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TFBP-TR-240
Rev. 1

REACTIVITY INITIATED ACCIDENT TEST SERIES

TEST RIA 1-1

EXPERIMENT OPERATING SPECIFICATION

August 1978

EG&G Idaho, Inc.

ENERGY SAFETY ENVIRONMENT

IDAHO NATIONAL ENGINEERING LABORATORY

DEPARTMENT OF ENERGY

IDAHO OPERATIONS OFFICE UNDER CONTRACT EY-76-C-07-1570

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1. INTRODUCTION

This document describes the experiment operating specifications for the Reactivity Initiated Accident (RIA) Test RIA 1-1 to be conducted in the Power Burst Facility (PBF) at the Idaho National Engineering Laboratory. The experiment requirements and objectives for the RIA tests are described in the RIA Experiment Requirements Document (ERD)[1] while the experiment specifications are described in the RIA 1-1 Experiment Specification Document (ESD)[2]. The RIA Series I research objectives are to determine fuel failure thresholds, modes and consequences as functions of enthalpy insertion, irradiation history, and fuel design. Coolant conditions of pressure, temperature, and flow rate that are typical of hot-startup conditions in commercial boiling water reactors (BWRs) will be used.

The first test in Series I, Test RIA 1-1, will be comprised of four individual rods, each surrounded by a separate flow shroud. Two rods will be preirradiated and two rods will be unirradiated. The specific objectives of the test are to: (1) characterize the response of unirradiated and preirradiated fuel rods during a RIA event conducted at BWR hot-startup conditions and (2) evaluate test instrumentation response during an RIA.

The test sequence will begin with steady state power operation to condition the fuel (pellet cracking and relocation) and determine the fuel rod power calibration. The loop will then be cooled down, the test train removed from the in-pile tube, and one of the unirradiated rods will be removed for fission product analysis and replaced with an identical unirradiated rod. The transient fuel rod energy deposition for Test RIA 1-1 will be chosen from the fuel rod response vs. energy deposition data observed in the first three phases of the RIA Scoping Test. It is anticipated that a fuel pellet surface energy deposition of about 1100 J/g will be required to ensure cladding failure of all four rods.

Section 2, which follows, describes the design of the test fuel rods, test assembly, and instrumentation associated with Test RIA 1-1. Section 3 describes the experiment conduct for the test. The data recording and reduction requirements are provided in Sections 4 and 5. Sections 6 and 7 describe the posttest support and the postirradiation examination requirements associated with Test RIA 1-1.

2. EXPERIMENT DESIGN

Test RIA 1-1 is comprised of four independently shrouded fuel rods which are installed in a support structure termed the test assembly. The non-instrumented high pressure spool pieces will be installed in the loop piping. This section describes the design of the fuel rods, flow shrouds, test assembly, and instrumentation associated with each component of the test train.

2.1 Fuel Rods

The fuel rods consist of two MAPI rods previously irradiated to a burnup of about 4600 MWd/t in the Saxton Reactor and three unirradiated Saxton fuel rods. The two irradiated rods are designated as 801-1 and 801-2, while the three unirradiated rods are designated as 801-3, 801-4, and 801-5. Rod 801-4 will be removed from the test assembly and replaced with Rod 801-5 after the power calibration and conditioning phases of the test are completed (prior to the transient testing). A third irradiated MAPI Rod, 801-6, will serve as a backup for the irradiated rods. The designation and burnup of the fuel rods are given in Table I. The as-fabricated nominal design characteristics of these fuel rods are given in Table II.

Rod 801-1 will be backfilled with 77.7% helium and 22.3% argon to a pressure of 0.103 MPa. This gas mixture simulates the thermal conductivity of fill gases, including fission gases in the Saxton MAPI fuel rods. Rods 801-2 and 801-6 will not be opened prior to testing. Rods 801-3, 801-4 and 801-5 will be backfilled with commercially pure helium to a pressure of 0.103 MPa.

2.2 Flow Shrouds

Individual zircaloy-4 flow shrouds, having a nominal inner diameter of 16.30 mm and an outer diameter of 22.6 mm, surround each rod. An orifice plate with a 6.95 $\pm$ 0.025 mm diameter hole is located below each shroud.

TABLE I

RIA 1-1 FUEL RODS

PBF RIA TEST ROD NUMBER	ORIGINAL WESTINGHOUSE NUMBER	AVERAGE BURNUP (MWd/t)
801-1	MAPI M-42	4600
801-2	MAPI M-9	4650
801-3	Saxton 958 (w/5.8% enriched fuel)	0
801-4	Saxton 951 (w/5.8% enriched fuel)	0
801-5	Saxton 950 (w/5.8% enriched fuel)	0
801-6	MAPI M-32 (will serve as back-up rod)	4390

TABLE II

TEST RIA 1-1 FUEL ROD DESIGN CHARACTERISTICS

Characteristic	MAPI [a]	Saxton [b]
Fuel		
Material	UO_2	UO_2
Pellet OD	8.59 mm	8.53 mm
Pellet Length	15.2 mm	15.2 mm
Pellet Enrichment	5.7%	5.8%
Density	94% TD	94.5% TD
Fuel Stack Length	0.914 m	0.914 m
End Configuration	dished	dished
Burnup	4600 MWd/t	0
Cladding		
Material	Zircaloy 4	Zircaloy 4
Tube OD	9.99 mm	9.93 mm
Tube Wall Thickness	0.572 mm minimum	0.533 mm minimum
Yield Strength	570 MPa	570 MPa
Ultimate Strength	700 MPa	700 MPa
Fuel Rod		
Gas Plenum Length	45.7 mm	45.7 mm
Insulator Pellets	None	None

[a] Data are preirradiation values.

[b] 5.8% enriched fuel pellets replace original 9.5% enriched fuel pellets.

2.3 Test Assembly

The Battelle, Pacific Northwest Laboratory four-rod test train will be used for Test RIA 1-1. In the test train, the fuel rods are held rigidly at the top, with the rods free to expand axially downward. The location of each fuel rod and associated flow shroud is shown in Figure 1.

2.4 Instrumentation

The instrumentation for this test is designed to aid in determining fuel rod response characteristics and failure mechanisms during an RIA transient.

2.4.1 Fuel Rod Instrumentation. Table III summarizes the fuel rod instrumentation including information as to description, range, response time, and signal conditioning.

Irradiated Rod 801-1 will be instrumented for measurement of the internal gas pressure, cladding surface temperature, and cladding elongation.

Unirradiated Rod 801-3 will be fully instrumented for measurement of the internal gas pressure, cladding surface temperature, fuel centerline temperature, plenum temperature, and cladding elongation.

The following gives the specification of the fuel rod instrumentation:

(1) A molybdenum-rhenium sheathed, tungsten-rhenium thermocouple will be located at an axial position of 790 mm above the bottom of the fuel stack of Rod 801-3 to measure the fuel centerline temperature.

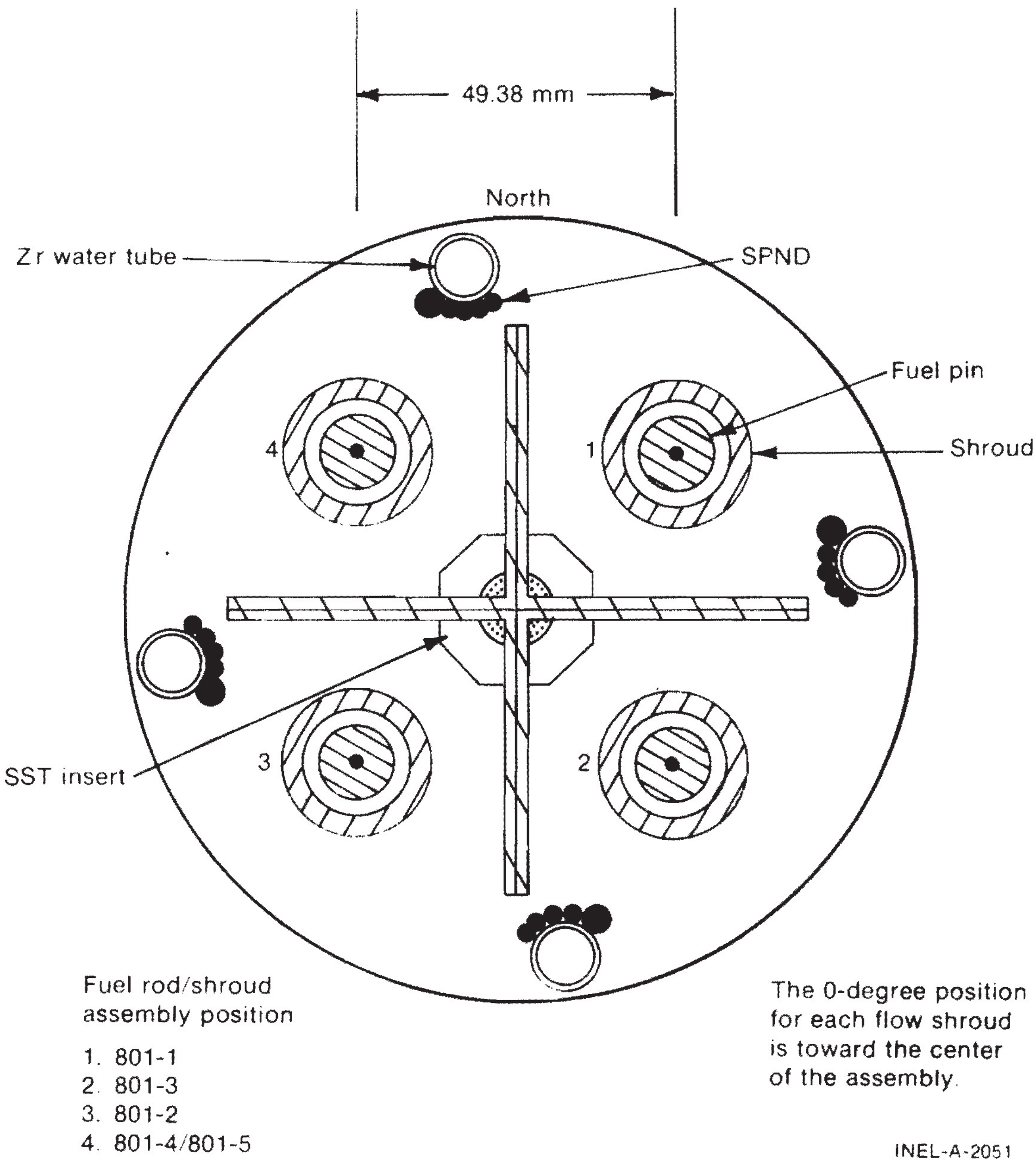

Fig. 1 Fuel rod arrangement in four-rod hardware for Test RIA 1-1.

