

JAERI-M

8 9 6 7

EXPERIMENT DATA OF ROSA-III TEST RUN 703
(SPLIT BREAK SIMULATION TEST WITH
ECCS ACTUATION)

July 1980

Yoshinari ANODA, Kanji TASAKA, Hiromichi ADACHI
Hideo MURATA, Kunihisa SODA, Motoaki OKAZAKI,
Mitsuhiro SUZUKI Makoto SOBAJIMA, Yasuo KOIZUMI
and Masayoshi SHIBA

この報告書は、日本原子力研究所が JAERI-M レポートとして、不定期に刊行している研究報告書です。入手、複製などのお問い合わせは、日本原子力研究所技術情報部（茨城県那珂郡東海村）あて、お申しこしください。

JAERI-M reports, issued irregularly, describe the results of research works carried out in JAERI. Inquiries about the availability of reports and their reproduction should be addressed to Division of Technical Information, Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken, Japan.

JAERI-M 8967

Experiment Data of ROSA-III Test RUN 703

(Split Break Simulation Test with ECCS Actuation)

Yoshinari ANODA, Kanji TASAKA, Hiromichi ADACHI

Hideo MURATA, Kunihisa SODA, Motoaki OKAZAKI, Mitsuhiro SUZUKI

Makoto SOB AJIMA, Yasuo KOIZUMI and Masayoshi SHIBA

Division of Reactor Safety, Tokai Research Establishment, JAERI

(Received June 26, 1980)

RUN 703 in the ROSA-III program is the third test of standard BWR LOCA test series. The test was simulated a 100 % split break at the recirculation pump inlet side. Its purposes are to provide data to evaluate the emergency core cooling system (ECCS) behavior during a BWR 100 % split break LOCA and to assess the system computer code. Therefore, the ROSA-III facility was configured to simulate a large (~ 1000 MWe) BWR LOCA resulting from a split break on the inlet side of the pump in a recirculation loop. The primary initial conditions are steam dome pressure 7.04 MPa, steam dome temperature 560 K, lower plenum subcooling 10 K, and core inlet flow 35.5 kg/s. During the system depressurization, emergency core cooling water was injected into the upper plenum and the core bypass in the pressure vessel. The data from RUN 703 are presented; the experiment achieved the above purposes successfully.

Keywords: BWR, LOCA, ROSA-III Facility, Data Report, Split Break,
Recirculation Loop, ECCS

ROSA-III実験データレポート：RUN703
(ECCS作動のスプリット破断模擬実験)

日本原子力研究所東海研究所安全工学部
安濃田良成・田坂 完二・安達 公道・村田 秀男
早田 邦久・岡崎 元昭・鈴木 光弘・傍島 真
小泉 安郎・斯波 正誼

(1980年6月26日受理)

ROSA-III実験RUN703は、標準BWR LOCA実験シリーズの3回目の実験である。この実験は、再循環ポンプ入口配管における100%スプリット破断を模擬した実験である。RUN703の目的は、LOCA時のECCS作動特性及び冷却材挙動を評価することと、解析コード評価のための総合実験データを提供することにある。そのため、ROSA-III装置は1000MW_e規模の大型BWRの再循環ポンプ入口配管の破断にともなうLOCAを模擬する構成となっている。主要な初期条件は、蒸気ドーム圧力7.04MPa, 同温度560K, 下部プレナム未飽和度10K, 炉心入口流量35.5kg/s等である。破断後、減圧過程において非常炉心冷却水が上部プレナムおよび炉心バイパスに注入された。

実験目的は、すべて達成され実験は成功であった。本稿には、その実験データが示されている。

CONTENTS

ABBREVIATIONS	vii
1. INTRODUCTION	1
2. ROSA-III TEST FACILITY	3
3. INSTRUMENTATION	5
4. TEST CONDITIONS	8
5. DATA PRESENTATION	10
6. CONCLUDING REMARKS	12
ACKNOWLEDGMENTS	12
REFERENCES	13

目 次

略 号.....	Vii
1. 序	1
2. ROSA-III 実験装置	3
3. 計 装	5
4. 実験条件	8
5. 実験結果	10
6. 結 語	12
謝 辞	12
文 献	13

List of Tables

Table 2.1	Primary characteristics of BWR-6 and ROSA-III
Table 3.1	ROSA-III measurement list 1
Table 3.2	List of instrumentation for supplemental recording system (1)
Table 4.1	Test conditions of the ROSA-III RUN 703
Table 4.2	Valve characteristics of steam discharge line
Table 5.1	Sequence of events in RUN 703

List of Figures

Fig. 2.1	Schematic diagram of ROSA-III test facility
2.2	Internal structure of pressure vessel of ROSA-III
2.3	ROSA-III piping schematic
2.4	Axial power distribution of heater rod
3.1	Flow diagram and instrumentation location of ROSA-III facility
3.2	ROSA-III recirculation loops with instrumentation
3.3	Instrumentation in the broken loop
3.4	Instrumentation in the intact loop
3.5	Instrumentation in the break unit
3.6	Instrumentation in the steam line
3.7	Instrumentation in the feed water line
3.8	ROSA-III pressure vessel with instrumentation
3.9	Instrumentation in the pressure vessel
3.10	Instrumentation in the lower plenum
3.11	Instrumentation in the filler block
3.12	ROSA-III core and lower plenum instrumentation
3.13	ROSA-III core map
3.14	Lead out nozzles of measurement in the pressure vessel
5.1	Core power
5.2	Pressure in the vessel
5.3	Pressure in broken loop jet pump
5.4	Pressure near the recirculation pump
5.5	Pressure near the break A (pump side) and the Break B (vessel side)
5.6	Differential pressure between lower plenum and upper plenum
5.7	Differential pressure in lower plenum
5.8	Differential pressure in downcomer
5.9	Differential pressure between vessel bottom and top
5.10	Differential pressure between jet pump discharge and suction
5.11	Differential pressure between jet pump drive and suction

- Fig. 5.12 Differential pressure between MRP-1,2 delivery and suction
- 5.13 Mass flow rate in the steam discharge line
 - 5.14 Injection flow rates of HPCS and LPCI
 - 5.15 Feed water flow rate
 - 5.16 Intact loop jet pump discharge flow rate
 - 5.17 Broken loop jet pump discharge flow rate
 - 5.18 Pump speed
 - 5.19 Fluid temperature in the vessel
 - 5.20 Fluid temperature in intact loop jet pumps
 - 5.21 Fluid temperature in broken loop jet pumps
 - 5.22 Fluid temperature in recirculation pump
 - 5.23 Fluid temperature in Break A and B
 - 5.24 Surface temperature of filler block
 - 5.25 Slab temperature of jet pump diffuser
 - 5.26 Inner surface temperature of pressure vessel
 - 5.27 Slab temperature of pressure vessel
 - 5.28 Heater rod surface temperature of All rod
 - 5.29 " " A22 rod
 - 5.30 " " A33 rod
 - 5.31 " " A44 rod
 - 5.32 " " A77 rod
 - 5.33 " " B15 rod
 - 5.34 " " B33 rod
 - 5.35 " " B85 rod
 - 5.36 " " C11 rod
 - 5.37 " " C33 rod
 - 5.38 " " C77 rod
 - 5.39 Surface temperature of water rod simulator, A55
 - 5.40 " " , B55
 - 5.41 " " , C55
 - 5.42 " " , D55
 - 5.43 Fluid temperature at channel box outlet
 - 5.44 Fluid temperature at channel box inlet
 - 5.45 Inner surface temperature of channel box A
 - 5.46 Fluid temperature in lower plenum, north
 - 5.47 Fluid temperature in lower plenum center
 - 5.48 Mixture levels in shroud

ABBREVIATIONS

Systemes

ROSA	Rig of Safety Assessment
BWR	Boiling Water Reactor
LBWR	Large Boiling Water Reactor
ECCS	Emergency Core Cooling System
HPCS	High Pressure Core Spray
LPCS	Low Pressure Core Spray
LPCI	Low Pressure Coolant Injection
ADS	Automatic Depressurization System

Vessels

PV	Pressure Vessel
PWT	Pure Water Tank
FWT	Feed Water Tank
AT	Air Tank
CWT	Cooling Water Tank
HPCST	High Pressure Core Spray Tank
LPCST	Low Pressure Core Spray Tank
LPCIT	Low Pressure Core Injection Tank
POOL	Pool

Pumps

JP	Jet Pump
MRP	Main Recirculation Pump
HPWP	High Pressure Water Pump
WSP	Water Supply Pump
FWP	Feed Water Pump
HPCSP	High Pressure Core Spray Pump
LPCSP	Low Pressure Core Spray Pump
LPCIP	Low Pressure Core Injection Pump

Piping

V	Valve
AV	Air actuation Valve
CV	Control Valve
CHV	Check Valve
QSV	Quick Shut-off Valve
OR	Orifice
RD	Rupture Disk
RCN	Rapid Condenser
(2)B	(2) inchs pipe of Schedule 80
DL(+100)	Elevation (+100 mm) from the bottom of PV

Measurements

P	Pressure
D	Differential Pressure
F	Flow Rate
T	Temperature
TS	Temperature of Solid
TF	Temperature of Fuel
L	Liquid Level
LB	Liquid Level in Channel Box
LL	Liquid Level in the Lower Plenum
S	Signal
W	Power
N	Rotation Speed
DF	Density of Fluid
M	Momentum Flux

Units

K	Kelvin
kg	Kilogram
ℓ	Liter
m	Meter
mm	Milimeter
MPa	Megapascal
rpm	Revolution per Minute
s	Second
W	Watt

Miscellaneous

ESF	Engineered Safety Features
LOCA	Loss-of-Coolant Accident
LOCE	Loss-of-Coolant Experiment
MLHR	Maximum Linear Heat Rate

1. INTRODUCTION

The ROSA (Rig of Safety Assessment)-III Program is one of several water reactor research test programs conducted by JAERI (Japan Atomic Energy Research Institute).

The ROSA-III facility is a volumetrically scaled (1/424) boiling water reactor (BWR) system with electrically heated core designed to study the response of the engineered safety features (ESF) in commercial BWR systems during the postulated loss-of-coolant accident (LOCA). With recognition of the differences in commercial BWR designs and inherent distortions in reduced scale systems, the design objective for the ROSA-III facility was to produce the significant thermal-hydraulic phenomena that would occur in commercial BWR systems in the same sequence and with approximately the same time frames and magnitudes. The objectives of the ROSA-III experimental program are:

- (1) To provide data required to evaluate the adequacy and improve the analytical methods currently used to predict the LOCA response of large BWRs. The performance of the ESFs, with particular emphasis on emergency core cooling systems (ECCS), and the quantitative margins of safety inherent in performance of the ESF are of primary interest.
- (2) To identify and investigate any unexpected event(s) or threshold(s) in the response of either the plant or the ESF and develop analytical techniques that adequately describe and account for such unexpected behavior.

The information acquired from loss-of-coolant experiments (LOCE) is thus used for evaluation and development of LOCA analytical methods and assessment for the quantitative margins of safety of ESFs in response to a LOCA.

Run 703, conducted on October 27, 1978 was the third test at ROSA-III facility. The test was specified to simulate a 200% double-ended shear break at the recirculation pump inlet side. But only one rupture plane was opened and quick shut-off valve (QSV) did not shut because of machine trouble. Consequently, the test simulated a 100% split break at the recirculation pump inlet side. The primary objectives of the test were to:

- (1) Provide data to evaluate ROSA-III emergency core cooling system (ECCS) behavior during LOCE operation.
- (2) Provide data to assess the system computer code.

Run 703 was conducted from initial conditions of 560 K and 7.04 MPa in the steam dome of the vessel. The subcooling in the lower plenum was 10 K. The core inlet flow rate was 35.5 kg/s and the core outlet quality was 3.9%. The steady state power for the core was 3.71 MW corresponding to 42% of a BWR steady state power, and the transient power simulated the delayed neutron fission power, the decay power of fission products and actinides and the stored heat in the fuel pin.

The purpose of this report is to present the data from Run 703 in an uninterpreted but readily usable form for use by the nuclear community in advance of detailed analysis and interpretation. Section II briefly describes the ROSA-III configuration: Section III discusses the ROSA-III instrumentation system and methods of obtaining certain measurements; and Section IV summarizes Run 703 initial conditions and test procedures. Section V presents the data with supporting information for data interpretation. Section VI describes concluding remarks.

2. ROSA-III TEST FACILITY

The ROSA-III facility is a volumetrically scaled (1/424) boiling water reactor (BWR) system with electrically heated core designed to study the response of the engineered safety features (ESF) in commercial BWR systems during the postulated loss-of-coolant accident (LOCA).

The test assembly consists of four major subsystems which have been instrumented such that desirable system parameters can be measured and recorded during a LOCE. The subsystems include: (a) the pressure vessel, (b) the steam line and the feedwater line, (c) the coolant recirculation system, and (d) the ECCS. System instrumentation is discussed in Section III. The ROSA-III major components and the pressure vessel internal structure are shown schematically in Figure 2.1 and 2.2, respectively. The ROSA-III piping system is shown in Figure 2.3, and the major characteristics of the ROSA-III facility are compared with those of a LBWR in Table 2.1.

The pressure vessel simulates the pressure vessel of a BWR. It has a simulated core, a lower plenum, an upper plenum, an annular downcomer, a steam separator, a simulated steam dryer plate, and a steam dome. The core is composed of four half-length simulated fuel assemblies and a control rod simulator. Each fuel assembly contains 63 fuel rods which are spaced and supported in a square (8 × 8) array by lower and upper tie plates. The simulated fuel rod is heated electrically with chopped-cosine axial power distribution. The effective heated length is 1880 mm, one half of the active length of a BWR fuel rod. The orifice plate assembly at core inlet simulates the flow resistance of the nuclear core.

The steam line and the feedwater line simulate those of a BWR. Steam is discharged into the atmosphere through the steam line connected to the steam dome. The steam line has three branches. The first branch has a

control valve to control the steady-state steam dome pressure before blow-down. The second branch simulates the automatic depressurization system (ADS). The third branch has an orifice to simulate the flow resistance of a steam turbine-generator. Immediately after the blowdown initiation, the steam line is changed from the first branch to the third one. The feedwater line is connected to the feedwater sparger located above the downcomer region. The ambient-temperature feedwater is supplied from the pure water tank (PWT) at steady state, and the feedwater tank (FWT) supplies preheated feedwater during the first two seconds in the blowdown.

The coolant recirculation system simulates the BWR recirculation loop. The system consists of two loops provided with a recirculation pump and two jet pumps in each loop. One is the intact loop which simulates the unbroken loop of a BWR and the other is the broken loop which simulates the broken loop of a BWR. The broken loop has two break simulators and a quick shutoff valve to simulate a double-ended shear break or a split break. Each break simulator is composed of an orifice which determines the break area, a rupture disk, and a spear to break the rupture disk. The break type, position, and area are experimental variables. The standard break condition is a 200 % double-ended shear break at the recirculation pump inlet side with the orifice diameter of 26.2 mm.

The ECCS of ROSA-III simulate those of a BWR. The ECC systems include HPCS, LPCS, LPCI and ADS. The spray systems, the HPCS and the LPCS, spray the emergency cooling water on the top surface of the core. The LPCI system supplies the emergency cooling water into the core-shroud directly. Each ECCS is provided with a tank, a pump, a valve, and a control system to control the valve trip delay, valve opening speed, and the pump flow rate.

3. INSTRUMENTATION

The instrumentation system of the ROSA-III was designed to obtain thermo-hydraulic data in a BWR LOCA to contribute to assess the analytical code. The channel configuration of the instrumentation differs following the renewal of the simulated fuel assembly or remodeling of the loop system. The measurement list for the present run is shown in Table 3.1. Most of the measurements are recorded on the main data acquisition system (DATAC-2000B) with a half-inch width magnetic tape and the rest are recorded on the supplemental recording system with a casset tape of 100 channel capacity (cf. Table 3.2). The list number corresponds to the fuel assembly number. In the case of list with two figures the first digit indicates the fuel assembly number and the second digit indicates the revised version number of the instrumentation system for the same assembly.

Pressure measurements are done with semi-conductor transducers measuring the piezoelectric resistance. The detector is cooled by water for the protection from high temperature environment.

Differential pressure transducers with two direct current cables convert displacement of a diaphragm to electric charge and then to proportional voltage. The pressure lead pipes are dual circular pipes for circulating cooling water to eliminate flashing of the fluid.

Flow rate is measured by orifice, venturi, turbine or electro-magnetic flow meters depending on the fluid condition and the measurement location.

Electric power for simulated fuel rods is controlled by the predetermined function of time for the after power simulation and it is measured by fast response electric power meter.

Pump revolution speed is measured by counting the number of gear blades on the axis of a pump.

On-off signals such as valve position, pump revolution direction,

rupture disk break and pump power supply are converted to voltage or current and recorded in respective channels in order to specify the exact time of the signal.

Temperatures of fluid, structure materials and fuel rods are measured with thermocouples of 1.6 mm ϕ or 1.0 mm ϕ .

Liquid levels are measured by means of needle type electrical conductivity probes developed in the ROSA-III program. The probes are attached on the walls of core barrel and channel boxes at several elevations and detect the existence of liquid water or steam at each level.

The void fraction of fluid is measured by a needle type electrical resistance probe or a correlation type electrical capacitance probe. The former detects passing bubble and the void fraction is obtained by integrating the void signal. The latter detects the average void distribution around the probe with the capacitance. The correlation between two sensors gives the velocity of the bubble.

Fluid density in the pipe is measured by means of a gamma ray densitometer. Each gamma ray densitometer has two or three beams to estimate the flow regime. The gamma source is Cs-137 and the detector is NaI scintillator which is cooled by water.

Flow direction in the core is measured from the canti-lever contact signal. The canti-lever is moved to the direction of the fluid flow and generates a contact signal.

Two-phase flow rate measurement is done by means of the combination of two signals from drag disk, turbine and gamma ray densitometer in a pipe.

Some of measurement methods described above are still under development and further improvements are expected in accuracy and reliability.

The measurement location of each instrumentation in the measurement list are shown in the figures of flow diagram, loop instrumentation, in-vessel instrumentation, or in-core instrumentation (Figs. 3.1 - 3.14).

The data acquisition system utilizes two recording systems of major and minor importance. The data recorded on the magnetic tape of the main acquisition system are processed by the FACOM 230-75 computer at JAERI by off-line. After the evaluation of each data by comparing the initial and the final values with the standard values of the pressure for example, the data tape is re-processed using the correct conversion factors determined from consistency examination. Data processing program developed for the ROSA-III test can compare the measured data in a figure not only with other channels of the same test but also with the data of other runs or with calculated results by LOCA analysis code such as RELAP or ALARM.

4. TEST CONDITIONS

The test conditions of Run 703 are summarized in Table 4.1. Run 703 simulates a 100 % split break at the recirculation pump inlet side. The stem dome of the pressure vessel was saturated initially at pressure of 7.04 MPa and the corresponding fluid temperature of 560 K. The initial lower plenum subcooling was 10 K. The core inlet flow rate is 35.5 kg/s and the core outlet quality was estimated as 3.9 %. The initial flow rate in the steam line in steady state were not measured because of unsuitable measurement range of the meter.

The steady state power supply to the simulated fuel rods was 3.71 MW which corresponds to 42 % of the BWR steady power, and the maximum linear heat rate (MLHR) was 11.2 kW/m. The transient power simulated the delayed neutron fission power, the decay power of fission products and actinides and the stored heat in the fuel pin. The transient power used in Run 703 is shown in Fig. 5.1 in Section V.

The stem line and feed water line are independent open loops for the present test. Each line has steady and transient lines as shown in the flow diagram in Fig. 3.1 and the steady line was switched to the transient line at the time of break. The closure of the valves in the steam line and feedwater line takes a few seconds as shown in Table 4.2. The valves on the feedwater line and the steam line were closed at 4.0 sec and 7.0 sec after break, respectively.

Emergency core coolant injection was directed to the upper plenum during blowdown. Injection from high pressure core spray (HPCS) began at 25.5 s after initiation of blowdown with the injection rate of 0.0011 m³/s. Injection from low pressure core spray (LPCS) began at 79.0s after break at a system pressure of 2.16 MPa. The injection flow rate of LPCS

was not measured but estimated as $0.001 \text{ m}^3/\text{s}$ from other runs. The low pressure coolant injection (LPCI) flow was initiated by LOCE control 91.5 s after the initiation of blowdown at the flow rate of $0.0046 \text{ m}^3/\text{s}$. Automatic depressurization system (ADS) valve was actuated at 131 s after break.

5. DATA PRESENTATION

The experiment RUN 703 proceeded, starting with a 100% split break simulated by breaking only one rupture disk and keeping the quick shut-off valve between the two break units open. The sequence of major events is shown in Table 5.1. The feed water line valve and the steam line valve were closed completely 4s and 7s, respectively. Jet pump suction nozzle was uncovered at 10.0s and recirculation pump suction nozzle was uncovered at 13.2s. Core power was reduced after 11.3s to simulate decay heat and stored heat of a nuclear fuel rod as specified. The lower plenum saturated and initiated flashing at 22.4s. HPCS, LPCS and LPCI systems initiated injection at 25.5s, 79.0s and 91.5s, respectively. ADS valve was opened at 131.0s and closed approximately at 480s after break. The surface temperature of fuel rods began to rise at 14s due to deficiency of liquid. The fuel rods quenched from bottom to top following the recovery of the liquid level in the core by ECCS. The latest quench occurred at 160s after break.

The test data are presented in Fig. 5.1 through 5.48. They are divided into four groups, system data, flow data, temperature data and liquid level data.

Fig. 5.1 through 5.12 show system data, of which Fig. 5.1 give power transients of three power suppliers for simulated fuel rods with the maximum capacities of 550, 1800 and 2100 kW. Fig. 5.2 through 5.5 show pressure transients in the vessel and loops, and Fig. 5.6 through 5.12 display differential pressures in the vessel and loops.

Fig. 5.13 through 5.18 give flow data, of which Fig. 5.13 through 5.17 show flow rates of main steam line, ECCS flows, feed water flow and jet pumps, respectively. Fig. 5.18 shows the revolution rates of two main recirculation pumps.

Fig. 5.19 through 5.47 exhibit temperature data, of which Fig. 5.19 through 5.23 show fluid temperature in the system. Fig. 5.24 through 5.27 show surface temperatures of structure materials. Fig. 5.28 through 5.47 give temperature data showing thermal-hydraulic responses in the core. Fig. 5.28 through 5.38 show fuel surface temperatures, Fig. 5.39 through 5.42 show fluid temperature around the tie rod, Fig. 5.43 and 5.44 show channel box outlet and inlet fluid temperatures, Fig. 5.45 shows channel box surface temperatures, and Fig. 5.46 and 5.47 show lower plenum surface temperatures and fluid temperatures.

The mixture level in shroud which was estimated by liquid level signals from the conductance probe is shown Fig. 5.48.

6. CONCLUDING REMARKS

The conduct of ROSA-III RUN 703 and the experimental data acquired concerning integral systems phenomena associated with a loss of coolant are considered to have met the objectives as described in Section I.

The ROSA-III facility and its instrumentation worked well, and the obtained experimental data are useful for assessing computer codes for BWR LOCA/ECCS analysis in a rather extreme transient with a 100 % split break at recirculation pump suction, ECCS actuation, 42 % steady state power, and a transient power simulating the decay power of fission products and actinoides, the delayed neutron fission power and the stored heat in the fuel pin.

ACKNOWLEDGMENTS

The authors are grateful to H. Osaki, T. Chiba, H. Itoh of Safety Facility Engineering Services Section, and to H. Asahi, T. Odaira, S. Sekiguchi, M. Tokoi, H. Yamada, and J. Tamura of Nuclear Engineering Corporation who conducted the experiment.

6. CONCLUDING REMARKS

The conduct of ROSA-III RUN 703 and the experimental data acquired concerning integral systems phenomena associated with a loss of coolant are considered to have met the objectives as described in Section I.

The ROSA-III facility and its instrumentation worked well, and the obtained experimental data are useful for assessing computer codes for BWR LOCA/ECCS analysis in a rather extreme transient with a 100 % split break at recirculation pump suction, ECCS actuation, 42 % steady state power, and a transient power simulating the decay power of fission products and actinoides, the delayed neutron fission power and the stored heat in the fuel pin.

ACKNOWLEDGMENTS

The authors are grateful to H. Osaki, T. Chiba, H. Itoh of Safety Facility Engineering Services Section, and to H. Asahi, T. Odaira, S. Sekiguchi, M. Tokoi, H. Yamada, and J. Tamura of Nuclear Engineering Corporation who conducted the experiment.

REFERENCES

1. Tasaka, K. et al. 1976. Study on the similarity between ROSA-III experiment and BWR LOCA (preanalysis of ROSA-III). JAERI-M 6703.
2. Kitaguchi, H. et al. 1978. Preliminary analysis of ROSA-III experiment (II). JAERI-M 7488.
3. Kitaguchi, H. et al. 1978, Preliminary analysis of ROSA-III experiment (III). JAERI-M 7791.
4. Kitaguchi, H. et al. 1979. LOCA analysis of BWR/6 for the ROSA-III test. JAERI-M 8185.
5. Soda, K. 1978. Prediction of ROSA-III experiment Run 701. JAERI-M 7712.
6. Koizumi, Y. et al. 1978. Prediction of ROSA-III experiment Run 702. JAERI-M 7970.
7. Koizumi, Y. et al. 1979. Prediction of ROSA-III experiment Run 703. JAERI-M 8300.
8. Soda, K. et al. 1979. Post test analysis of ROSA-III test Run 701. JAERI-M 8473.
9. Koizumi, Y. et al. 1980. Post test analysis of ROSA-III test Run 702. JAERI-M 8627.
10. Kikuchi, O. et al. 1979. Test results and post test analysis of ROSA-III Run 703. JAERI-M 8588.
11. Kikuchi, O. et al. 1980. Post test analysis of ROSA-III test Run 704. JAERI-M 8729.
12. Sobajima, M. et al. 1979. Instrumentation and data processing method of the ROSA-III test. JAERI-M 8499.
13. Suzuki, M. and Tasaka, K. 1980. Characteristic of the ROSA-III test facility (Characteristics test of the jet pumps in normal and reverse flow). JAERI-M 8670.
14. Sobajima, M. et al. 1979. Experiment data of ROSA-III test Run 701 (decay heat simulation test with ECCS activation). JAERI-M 8604.
15. Okazaki, M. et al. 1980. Experiment data of ROSA-III integral test Run 705 (isothermal blowdown test without ECCS actuation). JAERI-M 8723.
16. Suzuki, M. et al. 1980 Experiment data of ROSA-III integral test Run 706 (standard test without ECCS actuation). JAERI-M 8737.
17. Abe, N. and Tasaka, K. 1980 Electric power transient curve for ROSA-III tests. JAERI-M 8728.

Table 2.1 Primary characteristics of BWR-6 and ROSA-III.

	BWR-6	ROSA-III	BWR/ROSA
No. of Recirc. Loops	2	2	1
No. of Jet Pumps	24	4	6
No. of Separators	251	1	251
No. of Fuel Assemblies	848	4	212
Active Fuel Length (m)	3.76	1.88	2
Total Coolant Volume (m ³)	623	1.37	455
Power (MW)	3800	4.24	896
Pressure (MPa)	7.23	7.23	1
Core Flow (kg/sec)	1.39×10 ⁴	36.4	382
Recirculation Flow (l/sec)	2970	7.01	424
Feedwater Flow (kg/sec)	2060	4.86	424
Feedwater Temp (°K)	489	489	1

Table 3.1 ROSA-III. MEASUREMENT LIST 1

Ch. No.	Item	Symb.	Location	Descriptions	Loc. Fig. No.	Range & Output	Accuracy	Data Fig. No.	Measurement comments
1	Press,	P-1	Lower Plenum		3.2	0~100kg/cm ² 0~10 V	±1.08 %F.S.	5.2	Initial values are adjusted to precision pressure gauge data.
2	"	P-2	Upper Plenum		"	"	"	"	
3	"	P-3	Steam Dome		"	"	"	"	
4	"	P-4	Downcomer Bottom		"	"	"	"	
5	"	P-5	JP-1 Drive	broken loop	3.3	"	"	5.3	
6	"	P-6	JP-2 Drive	"	"	"	"	"	
7	"	P-7	JP-3 Suction	"	"	"	"	"	
8	"	P-8	JP-4 Suction	"	"	"	"	"	
9	"	P-9	MRP-1 Suction	intact loop	3.4	"	"	5.4	
10	"	P-10	MRP-2 Suction	broken loop	3.3	"	"	"	
11	"	P-11	MRP-2 Discharge	"	"	"	"	"	
12	"	P-12	Above Break A	pump side	"	"	"	5.5	
13	"	P-13	Below Break A	"	"	"	"	"	
14	"	P-14	Above Break B	vessel side	"	"	"	"	
15	"	P-15	Below Break B	"	"	"	"	"	
16	"	P-16	Steam Line		"	"	"	"	failed
17	Diff.P	D-1	Lower Pl.- Upper Pl.		3.2	-0.5~3.5kg/cm ² 2~10 V	±0.63% F.S.	5.6	
18	"	D-2	Upper Pl.-Steam Dome		"	-1.0~9.0kg/cm ² 2~10 V	"	"	failed

Table 3.1 (continued)

CH. No.	Item	Symb.	Location	Descriptions	Loc. Fig. No.	Range & Output	Accuracy	Data Fig. No.	Measurement comments
19	Diff.P	D-3	Lower Plenum Head		3.2	0~1.5kg/cm ² 2~10 V	±0.63% F.S.	5.7	
20	"	D-4	Downcomer Head		"	0~1.0kg/cm ² 2~10 V	"	5.8	
21	"	D-5	PV. Bottom-Top		"	-1.0~9.0kg/cm ² 2~10 V	"	5.9	
22	"	D-6	JP-1 Discharge-Suction	intact loop	3.4	-1.0~3.0kg/cm ² 2~10 V	"	5.10	
23	"	D-7	JP-1 Drive-Suction	"	"	0~25 kg/cm ² 2~10 V	"	5.11	
24	"	D-8	JP-2 Discharge-Suction	"	"	-1.0~3.0kg/cm ² 2~10 V	"	5.10	
25	"	D-9	JP-2 Drive-Suction	"	"	2~25 kg/cm ² 2~10 V	"	5.11	
26	"	D-10	JP-3 Discharge-Suction	broken loop	3.3	-1.0~3.0kg/cm ² 2~10 V	"	5.10	
27	"	D-11	JP-3 Drive-Suction	"	"	-5.0~25 kg/cm ² 2~10 V	"	5.11	
28	"	D-12	JP-4 Discharge-Suction	"	"	-1.0~3.0kg/cm ² 2~10 V	"	5.10	
29	"	D-13	JP-4 Drive-Suction	"	"	-5.0~25 kg/cm ² 2~10 V	"	5.11	
30	"	D-14	MPR-1 Discharge-Suction	intact loop	3.4	-1.0~25 kg/cm ² 2~10 V	"	5.12	

Table 3.1 (continued)

CH. No.	Item	Symb.	Location	Description	Loc. Fig. No.	Range & Output	Accuracy	Data Fig. No.	Measurement comments
31	Diff.P	D-15	MRP-2 Discharge-Suction	broken loop	3.3	-1.0~25 kg/cm ² 2~10 V	±0.63% F.S.	5.12	
32	Flow	F-1	Main Steam Line		3.6	0~15 kg/sec 2~10 V	±0.92% F.S.	5.13	
33	"	F-2	ADS. Steam Line		"	0~1.2kg/sec 2~10 V	"	"	
34	"	F-3	Condensed Water A		3.5	0~250kg/sec 2~10 V	±1.4 % F.S.		not presented
35	"	F-4	Cooling Water A		"	"	"	"	"
36	"	F-5	Condensed Water B		"	"	"	"	"
37	"	F-6	Cooling Water B		"	"	"	"	"
38	"	F-7	HPCS (Upper Plenum)		3.1	0~150ℓ/min 2~10 V	±0.79% F.S.	5.14	
39	"	F-8	HPCS (Lower Plenum)	not used	"	"	"		
40	"	F-9	LPCS (Upper Plenum)		"	"	"		
41	"	F-10	LPCS (Lower Plenum)	not used	"	"	"		not measured
42	"	F-11	LPCI (In-shroud)		"	0~500ℓ/min 2~10 V	"	5.14	
43	"	F-12	LPCI (Lower Plenum)	not used	"	"	"		
44	"	F-13	LPCI (MRP-2 Suction)	not used	"	0~250ℓ/min 2~10 V	"		
45	"	F-14	LPCI (MRP-1 Suction)	not used	"	"	"		

