

NUCLEAR ENGINEERING SCIENCES DEPARTMENT
Nuclear Reactor Facility
University of Florida



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June 9, 1988
Final Report
Safety Channel 1 Circuit Failure

Nuclear Regulatory Commission
Suite 2900
101 Marietta Street, N.W.
Atlanta, Georgia 30323

Attention: J. Nelson Grace
Regional Administrator, Region II

Re: University of Florida Training Reactor
Facility License: R-56, Docket No. 50-83

Gentlemen:

Pursuant to the reporting requirements of paragraph 6.6.2(3)(c) of the UFTR Technical Specifications, a description of a potential abnormal occurrence as defined in the UFTR Technical Specifications, Chapter 1 was previously described in an interim 14-day report dated April 25, 1988 to include NRC notification, occurrence scenario, corrective action and evaluation as well as current status of the system. This transmittal is intended to constitute a final report on the occurrence. The potential promptly reportable occurrence involved the recurrence of failure of the Safety Channel #1 circuit to provide proper power indication for several seconds on April 9, 1988 after the return to normal operations on April 1, 1988 following the previous failures on March 15 and 16, 1988 (the latter during a test prior to return to normal operations) per previous report dated March 28, 1988.

NRC Notification

The Executive Committee of the Reactor Safety Review Subcommittee reviewed this latest occurrence on April 11, 1988 and concluded that it is a potential abnormal occurrence as defined in UFTR Technical Specifications, Chapter 1 following NRC notification as per Section 6.6.2 of the UFTR Tech Specs earlier on the same day. This notification was carried out by both telephone to Mr. Paul Burnett and a following telecopy on April 11, 1988. In addition to several discussions to update Mr. Burnett on 11 April 1988, later conversations with Mr. Robert Carroll and Mr. Paul Frederickson of Projects have kept Region II apprised of reactor status including staged restart with extra monitors installed which occurred on April 25-27 and subsequent UFTR return to normal operations with an extra staff member monitoring Safety Channels for all operations until registering 10 hours compensated operation above 50 kw and finally a return to normal monitoring conditions on May 10, 1988 (implemented on May 23, 1988) with a caution memorandum issued to operators to make them aware that no root cause has been found for the Safety Channel failure (Attachment I).

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Initial Event Scenario

At 1209 on April 9, 1988, with a Reactor Operations Laboratory class (ENU-5176L) in progress with power increasing at ~75% power, Safety Channel 1 failed to the bottom meter stop. G.W. Fogle, reactor operator at the controls, noted that the indications on Safety Channel 2, the log pen recorder, the wide range indicator and other indicators were all normal and commenced a reactor shutdown while notifying the SRO on call who concurred. As power reduction began, Safety Channel 1 returned to normal indication as with the previous failures on March 15 and March 16, 1988. Again the subjective evaluation was that the return was not instantaneous, but the meter returned to normal indication relatively slowly over several seconds (i.e., not as if switched on, but rather as if recovering from an electrical transient). The shutdown was completed with all instruments responding normally at 1210 with the reactor secured at 1214.

Corrective Action Plan

For the first occurrence the reactor had been put on administrative shutdown and the full RSRS had met on March 22, 1988 with this event as one item on its agenda. All agreed the situation was being addressed properly although the exact cause of the event had not yet been identified. Via a series of troubleshooting and corrective maintenance activities, the problem was isolated to involve the fission chamber, preamp or connections shown in Attachment II which is Figure 1-8 of the UFTR Safety Analysis Report. There was a strong possibility that cleaning connectors on these components had corrected the problem per conversations with one vendor and concurred with by two UFTR personnel familiar with such instrumentation behavior. As a result, the UFTR was returned to normal operation on 1 April 1988 following completion of an approved special test procedure. It should be noted that failed noise suppression feedback capacitors have been replaced in both Safety Channels (originally thought to be the cause of SC-1 failure) but these were not at fault for the current failure and, in failed state, have negligible impact on circuit operations because this is a DC amplifier where the feedback coefficient is set by a precision resistor. Such a failure could have occurred anytime since console installation.