TABLE III

FUEL ROD INSTRUMENTATION FOR TEST RIA 1-1

Measurement	Instrument	Instrument Location	Fuel Rod to be Instrumented	Instrument Range	Requested Maximum Response Time (s)	Number and Type of Instruments
Fuel centerline temperature	Thermocouple	79 cm from bottom of fuel stack	801-3	500 to 2800 K	0.01	One tungsten-rhenium thermocouple
Rod internal pressure	Pressure Transducer	Upper Plenum	801-1, 801-3	0 to 6.9 MPa	0.002	Kaman pressure transducer
Cladding surface temperature	Thermocouple	46 cm from bottom of fuel stack at 0-degree orientation, and 79 cm from bottom of fuel stack at 180-degree orientation	801-1, 801-3	500 to 2150 K	0.01	Two Type [illegible] thermocouples per rod
Plenum temperature	Thermocouple	Upper Plenum	901-3	300 to 1000 K	0.02	One Type [illegible] thermocouple

(2) Two Type S, titanium-sheathed cladding surface thermocouples with spaded junctions will be installed on each of Rods 801-1 and 801-3. The thermocouples will be welded to the cladding outer surface. The location of each thermocouple above the bottom of the fuel stack and their azimuthal orientations are shown in Table III.

(3) A 6.9 MPa Kaman pressure transducer will be mounted on Rods 801-1 and 801-3 to measure rod internal pressure in the upper plenum.

(4) A plenum thermocouple (Type K) will be located at the centerline of the spring in the plenum region of Rod 801-3 to measure the plenum gas temperature.

The remaining rods (Rods 801-2, 801-4, 801-5, and 801-6) will not be instrumented except for measurement of the cladding elongation.

2.4.2 Test Assembly Instrumentation. Table IV summarizes the test assembly instrumentation including information as to description, range, response time, and signal conditioning. The test assembly instrumentation consists of the following:

(1) Three coolant pressure transducers (a 69 MPa EG&G, a 17.2 MPa Kaman, and a 17.2 MPa Schaevitz) located above the flow shroud outlet to measure the transient pressure response and normal system pressure.

(2) Four coolant Kaman pressure transducers located above the flow shroud outlets to measure individual flow shroud transient pressure pulses generated by fuel rod failure. The pressure transducer for the 801-5 rod shroud will be attached after the replacement of Rod 801-4 with Rod 801-5. This is necessary to facilitate assembly.

TABLE IV

TEST TRAIN INSTRUMENTATION FOR TEST RIA 1-1

Measurement	Instrument	Instrument Location	Instrument Range	Requested Maximum Response Time (s)	Signal Conditioning
Coolant pressure	EG&G Pressure Transducer	Near outlet of IPT flow tube	0 to 69 MPa	1×10^{-4}	Bridge completion network and power supply
Coolant pressure	Schaevitz Pressure Transducer	Near outlet of IPT flow tube	0 to 17 MPa	.003	LVDT-type pressure transducer
Coolant pressure	Kaman Pressure Transducer	Near outlet of IPT flow tube	0 to 17 MPa	0.002	Eddy-current type pressure transducer
Coolant pressure	Four Kaman Pressure Transducers	Near outlet of each flow shroud	0 to 17 MPa	0.002	Eddy-current type pressure transducer
Coolant flow	Turbine Flow Meter	Inlet of each flow shroud	0 to 820 cm^3/s	0.002	Preamplifier frequency to voltage converter and phase detector
Coolant inlet temperature	Thermocouple	Inlet of each flow shroud	300 to 600 K	N/A	Type K reference junction
Coolant outlet temperature	Thermocouple	Outlet of each flow shroud	300 to 600 K	N/A	Type K reference junction
Coolant differential temperature	Thermocouple pair, Type K	Inlet and outlet of each flow shroud	0 to 20 K	N/A	Differential Amplifier
Relative neutron flux	SPND	2 vertical columns of 5 detectors, located 180 degrees apart	1 ma	0.002	Each SPND will be connected to log amplifiers.
Neutron flux (IPT)	Flux wire (0.51% Co-Al) for steady state, 100% cobalt transient	Outer surface of each flow shroud (180 degrees orientation)	N/A	N/A	0.51% Co-Al wire will be replaced with 100% cobalt wires before transient
Neutron flux (core)	100% cobalt wire	PBF core periphery	N/A	N/A	New wire will be installed before transient
Cladding axial strain	LVDT	Lower end of each rod	-5 to 20 mm	0.003	Carrier amplifier

(3) A turbine flowmeter, located at the inlet of each flow shroud, to measure the experiment coolant flow.

(4) A pair of Chromel-Alumel (Type K) thermocouples (one located at the inlet and the other at the outlet of each flow shroud), to measure the temperature rise in the coolant.

(5) A Chromel-Alumel (Type K) thermocouple mounted at the inlet of each flow shroud to measure the coolant inlet temperature.

(6) A Chromel-Alumel (Type K) thermocouple mounted at the outlet of each flow shroud to measure the coolant outlet temperature.

(7) A linear variable differential transformer (LVDT) mounted below the lower end of each fuel rod to measure the cladding axial elongation.

(8) A flux wire mounted on the outer surface of each flow shroud at the 180-degree orientation to measure the integrated neutron flux. Flux wires with 0.51% cobalt and 99.49% aluminum content will be used during the power calibration and conditioning phases. These wires will be removed and replaced with 100% cobalt wires before the transient power burst.

(9) Ten (10) self-powered neutron detectors (SPND) located in two vertical columns 180 degrees apart to measure the relative neutron flux.

2.4.3 Plant Instrumentation. Plant instrument data to be recorded along with the test train instrument data are as follows:

(1) NMS-3 ion chamber

(2) PPS-1, PPS-2, PPS-3, PPS-4 ion chambers

(3) TR-1, TR-2 ion chambers

(4) EV-1, EV-2 ion chambers

(5) In-pile tube system pressure

(6) In-pile tube "ΔP"

(7) Loop flow rate

(8) Loop fission product detection system

(9) Core fuel rod LVDTs (3)

(10) Reactor vessel strain gauges (3)

(11) Loop Pressure transducers (9)

In addition, a 100% cobalt flux wire will be installed in the reflector region of the core. A new cobalt flux wire will be installed each time the reactor is scheduled to be shut down. The digital readout for the Heise loop pressure gauge should be available for monitoring from the PBF control room. If it is not, a closed circuit television camera will be positioned to view the Heise loop pressure gauge and the image displayed on the television monitor at the PBF control room.

3. EXPERIMENT OPERATING PROCEDURE

Details of the experimental procedure of Test RIA 1-1 are discussed in the following sections. Test RIA 1-1 will be conducted in three primary test phases preceded by the nonnuclear heat-up and interspaced with a number of instrumentation status checks. Coolant conditions for each phase of the test are given in Table V. Each experiment operating phase and the instrumentation status requirements are considered individually below.

3.1 Instrument Status Checks and Minimum Operable Instrumentation

To monitor the experiment status and to meet test objectives requires that certain fuel rod and test assembly instrumentation be operable throughout the experiment or during specific phases of the experiment. The loss of a critical instrument or a critical combination of instruments needed for a current or subsequent test phase will require the test procedures to be suspended. Since instrument status will be monitored on the PBF/DARS display, the source of instrument output difficulties can range from instrument malfunction or failure to signal conditioning, transmission, or DARS calibration problems. If the experiment is interrupted by an apparent instrumentation malfunction, it will be necessary for cognizant data system and instrumentation personnel to determine the source and potential remedies for the malfunction indication. When possible, remedial actions will be completed and the test procedures continued. If it is determined that the instrument is failed or that repairs can be made only by removing the test train from the reactor, test procedures will remain suspended. This experiment status will be maintained pending a decision by the RIA Project Leader, TFBD Management, and Directorate management as to the course of action to be followed.

Critical instrumentation for Test RIA 1-1 have been defined in terms of minimum operable instrumentation for various times during the test sequence. Table VI presents this information. Instrument status

TABLE V

TEST RIA 1-1 COOLANT CONDITIONS

Test Phase	Coolant Inlet Temperature (K)	System Pressure (MPa)	Shroud Coolant Flow Rate (cm^3/s)
Prenuclear	538 $\pm$ 1	6.45 $\pm$ 0.14	760 $\pm$ 15
Power Calibration	538 $\pm$ 1	6.45 $\pm$ 0.14	760 $\pm$ 15
Conditioning	538 $\pm$ 1	6.45 $\pm$ 0.14	760 $\pm$ 15
Transient Testing	538 $\pm$ 1	6.45 $\pm$ 0.14	85 $\pm$ 5

checks are planned before and during the test to ensure conformity to the requirements in Table VI. Instrument status checks will occur at the TRA assembly area and again in the reactor building prior to loading the test train in the in-pile tube (IPT). Each fuel rod and test assembly transducer will be checked according to the Instrument Checkout Procedures documented in TP-RIA-1101 and TP-RIA-1102. Any quality discrepancy reports issued as a result of TP-RIA-1101 and TP-RIA-1102 must be signed off by the RIA Project Leader or his alternate.

The remaining status checks are to be made at isothermal conditions during each heat-up of the IPT system, prior to the power calibration phase, and prior to the transient power burst. Table VII lists the operating conditions and the acceptance criteria for each instrument of the test. The acceptable operation criteria appear in the table as ranges of measured values in SI units. The ranges stipulated are based on the listed operating conditions and expected accuracies of the instruments used. Appendix A contains check lists, consistent with Table VII, that are to be incorporated in the Experiment Operating Procedures. Certification that each instrument is within range must be made by the supervisor of the Instrumentation and Data Systems Section or his alternate. If an instrument is not functioning the failure must be certified by the supervisor of the Test Train Fabrication Section or his alternate. For all cases where the instruments are not within range, the RIA Project Leader's or his alternate's approval must be obtained in order to continue the test procedures. Any deviation from the acceptance criteria will be cause for further instrument checkout and corrective action will be taken where possible. Criteria deviations must be cross-checked against the minimum operable instrumentation list presented in Table VI and appropriate actions taken where necessary.

The last status check will be performed after the flux wire replacement and the connection of the 801-5 shroud pressure transducer have been made and before the transient power burst.