Table 3.1 (continued)

CH. No.	Item	Symb.	Location	Description	Loc. Fig. No.	Range & Output	Accuracy	Data Fig. No.	Measurement comments
46	Flow	F-15	Transient Feed Water		3.7	0~600ℓ/min 2~10 V	±0.79% F.S.	5.15	
47	"	F-16	Steady Feed Water		"	0~250ℓ/min 2~10 V	"	"	
48	"	F-17	JP-1 Discharge		3.4	0~1000ℓ/min 2~10 V	±0.88% F.S.	5.16	
49	"	F-18	JP-2 Discharge		"	"	"	"	
50	"	F-19	JP-3 Discharge +		3.3	"	±0.92% F.S.	5.17	
51	"	F-20	JP-3 Discharge -	reverse flow	"	"	"	"	
52	"	F-21	JP-4 Discharge +		"	"	"	"	
53	"	F-22	JP-4 Discharge -	reverse flow	"	"	"	"	
54	Power	W-1	550 kW Power			0~550 kW 0~10 V	±1.0% F.S.	5.1	
55	"	W-2	1800 kW Power			0~1700kW 0~10 V	"	"	
56	"	W-3	2100 kW Power			0~2100kW 0~10 V	"	"	
57	Rev.No.	N-1	MRP-1		3.4	0~500r.p.m 0~10 V	±1.08% F.S.	5.18	
58	"	N-2	MRP-2		3.3	"	"	"	
59	Signal	S-1	Break Signal A		3.5	0 ~ 5 V	-		c.f chronology
60	"	S-2	Break Signal B		"	"			(Table 5.1)

Table 3.1 (continued)

CH. No.	Item	Symb.	Location	Description	Loc. Fig. No.	Range & Output	Accuracy	Data Fig. No.	Measurement comments
61	Signal	S-3	QSV Signal		3.5	Close/open 0 ~ 5 V	-		c.f chronology (Table 5.1)
62	"	S-9	Transient Feed Water		3.7	"	-		"
63	"	S-10	Main Steam Isolation Valve		3.6	"	-		"
64	"	S-11	Steam Line Valve		3.6	"	-		"
65	Temp.	T-1	Lower Plenum	Recirculation inlet fluid temp.	3.8	0 ~ 400°C 0 ~ 10 V	±0.94% F.S.	5.19	
66	"	T-2	Upper Plenum	fluid temp.	3.2	"	"	"	
67	"	T-3	Steam Dome	"	"	"	"	"	
68	"	T-4	Upper Downcomer	"	"	"	"	"	
69	"	T-5	Lower Downcomer	"	3.8	"	"	"	
70	"	T-6	JP-1 Driving Water	"	3.4	"	"	5.20	
71	"	T-7	JP-2 Driving Water	"	"	"	"	"	
72	"	T-8	JP-3 Driving Water	"	3.3	"	"	5.21	
73	"	T-9	JP-4 Driving Water	"	"	"	"	"	
74	"	T-10	JP-1 Discharge	"	3.4	"	"	5.20	
75	"	T-11	JP-2 Discharge	"	"	"	"	"	
76	"	T-12	JP-3 Discharge	"	3.3	"	"	5.21	
77	"	T-13	JP-4 Discharge	"	"	"	"	"	
78	"	T-14	MRP-1 Suction	"	3.4	"	"	5.22	
79	"	T-15	MRP-1 Discharge	"	"	"	"	"	

Table 3.1 (continued)

CH. No.	Item	Symb.	Location	Description	Loc. Fig. No.	Range & Output	Accuracy	Data Fig. No.	Measurement comments
80	Temp.	T-16	MRP-2 Suction	fluid temp.	3.3	0 ~ 400°C 0 ~ 10 V	±0.94% F.S.	5.22	
81	"	T-17	MRP-2 Discharge	"	"	"	"	"	
82	"	T-18	Above Break A	"	3.5	"	"	5.23	
83	"	T-19	Above Break B	"	"	"	"	"	
84	"	T-20	Condensed Water A	"	"	"	"	"	not presented
85	"	T-21	Condensed Water B	"	"	"	"	"	"
86	"	T-22	Discharged Steam Above V.	"	3.6	"	"	"	"
87	"	T-23	Discharged Steam Below V.	"	"	"	"	5.19	
88	"	TS-15	Filler Block B Side 3	Slab surface temp.	3.11	"	"	5.24	
89	"	TS-18	Filler Block B Side 6	"	"	"	"	"	
90	"	TS-21	Filler Block O Side 9	"	"	"	"	"	
91	"	TS-24	Filler Block O Side 12	"	"	"	"	"	
92	"	TS-25	JP-1 Diffuser Wall	Slab temp.	3.4	"	"	5.25	
93	"	TS-26	JP-2 Diffuser Wall	"	"	"	"	"	
94	"	TS-27	JP-3 Diffuser Wall	"	3.3	"	"	"	
95	"	TS-28	JP-4 Diffuser Wall	"	"	"	"	"	
96	"	TS-29	PV. Wall Inside 1-1	"	3.8	"	"	5.27	
97	"	TS-30	PV. Inner Surface 1-2	Slab surface temp.	"	"	"	5.26	
98	"	TS-31	PV. Inner Surface 1-3	"	"	"	"	"	
99	"	TS-32	PV. Wall Inside 2	Slab temp.	"	"	"	5.27	

Table 3.1 (continued)

CH. No.	Item	Symb.	Location	Description	Loc. Fig. No.	Range & Output	Accuracy	Data Fig. No.	Measurement comments
100	Temp.	TS-33	PV. Wall Inside 3	slab temp.	3.8	0 ~ 400°C 0 ~ 10 V	±0.94% F.S.	5.27	
101	"	TS-34	PV. Wall Inside 4	"	"	"	"	"	
102	"	TS-35	Lower Plenum Inner Surface	surface temp.	"	"	"	5.26	
103	"	TS-36	Lower Plenum Wall Inside	slab temp.	"	"	"	5.27	
104	"	TF-1	All Fuel Rod Pos. 1	surface temp.	3.12	0 ~ 1200°C 0 ~ 10 V		5.28	
105	"	TF-2	" 2	"	"	"		"	
106	"	TF-3	" 3	"	"	"			amplifier failed
107	"	TF-4	" 4	"	"	"		5.28	
108	"	TF-5	" 5	"	"	"			amplifier failed
109	"	TF-6	" 6	"	"	"		5.28	
110	"	TF-7	" 7	"	"	"		"	
111	"	TF-8	A22 Fuel Rod Pos. 1	"	"	"		5.27	
112	"	TF-9	" 2	"	"	"		"	
113	"	TF-10	" 3	"	"	"			amplifier failed
114	"	TF-11	" 4	"	"	"		5.29	
115	"	TF-12	" 5	"	"	"			amplifier failed
116	"	TF-13	" 6	"	"	"		5.29	
117	"	TF-14	" 7	"	"	"			amplifier failed
118	"	TF-15	A33 Fuel Rod Pos. 1	"	"	"		5.30	

Table 3.1 (continued)

CH. No.	Item	Symb.	Location	Description	Loc. Fig. No.	Range & Output	Accuracy	Data Fig. No.	
119	Temp.	TF-16	A33 Fuel Rod Pos. 2	surface temp.	3.12	0 ~ 1200°C 0 ~ 10 V			amplifier failed
120	"	TF-17	" 3	"	"	"			amplifier failed
121	"	TF-18	" 4	"	"	"		5.30	
122	"	TF-19	" 5	"	"	"			amplifier failed
123	"	TF-20	" 6	"	"	"		5.30	
124	"	TF-21	" 7	"	"	"		"	
125	"	TF-22	A44 Fuel Rod Pos. 1	"	"	"		5.31	
126	"	TF-23	" 2	"	"	"		"	
127	"	TF-24	" 3	"	"	"			amplifier failed
128	"	TF-25	" 4	"	"	"		5.31	
129	"	TF-26	" 5	"	"	"			amplifier failed
130	"	TF-27	" 6	"	"	"		5.31	
131	"	TF-28	" 7	"	"	"			amplifier failed
132	"	TF-29	A77 Fuel Rod Pos. 1	"	"	"		5.32	
133	"	TF-30	" 2	"	"	"		"	
134	"	TF-31	" 3	"	"	"			amplifier failed
135	"	TF-32	" 4	"	"	"		5.32	
136	"	TF-33	" 5	"	"	"			amplifier failed
137	"	TF-34	" 6	"	"	"		5.32	
138	"	TF-35	" 7	"	"	"		"	

Table 3.1 (continued)

CH. No.	Item	Symb.	Location	Description	Loc. Fig. No.	Range & Output	Accuracy	Data Fig. No.	Measurement comments
139	Temp.	TF-36	B15 Fuel Rod Pos. 3	surface temp.	3.12	0 ~ 1200°C 0 ~ 10 V			amplifier failed
140	"	TF-37	" 4	"	"	"		5.33	
141	"	TF-38	" 5	"	"	"			amplifier failed
142	"	TF-39	B33 Fuel Rod Pos. 1	"	"	"		5.34	
143	"	TF-40	" 3	"	"	"			amplifier failed
144	"	TF-41	" 4	"	"	"		5.34	
145	"	TF-42	" 5	"	"	"			amplifier failed
146	"	TF-43	" 7	"	"	"		5.34	
147	"	TF-44	B85 Fuel Rod Pos. 3	"	"	"			amplifier failed
148	"	TF-45	" 4	"	"	"		5.35	
149	"	TF-46	" 5	"	"	"			amplifier failed
150	"	TF-47	C11 Fuel Rod Pos. 3	"	"	"			amplifier failed
151	"	TF-48	" 4	"	"	"		5.36	
152	"	TF-49	" 5	"	"	"			amplifier failed
153	"	TF-50	C33 Fuel Rod Pos. 1	"	"	"		5.37	
154	"	TF-51	" 3	"	"	"			amplifier failed
155	"	TF-52	" 4	"	"	"		5.37	
156	"	TF-53	" 5	"	"	"			amplifier failed
157	"	TF-54	" 7	"	"	"		5.37	
158	"	TF-55	C77 Fuel Rod Pos. 3	"	"	"			amplifier failed

Table 3.1 (continued)

CH. No.	Item	Symb.	Location	Description	Loc. Fig. No.	Range & Output	Accuracy	Data Fig. No.	Measurement comments
159	Temp.	TF-56	C77 Fuel Rod Pos. 4	surface temp.	3.12	0 ~ 1200°C 0 ~ 10 V		5.38	
160	"	TF-57	" 5	"	"	0 ~ 1220°C 0 ~ 10 V			amplifier failed
161	"	TF-58	D27 Fuel Rod Pos. 1	"	"	"			"
162	"	TF-59	" 3	"	"	"			"
163	"	TF-60	" 4	"	"	"			"
164	"	TF-61	" 5	"	"	"			"
165	"	TF-62	" 7	"	"	"			"
166	"	TF-63	D54 Fuel Rod Pos. 3	"	"	"			"
167	"	TF-64	" 4	"	"	"			"
168	"	TF-65	" 5	"	"	"			"
169	"	TF-66	D88 Fuel Rod Pos. 3	"	"	"			"
170	"	TF-67	" 4	"	"	"			"
171	"	TF-68	" 5	"	"	"			"
172	"	TF-69	A55 Tie Rod Pos. 1	fluid temp.	"	"		5.39	
173	"	TF-70	" 2	"	"	"		"	
174	"	TF-71	" 3	"	"	"		"	
175	"	TF-72	" 4	"	"	"		"	
176	"	TF-73	" 5	"	"	"		"	
177	"	TF-74	" 6	"	"	"		"	

Table 3.1 (continued)

CH. No.	Item	Symb.	Location	Description	Loc. Fig. No.	Range & Output	Accuracy	Data Fig. No.	Measurement comments
178	Temp.	TF-75	A55 Tie Rod Pos. 7	fluid temp.	3.12	0 ~ 1220°C 0 ~ 10 V			amplifier failed
179	"	TF-76	B55 Tie Rod Pos. 1	"	"	"		5.40	
180	"	TF-77	"	"	"	"		"	
181	"	TF-78	"	"	"	"		"	
182	"	TF-79	"	"	"	"			amplifier failed
183	"	TF-80	"	"	"	"		5.40	
184	"	TF-81	"	"	"	"		"	
185	"	TF-82	"	"	"	"		"	
186	"	TF-83	C55 Tie Rod Pos. 1	"	"	"		5.41	
187	"	TF-84	"	"	"	"		"	
188	"	TF-85	"	"	"	"		"	
189	"	TF-86	"	"	"	"		"	
190	"	TF-87	"	"	"	"		"	
191	"	TF-88	"	"	"	"		"	
192	"	TF-89	"	"	"	"		"	
193	"	TF-90	D55 Tie Rod Pos. 1	"	"	"		5.42	
194	"	TF-91	"	"	"	"		"	
195	"	TF-92	"	"	"	"		"	
196	"	TF-93	"	"	"	"		"	
197	"	TF-94	"	"	"	"		"	

Table 3.1 (continued)

CH. No	Item	Symb.	Location	Description	Loc. Fig. No.	Range & Output	Accuracy	Data Fig. No.	Measurement comments
198	Temp.	TF-95	D55 Tie Rod Pos. 6	fluid temp.	3.12	0 ~ 1220°C 0 ~ 10 V		5.42	
199	"	TF-96	" 7	"	"	"		"	
200	"	TC- 1	Channel Box A Outlet	"	"	0 ~ 400°C 0 ~ 10 V		5.43	
201	"	TC- 2	" A Inlet	"	"	"		5.44	
202	"	TC- 3	" B Outlet	"	"	"		5.43	
203	"	TC- 4	" B Inlet	"	"	"		5.44	
204	"	TC- 5	" C Outlet	"	"	"		5.43	
205	"	TC- 6	" C Inlet	"	"	"		5.44	
206	"	TC-7	" D Outlet	"	"	"		5.43	
207	"	TC- 8	" D Inlet	"	"	"		5.44	
208	"	TB- 1	C.B. Inner Surface Pos.A-1	surface temp.	"	"		5.45	
209	"	TB- 2	" A-2	"	"	"		"	
210	"	TB- 3	" A-3	"	"	"		"	
211	"	TB- 4	" A-4	"	"	"		"	
212	"	TB- 5	" A-5	"	"	"		"	
213	"	TB- 6	" A-6	"	"	"		"	
214	"	TB- 7	" A-7	"	"	"		"	
215	"	TB- 8	C.B. Inner Surface Pos.A-8	"	"	"		"	amplifier failed
216	"	TB- 9	" A-9	"	"	"		"	"

Table 3.1 (continued)

C.H. No.	Item	Symb.	Location	Description	Loc. Fig. No.	Range & Outlet	Accuracy	Data Fig. No.	Measurement comments
217	Temp.	TB-10	C.B. Inner Surface Pos.A-10	surface temp.	3.12	0 ~ 400°C 0 ~ 10 V			amplifier failed
218	"	TB-11	"	"	"	"			"
219	"	TB-12	"	"	"	"			"
220	"	TB-13	"	"	"	"			"
221	"	TB-14	"	"	"	"			"
222	"	TP- 1	Lower PL. 0° High	"	3.10	"		5.46	
223	"	TP- 2	" Middle	"	"	"		"	
224	"	TP- 3	" Low	"	"	"		"	
225	"	TP- 4	Lower PL. 180° High	"	"	"			amplifier failed
226	"	TP- 5	" Middle	"	"	"			"
227	"	TP- 6	" Low	"	"	"			"
228	"	TP- 7	Lower PL. Center Low	fluid temp.	"	"		5.47	
229	"	TP- 8	Lower PL. Center Bottom	"	"	"		"	
230	Dens.	DF- 1	JP-1.2 Outlet Beam 1		3.4	0 ~ 1000kg/cm ³ 0 ~ 10 V log			not measured
231	"	DF- 2	" 2		"	"			"
232	"	DF- 3	" 3		"	"			"
233	"	DF- 4	JP-3.4 Outlet Beam 1		3.3	"			"
234	"	DF- 5	" 2		"	"			"
235	"	DF- 6	" 3		"	"			"

Table 3.1 (continued)

C.H. No.	Item	Symb.	Location	Description	Loc. Fig. No.	Range & Output	Accuracy	Data. Fig. No.	Measurement comments
236	Dens.	DF-7	Break A Beam 1		3,3	0 ~ 1000kg/cm ³ 0 ~ 10 V			not measured
237	"	DF-8	Break A Beam 2		"				"
238	Mome.F.	M-1	JP-1.2 Outlet		3,4	0 ~ 1.5 × 10 ⁵ kg/ms ² 0 ~ 10 V			"
239	"	M-2	JP-3.4 Outlet		3,3	"			"
240	"	M-3	Break A		"	"			"
241	Flow	F-23	JP-1.2 Outlet		3,4	0 ~ 30l/sec 0 ~ 10 V			"
242	"	F-24	JP-3.4 Outlet		3,3	"			"
243	"	F-25	Break A		"	0 ~ 30kg/sec 0 ~ 10 V			"
244	Press.	P-17	JP-1.2 Outlet		3,4	0 ~ 100kg/cm 0 ~ 10 V	±1.8 %F.S.		"
245	"	P-18	JP-3.4 Outlet		3,3	"	"		"
246	"	P-19	Break A		"	"	"		"
247	Temp.	T-24	JP-1.2 Outlet		3,4	0 ~ 400°C 0 ~ 10 V	±0.94 %F.S.		"
248	"	T-25	JP-3.4 Outlet		3,3	"	"		"
249	"	T-26	Break A		"	"	"		"

Table 3.2 List of instrumentation for supplemental recording system (1)

Ch. No.	Item	Symb.	Location	Descriptions	Loc. Fig. No.	Range	Data Fig. No.	Measurement comments
501	Fuel temp.	TF-3	A11 fuel rod, pos. 3	surface temp.	3.12	0 ~ 1000°C		not presented
502	"	TF-4	" pos. 4	"	"	"		"
503	"	TF-5	" pos. 5	"	"	"		"
504	"	TF-10	A22 fuel rod, pos. 3	"	"	"		"
505	"	TF-11	" pos. 4	"	"	"		"
506	"	TF-12	" pos. 5	"	"	"		"
507	"	TF-17	A33 fuel rod, pos. 3	"	"	"		"
508	"	TF-18	" pos. 4	"	"	"		"
509	"	TF-19	" pos. 5	"	"	"		"
510	"	TF-24	A44 fuel rod, pos. 3	"	"	"		"
511	"	TF-25	" pos. 4	"	"	"		"
512	"	TF-26	" pos. 5	"	"	"		"
513	"	TF-31	A77 fuel rod, pos. 3	"	"	"		"
514	"	TF-32	" pos. 4	"	"	"		"
515	"	TF-33	" pos. 5	"	"	"		"
516	"	TF-36	B15 fuel rod, pos. 3	"	"	"		"
517	"	TF-37	" pos. 4	"	"	"		"
518	"	TF-38	" pos. 5	"	"	"		"
519	"	TF-40	B33 fuel rod, pos. 3	"	"	"		"
520	"	TF-41	" pos. 4	"	"	"		"

Table 3.2 (continued)

Ch. No.	Item	Symb.	Location	Descriptions	Loc. Fig. No.	Range	Data Fig. No.	Measurement comments
521	Fuel temp.	TF-42	B33 fuel rod, pos. 5	surface temp.	3.12	0 ~ 1000°C		not presented
522	"	TF-44	B85 fuel rod, pos. 3	"	"	"		"
523	"	TF-45	" pos. 4	"	"	"		"
524	"	TF-46	" pos. 5	"	"	"		"
525	"	TF-47	C11 fuel rod, pos. 3	"	"	"		"
526	"	TF-48	" pos. 4	"	"	"		"
527	"	TF-49	" pos. 5	"	"	"		"
528	"	TF-51	C33 fuel rod, pos. 3	"	"	"		"
529	"	TF-52	" pos. 4	"	"	"		"
530	"	TF-53	" pos. 5	"	"	"		"
531	"	TF-55	C77 fuel rod, pos. 3	"	"	"		"
532	"	TF-56	" pos. 4	"	"	"		"
533	"	TF-57	" pos. 5	"	"	"		"
534	"	TF-59	D27 fuel rod, pos. 3	"	"	"		"
535	"	TF-60	" pos. 4	"	"	"		"
536	"	TF-61	" pos. 5	"	"	"		"
537	"	TF-63	D54 fuel rod, pos. 3	"	"	"		"
538	"	TF-24	" pos. 4	"	"	"		"
539	Slab temp.	TS- 1	Core barrel A 1	"	3.11	0 ~ 400°C		"
540	"	TS- 2	" A 2	"	"	"		"

Table 3.2 (continued)

Ch. No.	Item	Symb.	Location	Descriptions	Loc. Fig. No.	Range	Data Fig. No.	Measurement comments
541	Slab temp.	TS-3	Core barrel A 3	surface temp.	3.11	0 ~ 400°C		not presented
542	"	TS-4	" A 4	"	"	"		"
543	"	TS-5	" A 5	"	"	"		"
544	"	TS-6	" A 6	"	"	"		"
545	"	TS-7	Core barrel C 7	"	"	"		"
546	"	TS-8	" C 8	"	"	"		"
547	"	TS-9	" C 9	"	"	"		"
548	"	TS-10	" C 10	"	"	"		"
549	"	TS-11	" C 11	"	"	"		"
550	"	TS-12	" C 12	"	"	"		"
551	"	TS-13	Dummy block, B side 1	"	"	"		"
552	"	TS-14	" B side 2	"	"	"		"
553	"	TS-16	" B side 4	"	"	"		"
554	"	TS-17	" B side 5	"	"	"		"
555	"	TS-19	" O side 7	"	"	"		"
556	"	TS-20	" O side 8	"	"	"		"
557	"	TS-22	" O side 10	"	"	"		"
558	"	TS-23	" O side 11	"	"	"		"
559	Direction of rev.	RD-1	Main recirc, pump 1		3.4	pos. ~ neg.		"
560	"	RD-2	" 2		3.3	"		"

Table 3.2 (continued)

Ch. No.	Item	Symb.	Location	Descriptions	Loc. Fig. No.	Range	Data Fig. No.	Measurement comments
561	Signal	S - 4	Cooling water valve A		3.5	open~close		c.f chronology (Table 5.1)
562	"	S - 5	" B		"	"		
563	"	S - 6	HPCS valve		3.1	"		}
564	"	S - 7	LPCS valve		"	"		
565	"	S - 8	LPCI valve		"	"		
566	"	S -12	ADS valve		3.6	"		
567	"	S -13	MRP-1 power		3.4	ON ~ OFF		}
568	"	S -14	MRP-2 power		3.3	"		
569	Liquid level	LB- 1	Channel box A 1		3.12	"		undefined data
570	"	LB- 2	" 2		"	"		"
571	"	LB- 3	" 3		"	"		"
572	"	LB- 4	" 4		"	"		"
573	"	LB- 5	" 5		"	"		"
574	"	LB- 6	" 6		"	"		"
575	"	LB- 7	" 7		"	"		"
576	"	LB- 8	" 8		"	"		"
577	"	LB- 9	" 9		"	"		"
578	"	LB-10	" 10		"	"		"
579	"	LB-11	" 11		"	"		"
580	"	LB-12	" 12		"	"		"

Table 3.2 (continued)

Ch. No.	Item	Symb.	Location	Descriptions	Loc. Fig. No.	Range	Data Fig. No.	Measurement comments
581	Liquid level	LB-13	Channel box A 13		3.12	ON ~ OFF		undefined data
582	"	LB-14	" 14		"	"		"
583	Liquid level	LL- 1	Lower plenum 1		3.10	"		"
584	"	LL- 2	" 2		"	"		"
585	"	LL- 3	" 3		"	"		"
586	"	LL- 4	" 4		"	"		"
587	"	LL- 5	" 5		"	"		"
588	"	LL- 6	" 6		"	"		"
589	"	LL- 7	" 7		"	"		"
590	"	LL- 8	" 8		"	"		"
591	Liquid level	L - 1	Lower plenum		"	"		"
592	"	L - 2	"		"	"		"
593	"	L - 3	"		"	"		"
594	"	L - 4	"		"	"		"
595	"	L - 5	"		"	"		"
596	"	L - 6	Mixing plenum		3.8	"		"
597	"	L - 7	Downcomer		"	"		"
598	"	L - 8	"		"	"		"
599	"	L - 9	"		"	"		"
600	"	L -10	"		"	"		"

Table 4.1 Test Conditions of the ROSA-III RUN 703

Parameter	Specified Value	Measured Value
<u>Break Conditions</u>		
Location	Recirculation pump suction	Recirculation pump suction
Type	Double-ended	Split
Break Orifice Diameter (mm)	26.2	26.2
<u>Initial System Conditions</u>		
Steam Dome Pressure (MPa)	7.16	7.04
Lower Plenum Temperature (K)	----	552
Lower Plenum Subcooling (K)	----	10.0
Core Inlet Flow Rate (kg/s)	36.4	35.5
Broken Loop Flow Rate (m ³ /s)	----	21.9×10 ⁻³ (16.4 kg/s)
Intact Loop Flow Rate (m ³ /s)	----	25.4×10 ⁻³ (19.1 kg/s)
Core Outlet Quality (-)	----	0.039
Power Level (kW)	3733 (133+1600+2000)	3711 (131+1570+2010)
Maximum Linear Heat Rate		
of Region 1 [9 rods] (kW/m)	11.0	11.0
Region 2 [108 rods] (kW/m)	11.0	10.9
Region 3 [135 rods] (kW/m)	11.0	11.2
Power Curve	dp+dn+sh *	Fig 5.1
Water Level in PV (m)	4.62	4.63
<u>Feedwater Conditions</u>		
Steady State Line		
Temperature (K)	293	293
Flow Rate (m ³ /s)	----	1.37×10 ⁻³

* Note ; dp=decay power of fission products
 dn=delayed neutron fission power
 sh=stored heat release from heater rods.

Table 4.1 (Continued)

Parameter	Specified Value	Measured Value
<u>Feedwater Conditions (Continued)</u>		
Transient Line		
Temperature (K)	478.2	468
Flow Rate (m ³ /s)	2.41x10 ⁻³	3.04x10 ⁻³ (Fig5.15)
Termination Time (s)	2.0	4.0
<u>Steam Discharge Conditions</u>		
Steady State Line		
Flow Rate (kg /s)	----	Not Measured
Transient Line		
Flow Rate (kg /s)	2.07	2.55 (Fig5.13)
Orifice Diameter (mm)	20.0	20.0
Termination Time (s)	3.0	7.0
<u>ECCS Conditions</u>		
HPCS		
Injection Location	Upper plenum	Upper plenum
Initiation Time (s)	27 sec after break	25.5
at Pressure in PV (MPa)	----	5.76
Water Level in PV (m)	----	----
Coolant Temperature (K)	293	294.7
Injection Flow Rate (m ³ /s)	2.28x10 ⁻⁴ at 8.00MPa 9.67x10 ⁻⁴ at 0.945MPa	Fig 5.14

Table 4.1 (Continued)

Parameter	Specified Value	Measured Value
<u>ECCS Conditions (Continued)</u>		
LPCS		
Injection Location	Upper plenum	Upper plenum
Initiation Time (s)	----	79.0
at Pressure in PV (MPa)	2.16	2.16
Water Level in PV (m)	----	----
Coolant Temperature (K)	293	292.9
Injection Flow Rate (m ³ /s)	9.67x10 ⁻⁴	Not Measured
LPCI		
Injection Location		
Initiation Time (s)	13 sec after LPCS activation	91.5
at Pressure in PV (MPa)	----	1.73
Coolant Temperature (K)	293	293
Injection Flow Rate (m ³ /s)	3.83x10 ⁻⁴	Fig 5.14
<u>ADS Conditions</u>		
Valve Opening Time (s)	120	131
Valve Closed Time (s)	480	480 (Approx)
Flow Rate (m ³ /s)	----	Not Measured
Orifice Diameter (mm)	6.0	6.0

Table 4.2 Valve Characteristics of Steam Discharge Line

Valve	Close to Open (sec)	Open to Close (sec)
AV165 (MSIV Valve)	0.1	1.5
AV168 (Steady State Line)	-	0.1
AV169 (ADS Valve)	0.3	2.0

Orifice	Diameter (mm)	Area (mm ²)
OR3	Not Used	-
OR4	6.0	28.27
OR5	20.0	314.16

Table 5.1 Sequence of Events in RUN 703

Time After Break (s)	Events
0.0	Break Initiation of core power control (1) Terminate intact loop recirculation pump power Terminate broken loop recirculation pump power
2.5	Initiation of feed water valve closure
4.0	Closure of feed water line
4.5	Initiation of steam discharge line
7.0	closure of steam discharge line
10.0	Jet pump suction nozzle uncover
11.3	Initiation of core power reduction
13.2	Recirculation pump suction nozzle uncover
22.4	Lower plenum flashing initiation
25.5	HPCS injection initiation
79.0	LPCS injection initiation
91.5	LPCI injection initiation
131.0	ADS valve open
(480)*	ADS valve closure End of data acquisition