The immediate indications this time were the same as for the previous occurrences - namely, that an intermittent fault had developed in the circuitry for Safety Channel 1 (part of the wide range drawer) but not in any other section of the wide range drawer. With the reactor secured, Maintenance Log Page #88-14 was initiated to investigate and control correction of this failure recurrence. Although another series of checks was performed, again no root cause could be identified.

The recurrence of the Safety Channel 1 failure on April 9, 1988, following about a week of normal operation including 9.65 hours of operation above 50 kw indicates that the Safety Channel 1 fault is intermittent and not isolatable by the usual test methods of investigation. Therefore, a new program was developed to isolate and correct the cause of the failure; each potential problem is to be dealt with in a systematic manner followed by a retest and special monitoring period prior to restoring the reactor to normal unrestricted operation. Corrective actions as well as actions to expedite fault isolation are to be taken during each of three possible major steps in the maintenance program. Therefore, the following program was implemented (per isolation of the fault to the connections, preamplifier or fission chamber shown in Attachment II, Figure 1-8 of UFTR SAR) to isolate and correct the fault in Safety Channel 1 with the reactor to be restored to normal operations whenever the test program is successful for each of the following three (3) steps:

1. Attempt to isolate the intermittent failure as external to the console by interchanging SC-1 and SC-2 linear amplifier circuits and change out connectors on the wide range drawer and on the preamplifier cables to the wide range drawer. A crimp type connector will be used to replace one clamp type connector; this modification is considered a possible fix for the failure while the interchange of amplifiers is only considered an aid to fault isolation should the failure recur.
2. Replace the preamplifier with one equivalent to that presently in use at the UFTR according to the vendor except that the replacement item uses one cable connection for the pulsed and the current instruments while the currently installed preamplifier uses two. This will require a 10 CFR 50.59 evaluation to bring both signal lines to a single connector, but is not expected to present any significant difficulties technically or administratively.
3. Replace the fission chamber and its cables/cable connections. The fission chamber (previously, model RSN-314-L2552) is a standard item, but not stocked by the current vendor General Electric which requires 30 to 60 days lead time. Efforts are currently underway to obtain a detector from another source within the Department of Energy.

Evaluation

Except during the transient, the functions of indication and trip were not inhibited or changed; that is, there was only a temporary loss of indication and trip function in Safety Channel #1. The impact of this failure on system operation is minimized because it occurs for only a few seconds.

This Safety Channel #1 Circuit failure is potentially a promptly reportable occurrence per UFTR Technical Specifications, Section 6.6.2 delineating requirements for Special Reports where Paragraph (3)(c) states certain safety system failures are promptly reportable. Specifically, a special report is needed for a "reactor safety system malfunction that renders the reactor safety system incapable of performing its intended safety function, unless the malfunction or condition is discovered during maintenance tests or periods of reactor shutdowns" or involves components or systems in addition to those required by Tech Specs.

Similarly one definition of Abnormal Occurrences for the UFTR in Tech Specs Section 1.0 is "a malfunction of a safety system component or other component or system malfunction that could, or threatens to, render the (safety) system incapable of performing its intended safety function." Since Reactor Safety System is also defined in Tech Specs Section 1.0 to be "a combination of measuring channels and associated circuitry that forms the automatic protective action to be initiated, or provides information which requires the initiation of manual protective action," the initial and later occurrences of this event may not be strictly required to be promptly reported.

Basically, this event was considered to have no direct impact on safety and not to impact the health and safety of the public. However, the event was reported promptly on April 11, 1988 and later supported by the RSRS recommendation on the same day since there was at least a partial failure of the safety system. Nevertheless, safety implications are negligible since Safety Channel #2 was always operable and Safety Channel #1 was only lost for a few seconds.

Corrective Action - Current Status

The special test procedure contained in the April 25 Interim Report was used to control restart in March following the first occurrence. Except for an occasion when a monitoring connector slipped off necessitating a shutdown to reconnect the device, the original monitored restart on 31 March 1988 was uneventful with all systems responding properly with no recurrence of the Safety Channel circuit failure. After removing the monitoring instrumentation and performing a daily checkout during which a spurious noise-induced period trip signal due to wires laying on the preamp was corrected by securing the wires, a final run at full power with no special monitoring instrumentation was conducted as the final requirement prior to the first return to normal operations. All systems functioned normally for this run also so with concurrence by the RSRS (previously granted per the test procedure but reverified) and with NRC Region II verbal notification via telephone conversation with Paul Burnett, the UFTR was returned to normal operations with the problem considered corrected by the various maintenance activities to check and clean all connections. The recurrence on April 9 negated this declaration as the UFTR was returned to administrative shutdown to correct the cause of the Safety Channel failure recurrence.