TABLE VI

MINIMUM REQUIRED OPERABLE INSTRUMENTATION DURING VARIOUS PHASES OF TEST RIA 1-1

INSTRUMENTATION	NUMBER	PRE-INSTALLATION OF TEST TRAIN IN IPT	DURING HEAT-UP	PRE-POWER CALIBRATION PHASE	PRE-TRANSIENT PHASE
17 MPa Shroud Pressure Transducers	(4)	4 of 4 Req'd	3 of 4 Req'd	3 of 4 Req'd	3 of 4 Req'd
Fuel Thermocouple	(1)	Req'd	Req'd	Req'd	Req'd
Cladding Thermo-couples	(4)	4 of 4 Req'd	3 of 4 Req'd	2 of 4 Req'd	2 of 4 Req'd
Plenum Thermocouples	(1)	Not Req'd	Not Req'd	Not Req'd	Not Req'd
Internal Pressure Transducers	(2)	2 of 2 Req'd	1 of 2 Req'd	1 of 2 Req'd	1 of 2 Req'd
69 MPa Coolant Pressure Transducer	(1)	Req'd	Req'd	Req'd	Req'd
17 MPa Coolant Pressure Transducer	(2)	1 of 2 Req'd	1 of 2 Req'd	1 of 2 Req'd	1 of 2 Req'd
Fuel Rod Coolant Flowmeters	(4)	4 of 4 Req'd	4 of 4 Req'd	3 of 4 Req'd	2 of 4 Req'd
Cladding LVDTs	(4)	4 of 4 Req'd	3 of 4 Req'd	2 of 4 Req'd	2 of 4 Req'd
Coolant Inlet Thermocouples	(4)	4 of 4 Req'd	2 of 4 Req'd	1 of 4 Req'd	1 of 4 Req'd
Coolant Outlet Thermocouples	(4)	4 of 4 Req'd	2 of 4 Req'd	1 of 4 Req'd	Not Req'd
Coolant Differential Thermocouples	(4)	4 of 4 Req'd	4 of 4 Req'd	4 of 4 Req'd	Not Req'd
SPNDs	(2) Quadrants of 5 each)	2 of 2 Quadrants Req'd	2 of 2 Quadrants Req'd	1 of 2 Quadrants Req'd	1 of 2 Quadrants
Core Transient Ion Chambers Capable of Monitoring Expected Peak Power	Not Req'd	Not Req'd	Three of either: EV-1, EV-2, TR-1 and TR-2, Req'd	Three of either: EV-1, EV-2 TR-1 and TR-2, Req'd	Three of either: EV-1, EV-2, TR-1, and TR-2, Req'd

TABLE VII

TEST RIA 1-1 INSTRUMENT STATUS CHECK-OPERABLE INSTRUMENT CRITERIA

Calibration	Before Heatup	Before Power	Before Transient
Loop Temperature (K)	450 ± 10	538 ± 1	538 ± 1
Loop Pressure (MPa)	3.45 ± 0.14	6.45 ± 0.14	6.45 ± 0.14
Flow Through Shrouds (cm^3/s)	500 ± 15	760 ± 15	85 ± 5

INSTRUMENT	ACCEPTABLE RANGE		
Fuel Rod Instrument			
Fuel Rod 801-1			
Internal Pressure	0.4 to 0.9 MPa	0 to 1 MPa	0 to 1.0 MPa
Cladding T/Cs (2)	430 to 470K	522 to 544K	522 to 554K
Fuel Rod 802-2			
Internal Pressure	0.4 to 0.9 MPa	0 to 1.0 MPa	0 to 1.0 MPa
Cladding T/Cs (2)	430 to 470K	522 to 554K	522 to 554K
Plenum TC	430 to 470K	522 to 554K	522 to 554K
Fuel TC	420 to 480K	512 to 564K	512 to 564K
Test Train Instrumentation			
Flow Shroud Turbine Flowmeters(4)	485 to 515 cm^3/s	745 to 775 cm^3/s	80 to 90 cm^3/s
Coolant Inlet T/Cs (4)	440 to 460K	528 to 548K	528 to 548K
Coolant Outlet T/Cs (4)	440 to 460K	528 to 548K	528 to 548K
Coolant ΔTC Pairs (4)	-1.6 to 1.6K	-1.6 to 1.6K	Not Required
17.2 MPa Shroud Pressure Transducers (4)	± 1 MPa of Heise Gauge	± 1 MPa of Heise Gauge	± 1 MPa of Heise Gauge
17.2 MPa Pressure Transducer (2)	± 1 MPa of Heise Gauge	± 1 MPa of Heise Gauge	± 1 MPa of Heise Gauge
69 MPa Pressure Transducer (1) Gauge	± 3.5 MPa of Heise	± 3.5 MPa of Heise	± 3.5 MPa of Heise Gauge
Neutron Detector (10)	IR > 10^8	IR > 10^8	IR > 10^8
LVDT (4)	-6.4 to -3.8mm	-6.2 to -3.6mm	-6.2 to 3.6mm

Prior to any data acquisition, the PBF/DARS output will be verified by inputting voltages to the low level amplifiers or in accordance with a checklist to be supplied by the Instrument and Data Systems Section. This checklist will be incorporated in the Experiment Operating Procedures and will be signed off by the supervisor of the Instrumentation and Data section or his alternate prior to loop heatup.

In the event of a DARS channel failure, permission must be obtained from the Supervisor of the Instrumentation and Data Section or his alternate before the failed channel can be changed. If any channels are changed subsequent to the DARS verification then the changed channels must be reverified. In addition, any channels being doubly recorded on the surveillance system channel electronics cannot be changed after verification. A posttest integrated data systems calibration will be performed after reactor building re-entry is permitted.

3.2 Loop Heatup Prior to Power Calibration

The initial part of testing will consist of a hydrostatic pressure check, followed by heatup of the loop to the desired coolant temperature, pressure, and flow, which are: 538 $\pm$ 1 K, 6.45 $\pm$ 0.14 MPa, and 760 $\pm$ 15 cm^3/s flow through each flow shroud, respectively. Instrument status checks will be made during heatup and again after the loop coolant temperature has increased to 538 K. If possible, the IPT flow bypass will be measured at 538 K by closing the flow bypass line valve and then measuring the flow through the four flow shrouds and the total loop flow. Care should be taken not to exceed the 820 cm^3/s flow capability of the shroud flowmeters. The flow bypass valve will then be opened to verify that an experiment flow of 85 cm^3/s can be obtained at 538 $\pm$ 1 K and 6.45 $\pm$ 0.14 MPa.

Data will be recorded on the DARS during the hydrostatic pressure check, the heatup, and the flow checks.

3.3 Prenuclear Instrument Drift Recording

Data channels shall be recorded for at least 30 minutes to establish any instrument drift rates. This recording should be done after heat-up and prior to nuclear operation at stable system conditions of: 538 $\pm$ 1 K inlet temperature, 6.45 $\pm$ 0.14 MPa IPT pressure, and 760 $\pm$ 15 cm^3/s flow through each flow shroud.

3.4 Fuel Rod Power Calibration and Conditioning

The objectives of the power calibration and conditioning phases of the test are to intercalibrate the thermal-hydraulically determined fuel rod power with reactor power and the self-powered neutron detectors (SPNDs) mounted on the test assembly and to achieve pellet cracking and partial fuel restructuring of the unirradiated fuel rods. The on-line power calibration will be accomplished by measuring the coolant pressure, coolant inlet temperature, coolant temperature rise, and experiment flow for each rod. An axial peak-to-average neutron flux ratio of 1.35 will be used for preliminary calculations. The required coolant conditions during these phases are: 538 $\pm$ 1.0 K inlet temperature, 6.45 $\pm$ 0.14 MPa IPT pressure, and 760 $\pm$ 15 cm^3/s flow through each shroud. The anticipated PBF operation during these phases is summarized in Table VIII. Power calibration data will be recorded for about five minutes at each power level. The maximum ramp rate (increase or decrease) in fuel rod power should not exceed 1 kW/m per minute.

A temporary Channel 3 reactor shutdown is required that will shutdown the reactor if any of the cladding surface thermocouples on Rod 801-1 or 801-3 indicate a temperature exceeding 700 K. The shutdown circuit will include a time delay of 2 seconds to eliminate shutdown from noise spikes. This circuit will be removed or made inoperable prior to running the power transient.

TABLE VIII

OPERATING CONDITIONS DURING POWER CALIBRATION AND CONDITIONING PHASES OF TEST RIA 1-1

Expected Time Duration[a] (minute)	Peak Fuel Rod Power[b] (kW/m)	Anticipated Reactor Power[c] (MW)	Expected Temperature Rise of IPT Flow (K)
30	0 to 13	0 to 7.5	
5	13	7.5	2.9
7	13 to 20	7.6 to 11.6	
5	20	11.6	4.5
6	20 to 26	11.8 to 15.1	
5	26	15.1	5.9
6	26 to 32	15.3 to 18.6	
5	32	18.6	7.2
6	32 to 38	18.8 to 22.0	
5	38	22.0	8.6
6	38 to 44	22.4 to 25.5	
5	44	25.5	10.0
6	44 to 48	25.9 to 27.8	
180	48	27.8	10.9
47	48 to 3	28 to 1.7	
10	3	1.7	0.7
41	3 to 44	1.8 to 25.5	
180	44	25.5	10.0
41	44 to 3	25.9 to 1.7	
10	3	1.7	0.7
35	3 to 38	1.8 to 22.0	
180	38	22.0	8.6
35	38 to 3	22.4 to 1.8	
10	3	1.8	0.7
29	3 to 32	1.8 to 18.6	
180	32	18.6	7.2
6	32 to 26	18.8 to 15.1	
5	26	15.1	5.9
6	26 to 20	14.3 to 11.6	
5	20	11.6	4.5
7	20 to 13	11.8 to 7.5	
5	13	7.5	2.9
13	13 to 0	7.6 to 0	

[a] 18 hours and 52 minutes total time.

[b] Fuel rod power refers to Saxton rods. MAPI rod power about 1.3% less.

[c] Reactor power will be increased to 27.8 MW if measured fuel rod peak power does not exceed 52 kW/m.

3.5 Loop Heatup Prior to Transient Testing

Instrument status checks will be made before heatup and again before performing the power transient burst. IPT loop operating conditions required for the power transient testing will be: 538 $\pm$ 1.0 K inlet temperature, 6.45 $\pm$ 0.14 MPa IPT pressure, and 85 $\pm$ 5 cm^3/s flow through each experiment flow shroud. The test train flowmeters will be intercalibrated with the total loop flow by increasing the experiment coolant flow to a maximum and then decreasing the flow to a minimum at 538 K. Data will be recorded during the hydrostatic pressure check during the flow calibration, and during heatup. Reactor primary coolant conditions will be nominally 15,000 gpm flow, 294 to 300 K inlet temperature, and atmospheric pressure for the power burst.

3.6 Power Transient Testing

The reactor period for the transient test will be chosen on the basis of the PBF lead rod tests, the RIA Scoping Test, and Test RIA 1-1 power calibration test results. The Channel 3 reactor shutdown circuit will be made inoperable prior to running this transient.

The following sequence of operations leading to the initiation of a power transient burst is designed to minimize the steady state energy before the transient. It is essential that the steady state contribution of the flux wire activation be a small percentage of the power transient activation.

(1) The reactor will be made critical at about 100 W for determination of the low power critical position of the control rods.

(2) From this position the control rods will be withdrawn an amount required to establish a reactor transient period of approximately 10 seconds. The reactor power will be allowed

to increase until the "chamber operable light" indicates that the chambers are functioning properly. Immediately upon reaching this level, the control rods will be inserted an amount required to make the reactor subcritical causing the power to rapidly decrease. Allow no more than 50% power overshoot above the chamber operable set point in the event a chamber is not functioning properly.

(3) The transient rods will then be drawn into the core to a position representative of the reactivity insertion required for the reactor transient.

(4) The control rods will then be withdrawn to make the reactor critical at about 100 W. The reactivity inserted by the withdrawal of the control rods and the worth of the transient rods will be compared to assure the increment of control rod withdrawal determined for the reactor transient is not grossly in error.