Notes: (1) See Fig. 5.1

* Approximate value

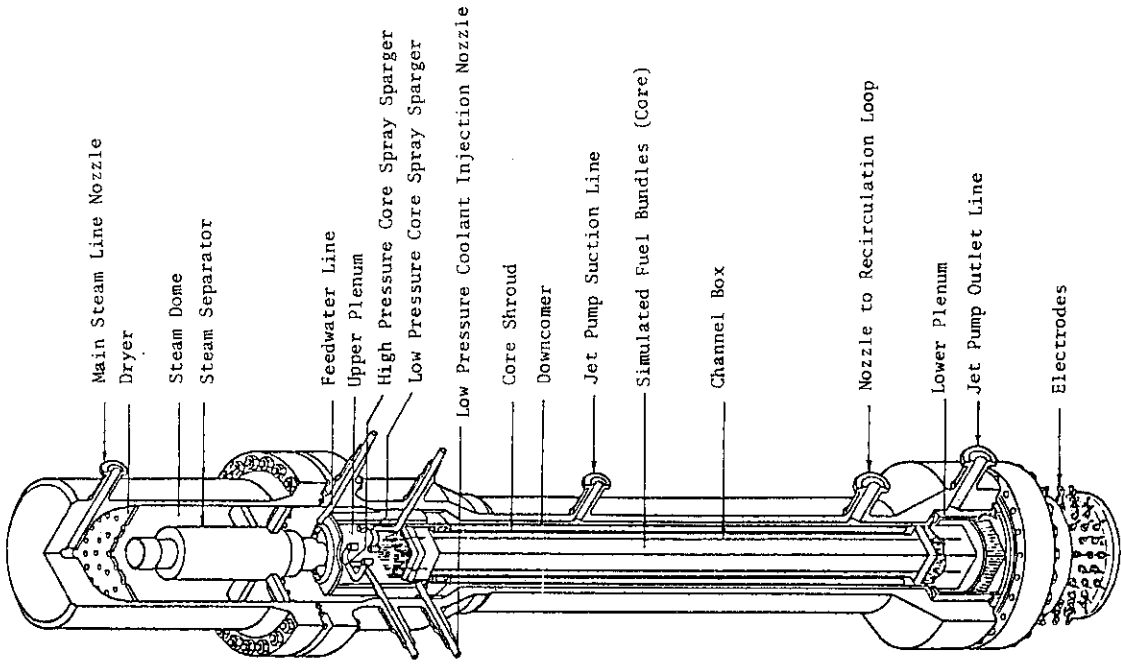


Fig. 2.2 Internal structure of pressure vessel of ROSA-III

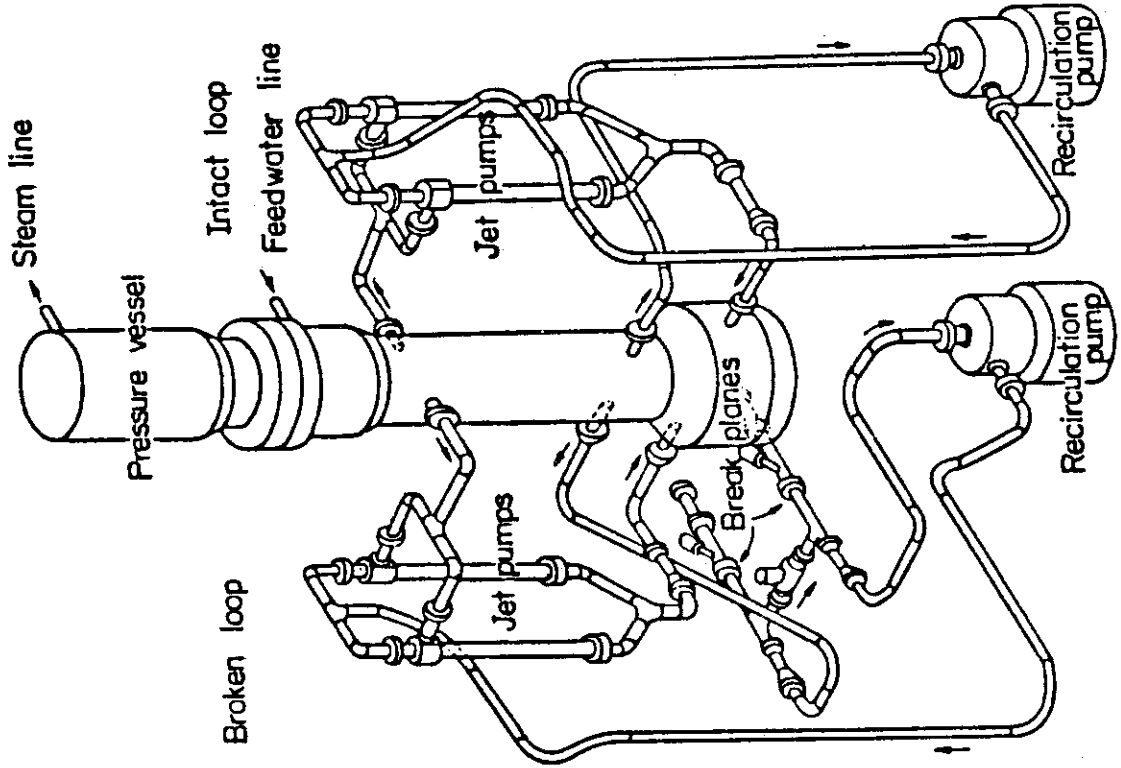


Fig. 2.1 ROSA-III Test Facility Isometric

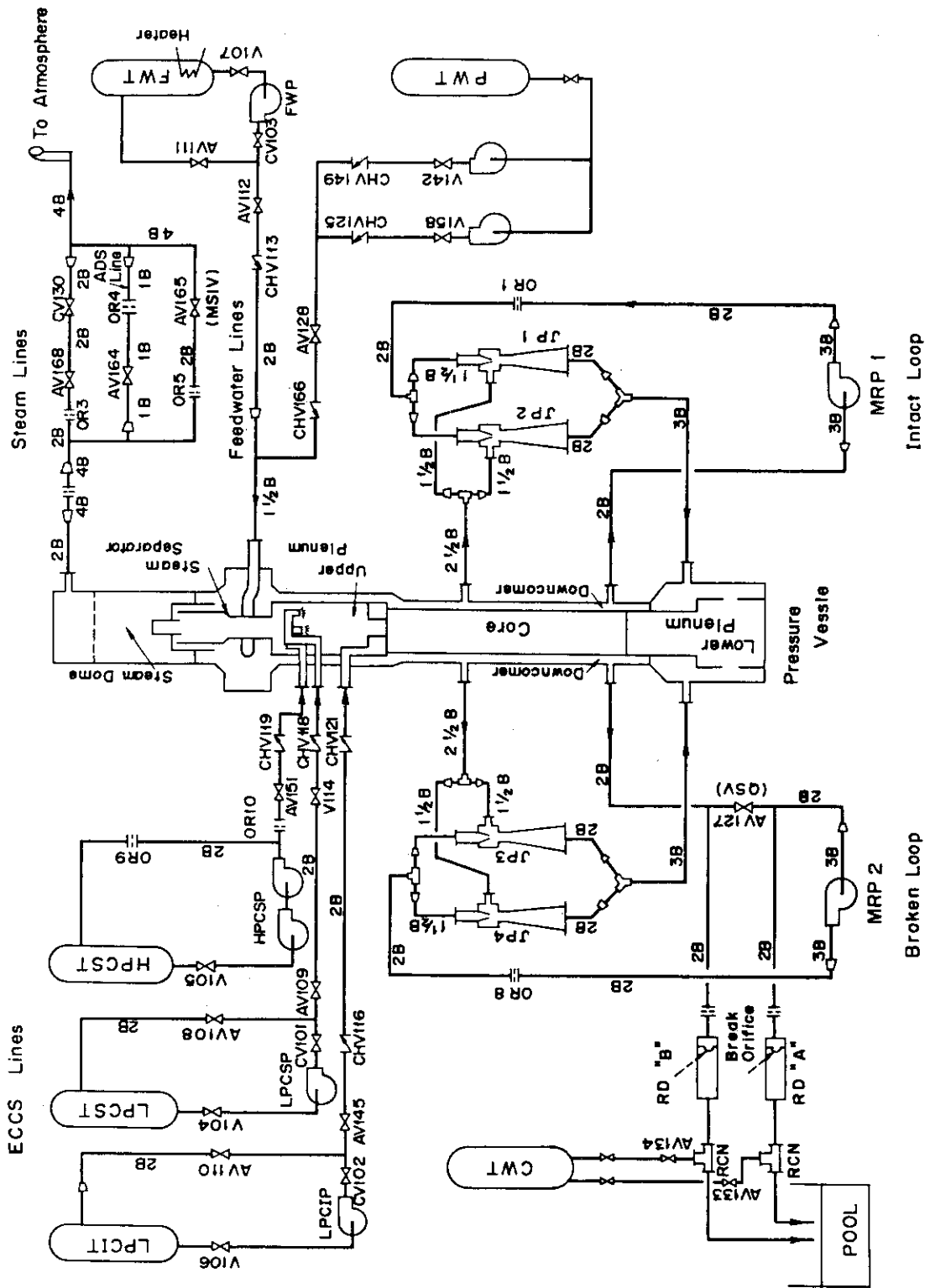


Fig. 2.3 ROSA-III piping schematic.

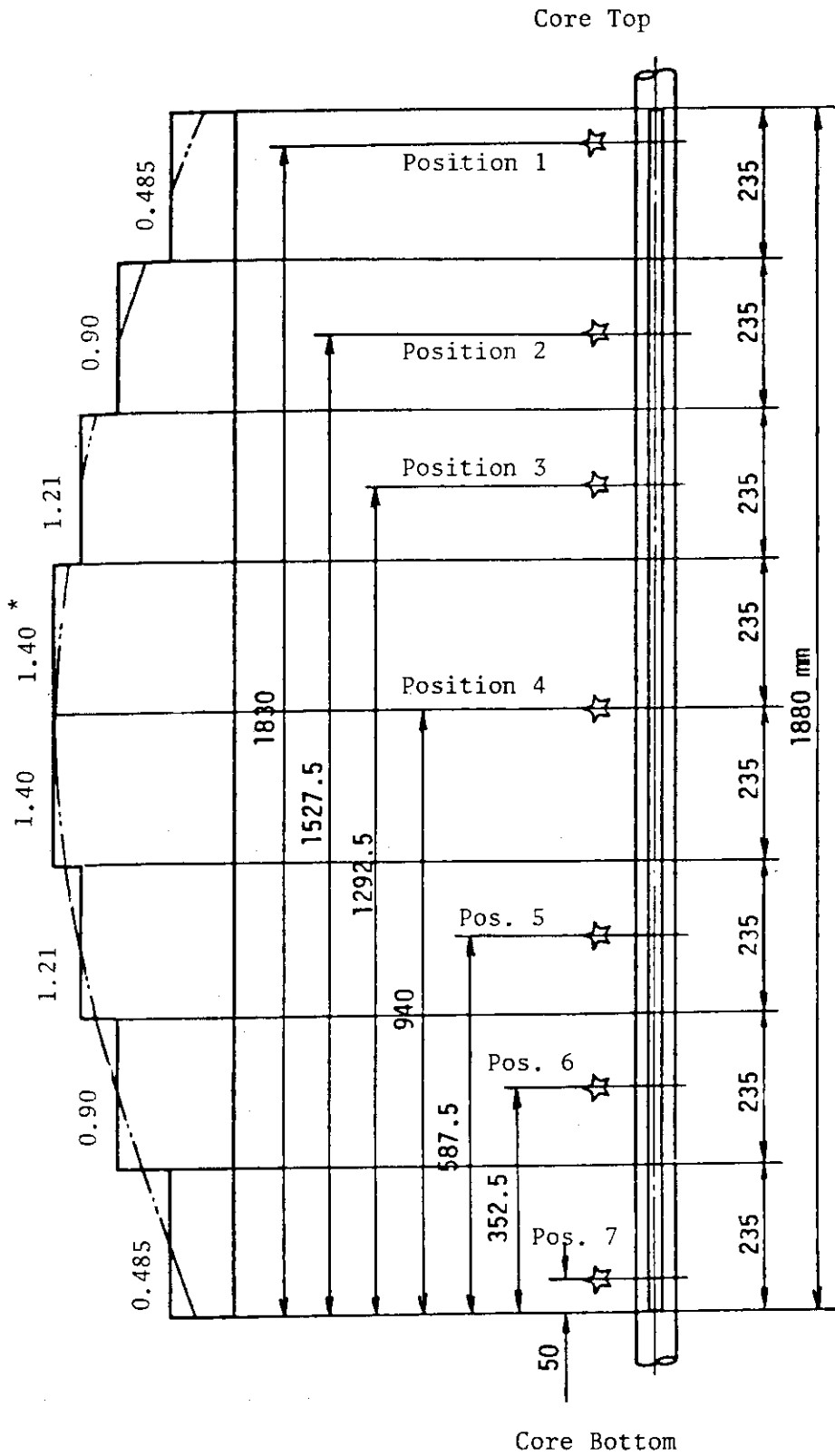
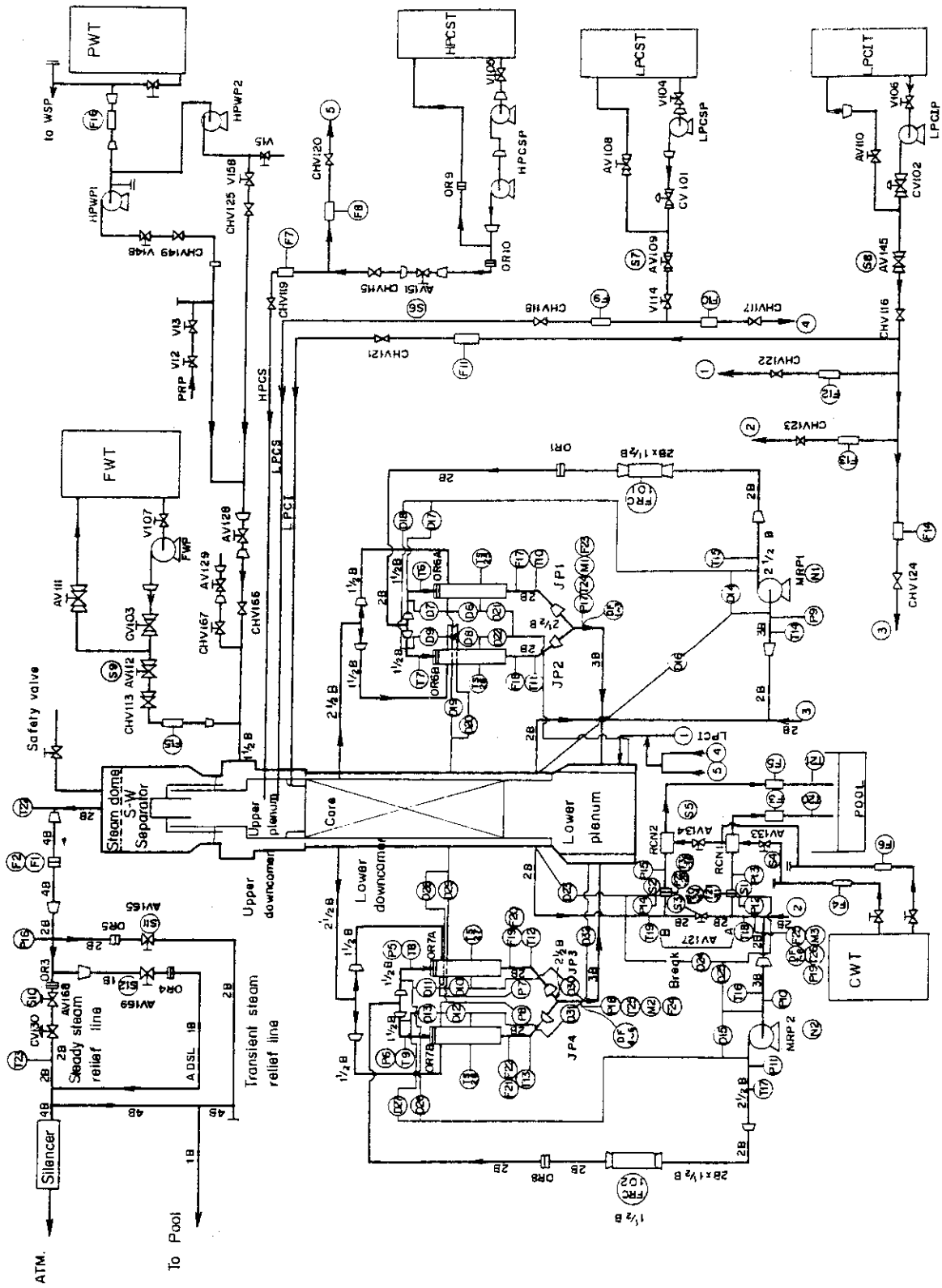


Fig. 2.4 Axial power distribution of heater rod.



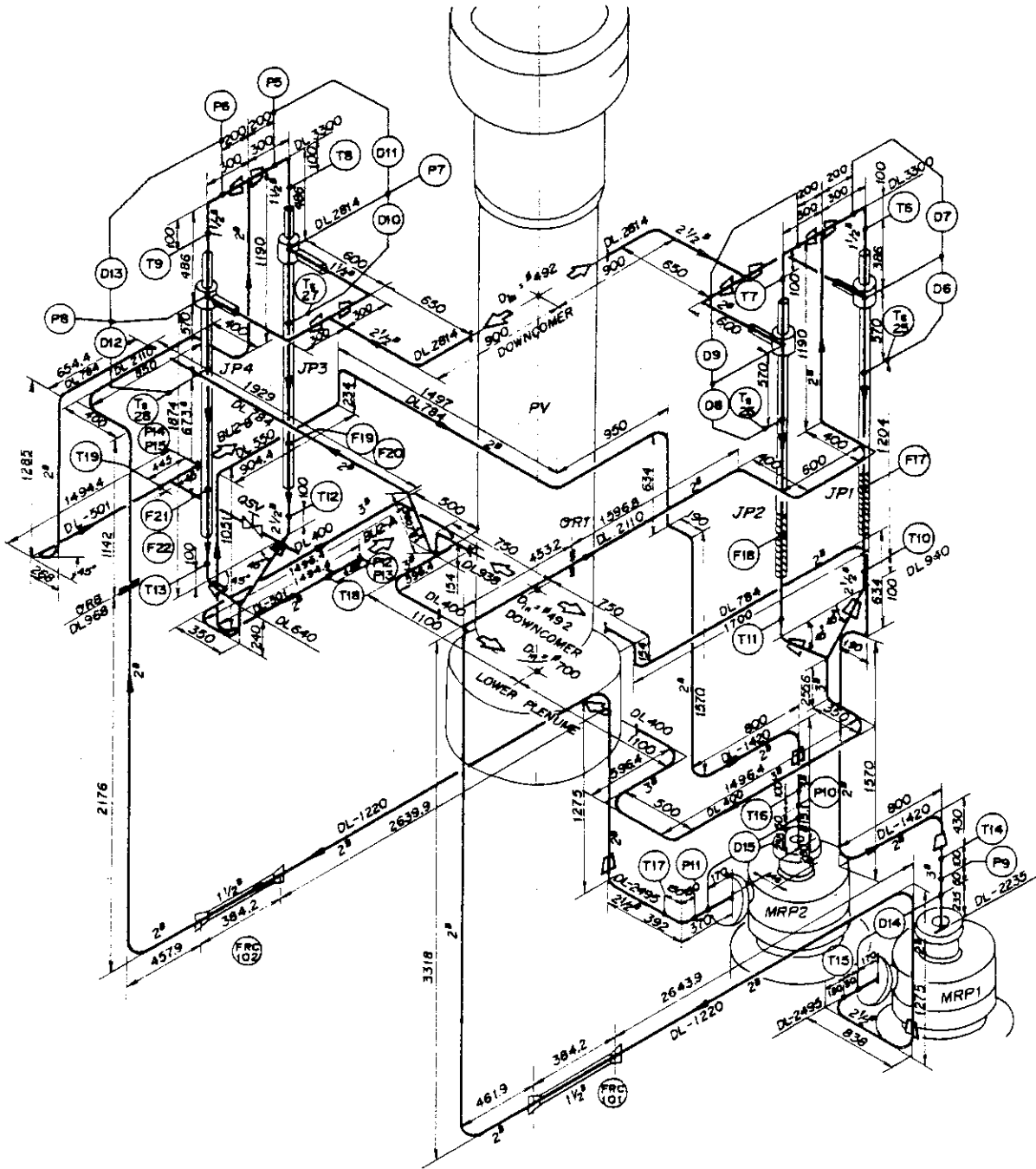


Fig. 3.2 ROSA-III recirculation loops with instrumentation

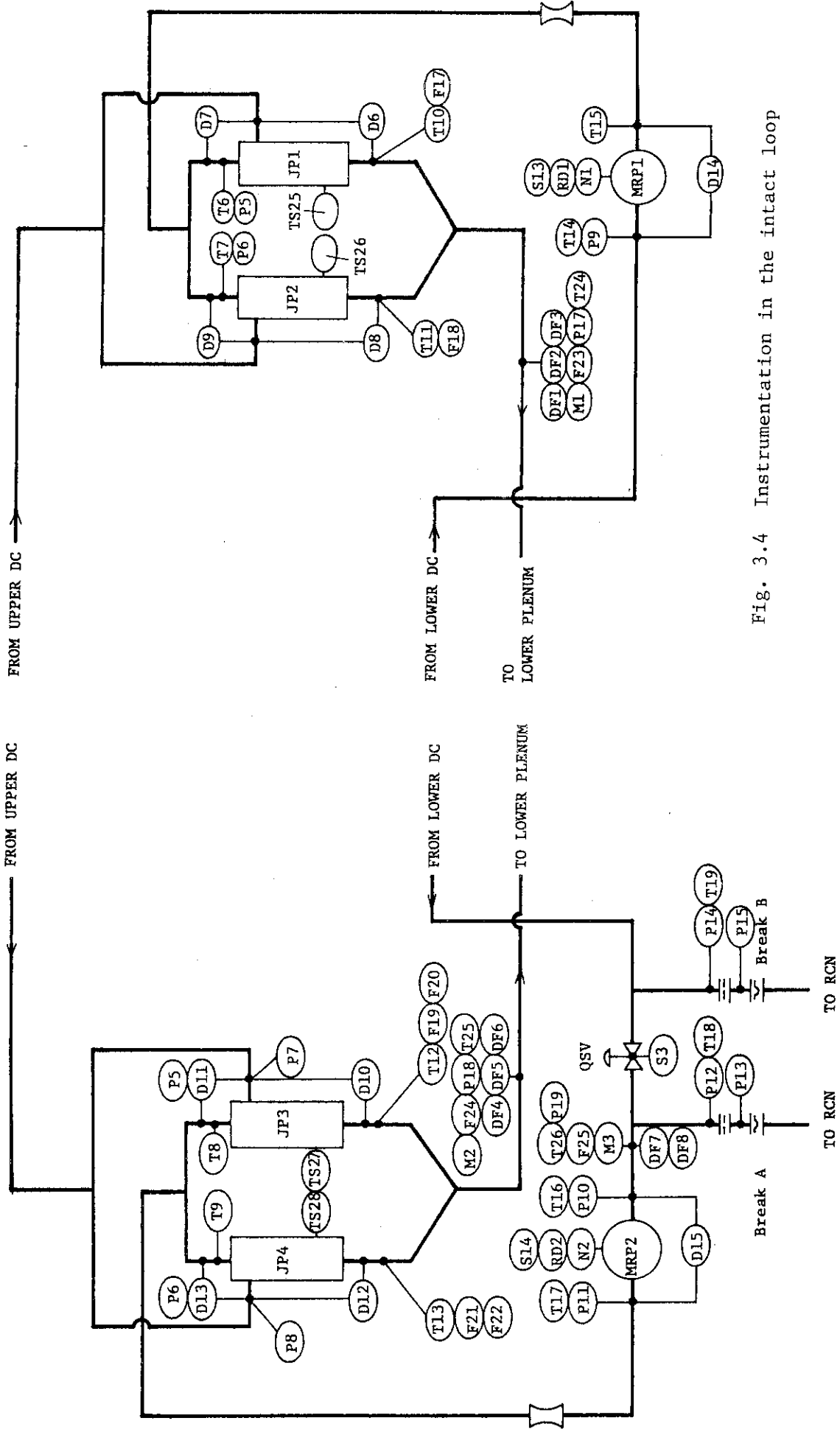


Fig. 3.4 Instrumentation in the intact loop

Fig. 3.3 Instrumentation in the broken loop

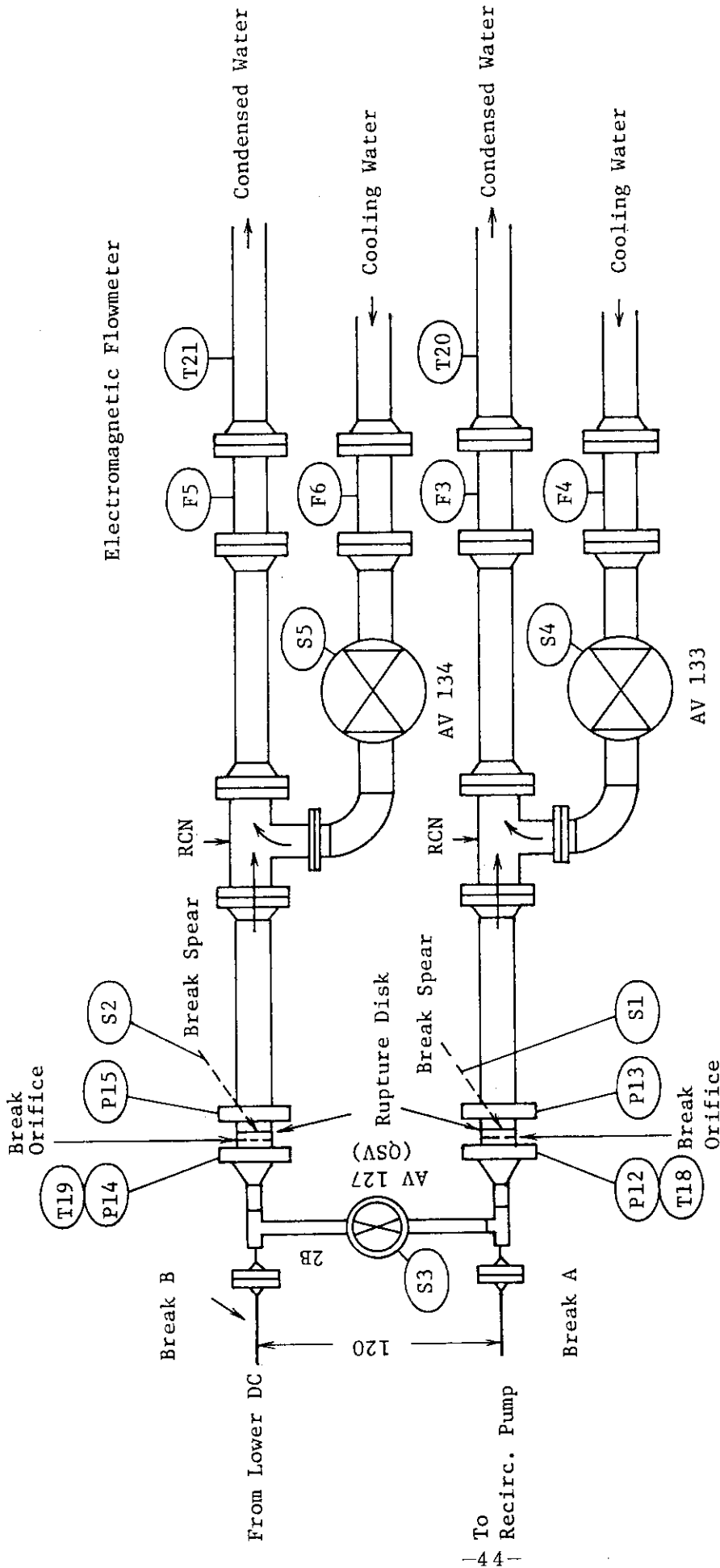


Fig. 3.5 Instrumentation in the break unit.

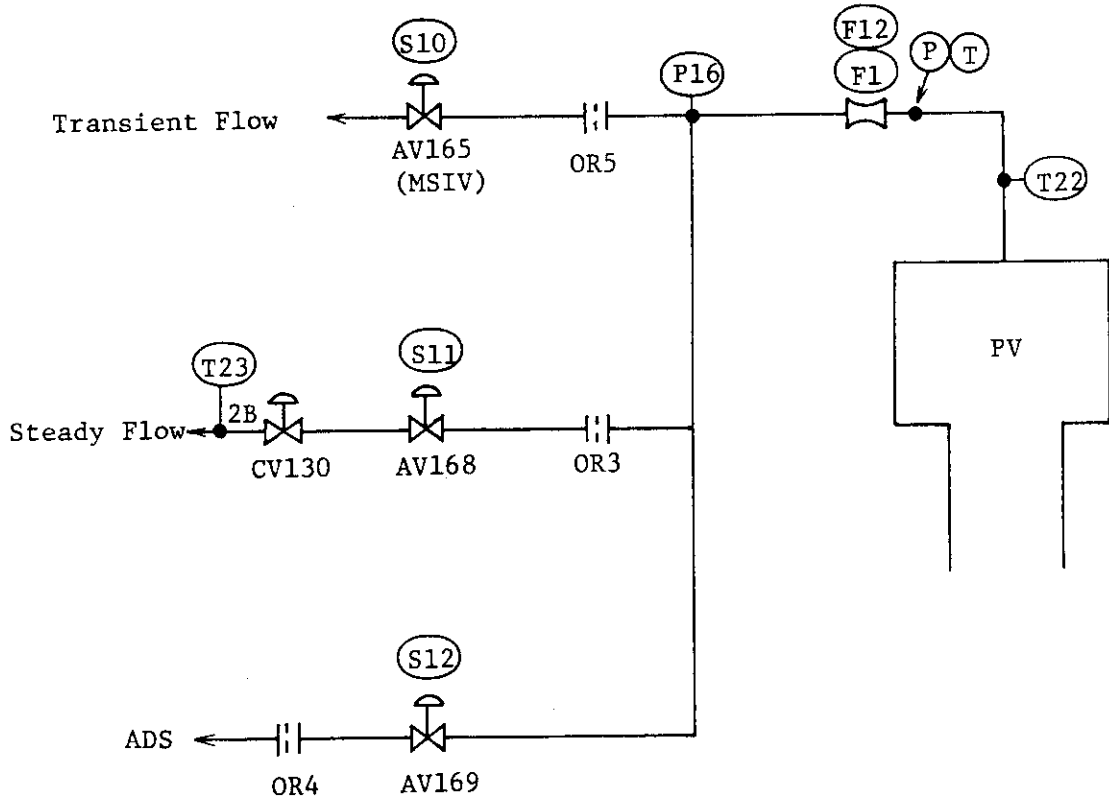


Fig. 3.6 Instrumentation in the steam line

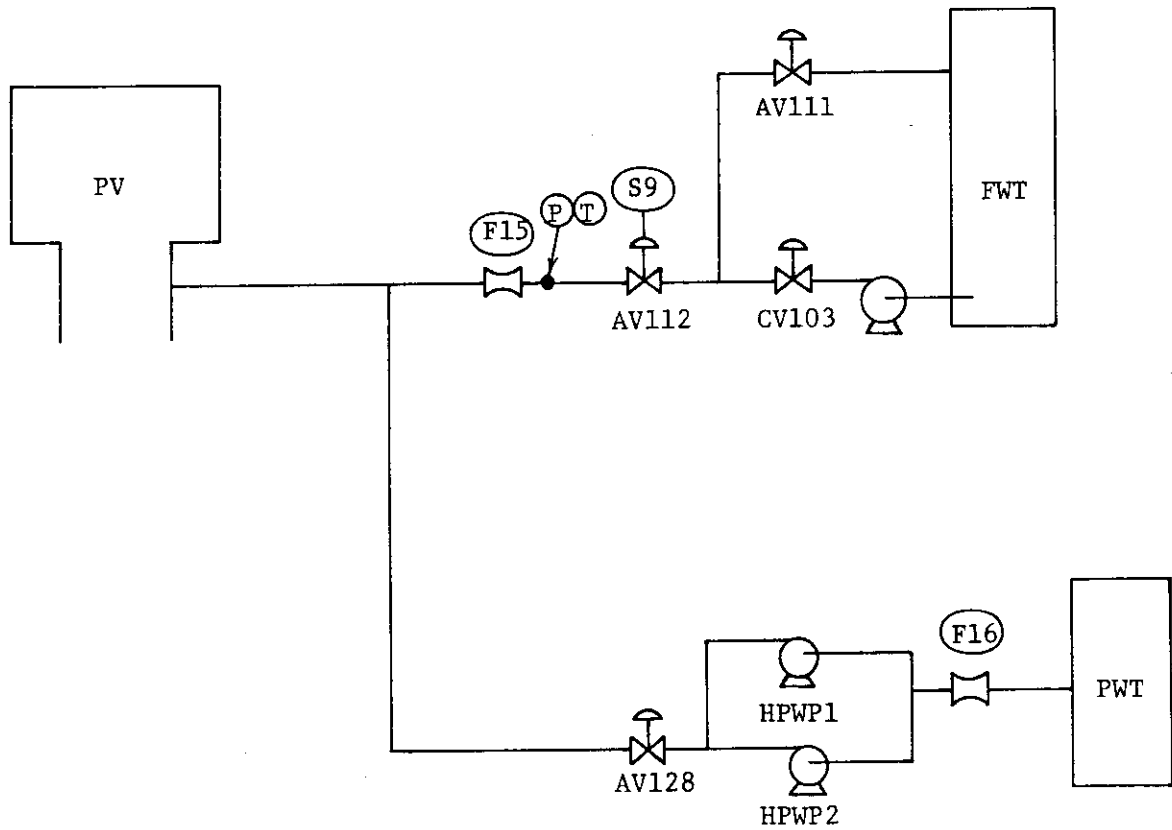


Fig. 3.7 Instrumentation in the feedwater line.

