007  POPW01
                   0000337     HTTEMP         002000102                                       *00520007  POPW01
                   0000338     HTTEMP         002000103                                       *00530007  POPW01
                   0000339     HTTEMP         002000104                                       *00540007  POPW01
                   0000340     HTTEMP         002000105                                       *00550007  POPW01
                   0000341     HTTEMP         002000106                                       *00560007  POPW01
                   0000342     HTTEMP         002000107                                       *00570007  POPW01
                   0000343     HTTEMP         002000108                                       *00580007  POPW01
                   0000344     HTTEMP         002000109                                       *00590007  POPW01
                   0000345     HTRNR          001000101                                       *00600007  POPW01
                   0000346     HTRNR          002000101                                       *00610007  POPW01
                   *000347     RKTPOW         000000000                                       *00630013  POPW01
                   *000348     RKFIPOW        000000000                                       *00640013  POPW01
                   *000349     RKGAPOW        000000000                                       *00641013  POPW01
                   *000350     RKREAC         000000000                                       *00642013  POPW01
                   *000351     RKRECPER       000000000                                       *00643013  POPW01
                   *                                                                          *00644000  POPW01
                   ***************************************************************************00650000  POPW01
                   ***************************************************************************00660000  POPW01
                   *                                                                          *00670000  POPW01
                   *           CORE  ( VOLUME 1 )                                             *00680000  POPW01
                   *                                                                          *00690000  POPW01
                   *           NAME         TYPE                                              *00700000  POPW01
                   0010000     C001         SNGLVOL                                           *00710000  POPW01
                   *                                                                          *00720000  POPW01
                   *         AREA      LEN      VOL  HZ    VR    ELV     ROUGH  HYD      FE   *00730000  POPW01
                   0010101   1.7576-4  0.4575   0.0  0.0   90.0  0.4575  0.0    1.1778-2 00   *00740000  POPW01
                   *                                                                          *00750000  POPW01
                   *          CTL   PRESSURE    TEMP                                          *00760006  POPW01
                   0010200    3     15.45+6     582.0                                         *00770006  POPW01
                   *                                                                          *00780000  POPW01
                   ***************************************************************************00781008  POPW01
                   *                                                                          *00782008  POPW01
                   *           CORE INLET ( BRANCH 2 )                                        *00783008  POPW01
                   *                                                                          *00784008  POPW01

FILE = J3491.LSR5P2.DATA                    DATE    87/10/13(TUESDAY)     TIME 20:03:49  PAGE 0002
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*            NAME        TYPE                                                                   *00785008  POPW01
0020000      C002        BRANCH                                                                 *00786008  POPW01
*                                                                                               *00786108  POPW01
*            NO.J        CTL                                                                    *00786208  POPW01
0020001      1           1                                                                      *00786308  POPW01
*                                                                                               *00787008  POPW01
*          AREA       LEN      VOL  HZ   VR    ELV     ROUGH  HYD     FE                        *00788008  POPW01
0020101    1.7576-4   0.05     0.0  0.0  90.0  0.05    0.0    0.0     10                        *00789008  POPW01
*                                                                                               *00789108  POPW01
*            CTL    PRESSURE      TEMP                                                          *00789208  POPW01
0020200      3      15.49+6       565.0                                                         *00789308  POPW01
*                                                                                               *00789408  POPW01
*          FROM        TO             AREA       FLOS   RLOS   CAHS                             *00789508  POPW01
0021101    002010000   001000000      1.7576-4   0.0    0.0    0000                             *00789608  POPW01
*                                                                                               *00789708  POPW01
*          FLOW-F     FLOW-G      VEL-G                                                         *00789808  POPW01
0021201    0.59170    0.0         0.0                                                           *00789908  POPW01
*                                                                                               *00790208  POPW01
**********************************************************************************************  *00790308  POPW01
*                                                                                               *00800000  POPW01
*            VOLUME 3                                                                           *00810006  POPW01
*                                                                                               *00820000  POPW01
*            NAME        TYPE                                                                   *00830000  POPW01
0030000      C003        TMDPVOL                                                                *00840006  POPW01
*                                                                                               *00850000  POPW01
*          AREA       LEN    VOL       HZ   VR    ELV   ROUGH  HYD     FE                       *00860000  POPW01
0030101    1.7576-4   1.0    1.7576-4  0.0  90.0  1.0   0.0    0.0     11                       *00870006  POPW01
*                                                                                               *00880000  POPW01
*            CTL    TRIP   ALPH   NUME                                                          *00890000  POPW01
0030200      3                                                                                  *00900006  POPW01
*                                                                                               *00910000  POPW01
*            TIME    PRESSURE     TEMP                                                          *00920007  POPW01
0030201      0.0     15.50+6      565.0                                                         *00930007  POPW01
0030202      15.3    12.50+6      593.1                                                         *00940007  POPW01
0030203    1000.0    12.50+6      593.1                                                         *00950007  POPW01
*                                                                                               *01150000  POPW01
**********************************************************************************************  *01151006  POPW01
*                                                                                               *01152006  POPW01
*            VOLUME 4                                                                           *01153007  POPW01
*                                                                                               *01154006  POPW01
*            NAME        TYPE                                                                   *01155006  POPW01
0040000      C004        TMDPVOL                                                                *01156007  POPW01
*                                                                                               *01157006  POPW01
*          AREA       LEN    VOL       HZ   VR    ELV   ROUGH  HYD     FE                       *01158006  POPW01
0040101    1.7576-4   1.0    1.7576-4  0.0  90.0  1.0   0.0    0.0     11                       *01159007  POPW01
*                                                                                               *01159106  POPW01
*            CTL    TRIP   ALPH   NUME                                                          *01159206  POPW01
0040200      2                                                                                  *01159307  POPW01
*                                                                                               *01159406  POPW01
*            TIME    PRESSURE     QUALITY                                                       *01159506  POPW01
0040201      0.0     15.50+6      1.0-10                                                        *01159619  POPW01
0040202      15.3    12.50+6      1.0-10                                                        *01159719  POPW01
0040203      25.0    10.60+6      1.0-10                                                        *01159819  POPW01
0040204      60.0     9.25+6      1.0-10                                                        *01159919  POPW01
0040205      77.0     8.95+6      1.0-10                                                        *01160019  POPW01
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0040206   124.0     8.45+6      1.0-10                                  *01160119  POPW01
0040207   148.0     8.40+6      1.0-10                                  *01160219  POPW01
0040208   167.0     8.15+6      1.0-10                                  *01160319  POPW01
0040209   207.0     7.75+6      1.0-10                                  *01160419  POPW01
0040210   239.0     7.25+6      1.0-10                                  *01160519  POPW01
0040211   400.0     5.10+6      1.0-10                                  *01160619  POPW01
0040212   486.0     3.95+6      1.0-10                                  *01160719  POPW01
0040213   549.0     3.30+6      1.0-10                                  *01160819  POPW01
0040214   557.0     3.05+6      1.0-10                                  *01160919  POPW01
0040215   582.0     2.60+6      1.0-10                                  *01161019  POPW01
0040216   609.0     2.40+6      1.0-10                                  *01161119  POPW01
0040217   627.0     2.30+6      1.0-10                                  *01161219  POPW01
0040218   774.0     2.20+6      1.0-10                                  *01161319  POPW01
0040219   810.0     2.05+6      1.0-10                                  *01161419  POPW01
0040220   910.0     2.00+6      1.0-10                                  *01161519  POPW01
0040221   938.0     1.85+6      1.0-10                                  *01161619  POPW01
0040222   969.0     1.65+6      1.0-10                                  *01161719  POPW01
0040223  1000.0     1.55+6      1.0-10                                  *01161819  POPW01
*                                                                       *01161907  POPW01
************************************************************************01162007  POPW01
*                                                                       *01170000  POPW01
*           VOLUME 5                                                    *01180007  POPW01
*                                                                       *01190000  POPW01
*           NAME        TYPE                                            *01200000  POPW01
0050000     C005        TMDPVOL                                         *01210007  POPW01
*                                                                       *01220000  POPW01
*         AREA      LEN     VOL  HZ   VR    ELV    ROUGH  HYD      FE   *01230000  POPW01
0050101   1.7576-4  1.0  1.7576-4  0.0  90.0  1.0  0.0    0.0      11   *01240007  POPW01
*                                                                       *01250000  POPW01
*          CTL    TRIP   ALPH   NUME                                    *01260000  POPW01
0050200     2                                                           *01270007  POPW01
*                                                                       *01280000  POPW01
*          TIME     PRESSURE     QUALITY                                *01290000  POPW01
0050201     0.0     15.40+6      1.0                                    *01300007  POPW01
0050202    15.3     12.40+6      1.0                                    *01310007  POPW01
0050203    25.0     10.50+6      1.0                                    *01311007  POPW01
0050204    60.0      9.15+6      1.0                                    *01320007  POPW01
0050205    77.0      8.85+6      1.0                                    *01330007  POPW01
0050206   124.0      8.35+6      1.0                                    *01340007  POPW01
0050207   148.0      8.30+6      1.0                                    *01350007  POPW01
0050208   167.0      8.05+6      1.0                                    *01360007  POPW01
0050209   207.0      7.65+6      1.0                                    *01370007  POPW01
0050210   239.0      7.15+6      1.0                                    *01380007  POPW01
0050211   400.0      5.00+6      1.0                                    *01390007  POPW01
0050212   486.0      3.85+6      1.0                                    *01400007  POPW01
0050213   549.0      3.20+6      1.0                                    *01410007  POPW01
0050214   557.0      2.95+6      1.0                                    *01420007  POPW01
0050215   582.0      2.50+6      1.0                                    *01430007  POPW01
0050216   609.0      2.30+6      1.0                                    *01440007  POPW01
0050217   627.0      2.20+6      1.0                                    *01450007  POPW01
0050218   774.0      2.10+6      1.0                                    *01460007  POPW01
0050219   810.0      1.95+6      1.0                                    *01470007  POPW01
0050220   910.0      1.90+6      1.0                                    *01480007  POPW01
0050221   938.0      1.75+6      1.0                                    *01490007  POPW01
0050222   969.0      1.55+6      1.0                                    *01500007  POPW01
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FILE = J3491.LSR5P2.DATA                DATE     87/10/13(TUESDAY)     TIME 20:03:49  PAGE 0005  *VIVAPO*