For this recurrence, a modified form of the previous special test procedure was used to support again a staged restart to normal operation begun on 25 April 1988 with delayed completion on 27 April 1988 after replacement of a failed motor on an Air Particulate Detector. To date only the first of the three program steps listed above under Corrective Action Plan has been found necessary. As indicated in the April 25 interim report, this Special Test Procedure was prepared for RSRS review and approval to allow declaring the UFTR operable pending successful completion of all normal checks and again permitted restart in steps following corrective and diagnostic maintenance activities as a test to verify proper operation of Safety Channel #1 by providing for continuous visual monitoring of voltage levels in the linear channel section of the preamplifier with respect to ground, the current drawn by detector operation from high voltage supply and the high voltage power supply output voltage. This procedure again provided compensation for possible recurrence of the Safety Channel failure by having a second competent staff member present in the control room to monitor both safety channels continuously during the entire restart program which included holds at 1 kw for 10 minutes, 10 kw for 10 minutes, 50 kw for 1 hour, 75 kw for 10 minutes and 100 kw for 1 hour with monitoring devices in place. This time the return to normal operations usage of the UFTR was accompanied by the requirement that the second competent individual be maintained for all operations until 10 hours operation above 50 kw was logged.

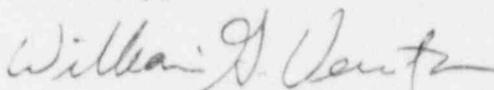
After successful completion of the staged restart begun on April 25 and completed on April 27, 1988, a memorandum (Attachment III) authorizing UFTR Return to Normal Operations Except for the Extra Staff Person Monitoring Safety Channels for all operations was then issued on April 28, 1988 as the UFTR was declared ready to return to normal operations with only the requirement that a second competent staff person be in the control room to monitor the Safety Channel meters for all operations until 10 hours operation above 50 kw had been completed. During the operations to get 10 hours above 50 kw with an extra monitoring individual, normal experimental and training usages of the UFTR were approved and conducted with no recurrence of safety channel failure. This ten hours of operation above 50 kw was completed as of May 19, 1988 as indicated in a memorandum (see Attachment IV) dated May 20, 1988 from the Facility Director to Acting Reactor Manager P.M. Whaley documenting having met the power requirement and approving the return to uncompensated operations; that is, no extra person monitoring the Safety Channels. The record of operations above 50 kw after May 20 through June 8 is contained in Table 1 as Attachment V. At this point the corrective action was considered successful and the reactor declared ready for return to normal operations with normal personnel requirements sufficient for further operations but with a caution to operations staff that no root cause had yet been found. This return to uncompensated operations was completed on May 23, 1988 and documented on that date for all operators via a memorandum (Attachment I) from P.M. Whaley acknowledging the return to uncompensated operations but with a caution to operations staff that no root cause has been identified for the Safety Channel failure.

Nuclear Regulator Commission
June 9, 1988
Page Six

Since May 23 the UFTR has been conducting normal operations, with no recurrence of the Safety Channel failure. Since May 20, 1988 the UFTR has operated above 50 kw for nearly (9) additional hours (see Attachment V). Based on the successful results of the staged test restart with special monitoring instrumentation installed, the operations with an extra individual monitoring until completing 10 hours operation above 50 kw and the subsequent operations with no additional monitoring, the corrective action taken is considered to have corrected the failure problems though admittedly no root cause has been found. At this time the Safety Channel failure incident is considered closed. Further information will be supplied and Region II will be kept updated should this event recur whereupon another step in the Special Test Procedure will be considered necessary.

If further information is needed please advise.