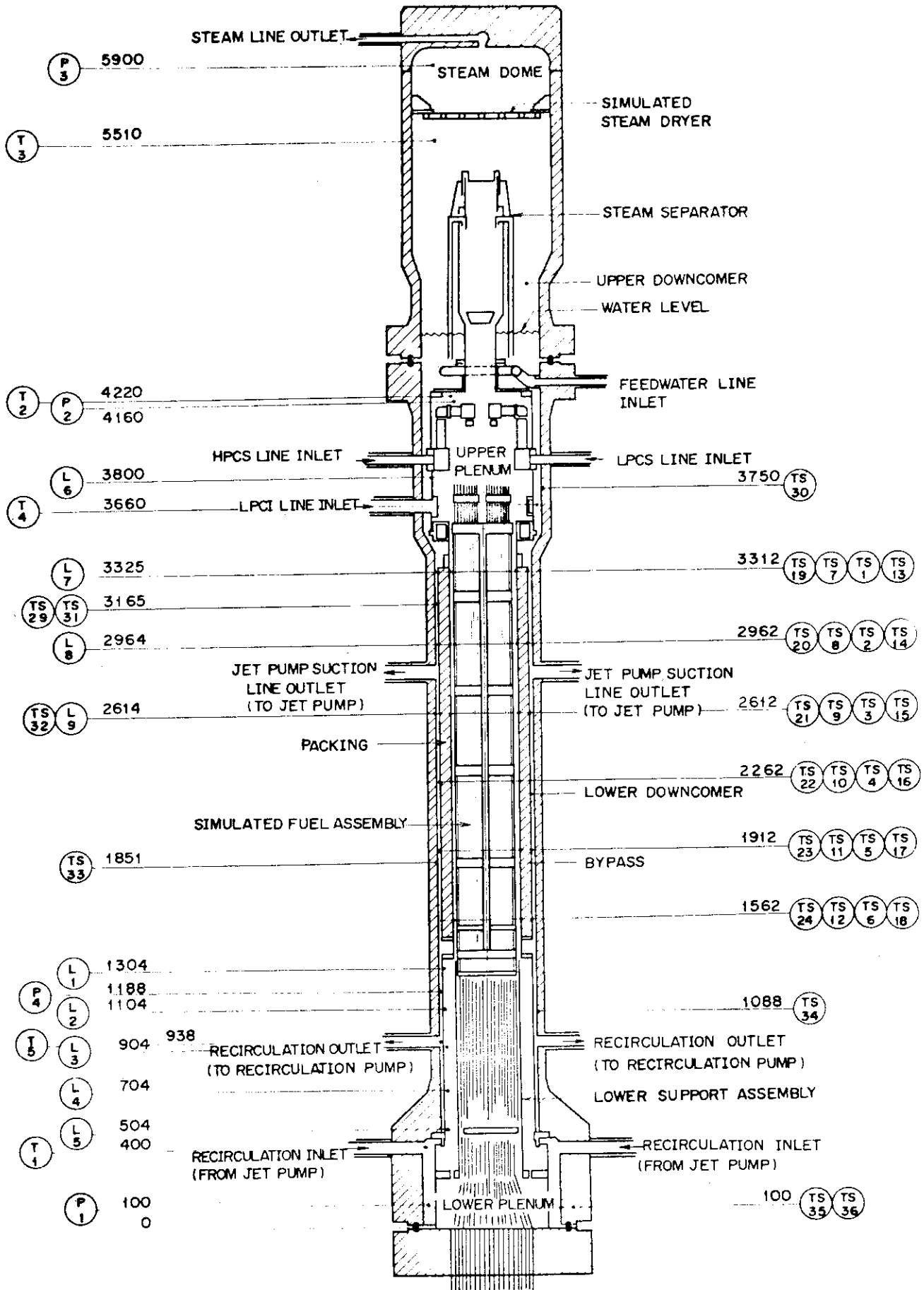


Fig. 3.8 INSTRUMENTATION IN THE ROSA III PRESSURE VESSEL

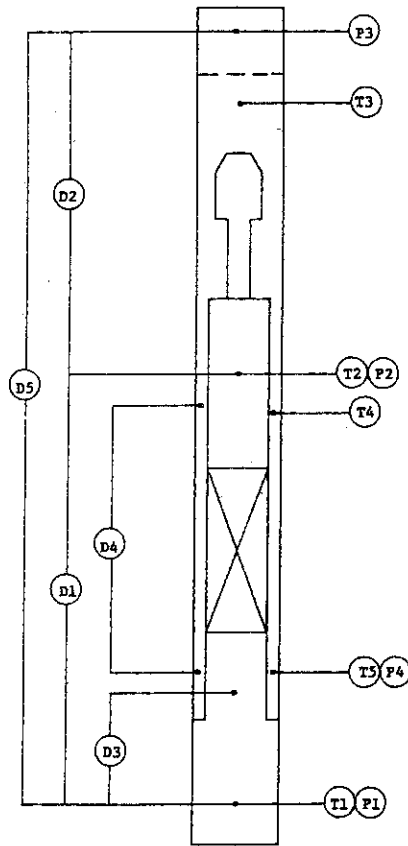


Fig. 3.9 Instrumentation in the pressure vessel

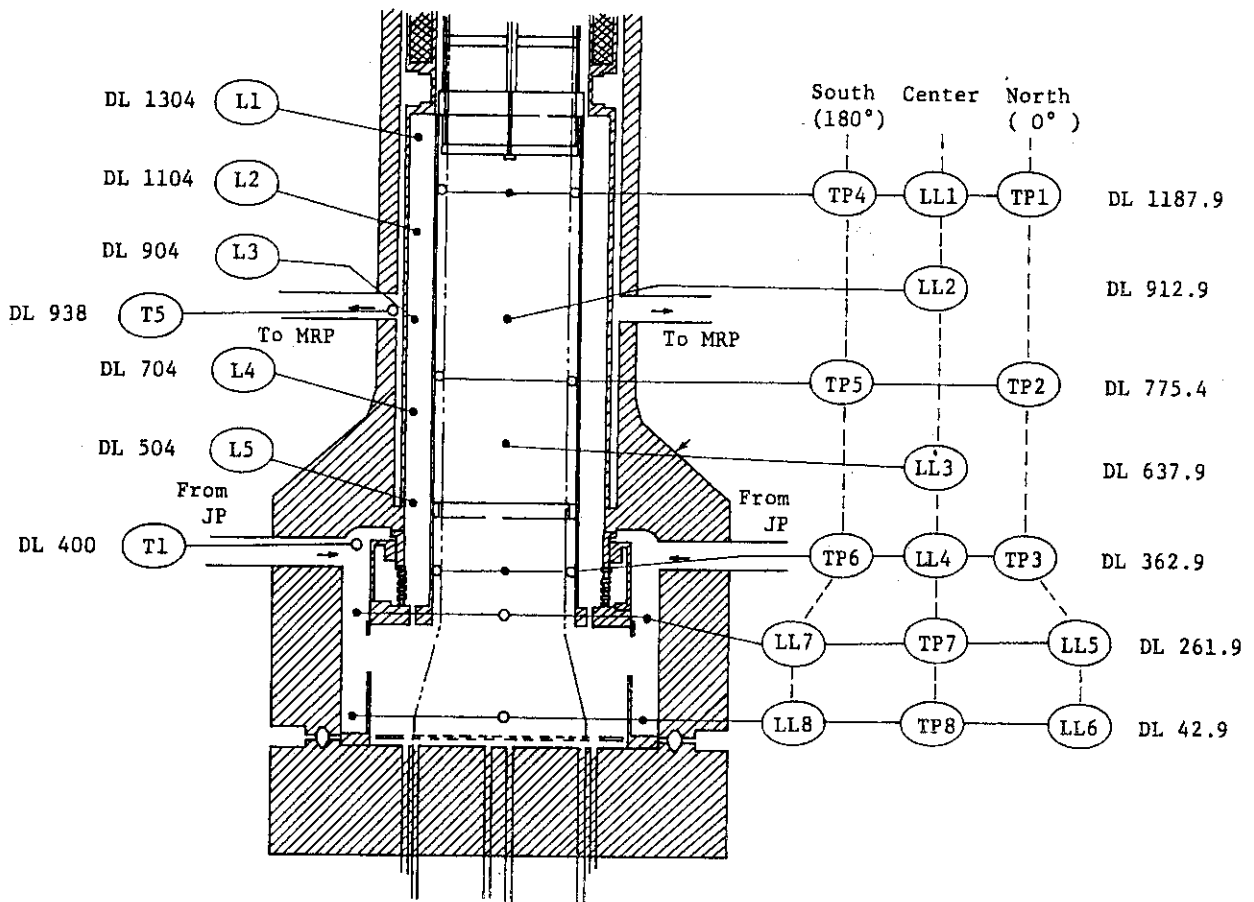


Fig. 3.10 Instrumentation location in lower plenum

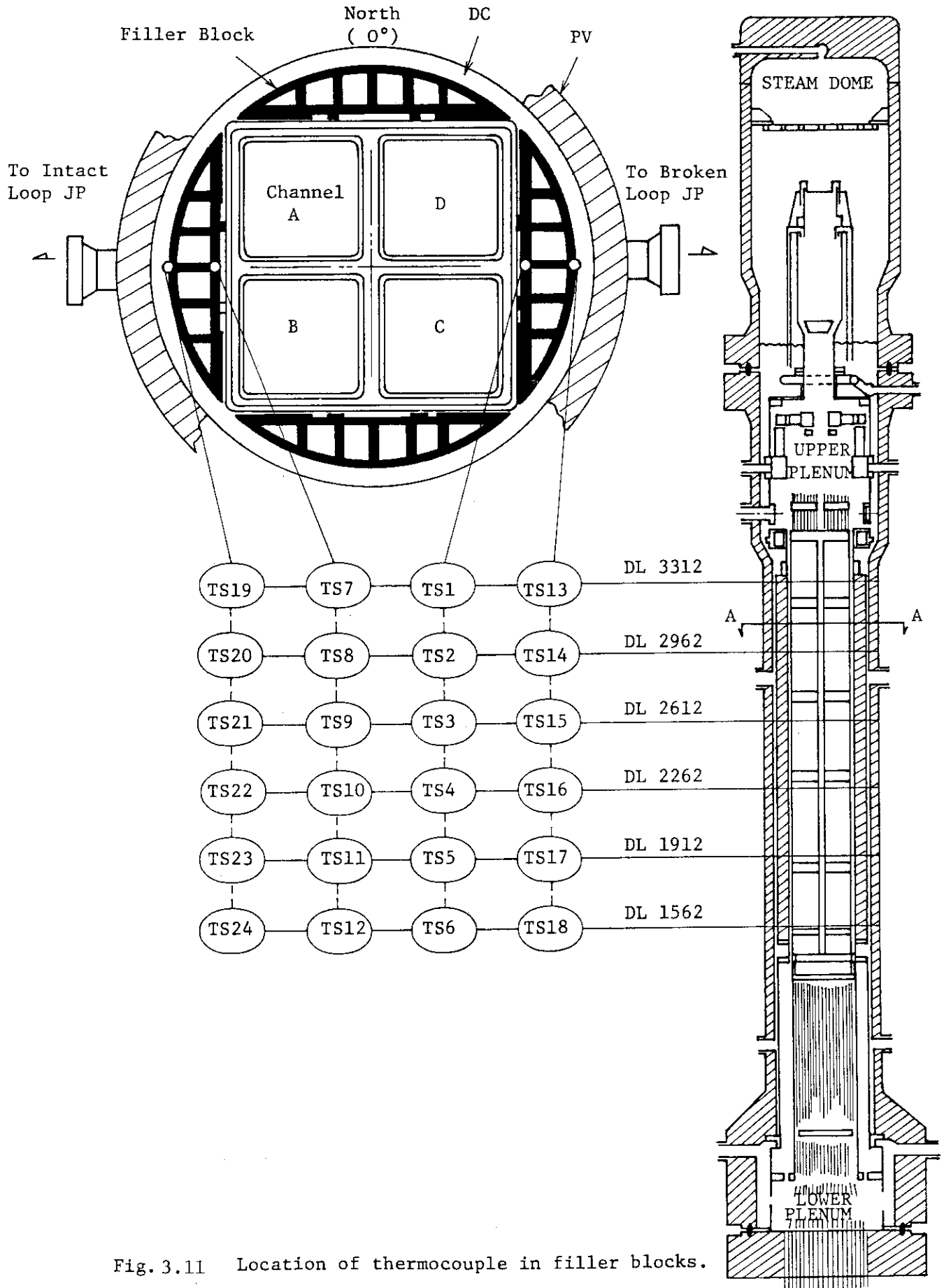


Fig. 3.11 Location of thermocouple in filler blocks.

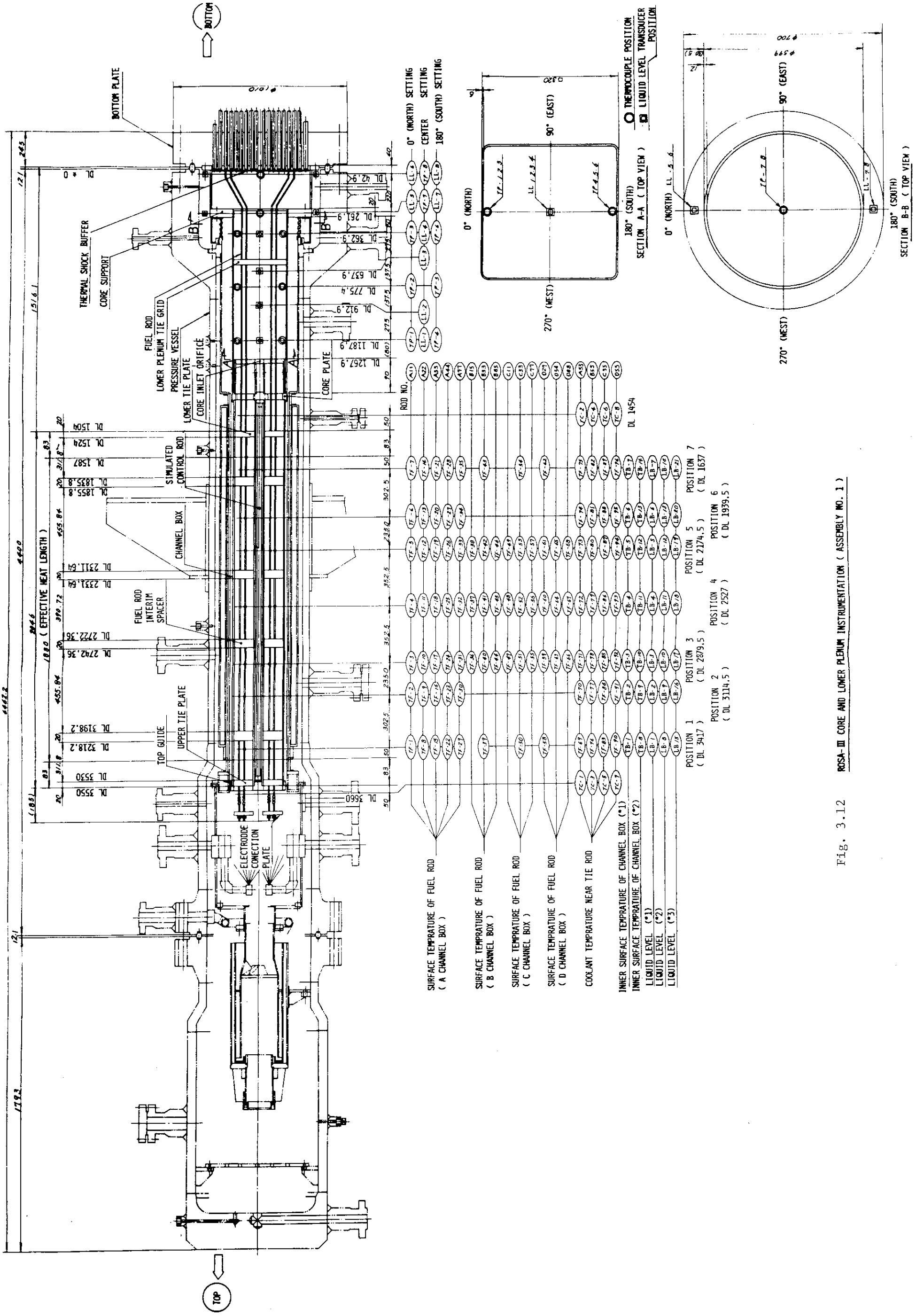


Fig. 3.12 ROSA-III CORE AND LOWER PLENUM INSTRUMENTATION (ASSEMBLY NO. 1)

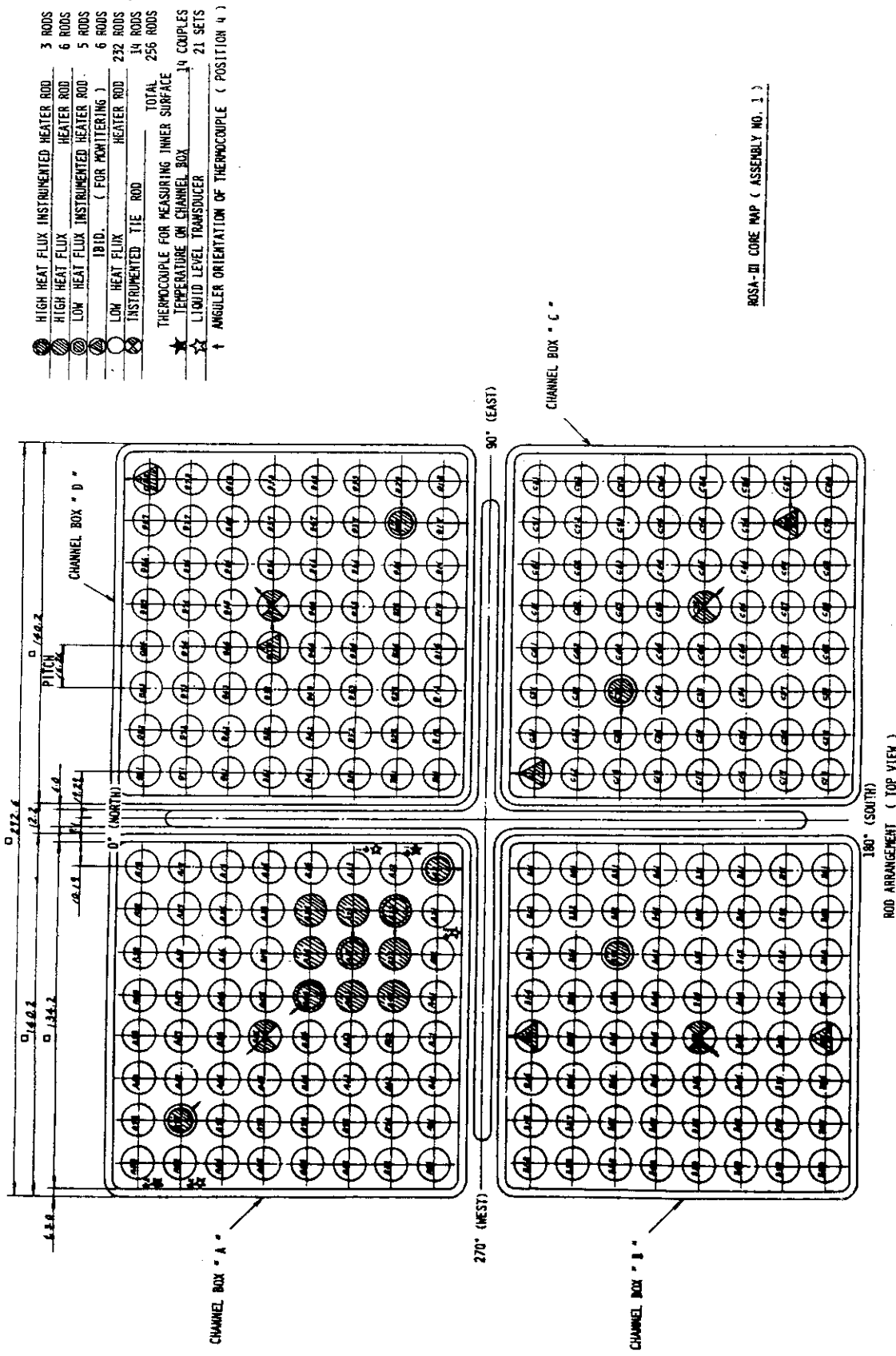


Fig. 3.13 ROSA-III core map

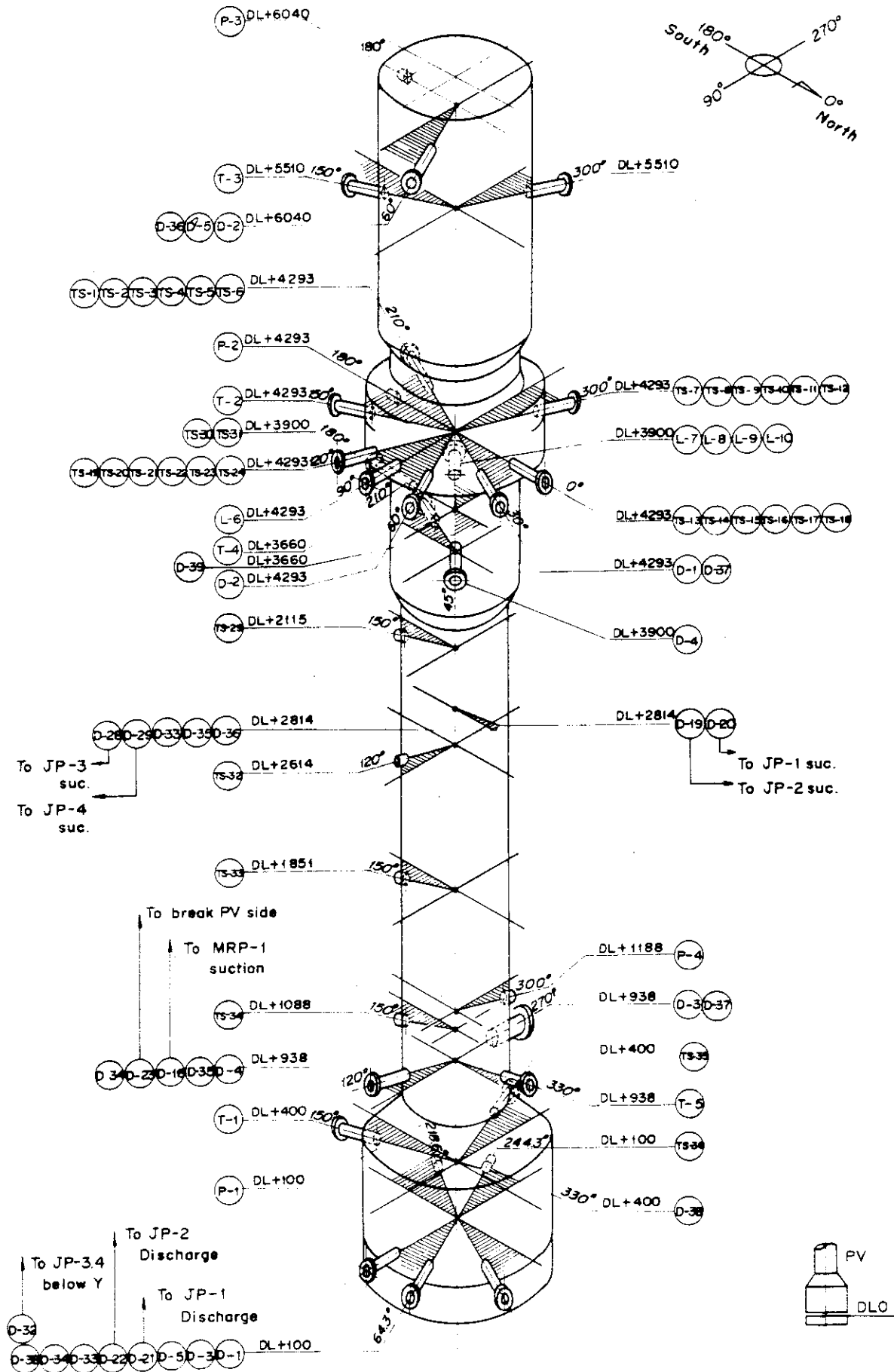


Fig. 3.14 Lead out nozzles of measurement in the pressure vessel

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	LI1-T.CO	LI2-
CH- 54	□ W -1	(550 KVA POWER)			CH- 55	○ W -2 (1800 KVA POWER)
CH- 56	△ W -3	(2100 KVA POWER)				

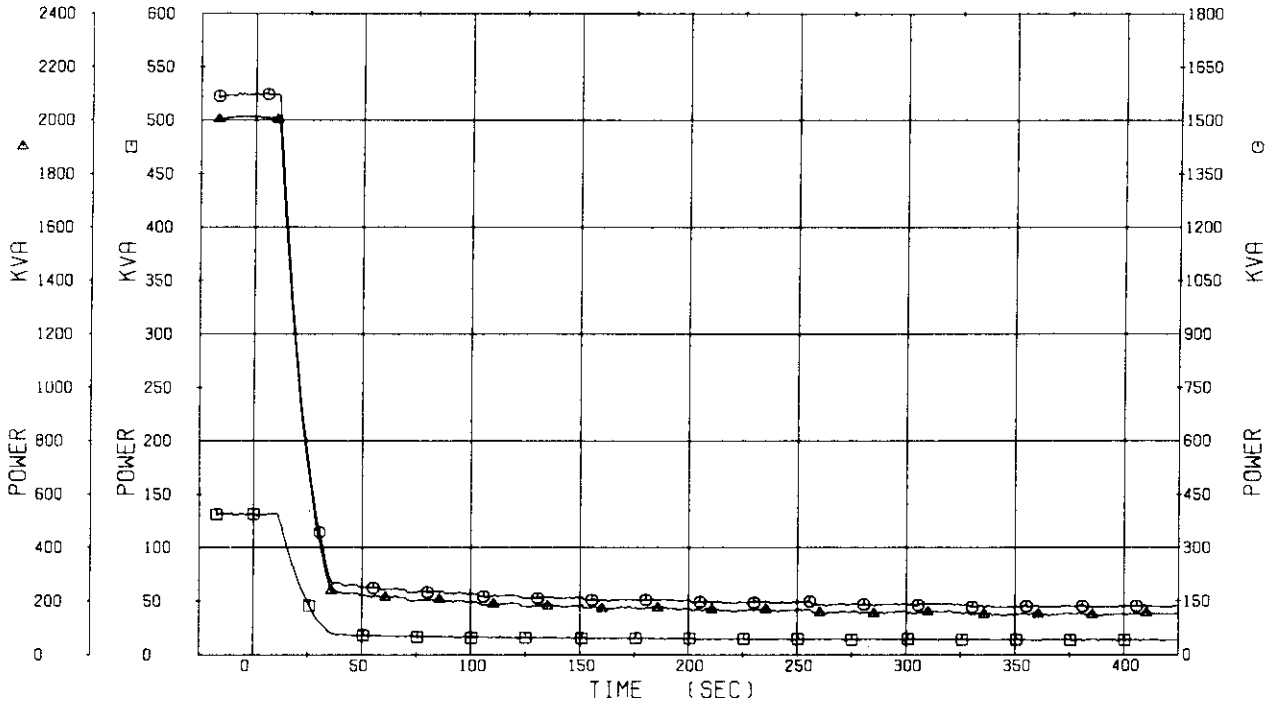


Fig. 5.1 Core power

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	LI1-T.CO	LI2-
CH- 1	□ P -1	(LOWER PLENUM)			CH- 2	○ P -2 (MIXING PLENUM)
CH- 3	△ P -3	(STEAM DOME)			CH- 4	+ P -4 (DOWNCOMER BOTTOM)

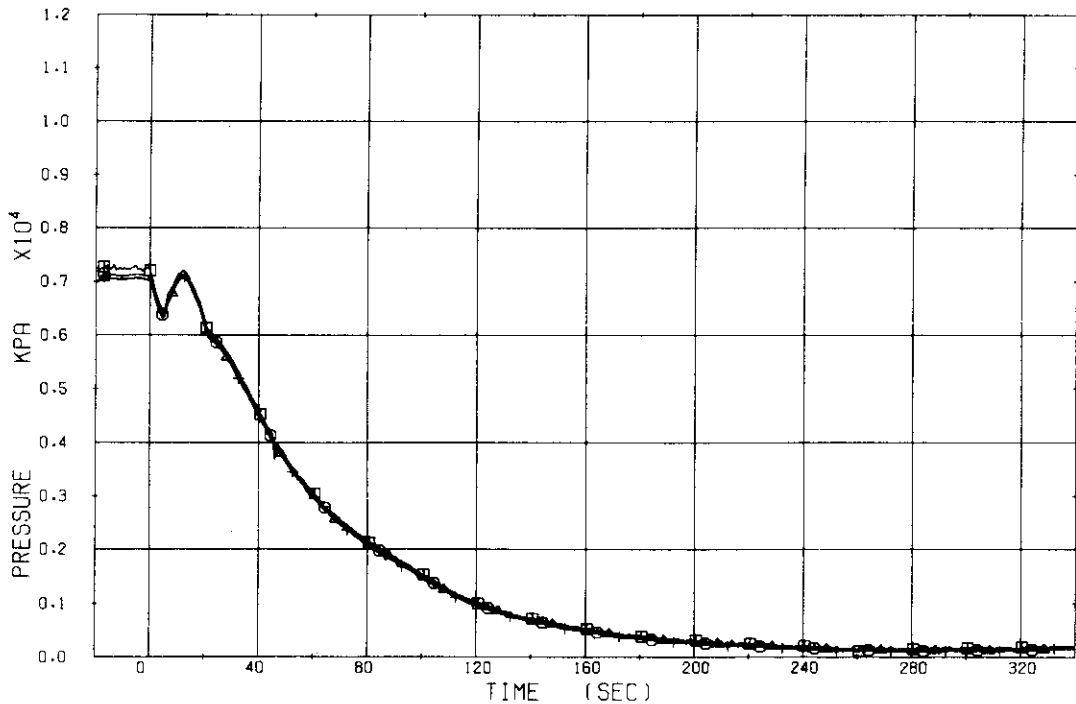


Fig. 5.2 Pressure in the vessel

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	LT1-T.CO	LT2-
CH- 5	□ P -5 (JP-3 DRIVE	)			CH- 6	○ P -6 (JP-4 DRIVE
CH- 7	△ P -7 (JP-3 SUCTION	)			CH- 8	+ P -8 (JP-4 SUCTION

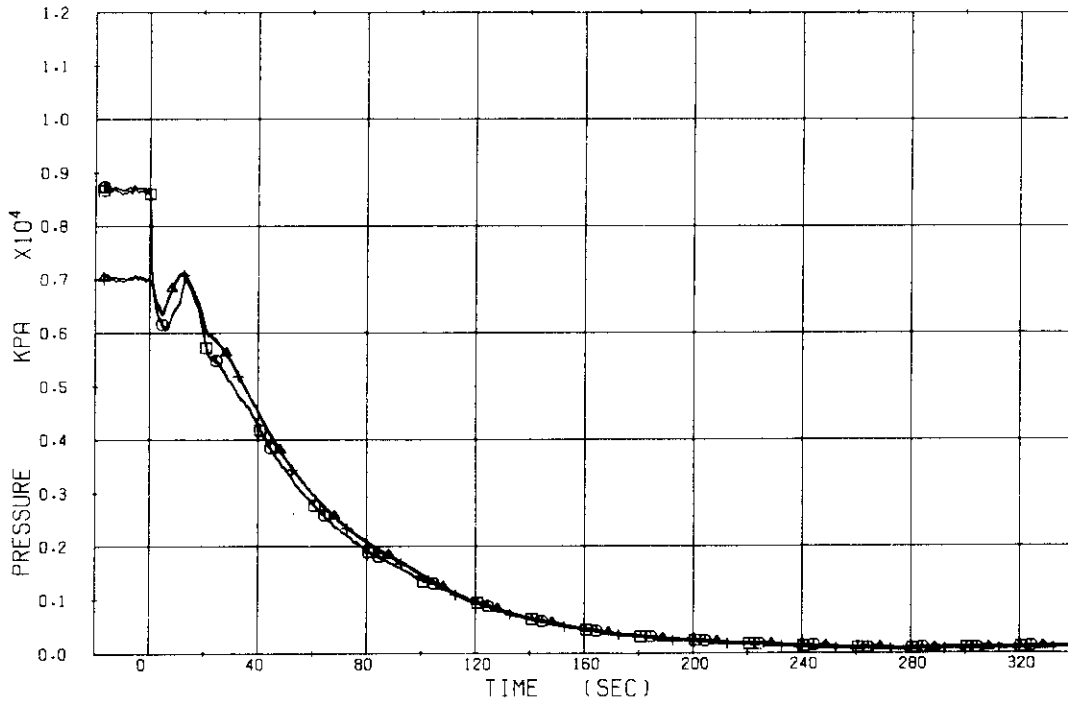


Fig. 5.3 Pressure in broken loop jet pump

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	LT1-T.CO	LT2-
CH- 9	□ P -9 (MRP-1 SUCTION	)			CH- 10	○ P -10 (MRP-2 SUCTION
CH- 11	△ P -11 (MRP-2 DISCHARGE)				

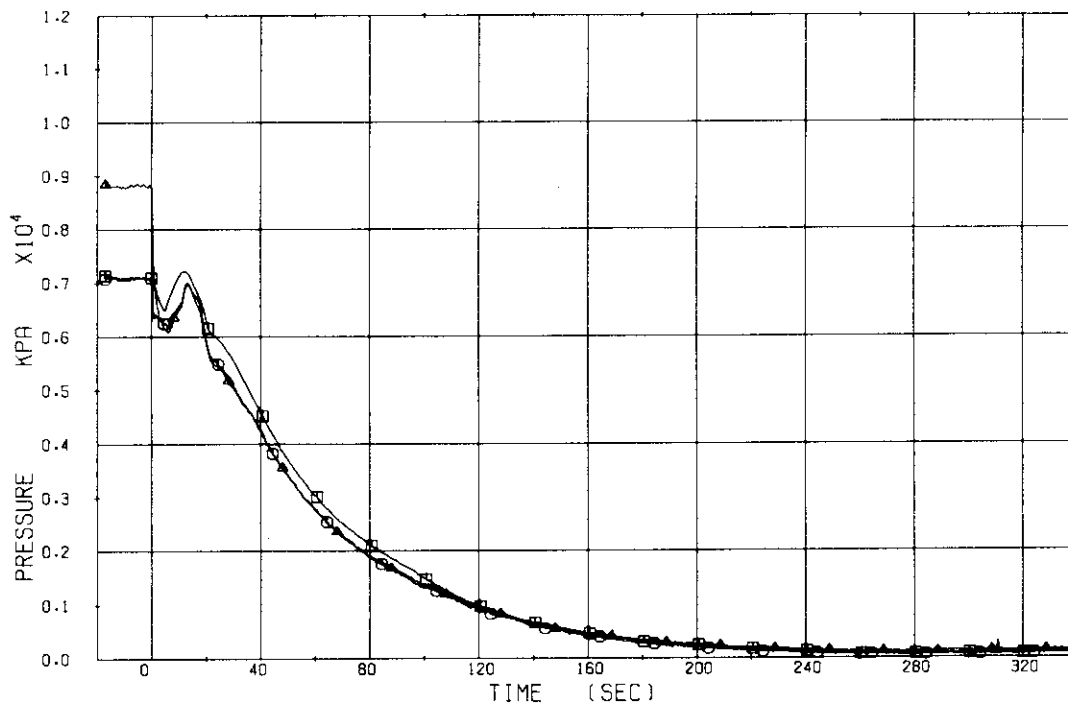


Fig. 5.4 Pressure near the recirculation pump

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS--- HSI-UP.P HS2- LSI-UP.P LS2- LI1-T.CO LI2-
 CH- 12 □ P -12 (ABOVE BREAK A) CH- 13 ○ P -13 (BELOW BREAK A)
 CH- 14 ▲ P -14 (ABOVE BREAK B)

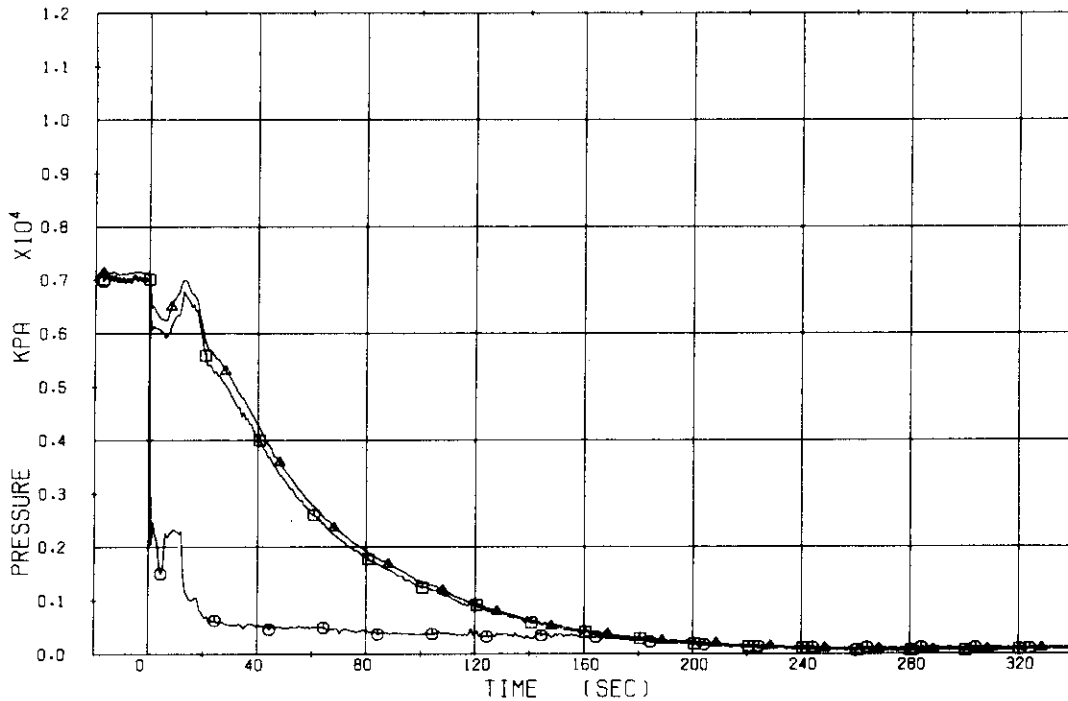


Fig. 5.5 Pressure near the break A (pump side) and the break B (vessel side)

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS--- HSI-UP.P HS2- LSI-UP.P LS2- LI1-T.CO LI2-
 CH- 17 D -1 (LOWER PL.-MXING PL.)