0050223  1000.0       1.45+6      1.0                                         *01510007  POPW01
*                                                                             *01520000  POPW01
******************************************************************************01530000  POPW01
*                                                                             *01540000  POPW01
*     JUNCTION BETWEEN VOLUME 3 AND BRANCH 2  ( JUNCTION 12 )                 *01550007  POPW01
*                                                                             *01560000  POPW01
*          NAME          TYPE                                                 *01570000  POPW01
0120000    C012          TMDPJUN                                              *01580007  POPW01
*                                                                             *01590000  POPW01
*        FROM          TO            AREA                                     *01600000  POPW01
0120101  003000000     002000000     1.7576-4                                 *01610007  POPW01
*                                                                             *01620000  POPW01
*          CTL                                                                *01630000  POPW01
0120200    1                                                                  *01640007  POPW01
*                                                                             *01650000  POPW01
*          TIME        FLOW-F        FLOW-G       VEL-J                       *01660000  POPW01
0120201    0.0         0.59170       0.0          0.0                         *01670007  POPW01
0120202    15.3        0.59170       0.0          0.0                         *01671007  POPW01
0120203    15.4        0.0           0.0          0.0                         *01672007  POPW01
0120204  1000.0        0.0           0.0          0.0                         *01673007  POPW01
*                                                                             *01680000  POPW01
******************************************************************************01681007  POPW01
*                                                                             *01682007  POPW01
*     JUNCTION BETWEEN VOLUME 4 AND BRANCH 2  ( JUNCTION 13 )                 *01683007  POPW01
*                                                                             *01684007  POPW01
*          NAME          TYPE                                                 *01685007  POPW01
0130000    C013          TMDPJUN                                              *01686007  POPW01
*                                                                             *01687007  POPW01
*        FROM          TO            AREA                                     *01688007  POPW01
0130101  004000000     002000000     1.7576-4                                 *01689007  POPW01
*                                                                             *01689107  POPW01
*          CTL                                                                *01689207  POPW01
0130200    1                                                                  *01689307  POPW01
*                                                                             *01689407  POPW01
*          TIME        FLOW-F        FLOW-G       VEL-J                       *01689507  POPW01
0130201    0.0         0.0           0.0          0.0                         *01689607  POPW01
0130202    15.2        0.0           0.0          0.0                         *01689707  POPW01
0130203    15.3        0.59170       0.59170-10   0.0                         *01689819  POPW01
0130204  1000.0        0.59170       0.59170-10   0.0                         *01689919  POPW01
*                                                                             *01690007  POPW01
******************************************************************************01690107  POPW01
*                                                                             *01700000  POPW01
*     JUNCTION BETWEEN VOLUME 1 AND VOLUME 5  ( JUNCTION 14 )                 *01710007  POPW01
*                                                                             *01720000  POPW01
*          NAME          TYPE                                                 *01730000  POPW01
0140000    C014          SNGLJUN                                              *01740007  POPW01
*                                                                             *01750000  POPW01
*        FROM          TO            AREA       FLOS RLOS CAHS  SUBC TWOC     *01760000  POPW01
0140101  005000000     001010000  1.7576-4      0.0  0.0  0000  1.0  1.0      *01770007  POPW01
*                                                                             *01780000  POPW01
*          CTL         FLOW-F        FLOW-G       VEL-J                       *01790000  POPW01
0140201    1          -0.59170       0.0          0.0                         *01800007  POPW01
*                                                                             *01810000  POPW01
******************************************************************************01820000  POPW01
******************************************************************************01830000  POPW01

FILE = J3491.LSR5P2.DATA                DATE     87/10/13(TUESDAY)     TIME 20:03:49  PAGE 0005
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FILE = J3491.LSR5P2.DATA                    DATE    87/10/13(TUESDAY)    TIME 20:03:49  PAGE 0006  *VIVAPO*

*****                   HEAT SLAB                                              *****01840000  POPW01
*****************************************************************************01850000  POPW01
*****                                                                          *****01860000  POPW01
*****************************************************************************01870000  POPW01
*****         AVERAGE POWER CHANNEL HEAT STRUCTURE                             *****01880000  POPW01
*****************************************************************************01890000  POPW01
*                                                                                  *01900000  POPW01
*          NH     NP     TYPE    S-FLG  L-COR                                      *01910000  POPW01
10010000    1      9      2        1      0.0                                      *01920000  POPW01
*                                                                                  *01930000  POPW01
*          LOC-F  MESH-F                                                           *01940000  POPW01
10010100    0      1                                                               *01950000  POPW01
*                                                                                  *01960000  POPW01
*         NO ITV   R-COR       NO ITV    R-COR       NO ITV    R-COR               *01970000  POPW01
10010101    5       0.00410 ,    1       0.00414 ,    2        0.00475             *01980000  POPW01
*                                                                                  *01990000  POPW01
*          CMP    NO      CMP    NO      CMP    NO                                 *02000000  POPW01
10010201    1      5 ,     2      6 ,     3      8                                 *02010000  POPW01
*                                                                                  *02020000  POPW01
*          SOURCE                                                                  *02030000  POPW01
10010301   1.0     5 ,    0.0     6 ,    0.0     8                                 *02040000  POPW01
*                                                                                  *02050000  POPW01
*          FLG                                                                     *02060000  POPW01
10010400    0                                                                      *02070000  POPW01
*                                                                                  *02080000  POPW01
*          TEMP         NP                                                         *02090000  POPW01
10010401   617.7        9                                                          *02100000  POPW01
*                                                                                  *02110000  POPW01
******  LEFT   *****                                                               *02120000  POPW01
*                                                                                  *02130000  POPW01
*           B.V.         INC  BCT    A-C      AREA       NH                        *02140000  POPW01
10010501    0            0    0      0       0.0         1                         *02150000  POPW01
*                                                                                  *02160000  POPW01
******  RIGHT  *****                                                               *02170000  POPW01
*                                                                                  *02180000  POPW01
*           B.V.         INC  BCT    A-C      AREA       NH                        *02190000  POPW01
10010601    001010000    0    1      0      1.3654-2     1                         *02200000  POPW01
*                                                                                  *02210000  POPW01
*           TYPE     IS MULTI     L-D-H    R-D-H    NH                             *02220000  POPW01
*0010701   1000      0.30699       0.0      0.0      1                             *02230004  POPW01
*0010701   1000      0.30145       0.0      0.0      1                             *02231012  POPW01
10010701    900      0.30145       0.0      0.0      1                             *02232012  POPW01
*                                                                                  *02240000  POPW01
******  LEFT   *****                                                               *02250000  POPW01
*                                                                                  *02260000  POPW01
*           CHF   HYD          HEQ           CHAN-L      NH                        *02270000  POPW01
10010801    0     0.0          0.0           0.0         1                         *02280000  POPW01
*                                                                                  *02290000  POPW01
******  RIGHT  *****                                                               *02300000  POPW01
*                                                                                  *02310000  POPW01
*           CHF   HYD          HEQ           CHAN-L      NH                        *02320000  POPW01
10010901    0     0.011778     0.011778      0.4575      1                         *02330000  POPW01
*                                                                                  *02340000  POPW01
*****************************************************************************02350000  POPW01
*****              HIGH POWER CHANNEL HEAT STRUCTURE                           *****02360000  POPW01