Sincerely,

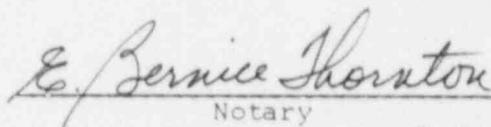


William G. Vernetson
Director of Nuclear Facilities

WGV/ps

Attachments

cc: P.M. Whaley
Reactor Safety Review Subcommittee



Notary

6-10-88

Date

Alachua County

Notary Public, State of Florida
My Commission Expires Oct. 5, 1991
Bonded Thru Tray Fain - Insurance Inc.

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May 23, 1988

MEMORANDUM

TO: All UFTR Operators and Staff

FROM: P.M. Whaley

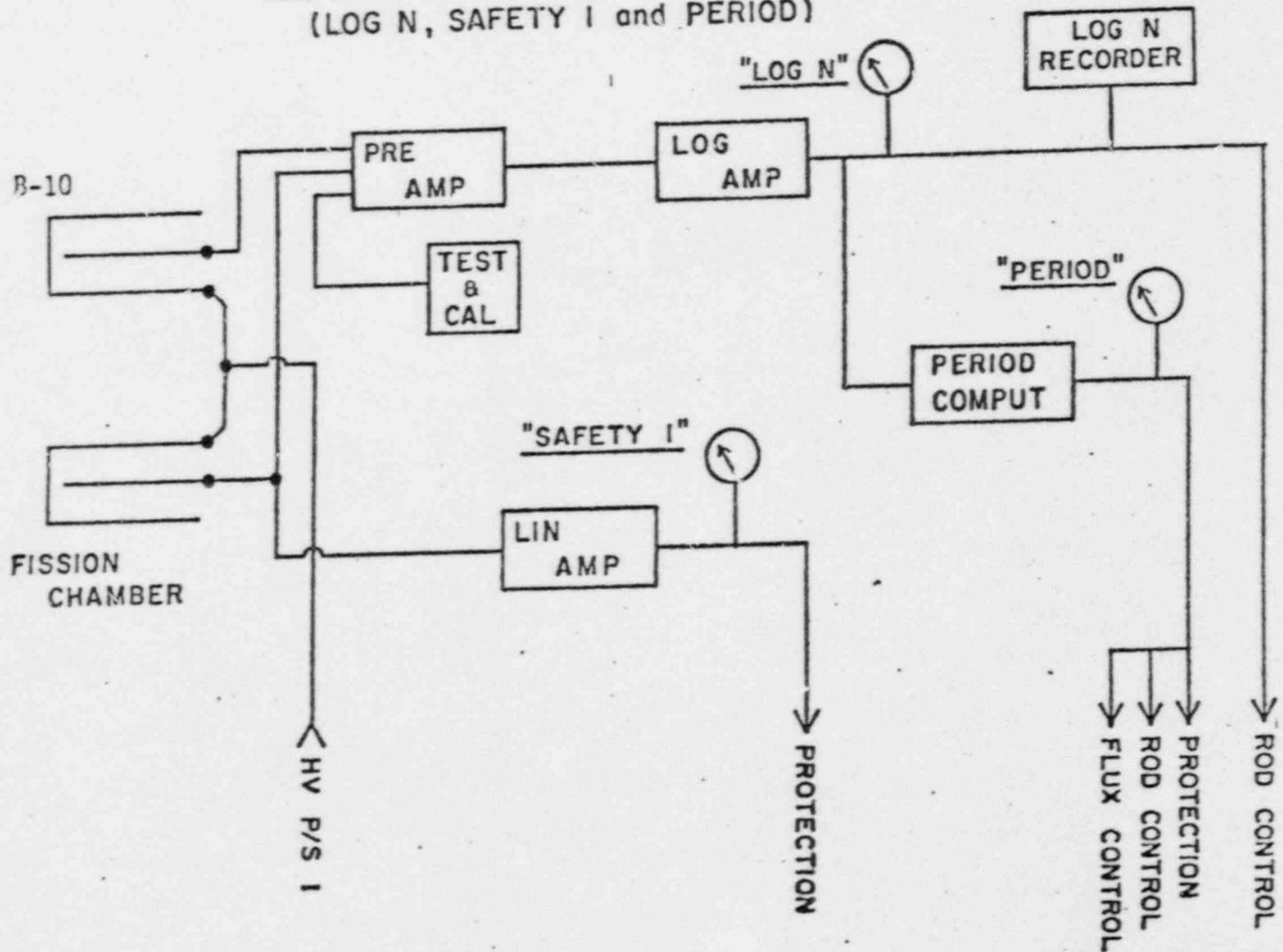
SUBJECT: Safety Channel 1 Test Program Status