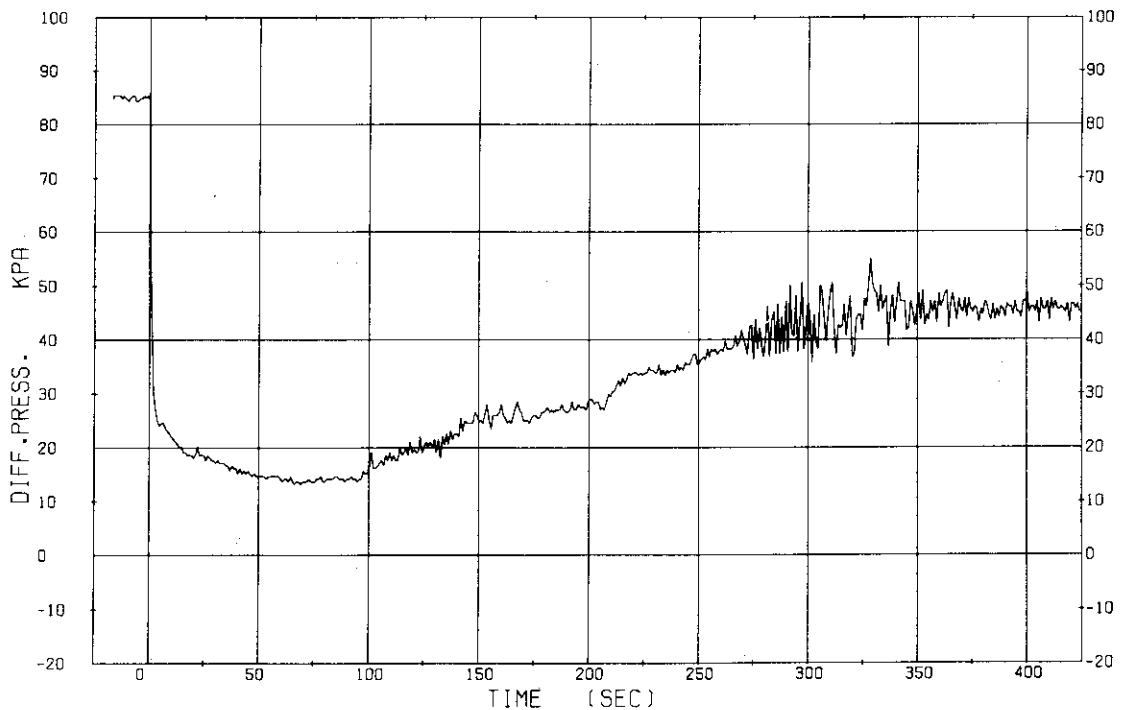


Fig. 5.6 Differential pressure between lower plenum and upper plenum

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS--- HS1-UP.P HS2- LS1-UP.P LS2- LI1-T.CO LI2-

CH- 19 D -3 (LOWER PLENUM HEAD)

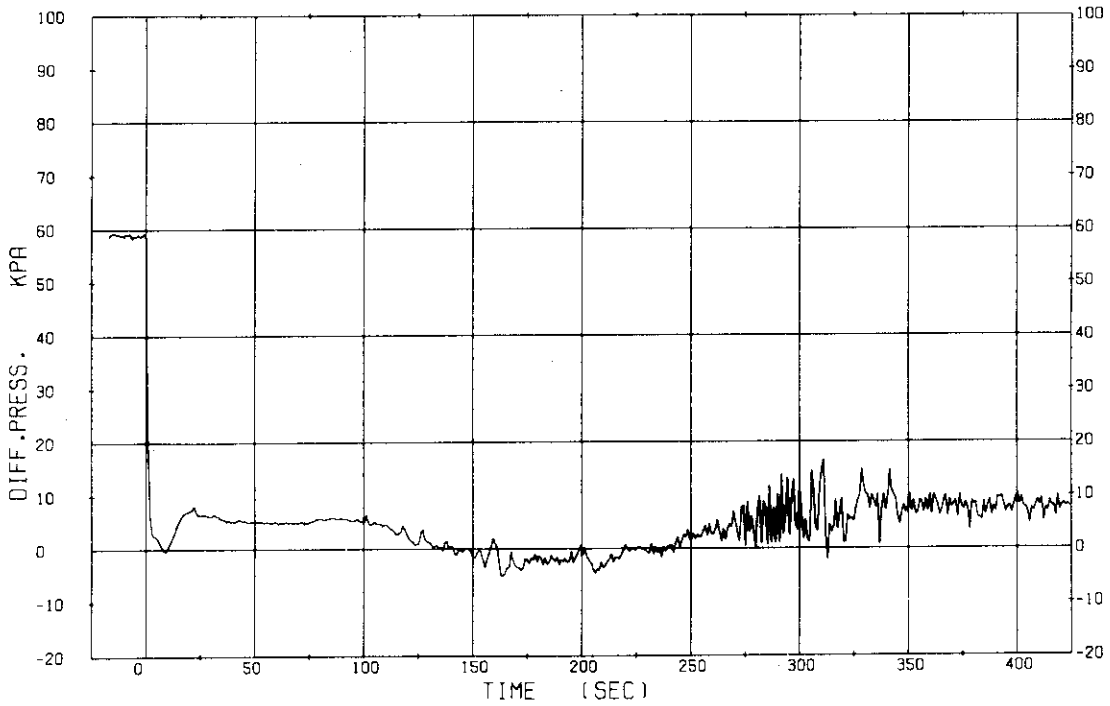


Fig. 5.7 Differential pressure in lower plenum

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS--- HS1-UP.P HS2- LS1-UP.P LS2- LI1-T.CO LI2-

CH- 20 D -4 (DOWNCOMER HEAD D)

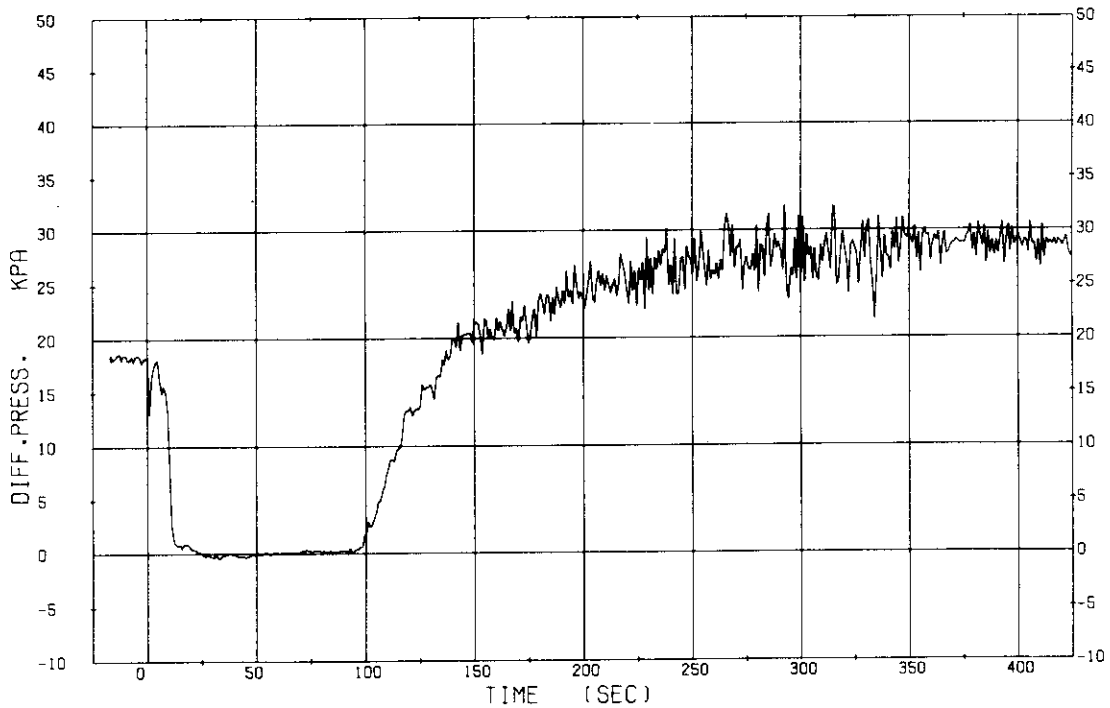


Fig. 5.8 Differential pressure in downcomer

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS--- HS1-UP.P HS2- LS1-UP.P LS2- LI1-T.CO LI2-

CH- 21 D -5 (PV. BOTTOM-TOP D)

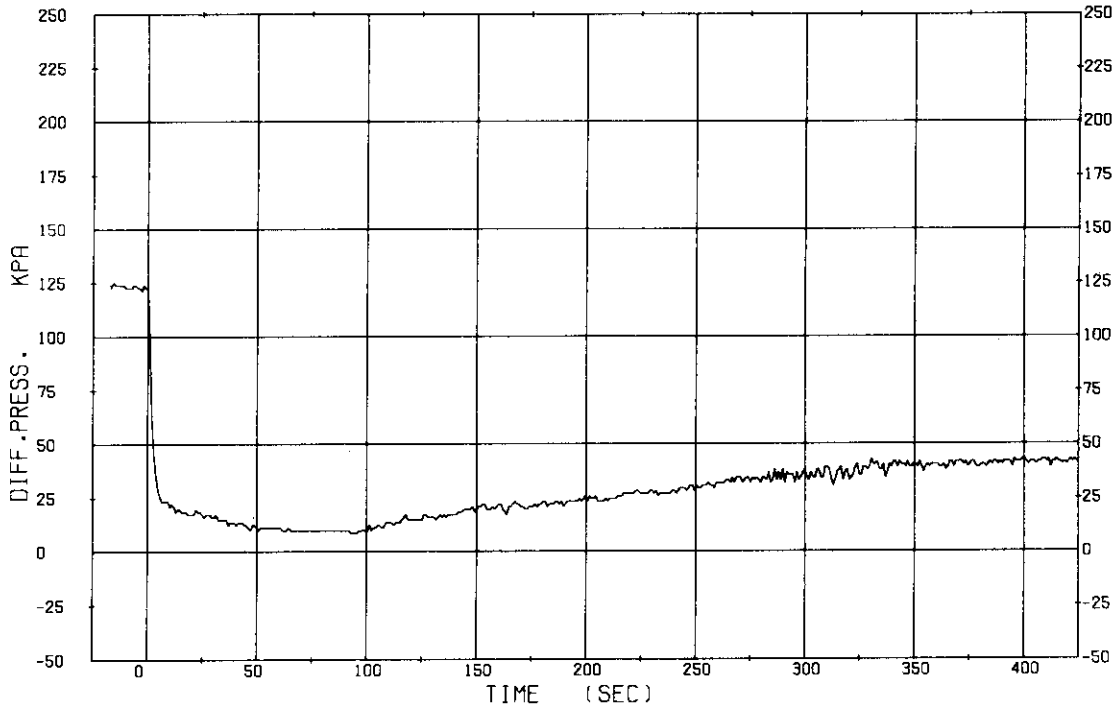


Fig. 5.9 Differential pressure between vessel bottom and top

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS--- HS1-UP.P HS2- LS1-UP.P LS2- LI1-T.CO LI2-

CH- 22 □ D -6 (JP-1 DISCHARGE-SUCTION) CH- 24 ○ D -8 (JP-2 DISCHARGE-SUCTION)
 CH- 26 ▲ D -10 (JP-3 DISCHARGE-SUCTION) CH- 28 + D -12 (JP-4 DISCHARGE-SUCTION)

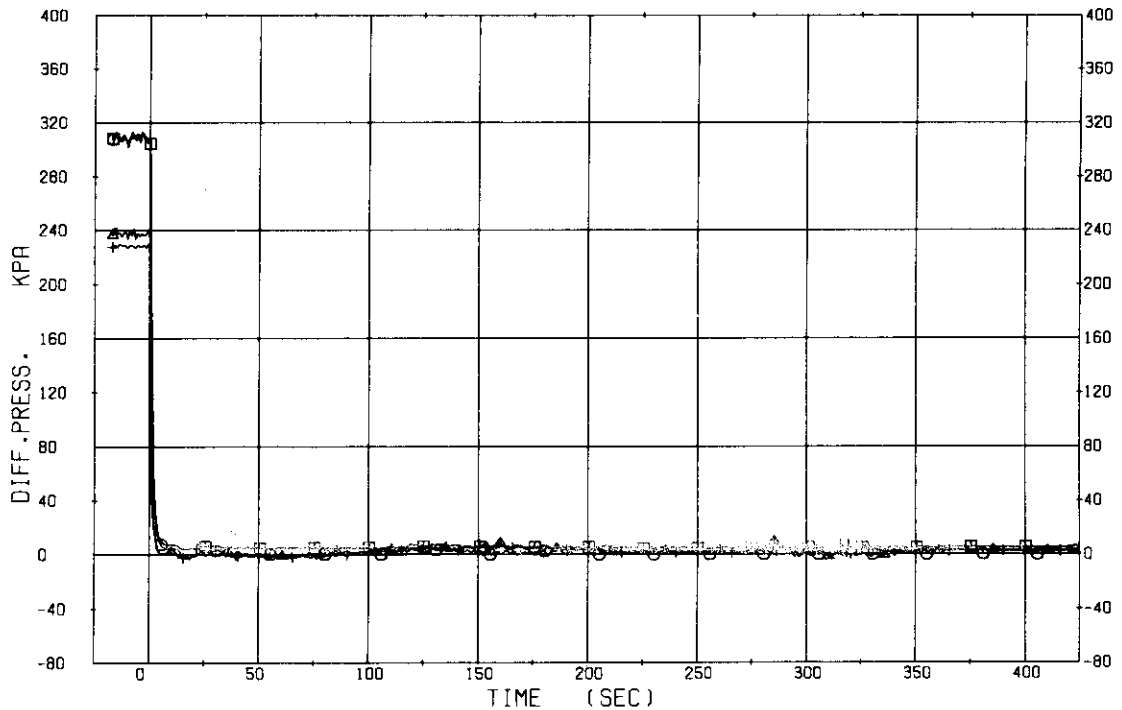


Fig. 5.10 Differential pressure between jet pump discharge and suction

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	LI1-T.CO	LI2-	
CH- 23	□ 0 -7	(JP-1 DRIVE-SUCTION)			CH- 25	○ 0 -9	(JP-2 DRIVE-SUCTION)
CH- 27	△ 0 -11	(JP-3 DRIVE-SUCTION)			CH- 29	+ 0 -13	(JP-4 DRIVE-SUCTION)

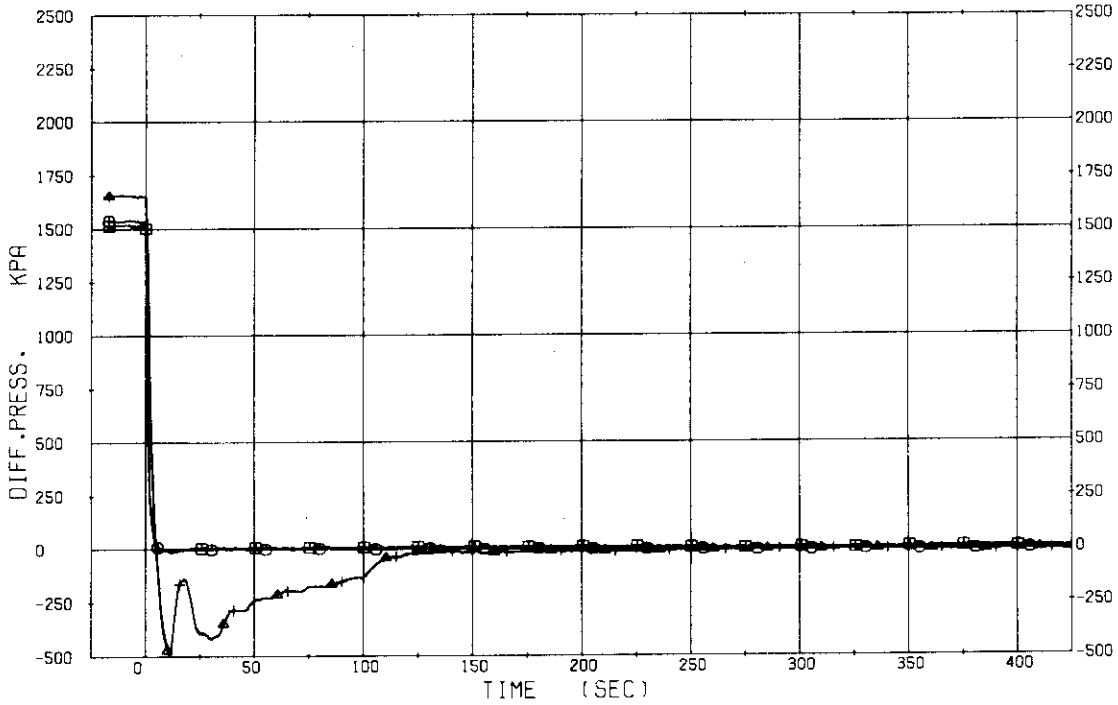


Fig. 5.11 Differential pressure between jet pump drive and suction

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	LI1-T.CO	LI2-	
CH- 30	□ 0 -14	(MRP-1 DISCHARGE-SUCTION)			CH- 31	○ 0 -15	(MRP-2 DISCHARGE-SUCTION)

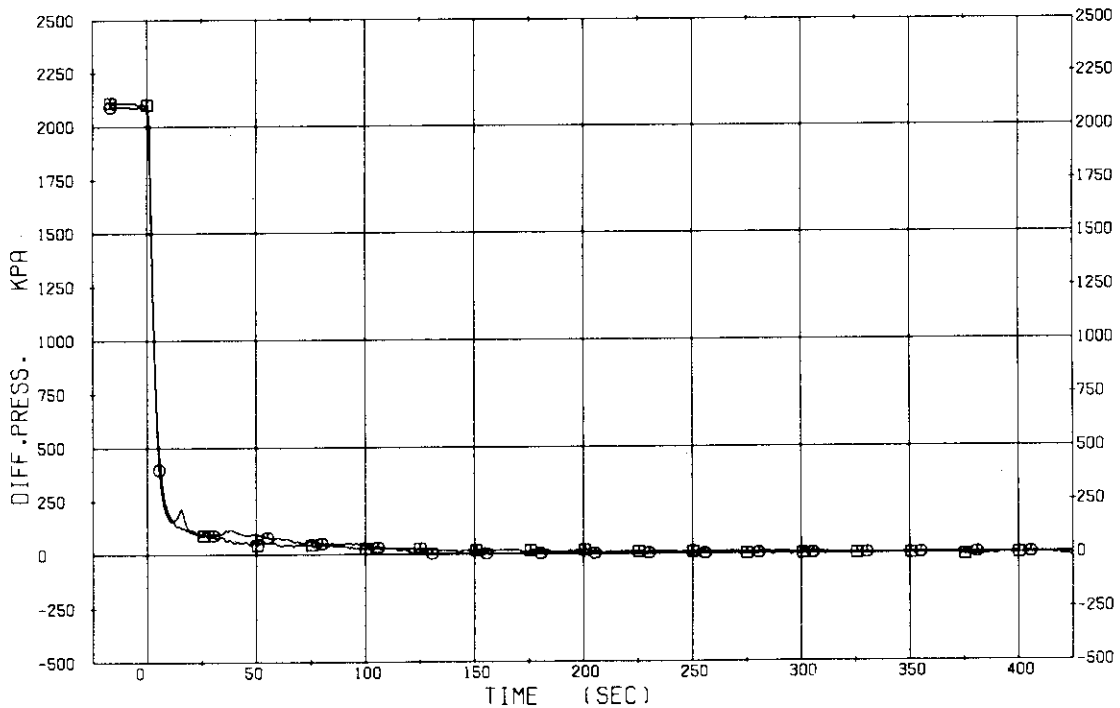


Fig. 5.12 Differential pressure between MRP-1,2 delivery and suction

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY
 ECCS--- HS1-UP.P HS2- LS1-UP.P LS2- L11-T.CO L12-
 CH- 32 □ F -1 (MAIN STEAM LINE) CH- 33 ○ F -2 (AOS. STEAM LINE)

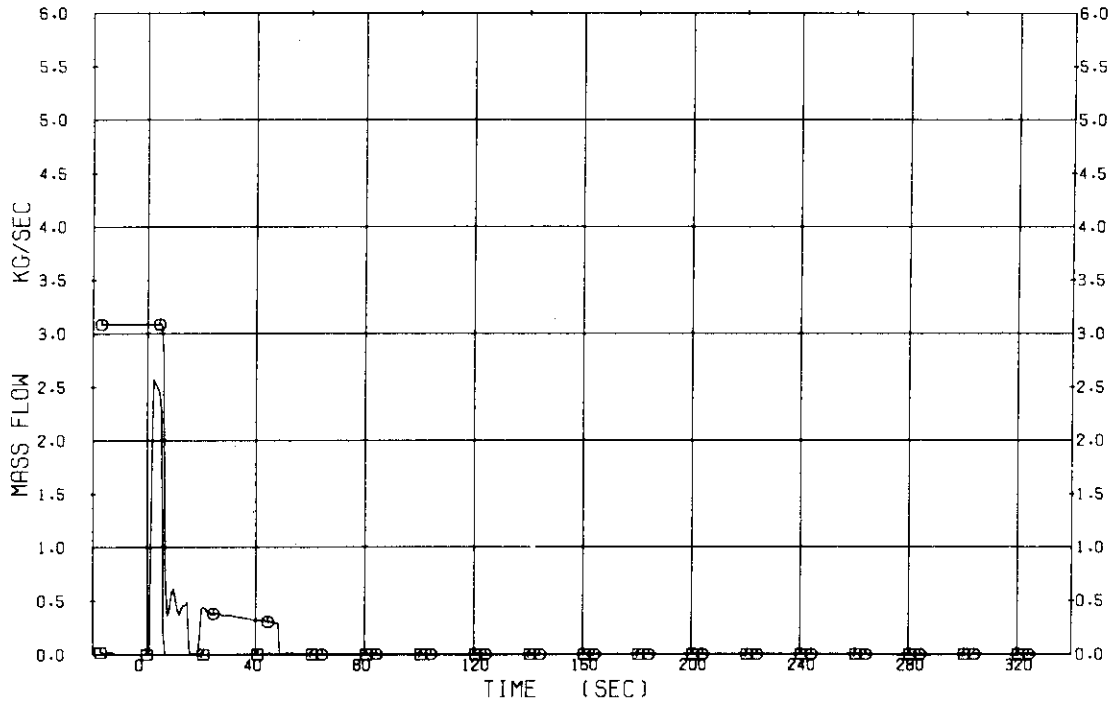


Fig. 5.13 Mass flow rate in the steam discharge line

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY
 ECCS--- HS1-UP.P HS2- LS1-UP.P LS2- L11-T.CO L12-
 CH- 38 □ F -7 (HPCS MIXING PLENUM) CH- 42 ○ F -11 (LPCI MIXING PLENUM)

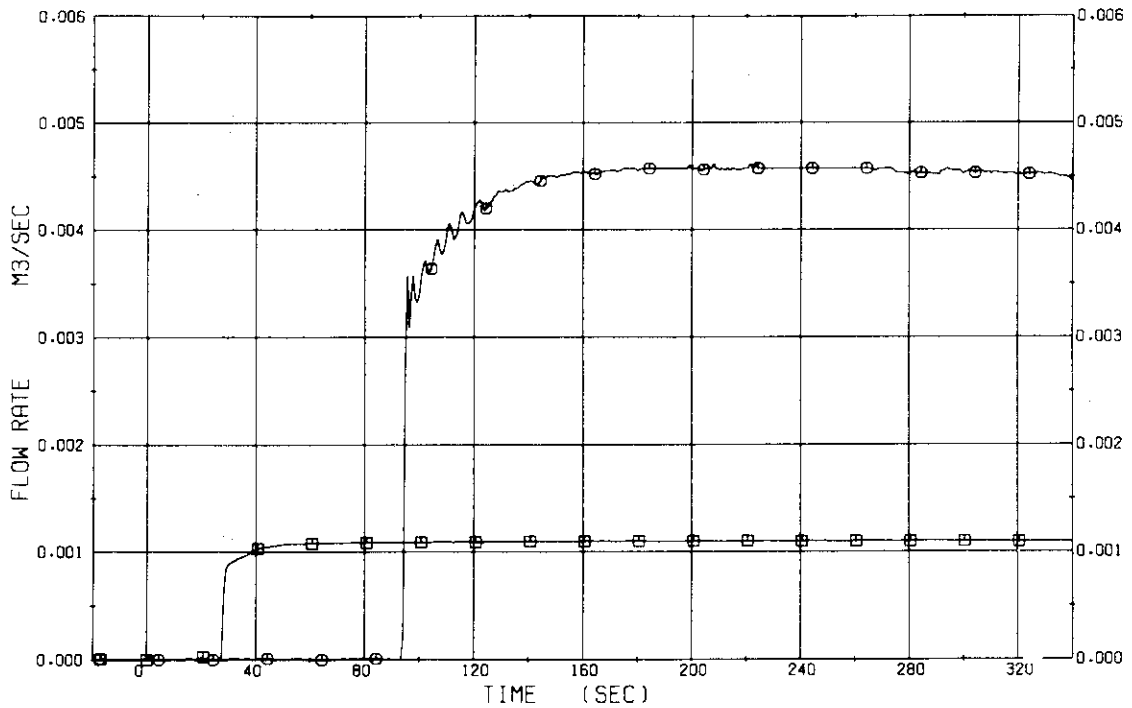


Fig. 5.14 Injection flow rates of HPCS and LPCI

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY
 ECCS--- HS1-UP.P HS2- LS1-UP.P LS2- LI1-T.CO LI2-
 CH- 46 □ F -15 (TRANSIENT FEED WATER) CH- 47 ○ F -16 (STEADY FEED WATER)

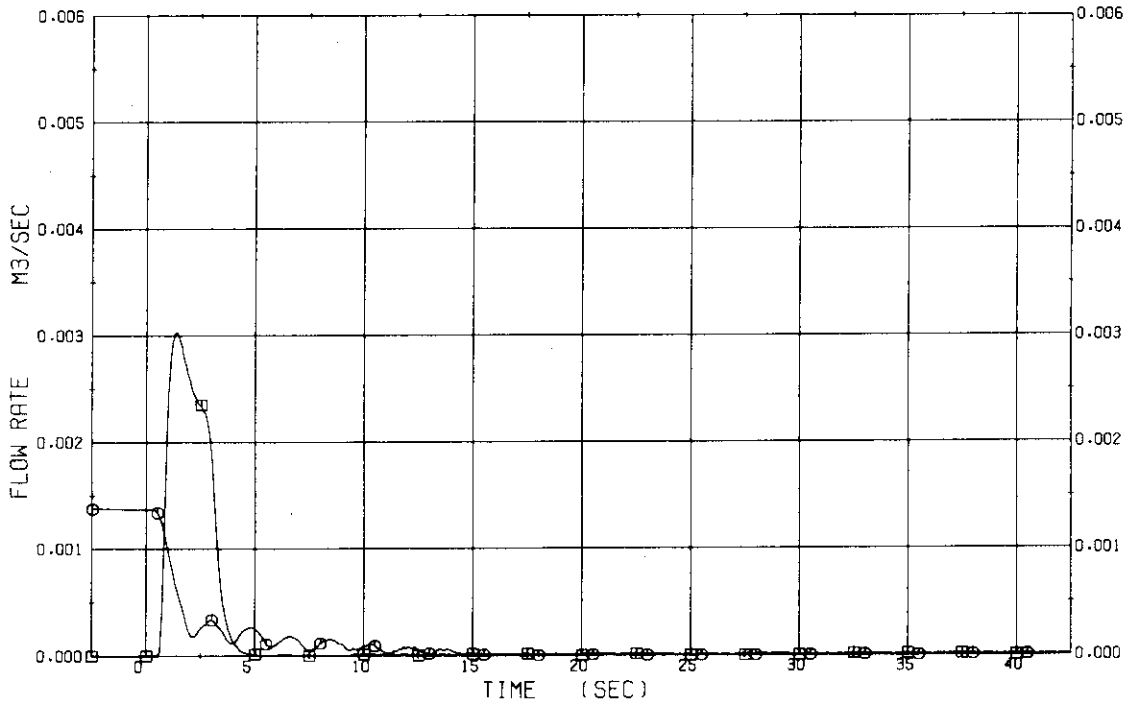


Fig. 5.15 Feed water flow rate

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY
 ECCS--- HS1-UP.P HS2- LS1-UP.P LS2- LI1-T.CO LI2-
 CH- 48 □ F -17 (JP-1 DISCHARGE) CH- 49 ○ F -18 (JP-2 DISCHARGE)