FILE = J3491.LSR5P2.DATA                    DATE    87/10/13(TUESDAY)    TIME 20:03:49  PAGE 0006
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FILE = J3491.LSR5P2.DATA                    DATE    87/10/13(TUESDAY)     TIME 20:03:49  PAGE 0007  *VIVAPO*

*************************************************************************02370000  POPW01
*                                                                        *02380000  POPW01
*            NH     NP     TYPE     S-FLG   L-COR                        *02390000  POPW01
10020000      1      9      2         1       0.0                        *02400000  POPW01
*                                                                        *02410000  POPW01
*           LOC-F   MESH-F                                               *02420000  POPW01
10020100    0010                                                         *02430000  POPW01
*                                                                        *02440000  POPW01
*           FLG                                                          *02450000  POPW01
10020400    0010                                                         *02460000  POPW01
*                                                                        *02470000  POPW01
******  LEFT   *****                                                     *02480000  POPW01
*                                                                        *02490000  POPW01
*            B.V.          INC   BCT   A-C      AREA       NH            *02500000  POPW01
10020501     0              0     0     0       0.0         1            *02510000  POPW01
*                                                                        *02520000  POPW01
******  RIGHT  *****                                                     *02530000  POPW01
*                                                                        *02540000  POPW01
*            B.V.          INC   BCT   A-C      AREA       NH            *02550000  POPW01
10020601     001010000      0     1     0     1.3654-2      1            *02560000  POPW01
*                                                                        *02570000  POPW01
*            TYPE      IS MULTI      L-D-H    R-D-H    NH                *02580000  POPW01
*0020701    1000       0.69301        0.0      0.0      1                *02590004  POPW01
*0020701    1000       0.69855        0.0      0.0      1                *02591012  POPW01
10020701     900       0.69855        0.0      0.0      1                *02592012  POPW01
*                                                                        *02600000  POPW01
******  LEFT   *****                                                     *02610000  POPW01
*                                                                        *02620000  POPW01
*           CHF    HYD          HEQ           CHAN-L      NH             *02630000  POPW01
10020801     0     0.0          0.0           0.0          1             *02640000  POPW01
*                                                                        *02650000  POPW01
******  RIGHT  *****                                                     *02660000  POPW01
*                                                                        *02670000  POPW01
*           CHF    HYD          HEQ           CHAN-L      NH             *02680000  POPW01
10020901     0     0.011778     0.011778      0.4575       1             *02690000  POPW01
*                                                                        *02700000  POPW01
*************************************************************************02710000  POPW01
*                                                                        *02720000  POPW01
*****     HEAT STRUCTURE THERMAL PROPERTY DATA                      *****02730000  POPW01
*                                                                        *02740000  POPW01
*************************************************************************02750000  POPW01
*                                                                        *02760000  POPW01
*                TYPE        K-FLAG     CV-FLAG                          *02770000  POPW01
*UO2                                                                     *02780000  POPW01
20100100         TBL/FCTN     1            1                             *02790000  POPW01
*HE GAS                                                                  *02800000  POPW01
20100200         TBL/FCTN     1            1                             *02810000  POPW01
*ZIRCONIUM                                                               *02820000  POPW01
*0100300         ZR                                                      *02830014  POPW01
20100300         TBL/FCTN     1            1                             *02831014  POPW01
*                                                                        *02840000  POPW01
*********          THERMAL CONDUCTIVITY (W/MK)                 **********02850000  POPW01
*                                                                        *02860000  POPW01
*            TEMP     COND       TEMP     COND       TEMP     COND       *02870000  POPW01
*UO2                                                                     *02880000  POPW01

FILE = J3491.LSR5P2.DATA                    DATE    87/10/13(TUESDAY)     TIME 20:03:49  PAGE 0007
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FILE = J3491.LSR5P2.DATA   DATE 87/10/13(TUESDAY)   TIME 20:03:49 PAGE 0008 *VIVAPO*

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20100101    311.1    8.657     422.1    6.915     533.2    5.759      *02890000  POPW01
20100102    644.3    4.939     755.4    4.329     866.5    3.858      *02900000  POPW01
20100103    977.6    3.488    1088.8    3.190    1199.9    2.947      *02910000  POPW01
20100104   1311.0    2.683    1421.2    2.553    1533.2    2.396      *02920000  POPW01
*0100105   1644.2    2.309    1927.2    2.197                         *02930002  POPW01
20100105   1644.2    2.309    1927.2    2.197    3927.2    0.7915     *02931014  POPW01
*                                                                     *02940000  POPW01
*                                                                     *02950000  POPW01
*HE GAS                                                               *02960000  POPW01
20100201    0.221                                                     *02970000  POPW01
*                                                                     *02971014  POPW01
*            TEMP     COND      TEMP     COND      TEMP     COND      *02972014  POPW01
*ZR-4                                                                 *02973014  POPW01
*0100301                         380.4    13.6      469.3    14.6     *02974014  POPW01
20100301    300.0    12.8        380.4    13.6      469.3    14.6     *02974114  POPW01
20100302    577.6    15.8        685.9    17.3      774.8    18.4     *02975014  POPW01
20100303    872.0    19.8        973.2    21.8     1073.2    23.2     *02976014  POPW01
20100304   1123.2    25.4       1152.3    24.2     1232.2    25.5     *02977014  POPW01
20100305   1331.2    26.6       1404.2    28.2     1576.2    33.0     *02979014  POPW01
20100306   1625.2    36.7       1755.2    41.2     2273.2    55.0     *02979114  POPW01
*0100307                                                              *02979214  POPW01
20100307   4273.2   108.3                                             *02979314  POPW01
*                                                                     *02980000  POPW01
*                                                                     *02990000  POPW01
*********         VOLUMETRIC HEAT CAPACITY (J/M3K)          **********03000000  POPW01
*                                                                     *03010000  POPW01
*            TEMP     COND        TEMP     COND       TEMP     COND   *03020000  POPW01
*UO2                                                                  *03030000  POPW01
*0100151    311.0   1076.0       422.1   1217.7      533.2   1287.4   *03040001  POPW01
*0100152    644.3   1330.0       755.4   1360.4      866.5   1384.4   *03050001  POPW01
*0100153    977.6   1404.5      1088.8   1422.4     1199.9   1439.0   *03060001  POPW01
*0100154   1644.3   1484.0                                            *03070001  POPW01
20100151    311.0  3.8736+6      422.1  4.3837+6     533.2  4.6346+6  *03071001  POPW01
20100152    644.3  4.7880+6      755.4  4.8974+6     866.5  4.9838+6  *03072001  POPW01
20100153    977.6  5.0562+6     1088.8  5.1206+6    1199.9  5.1804+6  *03073001  POPW01
*0100154   1644.3  5.3424+6                                           *03074002  POPW01
20100154   1644.3  5.3424+6     3644.3  6.0715+6                      *03075014  POPW01
*                                                                     *03080000  POPW01
*                                                                     *03090000  POPW01
*HE GAS                                                               *03100000  POPW01
*0100251    0.245                                                     *03110001  POPW01
20100251    882.0                                                     *03111001  POPW01
*                                                                     *03112014  POPW01
*            TEMP     COND        TEMP     COND       TEMP     COND   *03113014  POPW01
*ZR-4                                                                 *03114014  POPW01
20100351    300.0  1.841+6       400.0  1.978+6      640.0  2.168+6   *03119015  POPW01
20100352   1090.0  2.456+6      1093.0  3.288+6     1113.0  3.865+6   *03119115  POPW01
20100353   1133.0  4.028+6      1153.0  4.709+6     1173.0  5.345+6   *03119215  POPW01
20100354   1193.0  5.044+6      1213.0  4.054+6     1233.0  3.072+6   *03119415  POPW01
*0100355   1243.0  2.332+6      1477.0  2.332+6                       *03119515  POPW01
20100355   1243.0  2.332+6      1477.0  2.332+6     3477.0  2.332+6   *03119615  POPW01
*                                                                     *03120000  POPW01
*                                                                     *03130000  POPW01
**********************************************************************03140000  POPW01
*****                                                            *****03150000  POPW01
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FILE = J3491.LSR5P2.DATA   DATE 87/10/13(TUESDAY)   TIME 20:03:49 PAGE 0008