(5) The transient rods will then be fully inserted into the core with the control rod position adjusted to the required increment of withdrawal determined for the desired reactivity insertion.

(6) The transient will be initiated manually. The control rod shutdown time or power trip level will be the same as that used previously in the RIA Scoping Test for approximately the same reactor transient period.

4. DATA ACQUISITION AND REDUCTION REQUIREMENTS

Instrumentation displays in the PBF Data Acquisition and Reduction System (PBF/DARS) will identify the fuel rod, test assembly, and plant instruments according to the identifiers in Table IX. Prior to each nuclear operation, it shall be verified that data are being recorded and that data are retrievable.

4.1 Data Acquisition Requirements

The data channels should be set to record the data based on the requirements of Table IX. Those instruments requiring high frequency recording will be set up to record on the DARS wide band channels or the E&A system. Those channels on the wide band recorders should also be recorded on the narrow bands. All of the narrow band DARS channels should be available for display on the Vector General. All those instruments which are designated as minimum operable instrumentation for the pre-transient phase of Test RIA 1-1 (Table VI) will be recorded on at least two independent systems of equivalent response to insure against the loss of data in the event that one data system becomes inoperable. The PBF/DARS will record data during the cold hydrostatic pressure check, the flow calibration, the heatup phases, during all nuclear operation, and be left on until the loop has been depressurized after the transient. The Surveillance System (SS) need not record data during heatup and 30 minutes after test termination unless requested by the TFBD ES&A representative. The wide band DARS and E&A System need not be turned on except for 2 minutes before and 28 minutes after the transient power burst. Figure 2 indicates the data channels which will be required to be displayed on the strip charts during power calibration and fuel conditioning and the transient phase. The display and recording requirements are subject to change at the discretion of the TFBD representative in case of instrument failure or unusual test behavior. The core neutron chamber ranges shown in Table IX are preliminary and should be set according to the expected peak power of the test. The upper range will be set to cover the power peak.

TABLE IX

TEST RIA 1-1 INSTRUMENT IDENTIFICATION, DATA CHANNEL RECORDING, AND DISPLAY REQUIREMENTS

Measurement	Instrument	Location	Rod Number	Identifier	Recording Ranges	Frequency Response Required
Fuel Rod						
Fuel Centerline Temperature	TC	0.79 m[a]	801-3	FUEL TMP 79 03	500 to 3000 K	High
Cladding Surface Temperature	TC	0.46 m - 0°	801-1	CLAD TMP 46-0 01	300 to 1100 K	High
Cladding Surface Temperature	TC	0.79 m - 180°	801-1	CLAD TMP 79-18001	300 to 1100 K	High
Cladding Surface Temperature	TC	0.46 m - 0°	801-3	CLAD TMP 46-0 03	300 to 1100 K	High
Cladding Surface Temperature	TC	0.79 m - 180°	801-3	CLAD TMP 79-18003	300 to 1100 K	High
Fuel Rod Pressure	Kaman 6.9 MPa PXD	Fuel Rod Plenum	801-1	ROD PRES 6.9KA 01	0 to 6.9 MPa	High
Fuel Rod Pressure	Kaman 6.9 MPa PXD	Fuel Rod Plenum	801-3	ROD PRES 6.9KA 03	0 to 6.9 MPa	High
Plenum Temperature	TC	Fuel Rod Plenum	801-3	PLNM TMP 03	300 to 1100 K	Normal
Test Train						
Shroud Coolant Flow	Flow Turbine	Lower Shroud Extension	801-1	FLOWRATE INLET 01	0 to 820 cm^3/s	Normal
Shroud Coolant Flow	Flow Turbine	Lower Shroud Extension	801-2	FLOWRATE INLET 02	0 to 820 cm^3/s	Normal
Shroud Coolant Flow	Flow Turbine	Lower Shroud Extension	801-3	FLOWRATE INLET 03	0 to 820 cm^3/s	Normal
Shroud Coolant Flow	Flow Turbine	Lower Shroud Extension	801-4	FLOWRATE INLET 04	0 to 820 cm^3/s	Normal
Coolant Pressure	EG&G 69 MPa PXD	Upper Test Assembly	-	SYS PRES 69EG UTT	0 to 69 MPa	Normal
Coolant Pressure	EG&G 17 MPa PXD	Upper Test Assembly	-	SYS PRES 17EG UTT	0 to 17 MPa	High
Shroud Pressure	Kaman 17 MPa PXD	Upper Test Assembly	801-1	SHRDPRES 17KA 01	0 to 17 MPa	High
Shroud Pressure	Kaman 17 MPa PXD	Upper Test Assembly	801-2	SHRDPRES 17KA 02	0 to 17 MPa	High
Shroud Pressure	Kaman 17 MPa PXD	Upper Test Assembly	801-3	SHRDPRES 17KA 03	0 to 17 MPa	High
Shroud Pressure	Kaman 17 MPa PXD	Upper Test Assembly	801-4	SHRDPRES 17KA 04	0 to 17 MPa	High
Coolant Inlet Temperature	TC	Lower Shroud Extension	801-1	INLT TMP 01	300 to 600 K (ss); 1000 K (tr)	Normal
Coolant Inlet Temperature	TC	Lower Shroud Extension	801-2	INLT TMP 02	300 to 600 K (ss); 1000 K (tr)	Normal
Coolant Inlet Temperature	TC	Lower Shroud Extension	801-3	INLT TMP 03	300 to 600 K (ss); 1000 K (tr)	Normal
Coolant Inlet Temperature	TC	Lower Shroud Extension	801-4	INLT TMP 04	300 to 600 K (ss); 1000 K (tr)	Normal
Coolant Outlet Temperature	TC	Upper Shroud Extension	801-1	OUT TEMP 01	300 to 600 K (ss); 1000 K (tr)	Normal
Coolant Outlet Temperature	TC	Upper Shroud Extension	801-2	OUT TEMP 02	300 to 600 K (ss); 1000 K (tr)	Normal
Coolant Outlet Temperature	TC	Upper Shroud Extension	801-3	OUT TEMP 03	300 to 600 K (ss); 1000 K (tr)	Normal
Coolant Outlet Temperature	TC	Upper Shroud Extension	801-4	OUT TEMP 04	300 to 600 K (ss); 1000 K (tr)	Normal
Coolant Temperature Rise	ΔT Pair	Top and Bottom of Shroud	801-1	DEL TEMP 01	0 to 20 K	Normal
Coolant Temperature Rise	ΔT Pair	Top and Bottom of Shroud	801-2	DEL TEMP 02	0 to 20 K	Normal
Coolant Temperature Rise	ΔT Pair	Top and Bottom of Shroud	801-3	DEL TEMP 03	0 to 20 K	Normal
Coolant Temperature Rise	ΔT Pair	Top and Bottom of Shroud	801-4	DEL TEMP 04	0 to 20 K	Normal
Cladding Axial Strain	LVDT	Lower End of Rod	801-1	CLAD DSP 01	-5 to 25 mm	High
Cladding Axial Strain	LVDT	Lower End of Rod	801-2	CLAD DSP 02	-5 to 25 mm	High
Cladding Axial Strain	LVDT	Lower End of Rod	801-3	CLAD DSP 03	-5 to 25 mm	High
Cladding Axial Strain	LVDT	Lower End of Rod	801-4	CLAD DSP 04	-5 to 25 mm	High
Neutron Flux No. 1	SPND	0.091 m Quadrant 1	-	NEUT FLX 9-01 TT	10^{-11} to 10^{-3} amps	High
Neutron Flux No. 2	SPND	0.274 m Quadrant 1	-	NEUT FLX 27-01 TT	10^{-11} to 10^{-3} amps	High
Neutron Flux No. 3	SPND	0.745 m Quadrant 1	-	NEUT FLX 46-01 TT	10^{-11} to 10^{-3} amps	High
Neutron Flux No. 4	SPND	0.640 m Quadrant 1	-	NEUT FLX 64-01 TT	10^{-11} to 10^{-3} amps	High
Neutron Flux No. 5	SPND	0.823 m Quadrant 1	-	NEUT FLX 82-01 TT	10^{-11} to 10^{-3} amps	High
Neutron Flux No. 6	SPND	0.091 m Quadrant 3	-	NEUT FLX 9-03 TT	10^{-11} to 10^{-3} amps	High
Neutron Flux No. 7	SPND	0.274 m Quadrant 3	-	NEUT FLX 27-03 TT	10^{-11} to 10^{-3} amps	High
Neutron Flux No. 8	SPND	0.457 m Quadrant 3	-	NEUT FLX 46-03 TT	10^{-11} to 10^{-3} amps	High
Neutron Flux No. 9	SPND	0.640 m Quadrant 3	-	NEUT FLX 64-03 TT	10^{-11} to 10^{-3} amps	High
Neutron Flux No. 10	SPND	0.823 m Quadrant 3	-	NEUT FLX 82-03 TT	10^{-11} to 10^{-3} amps	High
LVDT DC Thru Capacitors	LVDT	Lower End of Rod	801-1	LVDT DC 01	--	High
LVDT DC Thru Capacitors	LVDT	Lower End of Rod	801-2	LVDT DC 02	--	High
LVDT DC Thru Capacitors	LVDT	Lower End of Rod	801-3	LVDT DC 03	--	High
LVDT DC Thru Capacitors	LVDT	Lower End of Rod	801-4	LVDT DC 04	--	High
Shroud PXD DC Thru Capacitors	Kaman 17 MPa PXD	Upper Test Assembly	801-1	PXD DC 01	--	High
Shroud PXD DC Thru Capacitors	Kaman 17 MPa PXD	Upper Test Assembly	801-2	PXD DC 02	--	High
Shroud PXD DC Thru Capacitors	Kaman 17 MPa PXD	Upper Test Assembly	801-3	PXD DC 03	--	High
Shroud PXD DC Thru Capacitors	Kaman 17 MPa PXD	Upper Test Assembly	801-4	PXD DC 04	--	High

[a] All elevations are measured from lower end of fuel stack end.