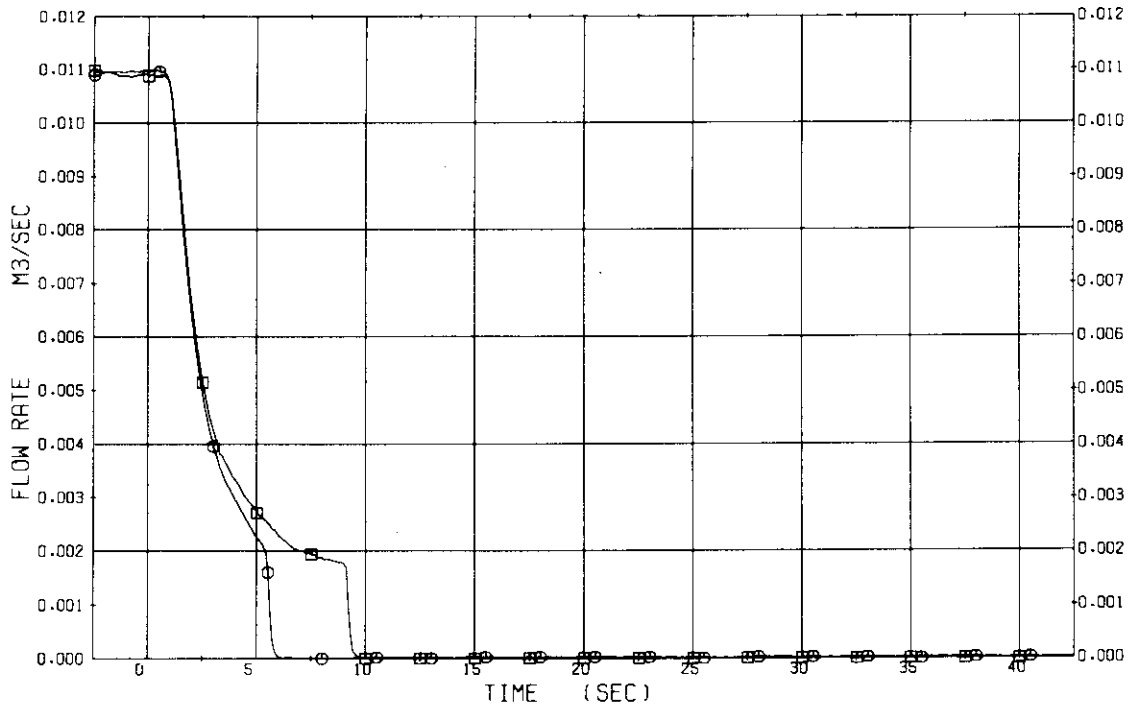


Fig. 5.16 Intact loop jet pump discharge flow rate

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	LI1-T.CO	LI2-
CH- 50	□ F -19	(JP-3 DISCHARGE +)			CH- 51	○ F -20 (JP-3 DISCHARGE -)
CH- 52	△ F -21	(JP-4 DISCHARGE +)			CH- 53	+ F -22 (JP-4 DISCHARGE -)

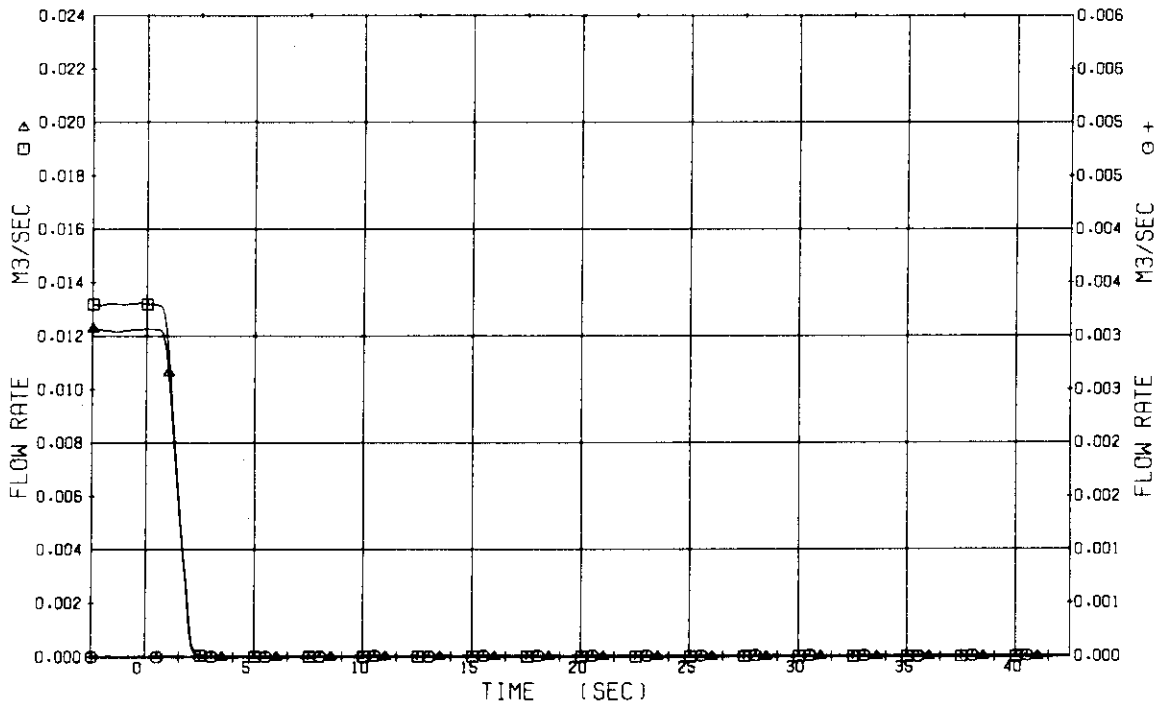


Fig. 5.17 Broken loop jet pump discharge flow rate

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	LI1-T.CO	LI2-
CH- 57	□ N -1	(MRP-1)			CH- 58	○ N -2 (MRP-2)

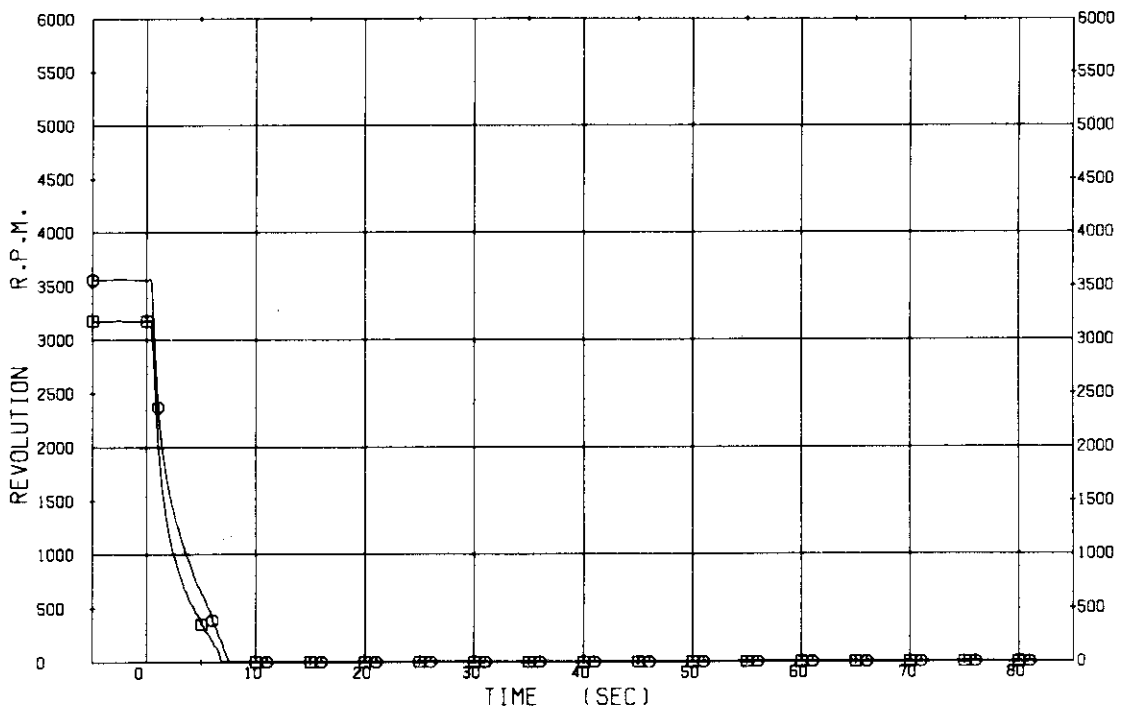


Fig. 5.18 Pump speed

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	L11-T.CO	L12-
CH- 65	□ T -1 (LOWER PLENUM)				CH- 66	○ T -2 (MIXING PLENUM)
CH- 67	△ T -3 (STEAM DOME)				CH- 68	+ T -4 (UPPER DOWNCOMER)
CH- 69	◇ T -5 (LOWER DOWNCOMER)				CH- 86	⋈ T -22 (DIS. STEAM ABOVE VALVE)

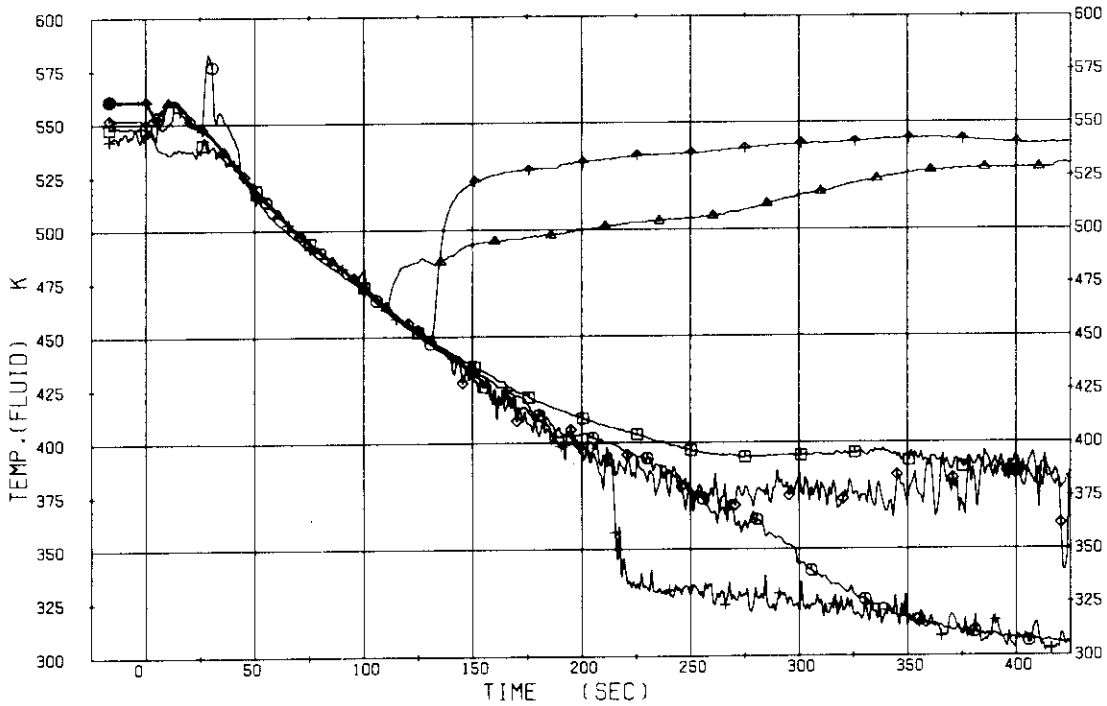


Fig. 5.19 Fluid temperature in the vessel

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	L11-T.CO	L12-
CH- 70	□ T -6 (JP-1 DRIVING WATER)				CH- 71	○ T -7 (JP-2 DRIVING WATER)
CH- 74	△ T -10 (JP-1 DISCHARGE)				CH- 75	+ T -11 (JP-2 DISCHARGE)

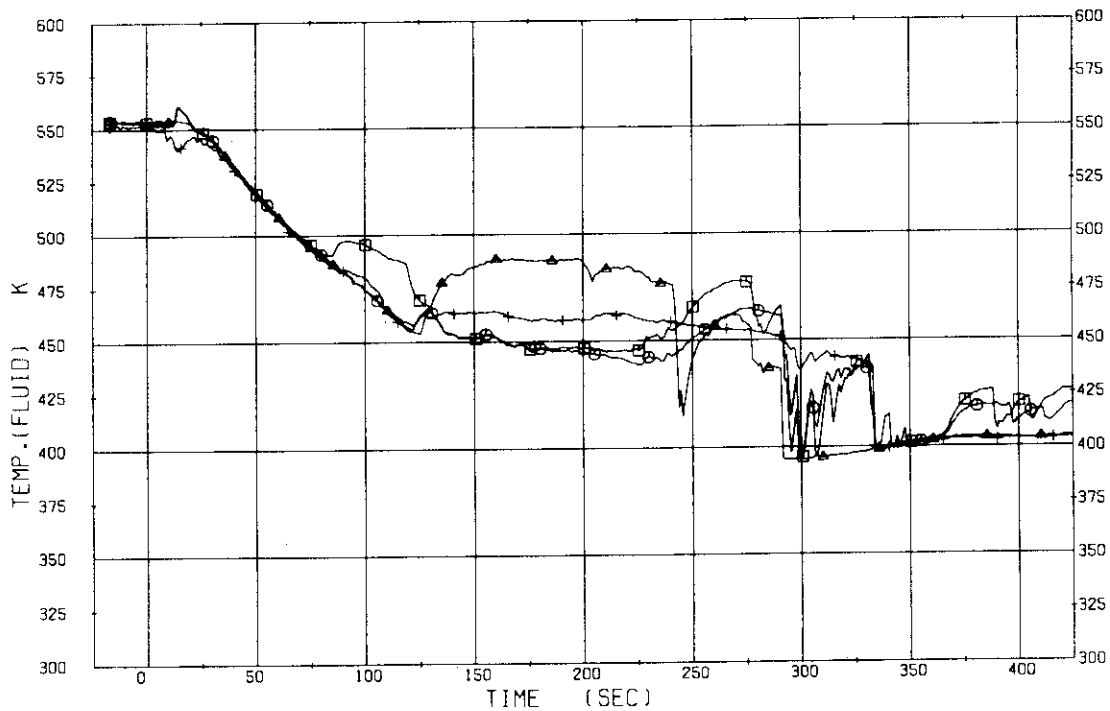


Fig. 5.20 Fluid temperature in intact jet pumps

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	LI1-T.CO	LI2-		
CH- 72	□ T -8	(JP-3 DRIVING WATER	)		CH- 73	○ T -9	(JP-4 DRIVING WATER)
CH- 76	△ T -12	(JP-3 DISCHARGE	)		CH- 77	+ T -13	(JP-4 DISCHARGE)

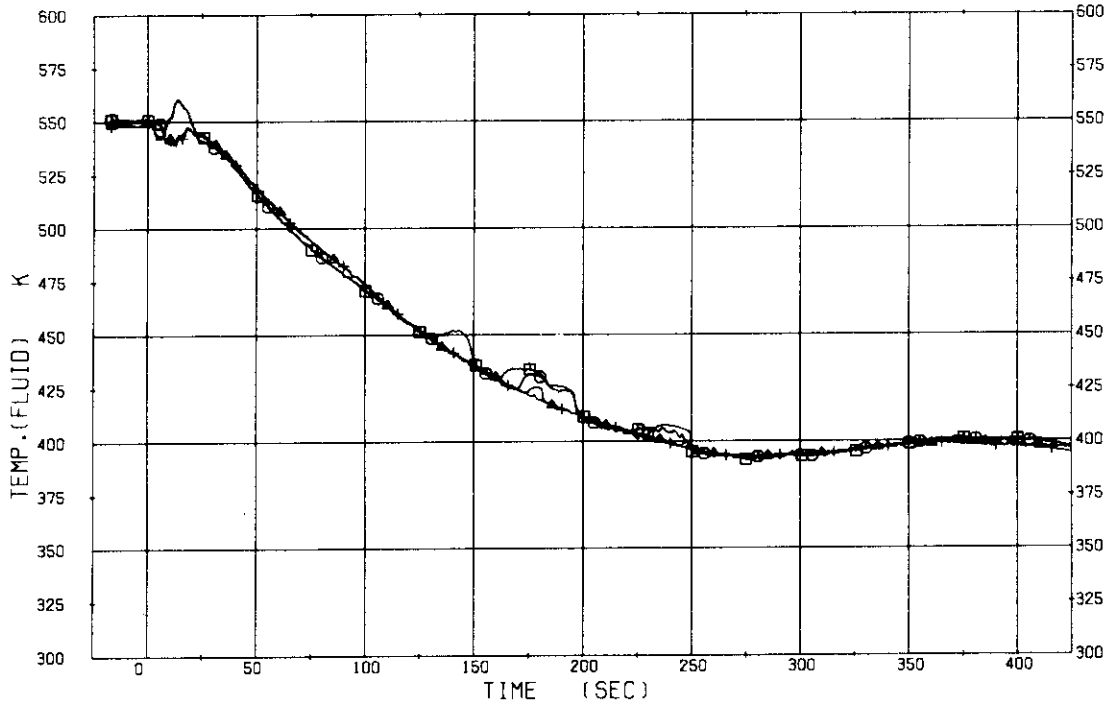


Fig. 5.21 Fluid temperature in broken loop jet pumps

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	LI1-T.CO	LI2-		
CH- 78	□ T -14	(MRP-1 SUCTION	)		CH- 79	○ T -15	(MRP-1 DISCHARGE)
CH- 80	△ T -16	(MRP-2 SUCTION	)		CH- 81	+ T -17	(MRP-2 DISCHARGE)

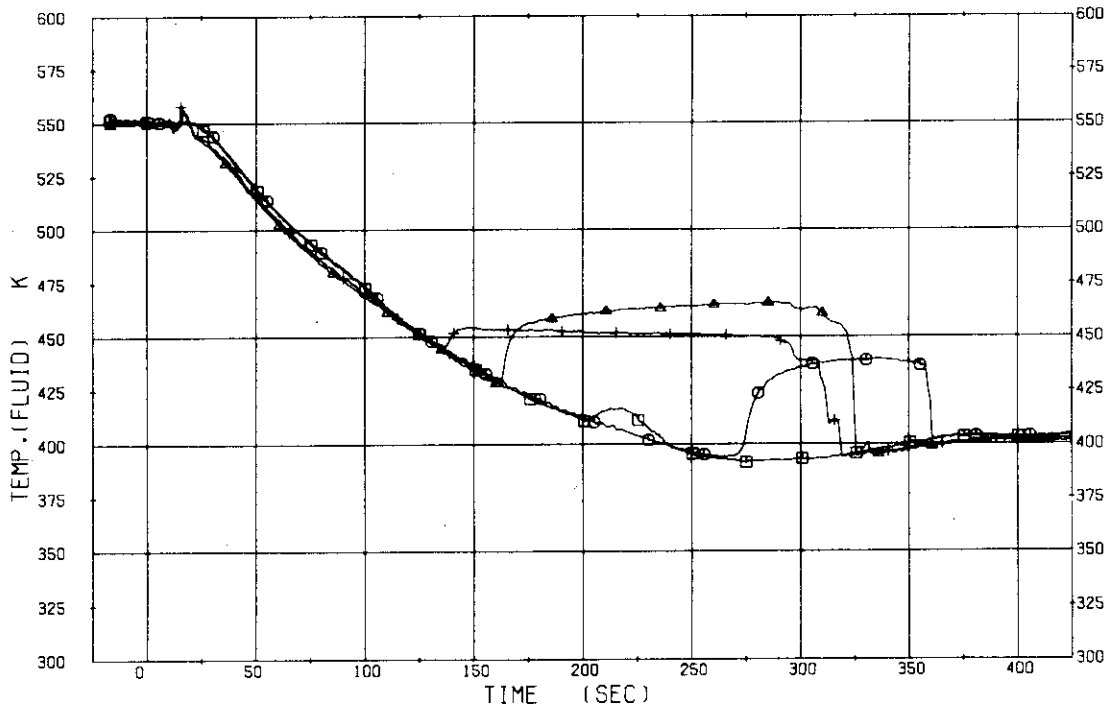


Fig. 5.22 Fluid temperature in recirculation pump

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS--- HS1-UP.P HS2- LS1-UP.P LS2- L11-T.CO L12-
 CH- 82 □ T-18 (ABOVE BREAK A) CH- 83 ○ T-19 (ABOVE BREAK B)

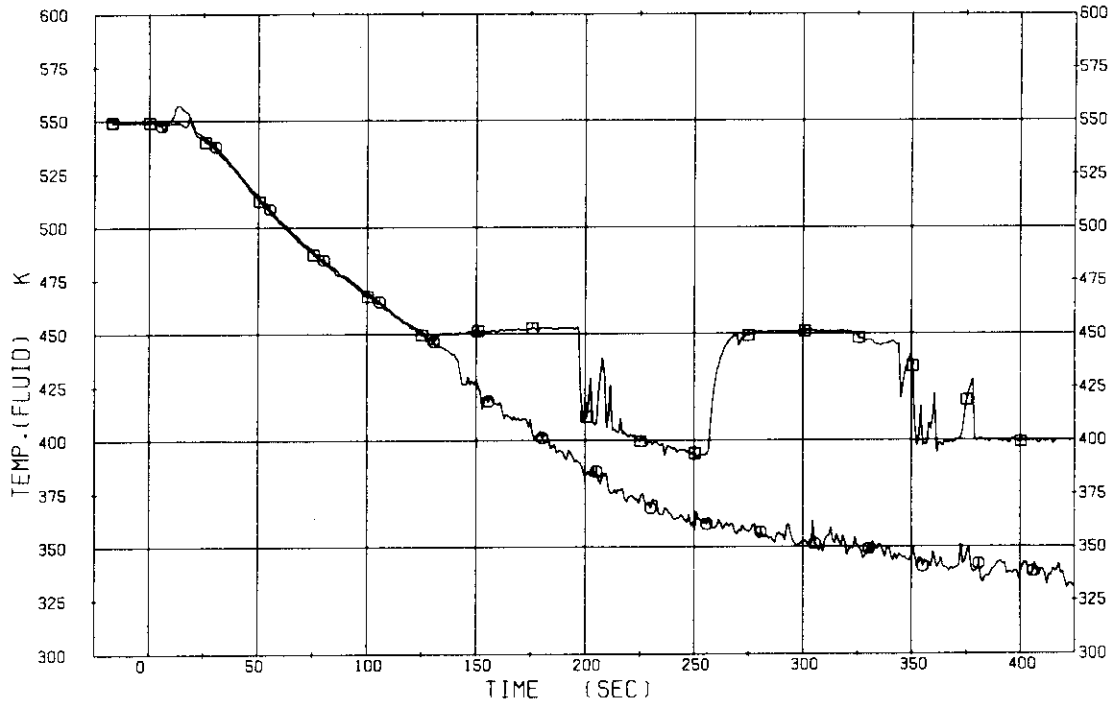


Fig. 5.23 Fluid temperature in break A and B

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS--- HS1-UP.P HS2- LS1-UP.P LS2- L11-T.CO L12-
 CH- 88 □ TS-15 (DUMMY BLOCK B SIDE 3) CH- 89 ○ TS-18 (DUMMY BLOCK B SIDE 6)
 CH- 90 ▲ TS-21 (DUMMY BLOCK D SIDE 9) CH- 91 + TS-24 (DUMMY BLOCK D SIDE 12)

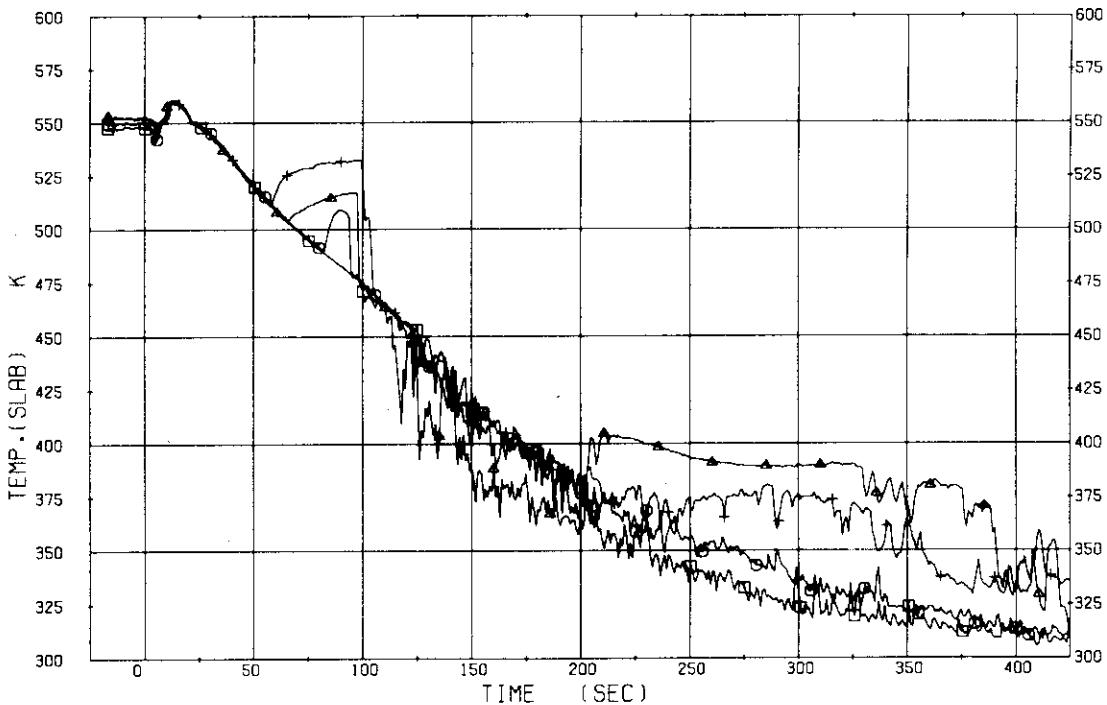


Fig. 5.24 Surface temperature of filler block

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	LI1-T.CO	LI2-	
CH- 92	□ TS-25	(JP-1 DIFFUSER WALL)			CH- 93	○ TS-26	(JP-2 DIFFUSER WALL)
CH- 94	△ TS-27	(JP-3 DIFFUSER WALL)			CH- 95	+ TS-28	(JP-4 DIFFUSER WALL)

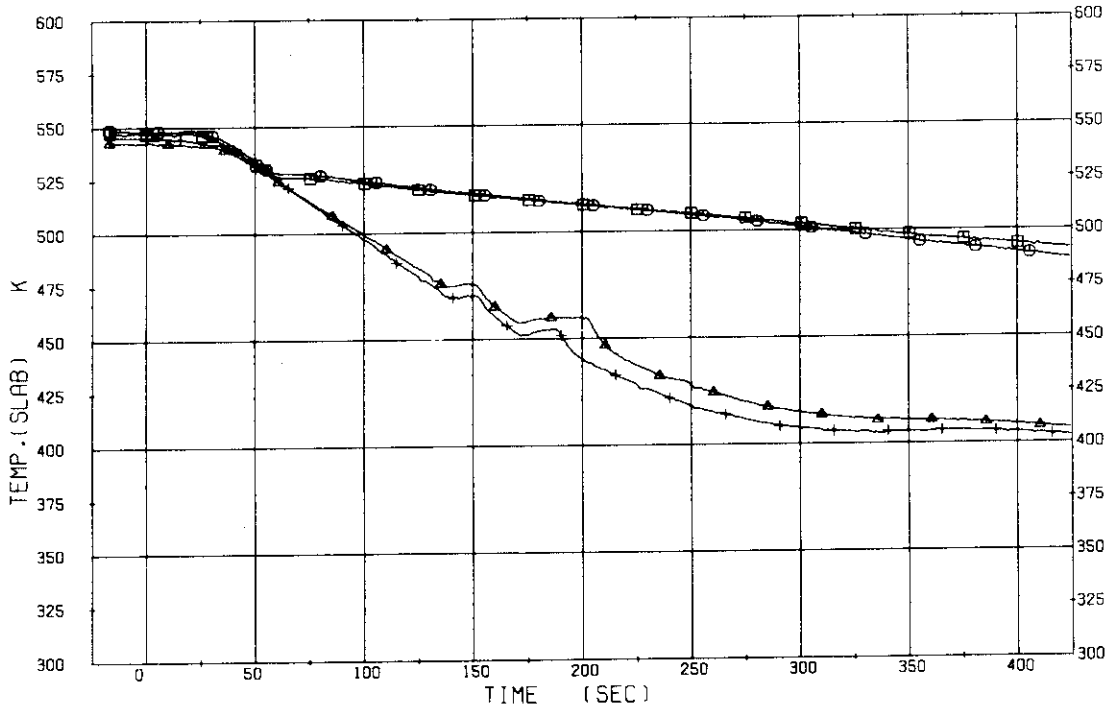


Fig. 5.25 Slab temperature of jet pump diffuser

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	LI1-T.CO	LI2-	
CH- 97	□ TS-30	(PV. INNER SURFACE 1-2)			CH- 98	○ TS-31	(PV. INNER SURFACE 1-3)
CH- 102	△ TS-35	(LOWER PL. INNER SURFACE)					

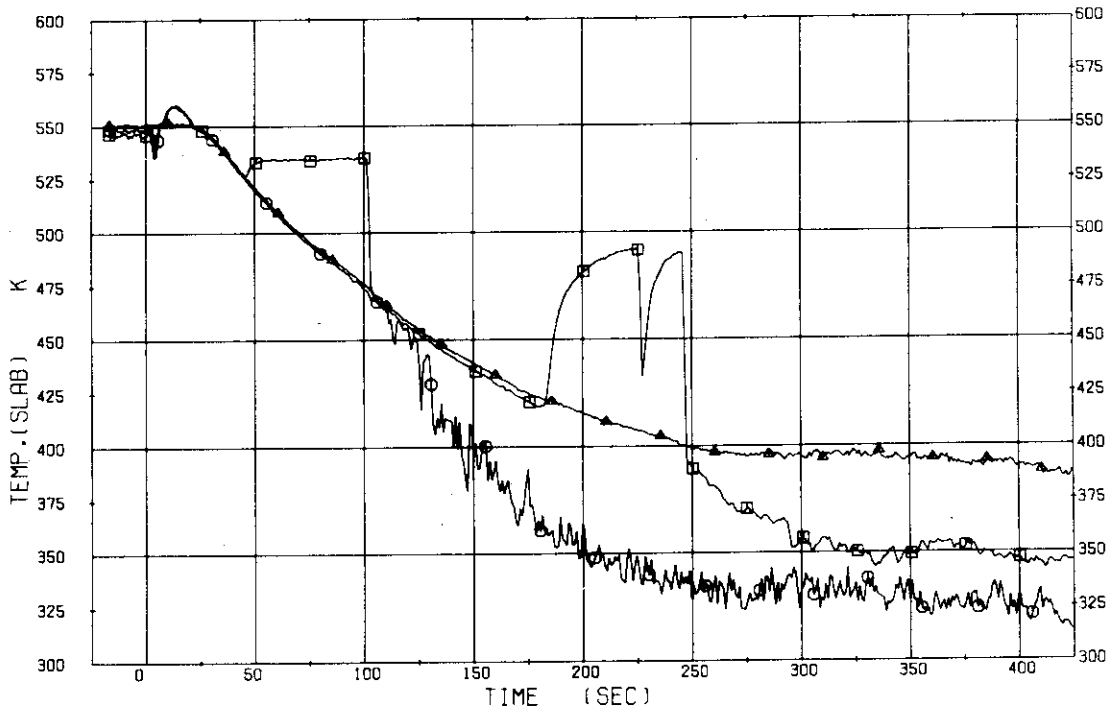


Fig. 5.26 Inner surface temperature of pressure vessel

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	L11-T.CO	L12-
CH- 96	□ TS-29 (PV. WALL INSIDE 1-1)				CH- 99	○ TS-32 (PV. WALL INSIDE 2)
CH- 100	△ TS-33 (PV. WALL INSIDE 3)				CH- 101	+ TS-34 (PV. WALL INSIDE 4)
CH- 103	◇ TS-36 (LOWER PLENUM WALL INSIDE)					