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FILE = J3491.LSR5P2.DATA                    DATE    87/10/13(TUESDAY)     TIME 20:03:49  PAGE 0009  *VIVAPO*

*****      POWER TRANSIENT DATA                                           *****03160012  POPW01
*****                                                                     *****03170000  POPW01
***************************************************************************03180000  POPW01
*                                                                              *03190000  POPW01
*          T TYPE    TRIP   F1      F2                                         *03200012  POPW01
20290000   POWER     501    1.0     27.380+3                                   *03210012  POPW01
*                                                                              *03220000  POPW01
*   ( DN FISSION POWER ) + ( FP DECAY POWER ) + ( A DECAY POWER )              *03330012  POPW01
*     RELAP5                  JAPAN                  JAERI-M 8728              *03340012  POPW01
*     BY H. KUMAMARU ( 1987/7/31 )                                             *03341012  POPW01
*                                                                              *03350000  POPW01
*                                                                              *03380000  POPW01
*          TIME              R POWER                                           *03390012  POPW01
20290001     0.0             1.00000                                           *03400012  POPW01
20290002     1.0             0.875012                                          *03410012  POPW01
20290003     1.5             0.696449                                          *03420012  POPW01
20290004     2.0             0.420201                                          *03430012  POPW01
20290005     3.0             0.164270                                          *03440012  POPW01
20290006     4.0             0.147012                                          *03450012  POPW01
20290007     5.0             0.134465                                          *03460012  POPW01
20290008     6.0             0.124604                                          *03470012  POPW01
20290009     8.0             0.109953                                          *03480012  POPW01
20290010    10.0             0.0996357                                         *03490012  POPW01
20290011    15.0             0.0835672                                         *03500012  POPW01
20290012    20.0             0.0739725                                         *03510012  POPW01
20290013    30.0             0.0621879                                         *03520012  POPW01
20290014    40.0             0.0547748                                         *03521012  POPW01
20290015    50.0             0.0495318                                         *03522012  POPW01
20290016    60.0             0.0456000                                         *03523012  POPW01
20290017    80.0             0.0401409                                         *03524012  POPW01
20290018   100.0             0.0366196                                         *03525012  POPW01
20290019   150.0             0.0318209                                         *03526012  POPW01
20290020   200.0             0.0294117                                         *03527012  POPW01
20290021   300.0             0.0268382                                         *03528012  POPW01
20290022   400.0             0.0253218                                         *03529012  POPW01
20290023   500.0             0.0242242                                         *03529112  POPW01
20290024   600.0             0.0233447                                         *03529212  POPW01
20290025   800.0             0.0219527                                         *03529314  POPW01
20290026  1000.0             0.0208547                                         *03529412  POPW01
20290027  1500.0             0.0188150                                         *03529512  POPW01
20290028  2000.0             0.0173568                                         *03529612  POPW01
20290029  3000.0             0.0153690                                         *03529712  POPW01
20290030  4000.0             0.0140639                                         *03529812  POPW01
20290031  5000.0             0.0131320                                         *03529912  POPW01
20290032  6000.0             0.0124259                                         *03530012  POPW01
20290033  8000.0             0.0114092                                         *03530112  POPW01
20290034  1.0+4              0.0106954                                         *03530212  POPW01
20290035  2.0+4              8.82632-3                                         *03530312  POPW01
20290036  5.0+4              6.88828-3                                         *03530412  POPW01
20290037  1.0+5              5.67446-3                                         *03530512  POPW01
20290038  2.0+5              4.64967-3                                         *03530612  POPW01
20290039  5.0+5              3.48400-3                                         *03530712  POPW01
20290040  1.0+6              2.74955-3                                         *03530812  POPW01
20290041  2.0+6              2.17533-3                                         *03530912  POPW01
20290042  5.0+6              1.56445-3                                         *03531012  POPW01

FILE = J3491.LSR5P2.DATA                    DATE    87/10/13(TUESDAY)     TIME 20:03:49  PAGE 0009
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FILE = J3491.LSRSP2.DATA                    DATE    87/10/13(TUESDAY)     TIME 20:03:49  PAGE 0010  *VIVAPO*

                  20290043   1.0+7             1.20688-3                                          *03531112  POPW01
                  20290044   2.0+7             9.11667-4                                          *03531212  POPW01
                  20290045   5.0+7             6.85618-4                                          *03531312  POPW01
                  20290046   1.0+8             5.86748-4                                          *03531412  POPW01
                  20290047   2.0+8             5.22337-4                                          *03531512  POPW01
                  20290048   5.0+8             4.19465-4                                          *03531612  POPW01
                  20290049   1.0+9             2.96290-4                                          *03531712  POPW01
                  20290050   1.0+10            2.79366-5                                          *03531812  POPW01
                  20290051   1.0+11            2.72816-5                                          *03531912  POPW01
                  20290052   1.0+12            2.44637-5                                          *03532012  POPW01
                  20290053   1.0+13            9.90464-6                                          *03532112  POPW01
                  *                                                                               *03532312  POPW01
                  ******************************************************************************* *03540000  POPW01
                  .                                                                               *03550000  POPW01
```

Appendix C Example of Input Data used for LSTF Heat Transfer Calculation (Case POLS01)