TABLE IX (Continued)

TEST RIA 1-1 INSTRUMENT IDENTIFICATION, DATA CHANNEL RECORDING, AND DISPLAY REQUIREMENTS

Measurement	Instrument	Location	Rod Number	Identifier	Recording Ranges	Frequency Response Required
FPDS[a]						
Gross Gamma Rate	No. 1 Gamma Detector	FPDS	-	FP GAMMA NO.1 FP	10 to 10^6 counts/s	Normal
Gross Gamma Rate	No. 2 Gamma Detector	FPDS	-	FP GAMMA NO.2 FP	10 to 10^6 counts/s	Normal
Gross Gamma Rate	No. 3 Gamma Detector	FPDS		FP GAMMA NO.3 FP	10 to 10^6 counts/s	Normal
Gross Neutron Rate	Neutron Detector	FPDS	-	FP NEUT FP	10 to 10^6 counts/s	Normal
FPDS Flow Rate	No. 1 Flowmeter	FPDS	-	FP FLOW NO.1 FP	0 to 64 cm^3/s	Normal
FPDS Flow Rate	No. 2 Flowmeter	FPDS	-	FP FLOW NO.2 FP	0 to 64 cm^3/s	Normal
Pipe Temperature	Thermocouple	FPDS	-	FP TEMP PIPE FP	300 to 600 K (ss); 1000 K (tr)	Normal
Cubical Temperature	Thermocouple	FPDS	-	FP TEMP CUBICLFP	300 to 600 K (ss); 1000 K (tr)	Normal
Plant[b]						
NMS-3 (40 MW)	Ion Chamber	Plant	-	REAC POW 40NMS3PT	0 to 40 MW	Normal
PPS-1 (50 MW)	Ion Chamber	Plant	-	REAC POW 50PPS1PT	0 to 50 MW	High
PPS-2 (50 MW)	Ion Chamber	Plant	-	REAC POW 50PPS2PT	0 to 50 MW	High
PPS-2 (50000 MW)	Ion Chamber	Plant	-	REAC POW 50KPS2PT	0 to 50000 MW	High
PPS-3 (16 MW)	Ion Chamber	Plant	-	REAC POW 16PPS3PT	0 to 16 MW	High
PPS-3 (16000 MW)	Ion Chamber	Plant	-	REAC POW 16KPS3PT	0 to 16000 MW	High
PPS-4 (16 MW)	Ion Chamber	Plant	-	REAC POW 16PPS4PT	0 to 16 MW	High
PPS-4 (16000 MW)	Ion Chamber	Plant	-	REAC POW 16KPS4PT	0 to 16000 MW	High
TR-1 (50 MW)	Ion Chamber	Plant	-	REAC POW 50TR1PT	0 to 50 MW	High
TR-1 (500 MW)	Ion Chamber	Plant	-	REAC POW 500TR1PT	0 to 500 MW	High
TR-1 (5000 MW)	Ion Chamber	Plant	-	REAC POW 5KTR1PT	0 to 5000 MW	High
TR-1 (50000 MW)	Ion Chamber	Plant	-	REAC POW 50KTR1PT	0 to 50000 MW	High
TR-2 (50 MW)	Ion Chamber	Plant	-	REAC POW 50TR2PT	0 to 50 MW	High
TR-2 (500 MW)	Ion Chamber	Plant	-	REAC POW 500TR2PT	0 to 500 MW	High
TR-2 (5000 MW)	Ion Chamber	Plant	-	REAC POW 5KTR2PT	0 to 5000 MW	High
TR-2 (50000 MW)	Ion Chamber	Plant	-	REAC POW 50KTR2PT	0 to 50000 MW	High
EV-1 (50 MW)	Evacuation Chamber	Plant	-	REAC POW 50EV1PT	0 to 50 MW	High
EV-1 (500 MW)	Evacuation Chamber	Plant	-	REAC POW 500EV1PT	0 to 500 MW	High
EV-1 (5000 MW)	Evacuation Chamber	Plant	-	REAC POW 5KEV1PT	0 to 5000 MW	High
EV-1 (50000 MW)	Evacuation Chamber	Plant	-	REAC POW 50KEV1PT	0 to 50000 MW	High
EV-2 (50 MW)	Evacuation Chamber	Plant	-	REAC POW 50EV2PT	0 to 50 MW	High
EV-2 (500 MW)	Evacuation Chamber	Plant	-	REAC POW 500EV2PT	0 to 500 MW	High
EV-2 (5000 MW)	Evacuation Chamber	Plant	-	REAC POW 5KEV2PT	0 to 5000 MW	High
EV-2 (50000 MW)	Evacuation Chamber	Plant	-	REAC POW 50KEV2PT	0 to 50000 MW	High
System Pressure	PXD	Plant	-	SYS PRES PT	0 to 17 MPa	Normal
IPT Pressure	ΔP PXD	Plant	-	IPT DELP PT	0 to 0.69 MPa	Normal
Loop Flow	Venturi	Plant	-	LOOP FLO PT	0 to 0.063 m^3/s	Normal
Vessel Strain	Strain Gauge	Plant	-	VESTRAIN NO.1 PT	0 to 500 μ in/in	Normal
Vessel Strain	Strain Gauge	Plant	-	VESTRAIN NO.2 PT	0 to 500 μ in/in	Normal
Core Rod Axial Growth	Core LVDT No. 1	Plant	-	CLAD DSP CORE1 PT	± 12.7 mm	High
Core Rod Axial Growth	Core LVDT No. 2	Plant	-	CLAD DSP CORE2 PT	± 12.7 mm	High
Core Rod Axial Growth	Core LVDT No. 3	Plant	-	CLAD DSP CORE3 PT	± 12.7 mm	High
Loop Coolant Pressure	0 to 34 MPa PXD	Plant	-	LOOPPRES 5-20 PT	0 to 34 MPa	High
Loop Coolant Pressure	0 to 34 MPa PXD	Plant	-	LOOPPRES 5-21 PT	0 to 34 MPa	High
Loop Coolant Pressure	0 to 34 MPa PXD	Plant	-	LOOPPRES 5-22 PT	0 to 34 MPa	High
Loop Coolant Pressure	0 to 34 MPa PXD	Plant	-	LOOPPRES 5-23 PT	0 to 34 MPa	High
Loop Coolant Pressure	0 to 34 MPa PXD	Plant	-	LOOPPRES 5-24 PT	0 to 34 MPa	High
Loop Coolant Pressure	0 to 34 MPa PXD	Plant	-	LOOPPRES 5-25 PT	0 to 34 MPa	High
Loop Coolant Pressure	0 to 34 MPa PXD	Plant	-	LOOPPRES 5-34 PT	0 to 34 MPa	High
Loop Coolant Pressure	0 to 34 MPa PXD	Plant	-	LOOPPRES 5-35 PT	0 to 34 MPa	High
Loop Coolant Pressure	0 to 34 MPa PXD	Plant	-	LOOPPRES 5-36 PT	0 to 34 MPa	High
Core Pressure	0 to 34 MPa PXD	Plant		COREPRES W PT	0 to 34 MPa	High
Core Pressure	0 to 34 MPa PXD	Plant		COREPRES NE PT	0 to 34 MPa	High
Core Pressure	0 to 34 MPa PXD	Plant		COREPRES SE PT	0 to 34 MPa	High

[a] Fission Product Detection System (FPDS)

[b] The indicated ranges of the core neutron chambers are preliminary and may be changed at the discretion of the TFBD representative if necessary.

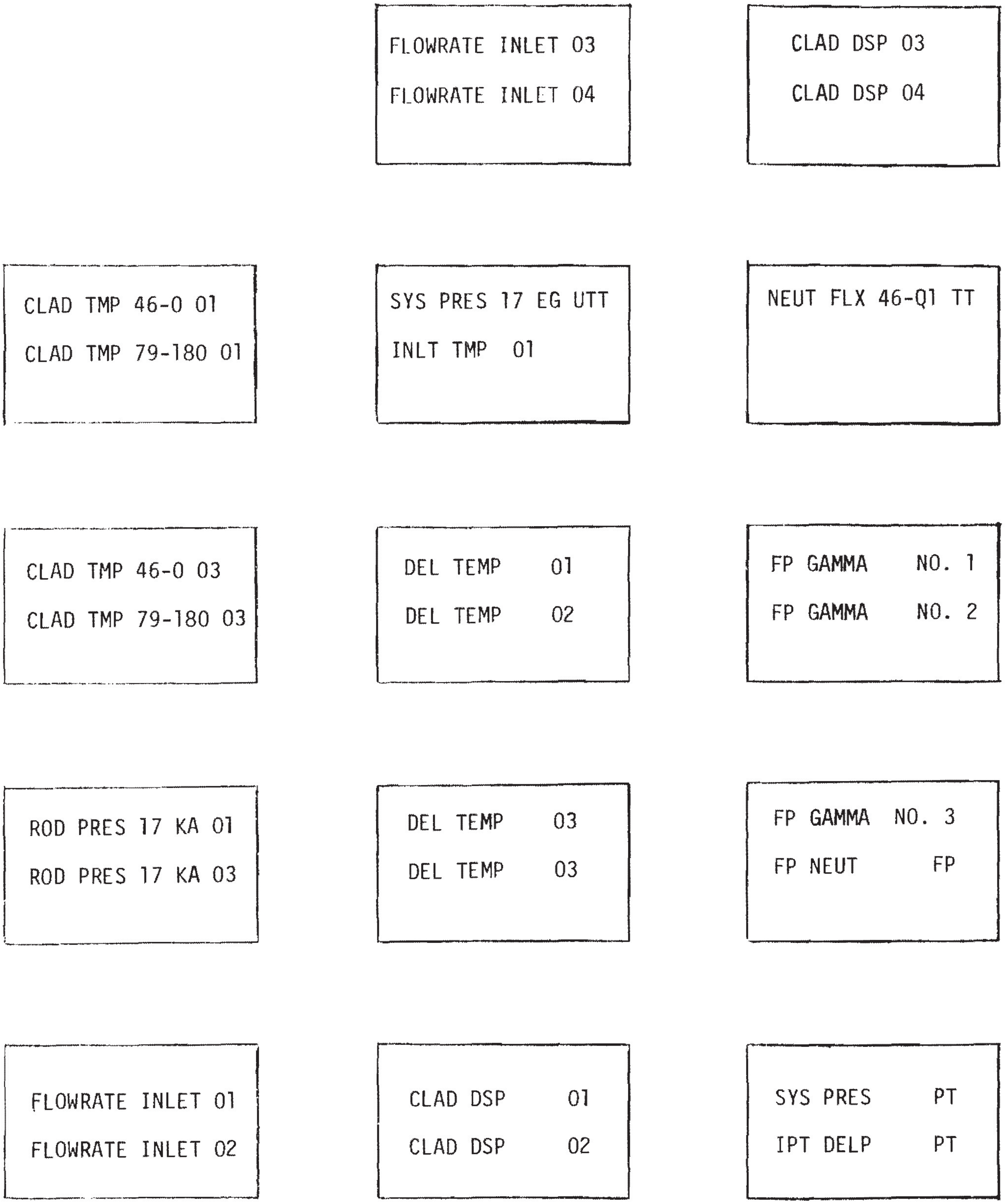

Fig. 2 Strip chart set-up for RIA 1-1 power calibration, conditioning, and transient phases.

4.2 Data Reduction Requirements

Data reduction and plotting requirements are separated into three segments below. The first segment concerns data reduction and plot requirements needed for the preparation of the RIA 1-1 Quick Look Report. The second concerns data reduction and presentation requirements for the Experimental Data Report and the third for the Test Results Report. Additional plotting requirements will be stipulated for the test analysis, based on test performance and posttest code analyses.

4.2.1 Quick Look Report. Test Data plots and data pretest calculation comparison plots for the Quick Look Report are to be prepared within 72 hours of the completion of the test. Due to the short time allocated for preparation of this document, it is mandatory that this requirement be met. The Quick Look Report will only contain plots of data from the transient portion of the test. That portion of the SPORT computer program required to compute reactor energy and reactivity as a function of time from the power history will be programmed into the PBF/DARS computer and the data processed through the program.