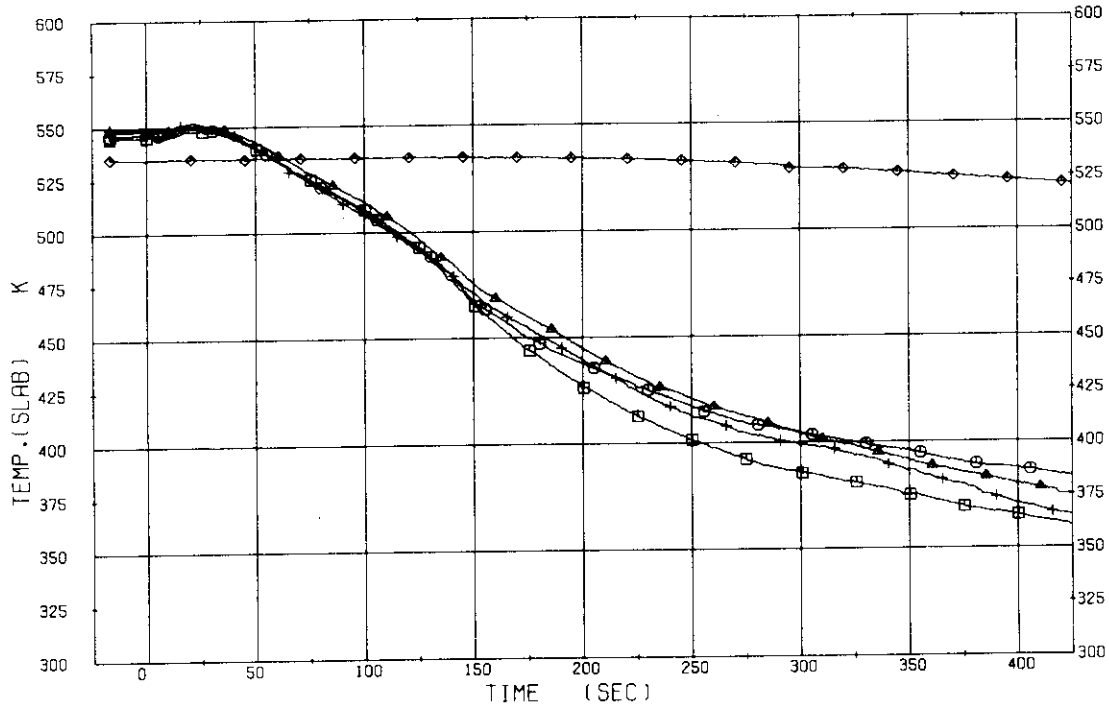


Fig. 5.27 Slab temperature of pressure vessel

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	L11-T.CO	L12-
CH- 104	□ TF-1 (A11 FUEL ROD POS. 1)				CH- 105	○ TF-2 (A11 FUEL ROD POS. 2)
CH- 107	△ TF-4 (A11 FUEL ROD POS. 4)				CH- 109	+ TF-6 (A11 FUEL ROD POS. 6)
CH- 110	◇ TF-7 (A11 FUEL ROD POS. 7)					

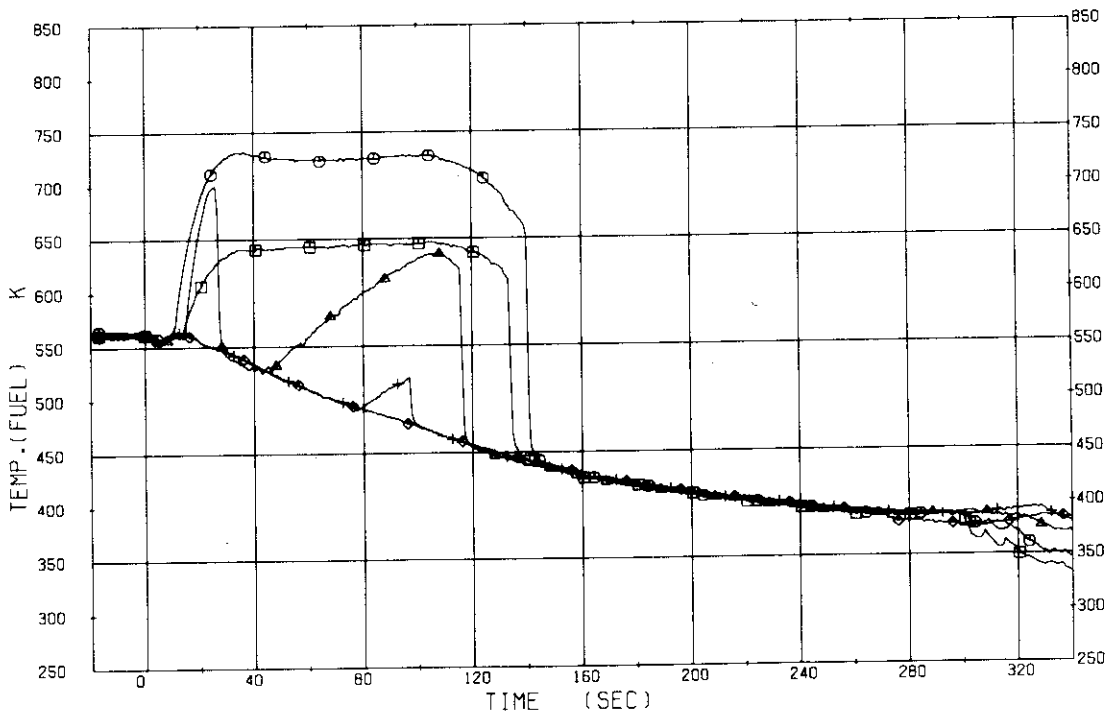


Fig. 5.28 Heater rod surface temperature of All rod

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	L11-T.CO	L12-
CH- 111	□ TF-8 (A22 FUEL ROD POS. 1)				CH- 112	○ TF-9 (A22 FUEL ROD POS. 2)
CH- 114	▲ TF-11 (A22 FUEL ROD POS. 4)				CH- 116	+ TF-13 (A22 FUEL ROD POS. 6)

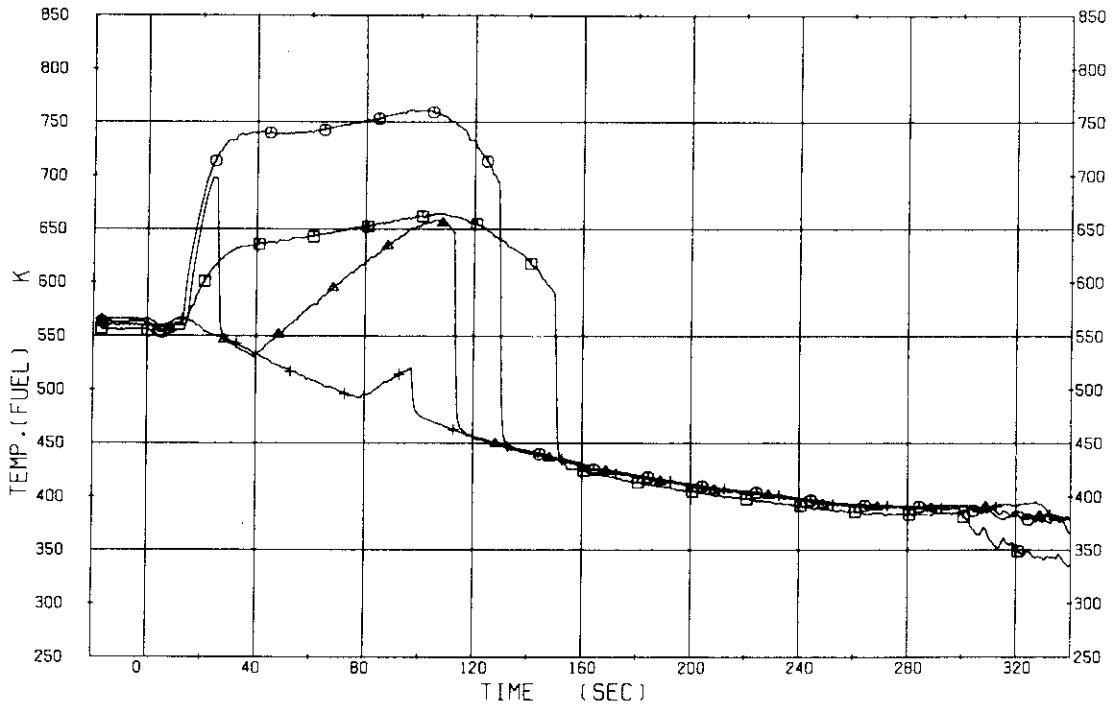


Fig. 5.29 Heater rod surface temperature of A22 rod

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	L11-T.CO	L12-
CH- 118	□ TF-15 (A33 FUEL ROD POS. 1)				CH- 121	○ TF-18 (A33 FUEL ROD POS. 4)
CH- 123	▲ TF-20 (A33 FUEL ROD POS. 6)				CH- 124	+ TF-21 (A33 FUEL ROD POS. 7)

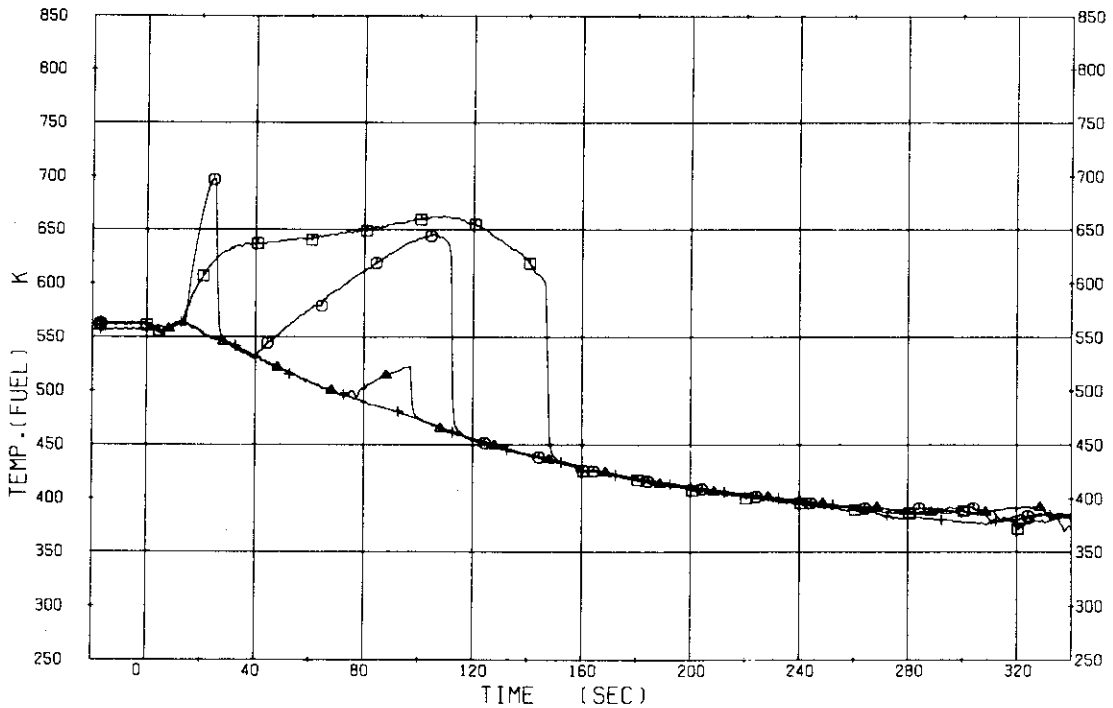


Fig. 5.30 Heater rod surface temperature of A33 rod

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	L11-T.CO	L12-
CH- 125	□ TF-22 (A44 FUEL ROD POS. 1)				CH- 126	○ TF-23 (A44 FUEL ROD POS. 2)
CH- 128	△ TF-25 (A44 FUEL ROD POS. 4)				CH- 130	+ TF-27 (A44 FUEL ROD POS. 6)

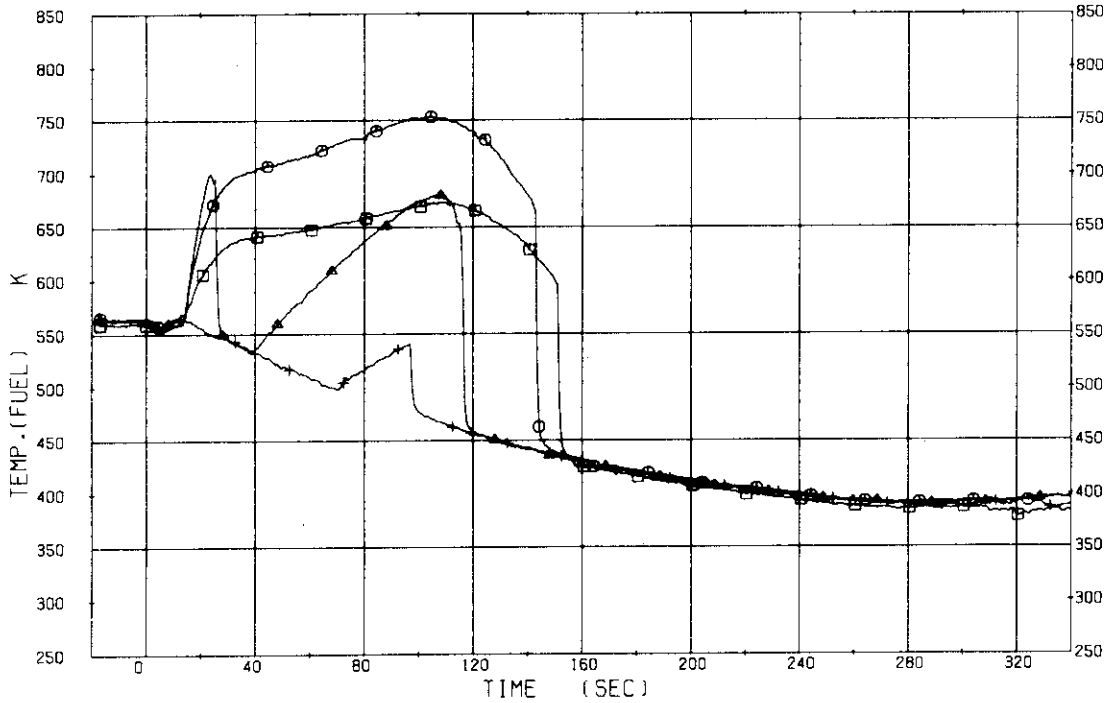


Fig. 5.31 Heater rod surface temperature of A44 rod

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	L11-T.CO	L12-
CH- 132	□ TF-29 (A77 FUEL ROD POS. 1)				CH- 133	○ TF-30 (A77 FUEL ROD POS. 2)
CH- 135	△ TF-32 (A77 FUEL ROD POS. 4)				CH- 137	+ TF-34 (A77 FUEL ROD POS. 6)
CH- 138	◇ TF-35 (A77 FUEL ROD POS. 7)					

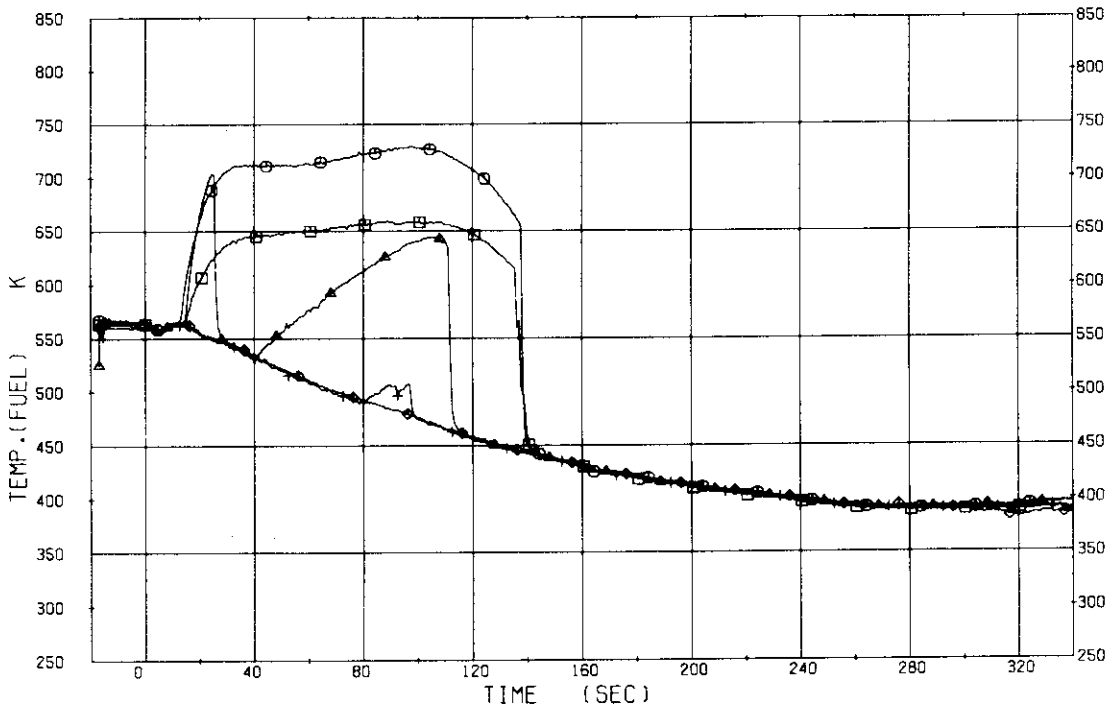


Fig. 5.32 Heater rod surface temperature of A77 rod

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS--- HS1-UP.P HS2- LSI-UP.P LS2- LI1-T.CO LI2-

CH- 140 TF-37 (B15 FUEL ROD POS. 4)

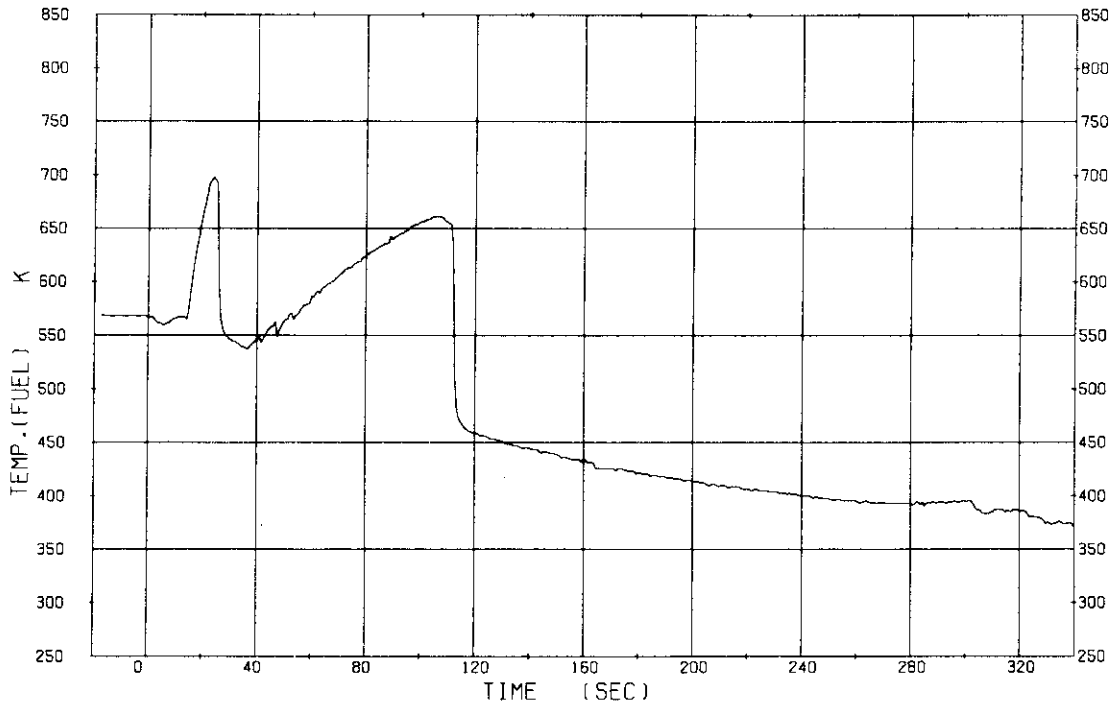


Fig. 5.33 Heater rod surface temperature of B15 rod

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS--- HS1-UP.P HS2- LSI-UP.P LS2- LI1-T.CO LI2-

CH- 142 □ TF-39 (B33 FUEL ROD POS. 1) CH- 144 ○ TF-41 (B33 FUEL ROD POS. 4)
 CH- 146 ▲ TF-43 (B33 FUEL ROD POS. 7)

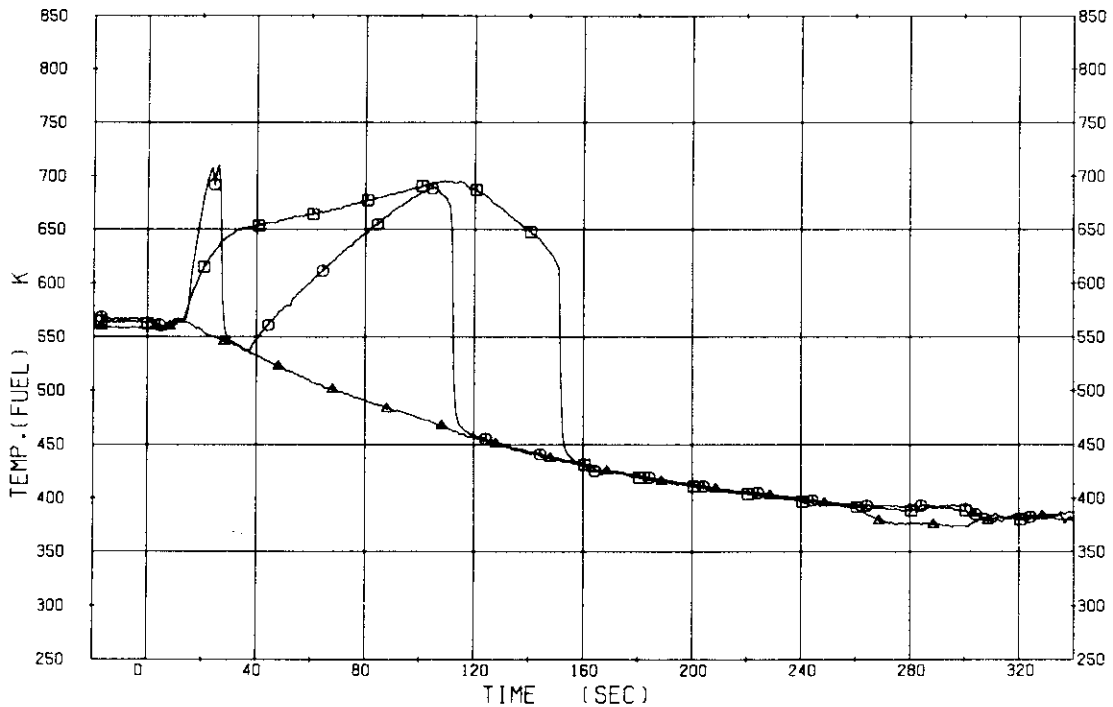


Fig. 5.34 Heater rod surface temperature of B33 rod

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY
 ECCS--- HS1-UP.P HS2- LS1-UP.P LS2- LI1-T.CO LI2-
 CH- 148 TF-45 (B85 FUEL ROD POS. 4)

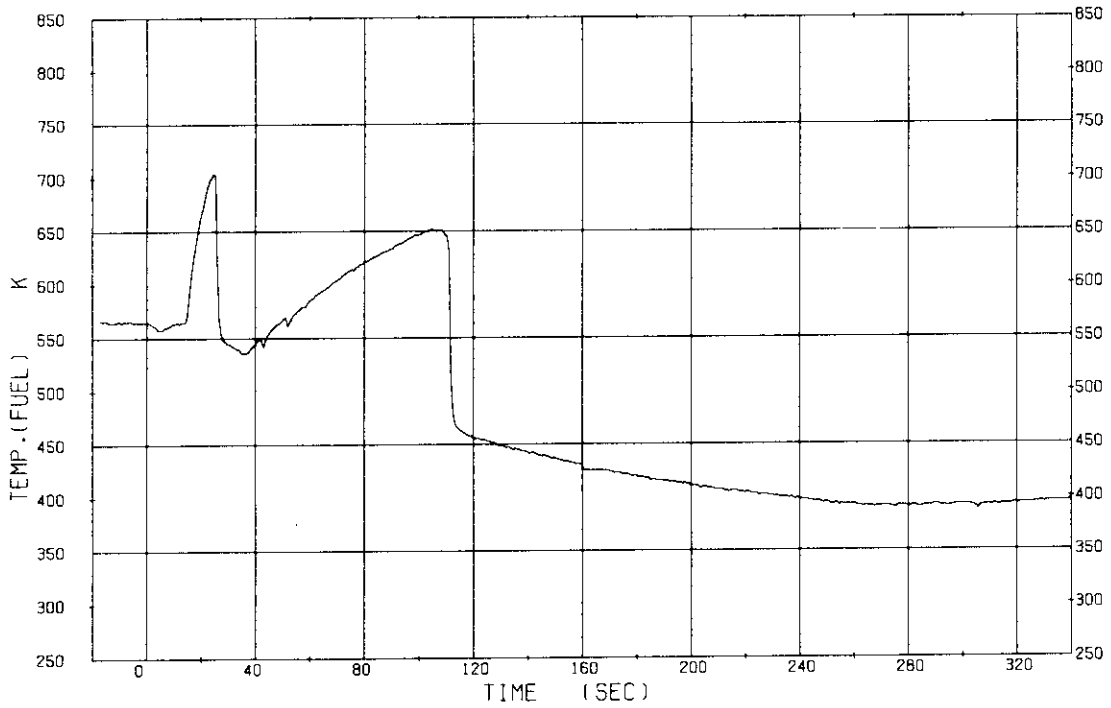


Fig. 5.35 Heater rod surface temperature of B85 rod

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY
 ECCS--- HS1-UP.P HS2- LS1-UP.P LS2- LI1-T.CO LI2-
 CH- 151 TF-48 (C11 FUEL ROD POS. 4)

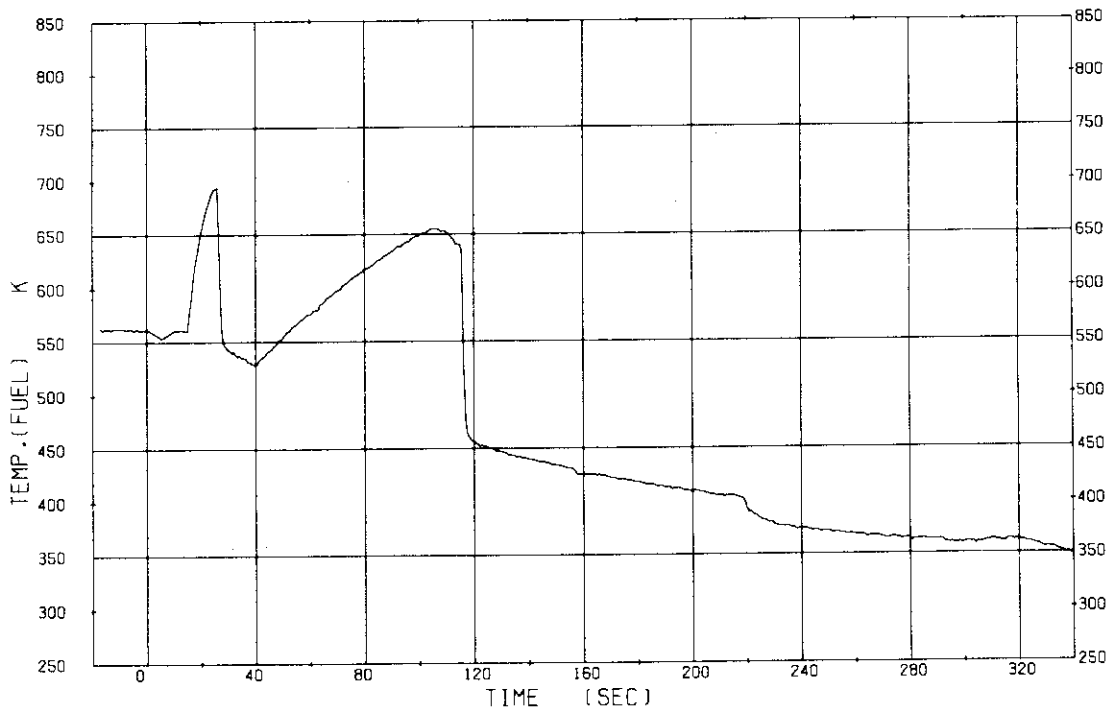


Fig. 5.36 Heater rod surface temperature of C11 rod

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS--- HS1-UP.P HS2- LS1-UP.P LS2- L11-T.CO L12-
 CH- 153 □ TF-50 (C33 FUEL ROD POS. 1) CH- 155 ○ TF-52 (C33 FUEL ROD POS. 4)
 CH- 157 ▲ TF-54 (C33 FUEL ROD POS. 7)

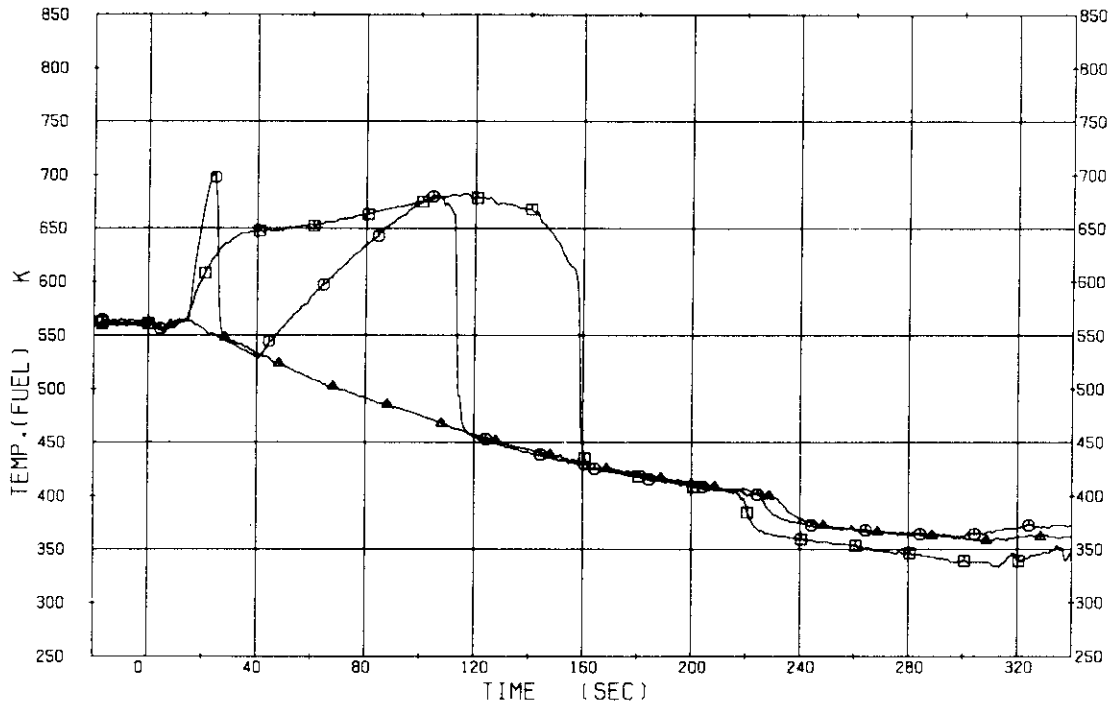


Fig. 5.37 Heater rod surface temperature of C33 rod

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS--- HS1-UP.P HS2- LS1-UP.P LS2- L11-T.CO L12-
 CH- 159 TF-56 (C77 FUEL ROD POS. 4)