```
**************
** POLS01   **
**************

= LSTF POWER CURVE                                                             *00000100  POLS01
*    RELAP5/MOD2 INPUT DATA                                                    *00000200  POLS01
*******************************************************************************00000300  POLS01
**************  MODULE NAME = POLS01             *****************************00000400  POLS01
**************  87/7/3  BY KUMAMARU              *****************************00000500  POLS01
**************  - INLET CONDITION :              *****************************00000600  POLS01
**************         SUBCOOLED TO SATURATED    *****************************00000600  POLS01
**************  - CORE FLOW RATE = 0.59170 KG/S  *****************************00000700  POLS01
**************  - POWER = 26.886 KW              *****************************00000800  POLS01
*******************************************************************************00000900  POLS01
*                                                                              *00001000  POLS01
*          TYPE     OPTION                                                     *00001100  POLS01
0000100     NEW      TRANSNT                                                   *00001200  POLS01
*                                                                              *00001300  POLS01
*          INPUT CHECK                                                         *00001400  POLS01
0000101     RUN                                                                *00001500  POLS01
*                                                                              *00001600  POLS01
*          INPUT    OUTPUT                                                     *00001700  POLS01
0000102     SI       SI                                                        *00001800  POLS01
*                                                                              *00001900  POLS01
*         T END     MIN     MAX    CON    MIE    MAE    MR                     *00002000  POLS01
0000201      20.0   1.0-10  0.005   1     100    4000   1000                   *00002100  POLS01
0000202      50.0   1.0-10  0.005   1     200    4000   1000                   *00002200  POLS01
0000203     200.0   1.0-10  0.01    1     250    4000   1000                   *00002300  POLS01
0000204     500.0   1.0-10  0.02    1     250    4000   1000                   *00002200  POLS01
0000205    1050.0   1.0-10  0.04    1     125    4000   1000                   *00002300  POLS01
*                                                                              *00002400  POLS01
*******************************************************************************00002500  POLS01
*  TRIP  ;  REACTOR SCRAM                                                      *00002600  POLS01
*                                                                              *00002700  POLS01
0000501     TIME    0    GE    NULL    0    15.0    L                          *00002300  POLS01
*                                                                              *00002400  POLS01
*******************************************************************************00002500  POLS01
*  MINOR EDIT REQUESTS                                                         *00002600  POLS01
*                                                                              *00002700  POLS01
0000301     P              005010000                                           *00002800  POLS01
0000302     TEMPF          005010000                                           *00002900  POLS01
0000303     P              003010000                                           *00003000  POLS01
0000304     TEMPF          003010000                                           *00003100  POLS01
0000305     TEMPG          003010000                                           *00003200  POLS01
0000306     QUALS          003010000                                           *00003300  POLS01
0000307     P              004010000                                           *00003000  POLS01
0000308     TEMPF          004010000                                           *00003100  POLS01
0000309     TEMPG          004010000                                           *00003200  POLS01
0000310     QUALS          004010000                                           *00003300  POLS01
0000311     P              001010000                                           *00003400  POLS01
0000312     TEMPF          001010000                                           *00003500  POLS01
0000313     TEMPG          001010000                                           *00003600  POLS01
0000314     QUALS          001010000                                           *00003700  POLS01
0000315     VOIDF          001010000                                           *00003800  POLS01
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FILE = J3491.LSR5P2.DATA                    DATE    87/10/13(TUESDAY)    TIME 16:16:21  PAGE 0002  *VIVAPO*

          0000316    VOIDG      001010000                                  *00003900  POLS01
          0000317    P          002010000                                  *00003400  POLS01
          0000318    TEMPF      002010000                                  *00003500  POLS01
          0000319    TEMPG      002010000                                  *00003600  POLS01
          0000320    QUALS      002010000                                  *00003700  POLS01
          0000321    VOIDF      002010000                                  *00003800  POLS01
          0000322    VOIDG      002010000                                  *00003900  POLS01
          0000323    MFLOWJ     012000000                                  *00004000  POLS01
          0000324    MFLOWJ     013000000                                  *00004100  POLS01
          0000325    MFLOWJ     014000000                                  *00004100  POLS01
          0000326    MFLOWJ     002010000                                  *00004100  POLS01
          0000327    HTTEMP     001000101                                  *00004200  POLS01
          0000328    HTTEMP     001000102                                  *00004300  POLS01
          0000329    HTTEMP     001000103                                  *00004400  POLS01
          0000330    HTTEMP     001000104                                  *00004500  POLS01
          0000331    HTTEMP     001000105                                  *00004600  POLS01
          0000332    HTTEMP     001000106                                  *00004700  POLS01
          0000333    HTTEMP     001000107                                  *00004800  POLS01
          0000334    HTTEMP     001000108                                  *00004900  POLS01
          0000335    HTTEMP     001000109                                  *00005000  POLS01
          0000336    HTTEMP     002000101                                  *00005100  POLS01
          0000337    HTTEMP     002000102                                  *00005200  POLS01
          0000338    HTTEMP     002000103                                  *00005300  POLS01
          0000339    HTTEMP     002000104                                  *00005400  POLS01
          0000340    HTTEMP     002000105                                  *00005500  POLS01
          0000341    HTTEMP     002000106                                  *00005600  POLS01
          0000342    HTTEMP     002000107                                  *00005700  POLS01
          0000343    HTTEMP     002000108                                  *00005800  POLS01
          0000344    HTTEMP     002000109                                  *00005900  POLS01
          0000345    HTRNR      001000101                                  *00006000  POLS01
          0000346    HTRNR      002000101                                  *00006100  POLS01
          *000347    HTPOW      0010001                                    *00006200  POLS01
          ***********************************************************************00006300  POLS01
          ***********************************************************************00006400  POLS01
          *                                                                *00006500  POLS01
          *          CORE  ( VOLUME 1 )                                    *00006600  POLS01
          *                                                                *00006700  POLS01
          *          NAME        TYPE                                      *00006800  POLS01
          0010000    C001        SNGLVOL                                   *00006900  POLS01
          *                                                                *00007000  POLS01
          *        AREA      LEN     VOL  HZ   VR    ELV    ROUGH  HYD    FE *00007100  POLS01
          0010101  1.7576-4  0.4575  0.0  0.0  90.0  0.4575  0.0  1.1778-2 00 *00007200  POLS01
          *                                                                *00007300  POLS01
          *         CTL   PRESSURE    TEMP                                 *00007400  POLS01
          0010200   3     15.45+6     582.0                                *00007500  POLS01
          *                                                                *00007600  POLS01
          ***********************************************************************00006400  POLS01
          *                                                                *00006500  POLS01
          *          CORE INLET ( BRANCH 2 )                               *00006600  POLS01
          *                                                                *00006700  POLS01
          *          NAME        TYPE                                      *00006800  POLS01
          0020000    C002        BRANCH                                    *00006900  POLS01
          *                                                                *00006700  POLS01
          *          NO.J        CTL                                       *00006800  POLS01
          0020001    1           1                                         *00006900  POLS01

FILE = J3491.LSR5P2.DATA                    DATE    87/10/13(TUESDAY)    TIME 16:16:21  PAGE 0002
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FILE = J3491.LSR5P2.DATA                  DATE    87/10/13(TUESDAY)     TIME 16:16:21  PAGE 0003  *VIVAPO*