The plots generated will go directly into the Quick Look Report without redrawing or handling by graphics personnel. The plots size should conform to 8-1/2 x 11-inch paper with conventional margins. All plotted data are to be in standard SI units.

Table X lists the plots that are required for the Quick Look Report. Comparison plots showing FRAP-T calculations and corresponding data as a function of time are included. The FRAP-T calculations were previously performed and the output tapes are available for data system personnel use.

Digital printout of all the data from the reactor neutron detecting chambers (EV-1, EV-2, TR-1 and TR-2) and the SPNDs during the transient will be required. The logarithmic amplifiers for the SPNDs

TABLE X

PLOTS FOR RIA 1-1 QUICK LOOK REPORT

	VERTICAL AXIS		HORIZONTAL AXIS			
PLOT NO.	PARAMETER	RANGE	PARA-METER	RANGE	PAGE ORIEN-TATION	PERIOD OF TEST COVERED
1.	FUEL TMP 79 03	500 to 3000 K	TIME	30s	Horizontal	[a]
	FRAP-T Calc. Fuel Temp.	500 to 3000 K				
	Fuel Rod Energy	0 to 1600 J/g				
2.	CLAD TMP 46-0 01 & 03	500 to 2200 K	TIME	30s	Horizontal	[a]
	FRAP-T Calc. Clad Temp.	500 to 2100 K				
	Fuel Rod Energy	0 to 1600 J/g	TIME	30s	Horizontal	[a]
3.	CLAD TMP 79-18001 & 03	500 to 2000 K	TIME	30s	Horizontal	[a]
	FRAP-T Calc. Clad Temp.	500 to 2000 K	TIME	30s	Horizontal	[a]
4.	ROD PRES 6.9 KA 01	0 to 10.0 MPa	TIME	30s	Horizontal	[a]
	ROD PRES 6.9 KA 03	0 to 10.0 MPa				
	FRAP-T Calc. Rod Pres.	0 to 10.0 MPa				
	Fuel Rod Energy	0 to 1600 J/g				[a]
5.	PLNM TMP 03	500 to 1000 K	TIME	30s	Horizontal	
	FRAP-T Calc. Plenum Temp.	500 to 1000 K				
	Flowrate Inlet 03	0 to 200 cm^3/s				[a]
6.	CLAD DSP 01	0 to 20 mm	TIME	30s	Horizontal	
	CLAD DSP 02	0 to 20 mm				
	FRAP-T Calc. Clad Disp.	0 to 20 mm				
	Fuel Rod Energy	0 to 1600 J/g				[a]
7.	CLAD DSP 03	0 to 20 mm	TIME	30s	Horizontal	
	CLAD DSP 04	0 to 20 mm				
	FRAP-T Calc. Clad Disp.	0 to 20 mm				
	Fuel Rod Energy	0 to 1600 J/g				[b]
8.	SYS PRES 69EG UTT	0 to 70 MPa	TIME	1s	Horizontal	
	SYS PRES 17EG UTT	0 to 20 MPa				[b]
9.	REAC POW 50KTR1	0 to 50000 MW	TIME	1s	Horizontal	
	REAC POW 50KEV1	0 to 50000 MW				
	Fuel Rod Energy	0 to 1600 J/g				[b]
10.	SHRDPRES 17KA 01	0 to 20 MPa	TIME	1s	Horizontal	
	SHRDPRES 17KA 02	0 to 20 MPa				
	SHRDPRES 17KA 03	0 to 20 MPa				
	SHRDPRES 17KA 04	0 to 20 MPa				[a]
11.	FP GAMMA NO.1 FP	0 to 10000 cpm	TIME	30 min.	Horizontal	
	FP GAMMA NO.2 FP	0 to 10000 cpm				
	FP GAMMA NO.3 FP	0 to 10000 cpm				[a]
12.	FP NEUT FP	As Required	TIME	30 min.	Horizontal	
	FP FLOW NO.1 FP	As Required				
	FP FLOW NO.2 FP	As Required				

[a] Zero time on plot should correspond to time of peak power minus 1 second.
[b] Zero time on plot should correspond to time of peak power minus 100 milliseconds.

yield the log of the neutron-induced current. These data should be converted back to actual neutron induced currents and processed through the SPORT program.

4.2.2 Experiment Data Report. Data plots presented in the Test RIA 1-1 Experiment Data Report will be used by Experiment Specification and Analysis personnel in analyzing the test performance.

4.2.3 Test Results Report. The initial data reduction requirements for the Test Results Report are given in Tables XI and XII. Comparison plots of posttest FRAP-T calculations with experimental data as a function of fuel rod power will be required for the steady state portions of the test. Comparison plots of FRAP-T calculations with experimental data as a function of time during the transient will be required. The calculated energy deposition for each fuel rod as derived from the SPNDs shall also be plotted. All plots will be 1/2-page size - horizontal orientation. Further data reduction requirements for the Test Results Report are expected to evolve during the analysis of the test data. These requirements will be transmitted to the data system group as the need arises.

TABLE XI

PLOTS FOR RIA 1-1 TEST RESULTS REPORT - POWER CALIBRATION AND CONDITIONING PHASES

CHANNEL REPONSE HZ	VERTICAL AXIS PARAMETER	VERTICAL AXIS RANGE	HORIZONTAL AXIS PARAMETER	HORIZONTAL AXIS RANGE	CALCULATION COMPARISON INCLUDED
100	CLAD TMP 46-0 01	500 to 600 K	Average Rod Power (801-1)	0-50 kW/m	FRAP-T
100	CLAD TMP 79-18001	500 to 600 K	Average Rod Power (801-1)	0-50 kW/m	FRAP-T
100	FUEL TMP 79 03	500 to 2500 K	Average Rod Power (801-3)	0-50 kW/m	FRAP-T
100	CLAD TMP 46-0 02	500 to 600K	Average Rod Power (801-3)	0-50 kW/m	FRAP-T
100	CLAD TMP 79-18002	500 to 600K	Average Rod Power (801-3)	0.50 kW/m	FRAP-T
100	PLNM TMP 02	500 to 600K	Average Rod Power (801-3)	0-50 kW/m	FRAP-T
100	ROD PRES 6.9KA 01	0 to 7 MPa	Average Rod Power (801-1)	0-50 kW/m	FRAP-T
100	ROD PRES 6.9KA 03	0 to 7 MPa	Average Rod Power (801-3)	0.50 kW/m	FRAP-T
10	CLAD DSP 01	-0.02% to 0.2%	Average Rod Power (801-1)	0-50 kW/m	FRAP-T
10	CLAD DSP 02	-0.02% to 0.2%	Average Rod Power (801-3)	0-50 kW/m	FRAP-T
10	CLAD DSP 03	-0.02% to 0.2%	Average Rod Power (801-3)	0.50 kW/m	FRAP-T
10	CLAD DSP 04	-0.02% to 0.2%	Average Rod Power (801-4)	0.50 kW/m	FRAP-T
100	NEUT FLX 9-01 TT	0 to 160 nA	Average Rod Power (801-1)	0.50 kW/m	NO
100	NEUT FLX 27-01 TT	0 to 160 nA	Average Rod Power (801-1)	0.50 kW/m	NO
100	NEUT FLX 46-01 TT	0 to 160 nA	Average Rod Power (801-1)	0.50 kW/m	NO
100	NEUT FLX 64-01 TT	0 to 160 nA	Average Rod Power (801-1)	0.50 kW/m	NO
100	NEUT FLX 82-01 TT	0 to 160 nA	Average Rod Power (801-1)	0.50 kW/m	NO
100	NEUT FLX 9-03 TT	0 to 160 nA	Average Rod Power (801-3)	0.50 kW/m	NO
100	NEUT FLX 27-03 TT	0 to 160 nA	Average Rod Power (801-3)	0.50 kW/m	NO
100	NEUT FLX 46-03 TT	0 to 160 nA	Average Rod Power (801-3)	0.50 kW/m	NO
100	NEUT FLX 64-03 TT	0 to 160 nA	Average Rod Power (801-3)	0.50 kW/m	NO
100	NEUT FLX 82-03 TT	0 to 160 nA	Average Rod Power (801-3)	0.50 kW/m	NO
10	REAC POW 50TR1PT	0 to 30 mw	Average Rod Power (801-3)	0.50 kW/m	NO
10	REAC POW 50TR2PT	0 to 30 mw	Average Rod Power (801-3)	0.50 kW/m	NO
10	REAC POW 50EV1PT	0 to 30 mw	Average Rod Power (801-1)	0.50 kW/m	NO
10	REAC POW 50EV2PT	0 to 30 mw	Average Rod Power (801-3)	0.50 kW/m	NO
10	INLT TMP 03	300 to 600K	TIME	Test	NO
	SYSPRES 17 EG UTT	0 to 10 MPa	(Composite Plot on	Duration	
	FLOWRATE INLET 03	0 to 1000 cm^3/s	full page of report		
	AVERAGE ROD POWER (801-3)	0 to 50 kW/m			