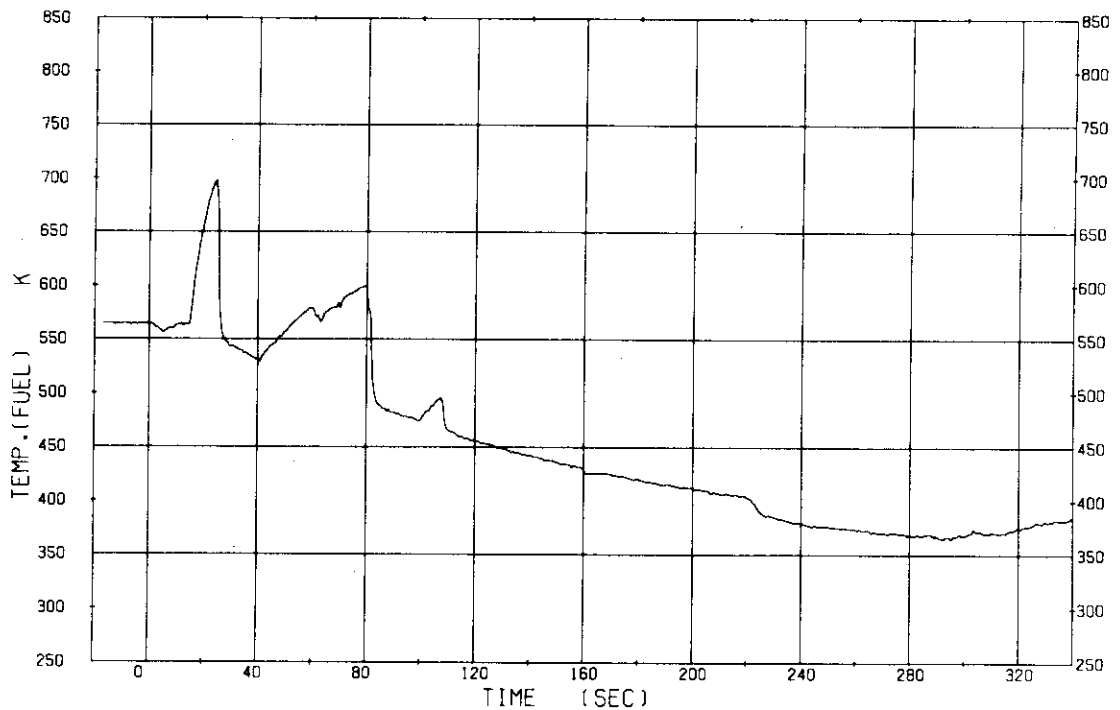


Fig. 5.38 Heater rod surface temperature of C77 rod

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	LI1-T.CO	LI2-
CH- 172	□ TF-69	(A55 TIE ROD POS. 1)			CH- 173	○ TF-70 (A55 TIE ROD POS. 2)
CH- 174	△ TF-71	(A55 TIE ROD POS. 3)			CH- 175	+ TF-72 (A55 TIE ROD POS. 4)
CH- 176	◇ TF-73	(A55 TIE ROD POS. 5)			CH- 177	⬆ TF-74 (A55 TIE ROD POS. 6)

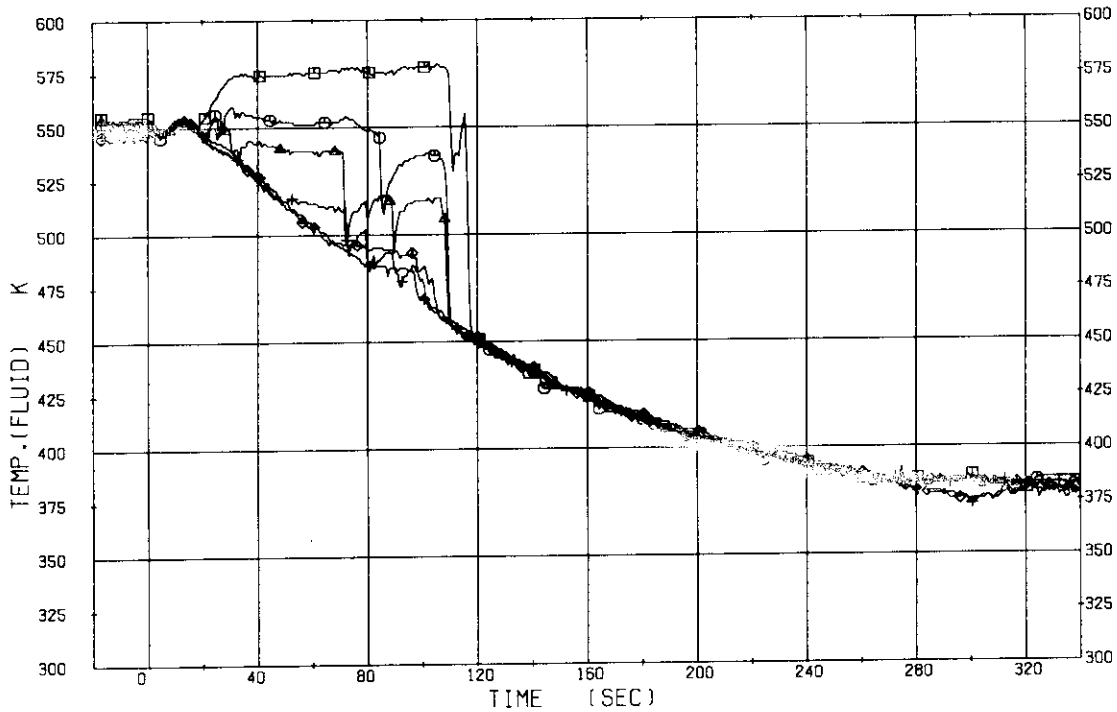


Fig. 5.39 Surface temperature of water rod simulator, A55

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	LI1-T.CO	LI2-
CH- 179	□ TF-76	(B55 TIE ROD POS. 1)			CH- 180	○ TF-77 (B55 TIE ROD POS. 2)
CH- 181	△ TF-78	(B55 TIE ROD POS. 3)			CH- 183	+ TF-80 (B55 TIE ROD POS. 5)
CH- 184	◇ TF-81	(B55 TIE ROD POS. 6)			CH- 185	⬆ TF-82 (B55 TIE ROD POS. 7)

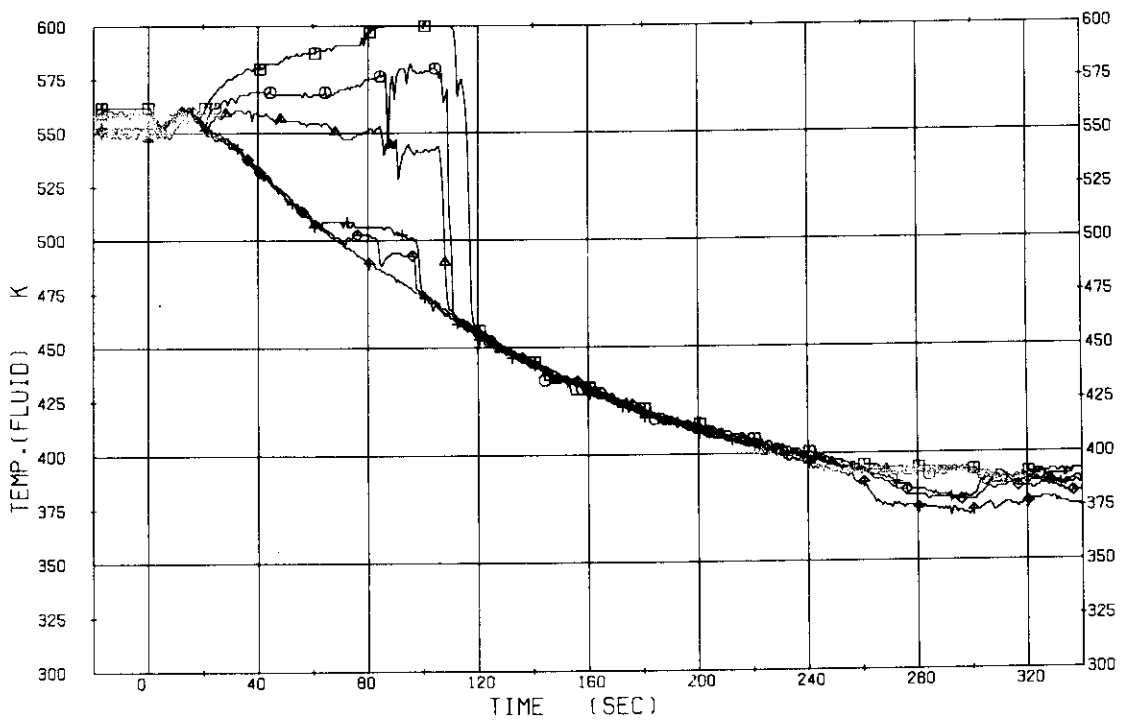


Fig. 5.40 Surface temperature of water rod simulator, B55

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	LI1-T.CO	LI2-
CH- 186	□ TF-83	(C55 TIE ROD POS. 1)			CH- 187	○ TF-84 (C55 TIE ROD POS. 2)
CH- 188	△ TF-85	(C55 TIE ROD POS. 3)			CH- 189	+ TF-86 (C55 TIE ROD POS. 4)
CH- 190	◇ TF-87	(C55 TIE ROD POS. 5)			CH- 191	⋈ TF-88 (C55 TIE ROD POS. 6)
CH- 192	✕ TF-89	(C55 TIE ROD POS. 7)				

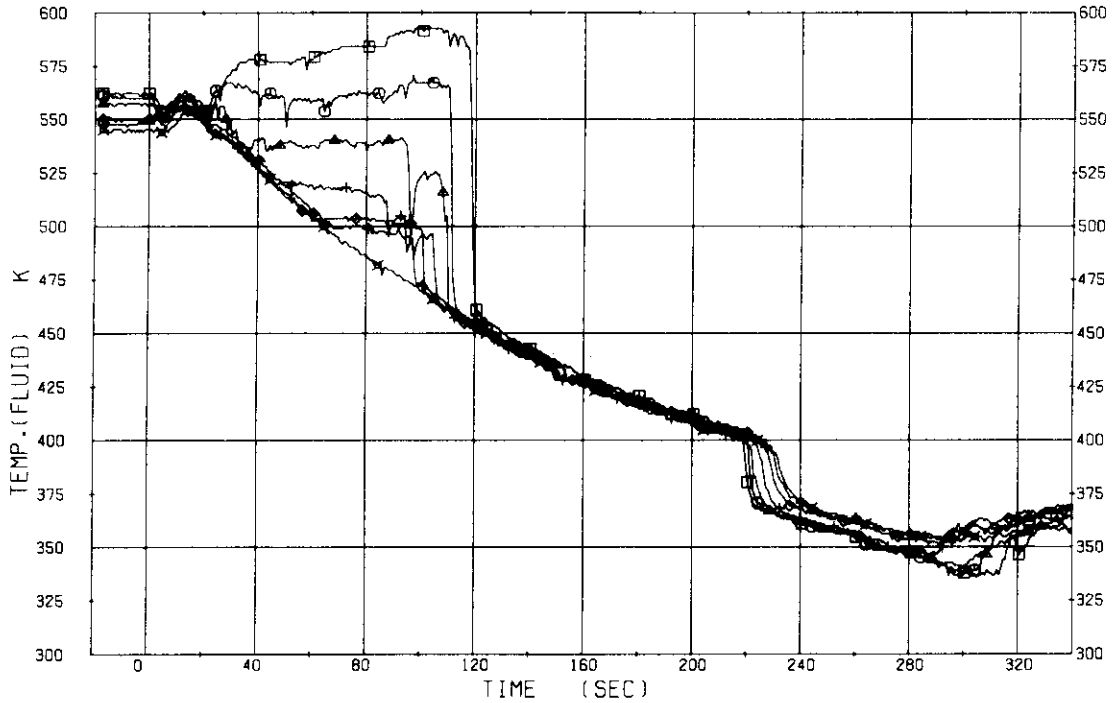


Fig. 5.41 Surface temperature of water rod simulator, C55

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	LI1-T.CO	LI2-
CH- 193	□ TF-90	(D55 TIE ROD POS. 1)			CH- 194	○ TF-91 (D55 TIE ROD POS. 2)
CH- 195	△ TF-92	(D55 TIE ROD POS. 3)			CH- 196	+ TF-93 (D55 TIE ROD POS. 4)
CH- 197	◇ TF-94	(D55 TIE ROD POS. 5)			CH- 198	⋈ TF-95 (D55 TIE ROD POS. 6)
CH- 199	✕ TF-96	(D55 TIE ROD POS. 7)				

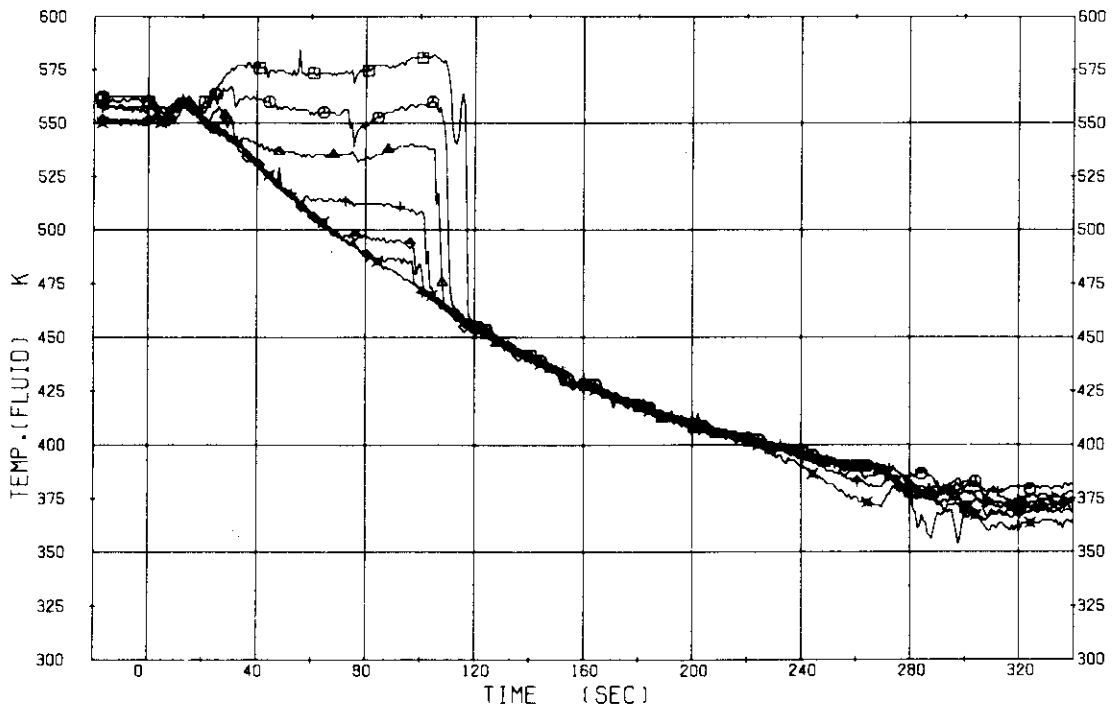


Fig. 5.42 Surface temperature of water rod simulator, D55

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	L11-T.CO	L12-
CH- 200	□ TC-1 (CHANNEL BOX A OUTLET)				CH- 202	○ TC-3 (CHANNEL BOX B OUTLET)
CH- 204	△ TC-5 (CHANNEL BOX C OUTLET)				CH- 206	+ TC-7 (CHANNEL BOX D OUTLET)

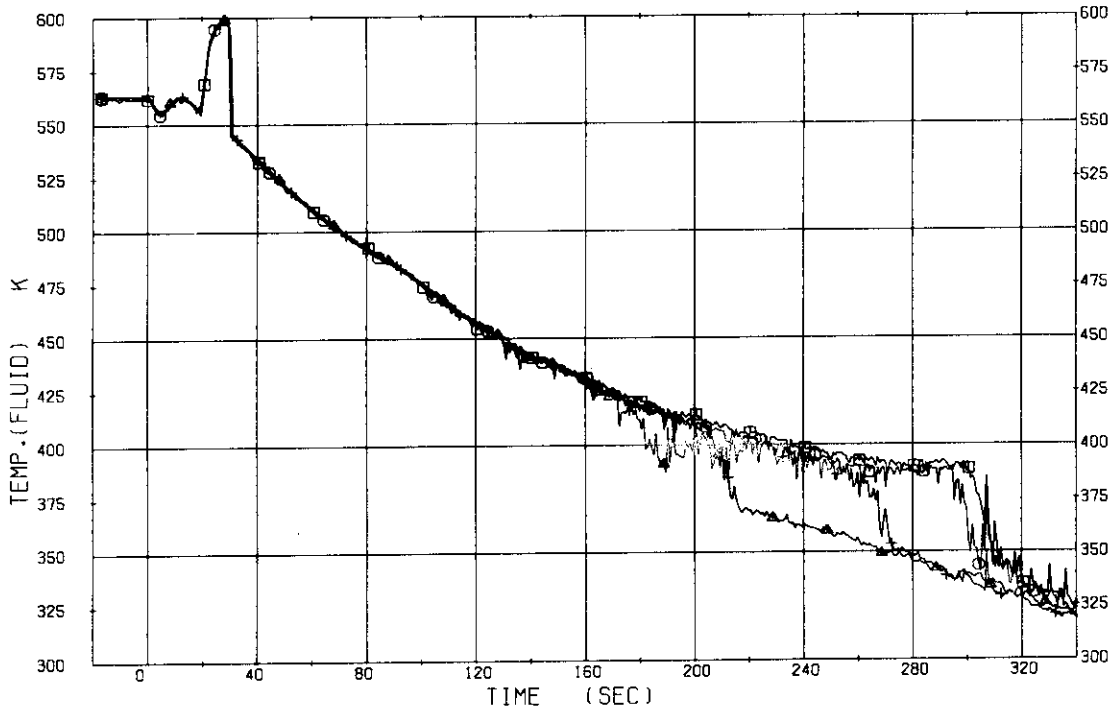


Fig. 5.43 Fluid temperature at channel box outlet

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	L11-T.CO	L12-
CH- 201	□ TC-2 (CHANNEL BOX A INLET)				CH- 203	○ TC-4 (CHANNEL BOX B INLET)
CH- 205	△ TC-6 (CHANNEL BOX C INLET)				CH- 207	+ TC-8 (CHANNEL BOX D INLET)

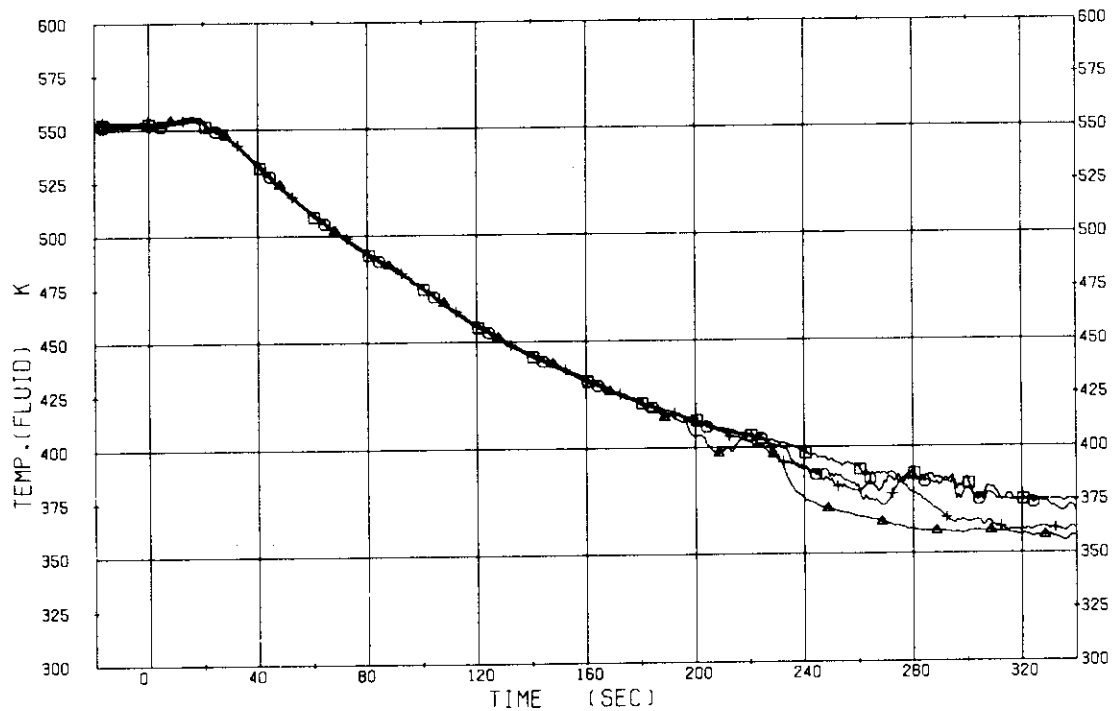


Fig. 5.44 Fluid temperature at channel box inlet

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	LI1-T.CO	LI2-	
CH- 208	□ TB-1	(C.B. INNER SURF. POS.A-1)			CH- 209	○ TB-2	(C.B. INNER SURF. POS.A-2)
CH- 210	△ TB-3	(C.B. INNER SURF. POS.A-3)			CH- 211	+ TB-4	(C.B. INNER SURF. POS.A-4)
CH- 212	◇ TB-5	(C.B. INNER SURF. POS.A-5)			CH- 213	⋈ TB-6	(C.B. INNER SURF. POS.A-6)
CH- 214	× TB-7	(C.B. INNER SURF. POS.A-7)					

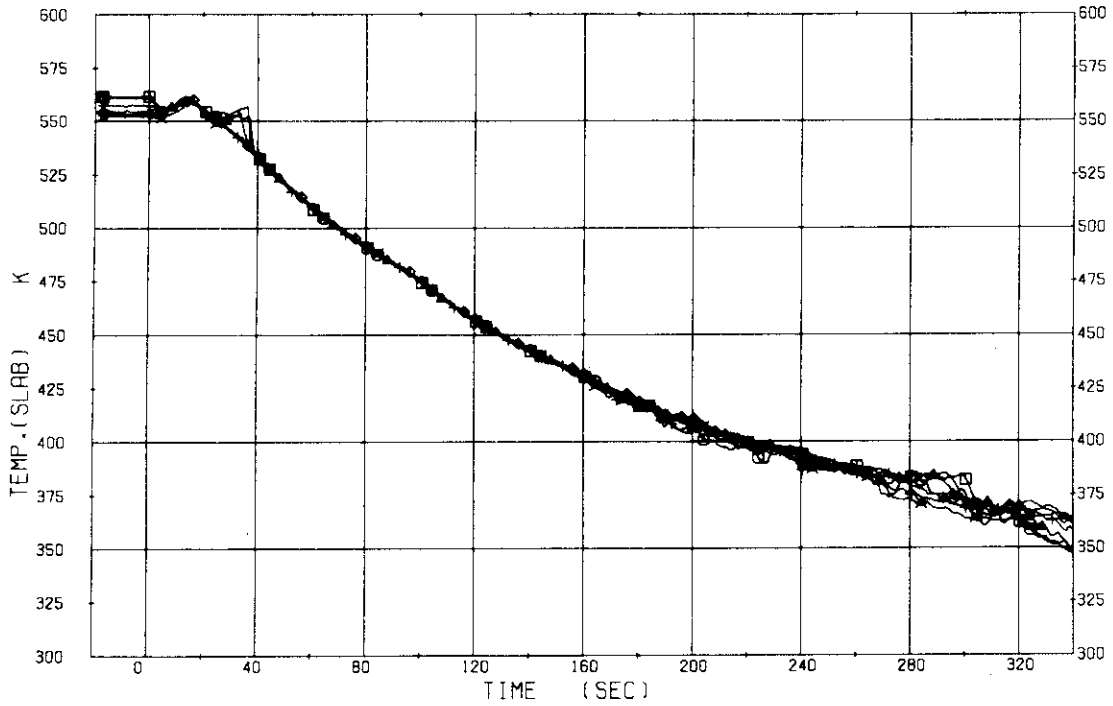


Fig. 5.45 Inner surface temperature of channel box A

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY

ECCS---	HS1-UP.P	HS2-	LS1-UP.P	LS2-	LI1-T.CO	LI2-	
CH- 222	□ TP-1	(LOWER PL. O HIGH)			CH- 223	○ TP-2	(LOWER PL. O MIDDLE)
CH- 224	△ TP-3	(LOWER PL. O LOW)					

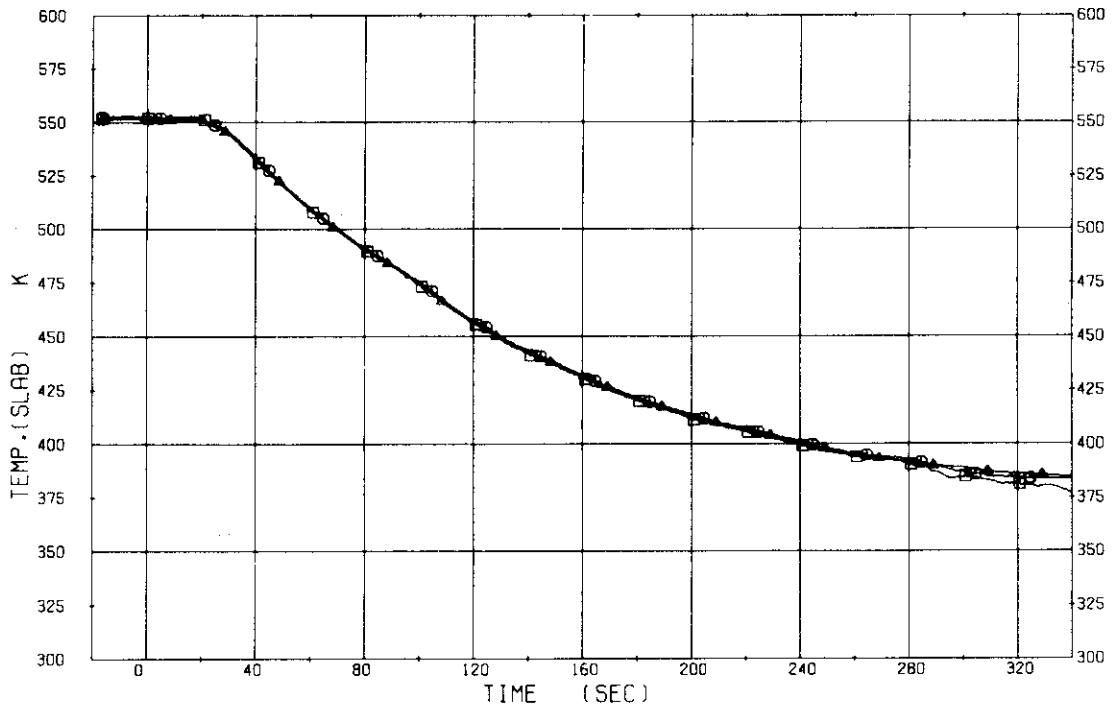


Fig. 5.46 Fluid temperature in lower plenum, north

RUN 703 MRP2 SU. BREAK BREAK DIAMETER 26.2/26.2 MM NO 1 ASSEMBLY
 ECCS--- HSI-UP.P HS2- LSI-UP.P LS2- LT1-T.CO LI2-
 CH- 228 □ TP-7 (LOWER PL. CENTER LOW) CH- 229 ○ TP-8 (LOWER PL. CENTER BOTTOM)

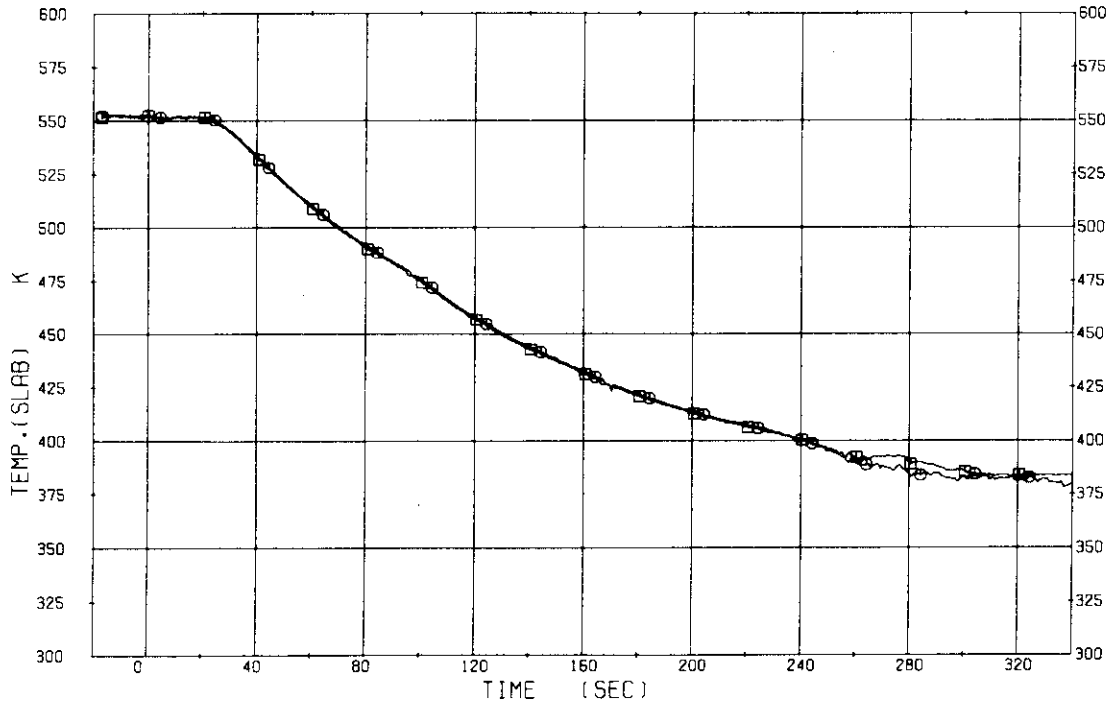


Fig. 5.47 Fluid temperature in lower plenum center

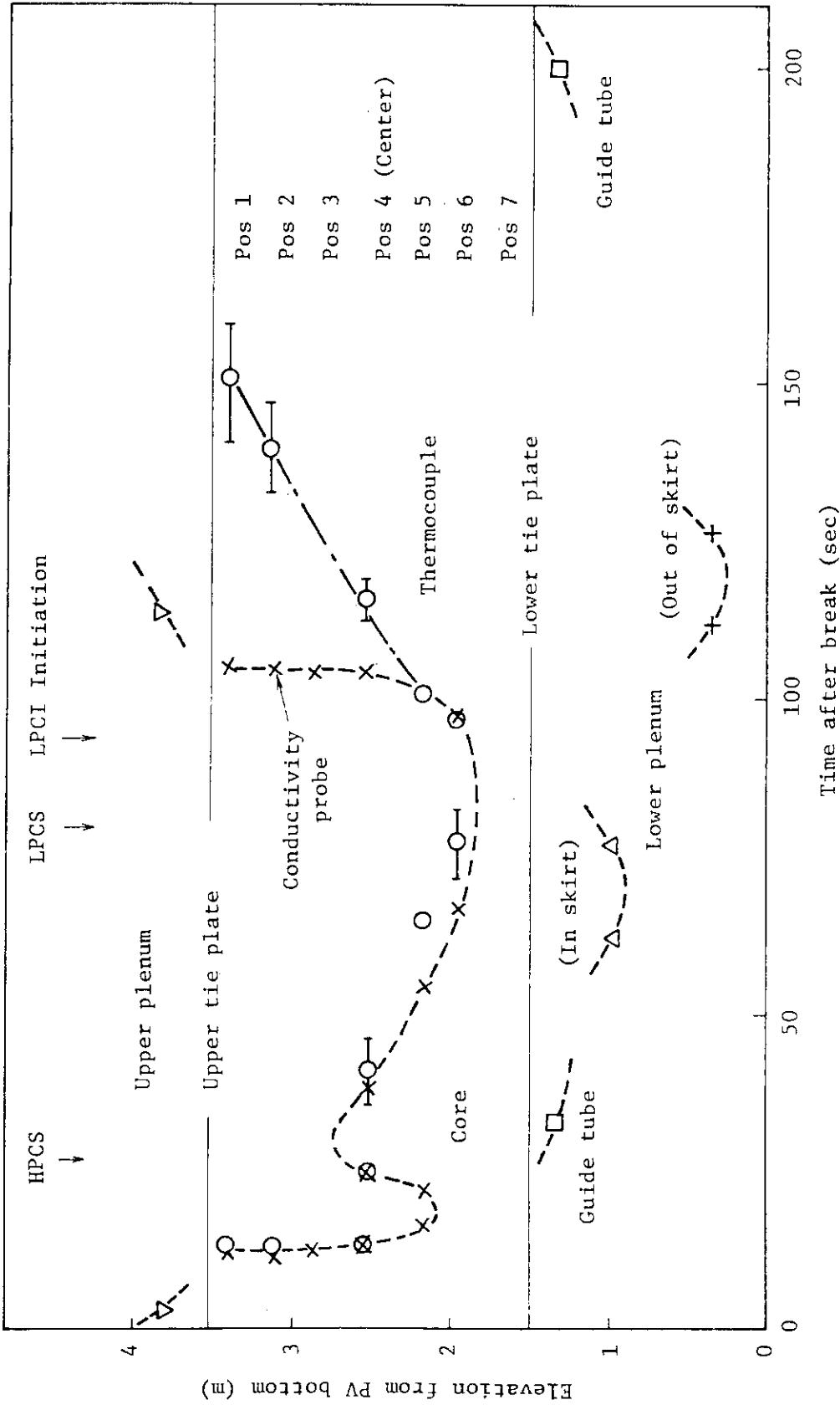


Fig. 5.48 Mixture levels in shroud