*                                                                            *00007000  POLS01
*        AREA      LEN      VOL  HZ   VR    ELV    ROUGH  HYD       FE  *00007100  POLS01
0020101  1.7576-4  0.05     0.0  0.0  90.0  0.05   0.0    0.0       10  *00007200  POLS01
*                                                                            *00007300  POLS01
*         CTL   PRESSURE    TEMP                                             *00007400  POLS01
0020200    3    15.49+6     565.0                                            *00007500  POLS01
*                                                                            *00007000  POLS01
*        FROM       TO         AREA        FLOS  RLOS  CAHS                  *00007100  POLS01
0021101  002010000  001000000  1.7576-4    0.0   0.0   0000                  *00007200  POLS01
*                                                                            *00007300  POLS01
*        FLOW-F   FLOW-G   VEL-J                                             *00007400  POLS01
0021201  0.59170  0.0      0.0                                               *00007500  POLS01
*                                                                            *00007600  POLS01
*****************************************************************************00007700  POLS01
*                                                                            *00007800  POLS01
*          VOLUME 3                                                          *00007900  POLS01
*                                                                            *00008000  POLS01
*          NAME        TYPE                                                  *00008100  POLS01
0030000    C003        TMDPVOL                                               *00008200  POLS01
*                                                                            *00008300  POLS01
*        AREA      LEN  VOL       HZ   VR    ELV  ROUGH  HYD       FE  *00008400  POLS01
0030101  1.7576-4  1.0  1.7576-4  0.0  90.0  1.0  0.0    0.0       11  *00008500  POLS01
*                                                                            *00008600  POLS01
*         CTL    TRIP   ALPH   NUME                                          *00008700  POLS01
0030200    3                                                                 *00008800  POLS01
*                                                                            *00008900  POLS01
*         TIME      PRESSURE     TEMP                                        *00009000  POLS01
0030201    0.0      15.50+6      565.0                                       *00009100  POLS01
0030202   15.3      12.50+6      593.1                                       *00009200  POLS01
0030203 1000.0      12.50+6      593.1                                       *00009300  POLS01
*                                                                            *00011300  POLS01
*****************************************************************************00007700  POLS01
*                                                                            *00007800  POLS01
*          VOLUME 4                                                          *00007900  POLS01
*                                                                            *00008000  POLS01
*          NAME        TYPE                                                  *00008100  POLS01
0040000    C004        TMDPVOL                                               *00008200  POLS01
*                                                                            *00008300  POLS01
*        AREA      LEN  VOL       HZ   VR    ELV  ROUGH  HYD       FE  *00008400  POLS01
0040101  1.7576-4  1.0  1.7576-4  0.0  90.0  1.0  0.0    0.0       11  *00008500  POLS01
*                                                                            *00008600  POLS01
*         CTL    TRIP   ALPH   NUME                                          *00008700  POLS01
0040200    2                                                                 *00008800  POLS01
*                                                                            *00008900  POLS01
*         TIME      PRESSURE     QUALITY                                     *00009000  POLS01
0040201    0.0      15.50+6      1.0-10                                      *00009100  POLS01
0040202   15.3      12.50+6      1.0-10                                      *00009100  POLS01
0040203   25.0      10.60+6      1.0-10                                      *00009200  POLS01
0040204   60.0       9.25+6      1.0-10                                      *00009300  POLS01
0040205   77.0       8.95+6      1.0-10                                      *00009400  POLS01
0040206  124.0       8.45+6      1.0-10                                      *00009500  POLS01
0040207  148.0       8.40+6      1.0-10                                      *00009600  POLS01
0040208  167.0       8.15+6      1.0-10                                      *00009700  POLS01
0040209  207.0       7.75+6      1.0-10                                      *00009800  POLS01
0040210  239.0       7.25+6      1.0-10                                      *00009900  POLS01

FILE = J3491.LSR5P2.DATA                  DATE    87/10/13(TUESDAY)     TIME 16:16:21  PAGE 0003
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FILE = J3491.LSR5P2.DATA                    DATE    87/10/13(TUESDAY)     TIME 16:16:21  PAGE 0004  *VIVAPO*

          0040211    400.0     5.10+6     1.0-10                                          *00010000  POLS01
          0040212    486.0     3.95+6     1.0-10                                          *00010100  POLS01
          0040213    549.0     3.30+6     1.0-10                                          *00010200  POLS01
          0040214    557.0     3.05+6     1.0-10                                          *00010300  POLS01
          0040215    582.0     2.60+6     1.0-10                                          *00010400  POLS01
          0040216    609.0     2.40+6     1.0-10                                          *00010500  POLS01
          0040217    627.0     2.30+6     1.0-10                                          *00010600  POLS01
          0040218    774.0     2.20+6     1.0-10                                          *00010700  POLS01
          0040219    810.0     2.05+6     1.0-10                                          *00010800  POLS01
          0040220    910.0     2.00+6     1.0-10                                          *00010900  POLS01
          0040221    938.0     1.85+6     1.0-10                                          *00011000  POLS01
          0040222    969.0     1.65+6     1.0-10                                          *00011100  POLS01
          0040223   1000.0     1.55+6     1.0-10                                          *00011200  POLS01
          *                                                                               *00011300  POLS01
          ***********************************************************************************00011400  POLS01
          *                                                                               *00011500  POLS01
          *         VOLUME 5                                                              *00011600  POLS01
          *                                                                               *00011700  POLS01
          *         NAME          TYPE                                                    *00011800  POLS01
          0050000   C005          TMDPVOL                                                 *00011900  POLS01
          *                                                                               *00012000  POLS01
          *       AREA       LEN      VOL   HZ    VR     ELV    ROUGH   HYD      FE       *00012100  POLS01
          0050101 1.7576-4   1.0  1.7576-4  0.0  90.0   1.0    0.0     0.0      11        *00012200  POLS01
          *                                                                               *00012300  POLS01
          *         CTL     TRIP    ALPH    NUME                                          *00012400  POLS01
          0050200    2                                                                    *00012500  POLS01
          *                                                                               *00012600  POLS01
          *         TIME      PRESSURE      QUALITY                                       *00012700  POLS01
          0050201     0.0     15.40+6       1.0                                           *00012800  POLS01
          0050202    15.3     12.40+6       1.0                                           *00012800  POLS01
          0050203    25.0     10.50+6       1.0                                           *00012900  POLS01
          0050204    60.0      9.15+6       1.0                                           *00013000  POLS01
          0050205    77.0      8.85+6       1.0                                           *00013100  POLS01
          0050206   124.0      8.35+6       1.0                                           *00013200  POLS01
          0050207   148.0      8.30+6       1.0                                           *00013300  POLS01
          0050208   167.0      8.05+6       1.0                                           *00013400  POLS01
          0050209   207.0      7.65+6       1.0                                           *00013500  POLS01
          0050210   239.0      7.15+6       1.0                                           *00013600  POLS01
          0050211   400.0      5.00+6       1.0                                           *00013700  POLS01
          0050212   486.0      3.85+6       1.0                                           *00013800  POLS01
          0050213   549.0      3.20+6       1.0                                           *00013900  POLS01
          0050214   557.0      2.95+6       1.0                                           *00014000  POLS01
          0050215   582.0      2.50+6       1.0                                           *00014100  POLS01
          0050216   609.0      2.30+6       1.0                                           *00014200  POLS01
          0050217   627.0      2.20+6       1.0                                           *00014300  POLS01
          0050218   774.0      2.10+6       1.0                                           *00014400  POLS01
          0050219   810.0      1.95+6       1.0                                           *00014500  POLS01
          0050220   910.0      1.90+6       1.0                                           *00014600  POLS01
          0050221   938.0      1.75+6       1.0                                           *00014700  POLS01
          0050222   969.0      1.55+6       1.0                                           *00014800  POLS01
          0050223  1000.0      1.45+6       1.0                                           *00014900  POLS01
          *                                                                               *00015000  POLS01
          ***********************************************************************************00015100  POLS01
          *                                                                               *00015200  POLS01
          *     JUNCTION BETWEEN VOLUME 3 AND BRANCH 2  ( JUNCTION 12 )                   *00015300  POLS01

FILE = J3491.LSR5P2.DATA                    DATE    87/10/13(TUESDAY)     TIME 16:16:21  PAGE 0004
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FILE = J3491.LSR5P2.DATA                DATE    87/10/13(TUESDAY)     TIME 16:16:21  PAGE 0005  *VIVAPO*