TABLE XII

PLOTS FOR RIA 1-1 TEST RESULTS REPORT - TRANSIENT PHASE

	VERTICAL AXIS			HORIZONTAL AXIS		
CHANNEL REPONSE (HZ)	PARAMETER		RANGE	PARA-METER	TIME RANGE (s)	CALCULATION COMPARISON INCLUDED
5000	CLAD TMP	46-0 01	500 to 2200 K	TIME	0.50 [b]	FRAP-T
5000	CLAD TMP	46-0 01	500 to 2200 K	TIME	30.0 [c]	FRAP-T
5000	CLAD TMP	79-18001	500 to 2200 K	TIME	0.50 [b]	FRAP-T
5000	CLAD TMP	79-18001	500 to 2200 K	TIME	30.0 [c]	FRAP-T
5000	FUEL TMP	79 03	500 to 3000 K	TIME	0.50 [b]	FRAP-T
5000	FUEL TMP	79 03	500 to 3000 K	TIME	30.0 [c]	FRAP-T
5000	CLAD TMP	46-0 03	500 to 2200K	TIME	0.50 [b]	FRAP-T
5000	CLAD TMP	46-0 03	500 to 2200K	TIME	30.0 [c]	FRAP-T
5000	CLAD TMP	79-18003	500 to 2200K	TIME	0.50 [b]	FRAP-T
5000	CLAD TMP	79-18003	500 to 2200K	TIME	30.0 [c]	FRAP-T
5000	ROD PRES	6.9KA 01	0 to 7 MPa	TIME	0.50 [b]	FRAP-T
5000	ROD PRES	6.9KA 01	0 to 7 MPa	TIME	30.0 [c]	FRAP-T
5000	ROD PRES	6.9KA 03	0 to 10 MPa	TIME	0.50 [b]	FRAP-T
5000	ROD PRES	6.9KA 03	0 to 10 MPa	TIME	30.0 [c]	FRAP-T
5000	PLNM TMP	03	500 to 1000K	TIME	0.50 [b]	FRAP-T
5000	CLAD DSP	01	0 to 3%	TIME	0.50 [b]	FRAP-T
5000	CLAD DSP	01	0 to 3%	TIME	30.0 [c]	FRAP-T
5000	CLAD DSP	02	0 to 3%	TIME	0.50 [b]	FRAP-T
5000	CLAD DSP	02	0 to 3%	TIME	30.0 [c]	FRAP-T
20000	CLAD DSP	03	0 to 3%	TIME	0.50 [b]	FRAP-T
20000	CLAD DSP	03	0 to 3%	TIME	30.0 [c]	FRAP-T
5000	CLAD DSP	04	0 to 3%	TIME	0.50 [b]	FRAP-T
5000	CLAD DSP	04	0 to 3%	TIME	0.50 [c]	FRAP-T
20000	SYS PRES	69EG UTT	0 to 30 MPa	TIME	0.50 [b]	NO
20000	SYS PRES	17EG UTT	0 to 20 MPa	TIME	0.50 [b]	NO
20000	SHRDPRES	17KA 03	0 to 15 MPa	TIME	0.50 [b]	NO
5000	REAC PWR	50KEV1PT	0 to 5000 MW	TIME	0.50 [b]	NO
5000	REAC PWR	50KEV2PT	0 to 5000 MW	TIME	0.50 [b]	NO
5000	REAC PWR	50KTR1PT	0 to 5000 MW	TIME	0.50 [b]	NO
5000	REAC PWR	50KTR2PT	0 to 5000 MW	TIME	0.50 [b]	NO
100	FLOWRATE INLET	01	0 to 200 cm^3/s	TIME	0.50 [b]	RELAP4
100	FLOWRATE INLET	01	0 to 200 cm^3/s	TIME	30.0 [c]	RELAP4
100	FLOWRATE INLET	02	0 to 200 cm^3/s	TIME	0.50 [b]	RELAP4
100	FLOWRATE INLET	02	0 to 200 cm^3/s	TIME	30.0 [c]	RELAP4
100	FLOWRATE INLET	03	0 to 200 cm^3/s	TIME	0.50 [b]	RELAP4
100	FLOWRATE INLET	03	0 to 200 cm^3/s	TIME	30.0 [c]	RELAP4
100	FLOWRATE INLET	04	0 to 200 cm^3/s	TIME	0.50 [b]	RELAP4
100	FLOWRATE INLET	04	0 to 200 cm^3/s	TIME	30.0 [c]	RELAP4
10	INLET TMP	01	300 to 600 K	TIME	30.0 [c]	NO
10	INLET TMP	02	300 to 600 K	TIME	30.0 [c]	NO
10	INLET TMP	03	300 to 600 K	TIME	30.0 [c]	NO
10	INLET TMP	04	300 to 600 K	TIME	30.0 [c]	NO
10	OUT TEMP	01	300 to 600 K	TIME	30.0 [c]	NO
10	OUT TEMP	02	300 to 600 K	TIME	30.0 [c]	NO
10	OUT TEMP	03	300 to 600 K	TIME	30.0 [c]	NO
10	OUT TEMP	04	300 to 600 K	TIME	30.0 [c]	NO
5000	NEUT FLX	9-03 TT	0 to 0.5 ma	TIME	0.50 [b]	NO
5000	NEUT FLX	27-03 TT	0 to 0.5 ma	TIME	0.50 [b]	NO
5000	NEUT FLX	46-03 TT	0 to 0.5 ma	TIME	0.50 [b]	NO
5000	NEUT FLX	64-03 TT	0 to 0.5 ma	TIME	0.50 [b]	NO
5000	NEUT FLX	82-03 TT	0 to 0.5 ma	TIME	0.50 [b]	NO

[a] Each plot should also include fuel rod energy (0-1600 J/g) on right veritcal axis and selected parameter on left vertical axis.

[b] Zero time on plot should correspond to time of peak power minus 50 milliseconds.

[c] Zero time on plot should correspond to time of peak power minus 200 milliseconds.

5. POSTTEST OPERATIONS SUPPORT

Before the test and following each cooldown, two loop water samples will be taken for chemical and fission product analysis. One sample should be analyzed for nitrogen, oxygen, and hydrogen and the other sent to the TRA counting laboratory for fission product and uranium analysis.

Table XIII lists the fission product inventory and the total activity (R/hr) at 30.5 cm distance, in air, from the fuel rods at various times after nuclear operation. Scheduling of the disassembly of the test train in the canal will depend on worker safety limits and the data in Table XIII. The calculations presented are based on expected power operation. Deviations between the planned and actual power histories may require recalculation of the activity levels and fission product inventories. The TRA hot cell has a current acceptance limit of 10^{-2} curies of I^{131} per fuel rod. Efforts are being made to increase this limit. According to Table XIII, intact fuel rods can be shipped within 84 days after the final shutdown of Test RIA 1-1. Fuel rods that fail during testing may be shipped within one week after the test is completed.

It is anticipated that the fuel rod cladding will be heavily oxidized and in an embrittled condition. Therefore, posttest handling, shipment, and storage should be performed as carefully as possible to minimize further fuel rod damage. Disassembly should be performed with the test train in a vertical position, if possible.

The cladding thermocouple and internal pressure transducer leads should be cut about 25 to 50 mm above the upper end plug. The fuel thermocouple and plenum thermocouple leads should be cut 25 to 50 mm above the gas seal in each lead.

Closure plugs should be installed on the upper and lower ends of each flow shroud after removal from the test assembly to prevent

TABLE XIII

RADIOLOGICAL PARAMETERS APPLICABLE TO RIA 1-1 ROD AFTER PBF TESTING[a]

	DECAY TIMES							
Isotope	1d	7d	28d	56d	63d	70d	77d	84d
I-131 (Ci)	6.2	5.3	0.88	0.08	0.043	0.024	1.29×10^{-2}	7.1×10^{-3}
I-132 (Ci)	19.2	5.3	0.06	1.5×10^{-4}	3.5×10^{-4}	7.8×10^{-6}	1.8×10^{-6}	4×10^{-7}
I-133 (Ci)	11.1	0.10	6×10^{-9}	neg.	neg.	neg.	neg.	neg.
I-134 (Ci)	1×10^{-7}	neg.	neg.	neg.	neg.	neg.	neg.	neg.
I-135 (Ci)	0.08	3×10^{-8}	neg.	neg.	neg.	neg.	neg.	neg.
						5.25	4.68	4.23
						13.9	12.4	11.3
Total Fission Product (Ci)	216.2	75	16.6	6.95	5.98	5.25	4.68	4.23
R/hr at 30.5 cm	425	165	43	18.3	15.7	13.9	12.4	11.3

[a] These valves do not include the irradiation in the Saxton Reactor. Calculated I-131 content from Saxton irradiation is zero. Two years after irradiation in the Saxton reactor had terminated, the gamma-beta activity was 90 R/hr at a distance of 30.5 cm in air.

further loss of material from failed fuel rods during handling and shipment to the hot cell. The test train will be reused in Test RIA 1-2.

6. PIE REQUIREMENTS

The flow shrouds for Rods 801-1, 801-2, 801-3 and 801-5 should be split into two pieces to facilitate fuel rod removal. Care should be taken to retain all fuel particles during disassembly. The planned postirradiation examination (PIE) for Test RIA 1-1 consists of the following:

(1) A gamma scan and nvt determination of the 0.51% cobalt - 99.49% aluminum flux wires for Rods 801-1 through 801-4, and the 100% cobalt flux wires for Rods 801-1, 801-2, 801-3, and 801-5. Each wire will be tagged to identify Test No., fuel rod number, test phase, and bottom end of wire.

(2) A gamma scan and nvt determination of the 100% cobalt flux wires inserted in the core region. Each flux wire will be cut to 1.22 m length. Each flux wire will be tagged to identify Test No., irradiation time, and bottom end of wire.

(3) The visual, dimensional, and photographic examination of Rods 801-1 through 801-5. All remaining fragments of failed fuel rods should be weighed for each rod.

(4) A leak check of all rods if cladding failure is not obvious.

(5) The posttest measurement of the void volume and internal gas pressure and gas analysis of Rods 801-1, 801-2, 801-3, and 801-5 if cladding failure did not occur.

(6) A spectral gamma scan of Rod 801-2 and 801-5.

(7) The neutron radiography of Rods 801-1, 801-2, 801-3, and 801-5.

(8) The fission product analysis of five samples each from Rod 801-4 and 801-5 to determine burnup in terms of fissions per gram of uranium. The locations will be determined after visual examination of the fuel rods. Each sample will be tagged to identify fuel rod number and axial location of sample.

(9) The preparation of twenty metallurgical mounts from Rods 801-1, 801-2, 801-3, 801-4, and 801-5. The location of each of the metallurgical samples will be specified after posttest visual and photographic examination is completed.

(10) The preparation of two samples for scanning electron microscope (SEM) examination (one each from two rods to be specified later).

(11) The analysis and documentation of fuel and cladding structure and estimation of maximum temperatures for each metallurgical sample.

(12) The analysis and documentation of SEM examination of cladding fracture surface.

(13) A special examination including one microprobe sample and four cladding gas samples.

7. REFERENCES

1. L. B. Thompson, D. L. Hagrman, P. E. MacDonald, Light-Water Reactor Fuel Behavior Program Description: RIA Fuel Behavior Experiment Requirements, RE-S-76-187 (October 1976).

2. Z. R. Martinson, RIA 1-1 Experiment Specification Document, TFBP-TR-202 (June 1977).

APPENDIX A

STATUS CHECK LISTS FOR INSTRUMENTATION

The check lists provided in this appendix are to be incorporated in the RIA 1-1 Experiment Operating Procedure.

INSTRUMENT STATUS CHECKS

Check List No. 1

TRA Assembly Area

This check list is found in "Instrument Check Procedure", TR-RIA-1101.

Check List No. 2

Pre-In pile Tube Loading

This check list is found in "Instrument Checkout Procedure", TP-RIA-1102.