*                                                                        *00015400  POLS01
*           NAME         TYPE                                            *00015500  POLS01
0120000     C012         TMDPJUN                                         *00015600  POLS01
*                                                                        *00015700  POLS01
*         FROM         TO            AREA                                *00015800  POLS01
0120101   003000000    002000000     1.7576-4                            *00015900  POLS01
*                                                                        *00016000  POLS01
*          CTL                                                           *00016100  POLS01
0120200     1                                                            *00016200  POLS01
*                                                                        *00016300  POLS01
*           TIME         FLOW-F      FLOW-G       VEL-J                  *00016400  POLS01
0120201     0.0          0.59170     0.0          0.0                    *00016500  POLS01
0120202    15.3          0.59170     0.0          0.0                    *00016500  POLS01
0120203    15.4          0.0         0.0          0.0                    *00016500  POLS01
0120204  1000.0          0.0         0.0          0.0                    *00016500  POLS01
*                                                                        *00016600  POLS01
*************************************************************************00015100  POLS01
*                                                                        *00015200  POLS01
*     JUNCTION BETWEEN VOLUME 4 AND BRANCH 2  ( JUNCTION 13 )            *00015300  POLS01
*                                                                        *00015400  POLS01
*           NAME         TYPE                                            *00015500  POLS01
0130000     C013         TMDPJUN                                         *00015600  POLS01
*                                                                        *00015700  POLS01
*         FROM         TO            AREA                                *00015800  POLS01
0130101   004000000    002000000     1.7576-4                            *00015900  POLS01
*                                                                        *00016000  POLS01
*          CTL                                                           *00016100  POLS01
0130200     1                                                            *00016200  POLS01
*                                                                        *00016300  POLS01
*           TIME         FLOW-F      FLOW-G       VEL-J                  *00016400  POLS01
0130201     0.0          0.0         0.0          0.0                    *00016500  POLS01
0130202    15.2          0.0         0.0          0.0                    *00016500  POLS01
0130203    15.3          0.59170     0.59170-10 0.0                      *00016500  POLS01
0130204  1000.0          0.59170     0.59170-10 0.0                      *00016500  POLS01
*                                                                        *00016600  POLS01
*************************************************************************00016700  POLS01
*                                                                        *00016800  POLS01
*     JUNCTION BETWEEN VOLUME 1 AND VOLUME 5  ( JUNCTION 14 )            *00016900  POLS01
*                                                                        *00017000  POLS01
*           NAME         TYPE                                            *00017100  POLS01
0140000     C014         SNGLJUN                                         *00017200  POLS01
*                                                                        *00017300  POLS01
*         FROM         TO            AREA      FLOS RLOS CAHS  SUBC TWOC *00017400  POLS01
0140101   005000000    001010000  1.7576-4     0.0  0.0  0000  1.0  1.0  *00017500  POLS01
*                                                                        *00017600  POLS01
*           CTL          FLOW-F      FLOW-G       VEL-J                  *00017700  POLS01
0140201     1           -0.59170     0.0          0.0                    *00017800  POLS01
*                                                                        *00017900  POLS01
*************************************************************************00018000  POLS01
*************************************************************************00018100  POLS01
*****                HEAT SLAB                                       *****00018200  POLS01
*************************************************************************00018300  POLS01
*****                                                                *****00018400  POLS01
*************************************************************************00018500  POLS01
*****          AVERAGE POWER CHANNEL HEAT STRUCTURE                  *****00018600  POLS01

FILE = J3491.LSR5P2.DATA                DATE    87/10/13(TUESDAY)     TIME 16:16:21  PAGE 0005
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FILE = J3491.LSR5P2.DATA                     DATE    87/10/13(TUESDAY)     TIME 16:16:21  PAGE 0006  *VIVAPO*

*************************************************************************00018700  POLS01
*                                                                       *00018800  POLS01
*          NH    NP    TYPE   S-FLG  L-COR                              *00018900  POLS01
10010000   1     9     2      1      0.0                                *00019000  POLS01
*                                                                       *00019100  POLS01
*          LOC-F  MESH-F                                                *00019200  POLS01
10010100   0      1                                                     *00019300  POLS01
*                                                                       *00019400  POLS01
*         NO ITV   R-COR       NO ITV   R-COR       NO ITV   R-COR      *00019500  POLS01
10010101   3       0.00200 ,    1       0.00260 ,    1       0.00375 ,  *00019600  POLS01
10010102   3       0.00475                                              *00019700  POLS01
*                                                                       *00019800  POLS01
*          CMP   NO     CMP   NO     CMP   NO     CMP   NO              *00019900  POLS01
10010201   1     3 ,    2     4 ,    3     5 ,    4     8               *00020000  POLS01
*                                                                       *00020100  POLS01
*          SOURCE                                                       *00020200  POLS01
10010301   0.0   3 ,    1.0   4 ,    0.0   5 ,    0.0   8               *00020300  POLS01
*                                                                       *00020400  POLS01
*          FLG                                                          *00020500  POLS01
10010400   0                                                            *00020600  POLS01
*                                                                       *00020700  POLS01
*          TEMP        NP                                               *00020800  POLS01
10010401   617.7       9                                                *00020900  POLS01
*                                                                       *00021000  POLS01
******  LEFT   *****                                                    *00021100  POLS01
*                                                                       *00021200  POLS01
*           B.V.         INC  BCT   A-C     AREA        NH              *00021300  POLS01
10010501    0            0    0     0       0.0         1               *00021400  POLS01
*                                                                       *00021500  POLS01
******  RIGHT  *****                                                    *00021600  POLS01
*                                                                       *00021700  POLS01
*           B.V.         INC  BCT   A-C     AREA        NH              *00021800  POLS01
10010601    001010000    0    1     0       1.3654-2    1               *00021900  POLS01
*                                                                       *00022000  POLS01
*           TYPE   IS MULTI    L-D-H    R-D-H   NH                      *00022100  POLS01
10010701    900    0.30699     0.0      0.0     1                       *00022200  POLS01
*                                                                       *00022300  POLS01
******  LEFT   *****                                                    *00022400  POLS01
*                                                                       *00022500  POLS01
*           CHF   HYD         HEQ          CHAN-L     NH                *00022610  POLS01
10010801    0     0.0         0.0          0.0        1                 *00022700  POLS01
*                                                                       *00022800  POLS01
******  RIGHT  *****                                                    *00022900  POLS01
*                                                                       *00023000  POLS01
*           CHF   HYD         HEQ          CHAN-L     NH                *00023100  POLS01
10010901    0     0.011778    0.011778     0.4575     1                 *00023200  POLS01
*                                                                       *00023300  POLS01
*************************************************************************00024300  POLS01
*****             HIGH POWER CHANNEL HEAT STRUCTURE                *****00025300  POLS01
*************************************************************************00026300  POLS01
*                                                                       *00027300  POLS01
*          NH    NP    TYPE   S-FLG  L-COR                              *00028300  POLS01
10020000   1     9     2      1      0.0                                *00029300  POLS01
*                                                                       *00030300  POLS01
*          LOC-F  MESH-F                                                *00031300  POLS01

FILE = J3491.LSR5P2.DATA                     DATE    87/10/13(TUESDAY)     TIME 16:16:21  PAGE 0006
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FILE = J3491.LSR5P2.DATA                    DATE    87/10/13(TUESDAY)     TIME 16:16:21  PAGE 0007  *VIVAPO*

10020100    0010                                                                     *00032300  POLS01
*                                                                                    *00033300  POLS01
*           FLG                                                                      *00044300  POLS01
10020400    0010                                                                     *00045300  POLS01
*                                                                                    *00049300  POLS01
******  LEFT   *****                                                                 *00050300  POLS01
*                                                                                    *00051300  POLS01
*           B.V.         INC  BCT   A-C     AREA      NH                             *00052300  POLS01
10020501    0            0    0     0       0.0        1                             *00053300  POLS01
*                                                                                    *00054300  POLS01
******  RIGHT  *****                                                                 *00055300  POLS01
*                                                                                    *00056300  POLS01
*           B.V.         INC  BCT   A-C     AREA      NH                             *00057300  POLS01
10020601    001010000    0    1     0       1.3654-2   1                             *00058300  POLS01
*                                                                                    *00059300  POLS01
*           TYPE   IS MULTI    L-D-H   R-D-H   NH                                    *00060300  POLS01
10020701    900    0.69301     0.0     0.0     1                                     *00061300  POLS01
*                                                                                    *00062300  POLS01
******  LEFT   *****                                                                 *00063300  POLS01
*                                                                                    *00064300  POLS01
*           CHF   HYD        HEQ         CHAN-L    NH                                *00065300  POLS01
10020801    0     0.0        0.0         0.0       1                                 *00066300  POLS01
*                                                                                    *00067300  POLS01
******  RIGHT  *****                                                                 *00068300  POLS01
*                                                                                    *00069300  POLS01
*           CHF   HYD        HEQ         CHAN-L    NH                                *00070300  POLS01
10020901    0     0.011778   0.011778    0.4575    1                                 *00071300  POLS01
*                                                                                    *00072300  POLS01
*************************************************************************************00168700  POLS01
*                                                                                    *00168800  POLS01
*****      HEAT STRUCTURE THERMAL PROPERTY DATA                                  *****00168900  POLS01
*                                                                                    *00169000  POLS01
*************************************************************************************00169010  POLS01
*                                                                                    *00169100  POLS01
*               TYPE       K-FLAG    CV-FLAG                                         *00169200  POLS01
*AL203                                                                               *00169210  POLS01
20100100        TBL/FCTN    1          1                                             *00169300  POLS01
*NICHROME                                                                            *00169310  POLS01
20100200        TBL/FCTN    2          2                                             *00169400  POLS01
*MGO                                                                                 *00169410  POLS01
*0100300        TBL/FCTN    2          2                                             *00169500  POLS01
20100300        TBL/FCTN    1          2                                             *00169500  POLS01
*INCONEL600                                                                          *00169510  POLS01
20100400        TBL/FCTN    2          2                                             *00169600  POLS01
*                                                                                    *00169800  POLS01
*********        THERMAL CONDUCTIVITY (W/MK)                                ***********00169900  POLS01
*                                                                                    *00170000  POLS01
*            TEMP    COND        TEMP    COND        TEMP    COND                    *00170200  POLS01
*AL203                                                                               *00170300  POLS01
20100101     373.15  25.122      473.15  20.935      673.15  14.437                  *00170400  POLS01
20100102     873.15  11.104     1073.15   9.0774    1273.15   8.374                  *00170500  POLS01
*0100103    1473.15   8.374                                                          *00170600  POLS01
20100103    1473.15   8.374     3473.15   8.374                                      *00170600  POLS01
*                                                                                    *00170700  POLS01
*            LOWER  UPPER   A0     A1       A2  A3  A4  A5  C                        *00170800  POLS01

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*NICHROME                                                                              *00170900  POLS01
*0100201     273.15 1473.15 6.1988 0.015933 0.0 0.0 0.0 0.0 273.15                    *00171000  POLS01
20100201     273.15 3473.15 6.1988 0.015933 0.0 0.0 0.0 0.0 273.15                    *00171000  POLS01
*                                                                                      *00171100  POLS01
*            LOWER  UPPER   A0     A1       A2  A3  A4  A5  C                          *00171200  POLS01
*MGO                                                                                   *00171300  POLS01
*0100301     273.15 1273.15 1.1049 0.0      0.0 0.0 0.0 0.0 273.15                     *00171400  POLS01
*0100301     273.15 3473.15 1.1049 0.0      0.0 0.0 0.0 0.0 273.15                     *00171400  POLS01
20100301     334.15  1.3142     443.15  2.3493     554.15  3.9309                      *00170400  POLS01
20100302    3473.15  3.9309                                                            *00170500  POLS01
*                                                                                      *00171500  POLS01
*            LOWER  UPPER   A0     A1       A2  A3  A4  A5  C                          *00171600  POLS01
*INCONEL600                                                                            *00171700  POLS01
*0100401     273.15 1173.15 13.956 0.016747 0.0 0.0 0.0 0.0 273.15                     *00171800  POLS01
20100401     273.15 3473.15 13.956 0.016747 0.0 0.0 0.0 0.0 273.15                     *00171800  POLS01
*                                                                                      *00173200  POLS01
*********          VOLUMETRIC HEAT CAPACITY (J/M3K)                          **********00173300  POLS01
*                                                                                      *00173400  POLS01
*             TEMP     COND        TEMP     COND        TEMP     COND                  *00173500  POLS01
*AL203                                                                                 *00173600  POLS01
20100151     373.15  3.0246+6    473.15  3.5751+6    673.15  4.0014+6                  *00173700  POLS01
20100152     873.15  4.2959+6   1073.15  4.5106+6   1273.15  4.6649+6                  *00173800  POLS01
*0100153    1473.15  4.7732+6                                                          *00173900  POLS01
20100153    1473.15  4.7732+6   3473.15  4.7732+6                                      *00173900  POLS01
*                                                                                      *00174000  POLS01
*            LOWER  UPPER   A0        A1        A2  A3  A4  A5  C                      *00174100  POLS01
*NICHROME                                                                              *00174200  POLS01
*0100251     273.15 1473.15 3.1058+6 2.0775+3 0.0 0.0 0.0 0.0 273.15                   *00174300  POLS01
20100251     273.15 3473.15 3.1058+6 2.0775+3 0.0 0.0 0.0 0.0 273.15                   *00174300  POLS01
*                                                                                      *00174400  POLS01
*            LOWER  UPPER   A0        A1        A2  A3  A4  A5  C                      *00174500  POLS01
*MGO                                                                                   *00174600  POLS01
*0100351     273.15 1173.15 2.8723+6 0.97658+3 0.0 0.0 0.0 0.0 273.15                  *00174700  POLS01
20100351     273.15 3473.15 2.8723+6 0.97658+3 0.0 0.0 0.0 0.0 273.15                  *00174700  POLS01
*                                                                                      *00174800  POLS01
*            LOWER  UPPER   A0        A1        A2  A3  A4  A5  C                      *00174900  POLS01
*INCONEL600                                                                            *00175000  POLS01
*0100451     273.15 1373.15 3.7061+6 1.9237+3 0.0 0.0 0.0 0.0 273.15                   *00175100  POLS01
20100451     273.15 3473.15 3.7061+6 1.9237+3 0.0 0.0 0.0 0.0 273.15                   *00175100  POLS01
*                                                                                      *00175200  POLS01
***********************************************************************************00176200  POLS01
*****        POWER TRANSIENT DATA                                            *****00190400  POLS01
***********************************************************************************00190410  POLS01
*                                                                                      *00190500  POLS01
*            T TYPE     TRIP     F1       F2                                           *00190500  POLS01
20290000     POWER      501      1.0      26.886+3                                     *00194900  POLS01
*                                                                                      *00194910  POLS01
* BELOW IS HEAT TRANSFER RATE IN PWR                                                   *00195000  POLS01
*                                                                                      *00195100  POLS01
*             TIME        R  POWER                                                     *00195110  POLS01
20290001       0.0        1.0                                                          *00195200  POLS01
20290002       1.0        0.875012                                                     *00195200  POLS01
20290003       1.5        0.696449                                                     *00195300  POLS01
20290004       2.0        0.420201                                                     *00195400  POLS01
20290005       3.0        0.164270                                                     *00195500  POLS01

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          20290006      4.0      0.147012                                          *00195600  POLS01
          20290007      5.0      0.134465                                          *00195700  POLS01
          20290008      6.0      0.124604                                          *00195800  POLS01
          20290009      8.0      0.109953                                          *00195900  POLS01
          20290010     10.0      0.0996357                                         *00196000  POLS01
          20290011     15.0      0.0835672                                         *00196100  POLS01
          20290012     20.0      0.0739725                                         *00196200  POLS01
          20290013     30.0      0.0621879                                         *00196300  POLS01
          20290014     40.0      0.0547748                                         *00196400  POLS01
          20290015     50.0      0.0495318                                         *00196500  POLS01
          20290016     60.0      0.0456000                                         *00196600  POLS01
          20290017     80.0      0.0401409                                         *00196700  POLS01
          20290018    100.0      0.0366196                                         *00196800  POLS01
          20290019    150.0      0.0318209                                         *00196900  POLS01
          20290020    200.0      0.0294117                                         *00197000  POLS01
          20290021    300.0      0.0268382                                         *00200101  POLS01
          20290022    400.0      0.0253218                                         *00200102  POLS01
          20290023    500.0      0.0242242                                         *00200103  POLS01
          20290024    600.0      0.0233447                                         *00200104  POLS01
          20290025    800.0      0.0219527                                         *00200105  POLS01
          20290026   1000.0      0.0208547                                         *00200106  POLS01
          *                                                                        *00200122  POLS01
          ************************************************************************ *00362400  POLS01
                                                                                   *00364200  POLS01
          .
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