HEATUP INSTRUMENT STATUS

Check List No. 3

Reactor Power	- 0.0 MW	Minimum required operable instrumentation available for RIA 1-1 EOS
Plant IPT Coolant Temperature	450 K	
Heise Gauge	3.45 ± 0.14 MPa	__________ Instrument Data Section representative
Shroud Flow Rate	500 ± 15 cm^3/s	__________ TFBD representative in charge

Instrument Identifier	PBF/DARS Reading	Required Range	Certification Instrument is within Range[a]
FUEL TMP 79 03	________ K	420 to 480 K	________
CLAD TMP 46-0 01	________ K	430 to 470 K	________
CLAD TMP 79-18001	________ K	430 to 470 K	________
CLAD TMP 46-0 03	________ K	430 to 470 K	________
CLAD TMP 79-18003	________ K	430 to 470 K	________
ROD PRES 6.9KA 03	________ MPa	0 to 1.0 MPa	________
ROD PRES 6.9KA 01	________ MPa	0 to 1.0 MPa	________
PLNM TMP 03	________ K	430 to 470 K	Not Required
SYS PRES 69EG UTT	________ MPa	± 3.5 MPa of Heise	________
SYS PRES 17KA UTT	________ MPa	± 1 MPa of Heise	________
SYS PRES 17SCHUTT	________ MPa	± 1 MPa of Heise	________
FLOWRATE INLET 01	________ cm^3/s	500 ± 15 cm^3/s	________
FLOWRATE INLET 02	________ cm^3/s	500 ± 15 cm^3/s	________
FLOWRATE INLET 03	________ cm^3/s	500 ± 15 cm^3/s	________
FLOWRATE INLET 04	________ cm^3/s	500 ± 15 cm^3/s	________
CLAD DSP 01	________ mm	-6.4 to -3.8mm	________
CLAD DSP 02	________ mm	-6.4 to -3.8mm	________
CLAD DSP 03	________ mm	-6.4 to -3.8mm	________
CLAD DSP 04	________ mm	-6.4 to -3.8mm	________
INLT TMP 01	________ K	440 to 460K	________
INLT TMP 02	________ K	440 to 460K	________
INLT TMP 03	________ K	440 to 460K	________
INLT TMP 04	________ K	440 to 460K	________

OUT TEMP	01	______	K	440 to 460K	______
OUT TEMP	02	______	K	440 to 460K	______
OUT TEMP	03	______	K	440 to 460K	______
OUT TEMP	04	______	K	440 to 460K	______
SHRD PRES	17KA 01	______	MPa	$\pm$ 1MPa of Heise	______
SHRD PRES	17KA 02	______	MPa	$\pm$ 1MPa of Heise	______
SHRD PRES	17KA 03	______	MPa	$\pm$ 1MPa of Heise	______
SHRD PRES	17KA 04	______	MPa	$\pm$ 1MPa of Heise	______
DEL TEMP	01	______	K	$\pm$ 1.6K	______
DEL TEMP	02	______	K	$\pm$ 1.6K	______
DEL TEMP	03	______	K	$\pm$ 1.6K	______
DEL TEMP	04	______	K	$\pm$ 1.6K	______
NEUT FLX	9-01	______	Ω	IR $>10^8\ \Omega$	______
NEUT FLX	27-01	______	Ω	IR $>10^8\ \Omega$	______
NEUT FLX	46-01	______	Ω	IR $>10^8\ \Omega$	______
NEUT FLX	64-01	______	Ω	IR $>10^8\ \Omega$	______
NEUT FLX	82-01	______	Ω	IR $>10^8\ \Omega$	______
NEUT FLX	9-03	______	Ω	IR $>10^8\ \Omega$	______
NEUT FLX	27-03	______	Ω	IR $>10^8\ \Omega$	______
NEUT FLX	46-03	______	Ω	IR $>10^8\ \Omega$	______
NEUT FLX	64-03	______	Ω	IR $>10^8\ \Omega$	______
NEUT FLX	82-03	______	Ω	IR $>10^8\ \Omega$	______

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[a] This certification must be signed by the Supervisor of the Instrumentation and Data Section or his alternate. For instruments not within range the Supervisor of the Test Train Fabrication Section or his alternate must certify that the instrument is not functioning. For all cases where the instruments are not within range the RIA Projects Leaders or his alternate approval must be obtained to continue the test procedures.

PRE-POWER CALIBRATION INSTRUMENT STATUS

Check List No. 4

Reactor Power	- 0.0 MW	Minimum required operable instrumentation available for RIA 1-1 EOS
Plant IPT Coolant Temperature	538 ± 1K	
Heise Gauge Pressure	6.45 ± 0.14 MPa	________ Instrument Data Section representative
Shroud Flow Rate	760 ± 15 cm^3/s	________ TFBD representative in charge

Instrument Identifier	PBF/DARS Reading	Required Range	Certification Instrument is within Range [a]
FUEL TMP 79C/L 03	________ K	512 to 564K	________
CLAD TMP 46-0 01	________ K	522 to 554 K	________
CLAD TMP 79-18001	________ K	522 to 554 K	________
CLAD TMP 46-0 03	________ K	522 to 554K	________
CLAD TMP 79-18003	________ K	522 to 554K	________
ROD PRES 6.9KA 01	________ MPa	0 to 1 MPa	________
ROD PRES 6.9KA 03	________ MPa	0 to 1 MPa	________
PLNM TMP 03	________ K	522 to 554K	Not Required
SYS PRES 69EG UTT	________ MPa	± 3.5 MPa of Heise	________
SYS PRES 17KA UTT	________ MPa	± 1 MPa of Heise	________
SYS PRES 17SCHUTT	________ MPa	± 1 MPa of Heise	________
FLOWRATE INLET 01	________ cm^3/s	745 to 775 cm^3/s	________
FLOWRATE INLET 02	________ cm^3/s	745 to 775 cm^3/s	________
FLOWRATE INLET 03	________ cm^3/s	745 to 775 cm^3/s	________
FLOWRATE INLET 04	________ cm^3/s	745 to 775 cm^3/s	________
CLAD DSP 01	________ mm	-6.2 to -3.6mm	________
CLAD DSP 02	________ mm	-6.2 to -3.6mm	________
CLAD DSP 03	________ mm	-6.2 to -3.6mm	________
CLAD DSP 04	________ mm	-6.2 to -3.6mm	________
INLT TMP 01	________ K	528 to 548K	________
INLT TMP 02	________ K	528 to 548K	________
INLT TMP 03	________ K	528 to 548K	________
INLT TMP 04	________ K	528 to 548K	________
OUT TEMP 01	________ K	528 to 548K	________

OUT TEMP 02	____________K	528 to 548K	____________
OUT TEMP 03	____________K	528 to 548K	____________
OUT TEMP 04	____________K	528 to 548K	____________
SHRD PRES 17 KA 01	____________MPa	$\pm$ 1MPa of Heise	____________
SHRD PRES 17 KA 02	____________MPa	$\pm$ 1MPa of Heise	____________
SHRD PRES 17 KA 03	____________MPa	$\pm$ 1MPa of Heise	____________
SHRD PRES 17 KA 04	____________MPa	$\pm$ 1MPa of Heise	____________
DEL TEMP 01	____________K	$\pm$ 1.6K	____________
DEL TEMP 02	____________K	$\pm$ 1.6K	____________
DEL TEMP 03	____________K	$\pm$ 1.6K	____________
DEL TEMP 04	____________K	$\pm$ 1.6K	____________
NEUT FLX 9-01	____________Ω	IR $>10^8\,\Omega$	____________
NEUT FLX 27-01	____________Ω	IR $>10^8\,\Omega$	____________
NEUT FLX 46-01	____________Ω	IR $>10^8\,\Omega$	____________
NEUT FLX 64-01	____________Ω	IR $>10^8\,\Omega$	____________
NEUT FLX 82-01	____________Ω	IR $>10^8\,\Omega$	____________
NEUT FLX 9-03	____________Ω	IR $>10^8\,\Omega$	____________
NEUT FLX 29-03	____________Ω	IR $>10^8\,\Omega$	____________
NEUT FLX 46-03	____________Ω	IR $>10^8\,\Omega$	____________
NEUT FLX 64-03	____________Ω	IR $>10^8\,\Omega$	____________
NEUT FLX 82-03	____________Ω	IR $>10^8\,\Omega$	____________

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PRE-TRANSIENT INSTRUMENT STATUS

Check List No. 5

Reactor Power	- 0.0 MW	Minimum required operable instrumentation available for RIA 1-1 EOS
Plant IPT Coolant Temperature	538 ± 1 K	
Heise Gauge Pressure	6.45 ± 0.14 MPa	________ Instrument Data Section representative
Shroud Flow Rate	760 ± 15 cm^3/s	________ TFBD representative in charge

Instrument Identifier	PBF/DARS Reading	Required Range	Certification Instrument is within Range[a]
FUEL TMP 79C/L 03	________K	512 to 564K	________
CLAD TMP 46-0 01	________K	522 to 554K	________
CLAD TMP 79-180 01	________K	522 to 554K	________
CLAD TMP 46-0 03	________K	522 to 554K	________
CLAD TMP 79-180 03	________K	522 to 554K	________
ROD PRES 6.9 KA 01	________MPa	0 to 1 MPa	________
ROD PRES 6.9 KA 03	________MPa	0 to 1 MPa	________
PLNM TMP 03	________K	522 to 554K	Not Required
SYS PRES 69 EG UTT	________MPa	± 3.5 MPa of Heise	________
SYS PRES 17 KA UTT	________MPa	± 1 MPa of Heise	________
SYS PRES 17 SCHUTT	________MPa	± 1 MPa of Heise	________
FLOWRATE INLET 01	________cm^3/s	745 to 775 cm^3/s	________
FLOWRATE INLET 02	________cm^3/s	745 to 775 cm^3/s	________
FLOWRATE INLET 03	________cm^3/s	745 to 775 cm^3/s	________
FLOWRATE INLET 04	________cm^3/s	745 to 775 cm^3/s	________
CLAD DSP 01	________mm	-6.2 to -3.6mm	________
CLAD DSP 02	________mm	-6.2 to -3.6mm	________
CLAD DSP 03	________mm	-6.2 to -3.6mm	________
CLAD DSP 04	________mm	-6.2 to -3.6mm	________
INLT TMP 01	________K	528 to 548K	________
INLT TMP 02	________K	528 to 548K	________
INLT TMP 03	________K	528 to 548K	________
INLT TMP 04	________K	528 to 548K	________
OUT TEMP 01	________K	528 to 548K	________

OUT TEMP 02	________K	528 to 548K	________
OUT TEMP 03	________K	528 to 548K	________
OUT TEMP 04	________K	528 to 548K	________
SHRD PRES 17 KA 01	________MPa	$\pm$ 1MPa of Heise	________
SHRD PRES 17 KA 02	________MPa	$\pm$ 1MPa of Heise	________
SHRD PRES 17 KA 03	________MPa	$\pm$ 1MPa of Heise	________
SHRD PRES 17 KA 04	________MPa	$\pm$ 1MPa of Heise	________
DEL TEMP 01	________K	$\pm$ 1.6K	________
DEL TEMP 02	________K	$\pm$ 1.6K	________
DEL TEMP 03	________K	$\pm$ 1.6K	________
DEL TEMP 04	________K	$\pm$ 1.6K	________
NEUT FLX 9-01	________Ω	IR $>10^8$ Ω	________
NEUT FLX 27-01	________Ω	IR $>10^8$ Ω	________
NEUT FLX 46-01	________Ω	IR $>10^8$ Ω	________
NEUT FLX 64-01	________Ω	IR $>10^8$ Ω	________
NEUT FLX 82-01	________Ω	IR $>10^8$ Ω	________
NEUT FLX 9-03	________Ω	IR $>10^8$ Ω	________
NEUT FLX 29-03	________Ω	IR $>10^8$ Ω	________
NEUT FLX 46-03	________Ω	IR $>10^8$ Ω	________
NEUT FLX 64-03	________Ω	IR $>10^8$ Ω	________
NEUT FLX 82-03	________Ω	IR $>10^8$ Ω	________
Fission Product Detection System	Operable/not operable	Operable	________

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