As of May 20, 1988 the first step of the proposed test procedure has been completed with the accumulation of 10 hours 23 minutes of run time above 50 kw with no failure of Safety Channel 1. Since this 10 hour interval was based on the longest time above 50 kw between failures for Safety Channel 1, the successful completion of greater than 10 hours is evidence that the cable re-termination has repaired the Safety Channel 1 fault; nevertheless, the root cause has not been definitely determined except by the absence of a failure. Therefore, all UFTR reactor operators and reactor operator trainees are cautioned to be particularly vigilant of the performance of Safety Channel 1 and Safety Channel 2 during reactor operations in the power range.

PMW/ps

cc: Required Reading •
- Director of Nuclear Facilities

NI CHANNEL 1
(LOG N, SAFETY I and PERIOD)



1-21

ATTACHMENT II

Figure 1-8. NI CHANNEL 1: UFTR Nuclear Instrumentation Channel 1 Diagram (Log N, Safety #1 and Period Channels).

REV 2, 7/86

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April 28, 1988

MEMORANDUM

TO: P.M. Whaley
FROM: W.G. Vernetson *WGV*
SUBJECT: UFTR Return to Normal Operations

Based upon the successful completion of the special test procedure with the monitoring equipment in place at 1617 hours on April 27 and subsequent removal of the equipment on April 28, 1988 to address the UFTR Safety Channel #1 Circuit Failure and prior concurrences by the RSRS Executive and Full Committees as well as NRC Region II (Paul Frederickson), the UFTR is hereby authorized to commence normal experimental operations as of 9:00 a.m. today, April 28, 1988.

Remember that the second individual as a member of our staff must be monitoring the safety channel indications for all operations until at least 10 more hours of normal operation above 50 kw have been completed and until I authorize otherwise. Only upon such successful completion will the UFTR be cleared for return to normal operation with no extra monitoring.

WGV/ps

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 Phone (904) 392-1429 - Telex 54330

May 20, 1988

MEMORANDUM

TO: P.M. Whaley

FROM: W.G. Vernetson *WGV*

SUBJECT: Approval for Return to Normal Control Room Operations Staffing Requirements

Since the successful conclusion of the UFTR restart on April 27, 1988, with special monitors installed per the Special Test Procedure approved on April 11, 1988, the UFTR has conducted power operations above 50 kw for the time intervals and on the dates shown as follows:

<u>Date</u>	<u>Time</u>	<u>Total Time (hr-min)</u>
28 April	1009 - 1014	0 - 5
	1102 - 1241	1 - 39
	1331 - 1431	1 - 00
29 April	1645 - 1700	0 - 15
3 May	1214 - 1233	0 - 19
5 May	1220 - 1302	0 - 42
10 May	1538 - 1545	0 - 7
	1628 - 1659	0 - 31
11 May	1608 - 1626	0 - 18
12 May	1500 - 1703	2 - 03
13 May	1613 - 1622	0 - 09
	1655 - 1755	1 - 00
16 May	1402 - 1602	2 - 00
17 May	1612 - 1627	0 - 15

Total Time Above 50 kw: 10 hr. 23 min.

An extra monitoring staff member has been on duty to monitor the two safety channels during all of these operations. Since the safety channel failure loss of indication and signal has not recurred and since this 10.38 hours of operation above 50 kw meets the condition set in the Special Test Procedure per NRC and RSRS commitments of greater than 10 hours above 50 kw with no failure, the UFTR is now approved to continue normal operations with the usual control room and other staff requirements. The requirement for the separate individual to monitor the safety channels is hereby ended.

ATTACHMENT V

TABLE 1

UFTR POWER (> 50 KW) OPERATIONS SINCE 20 MAY 1988
THROUGH 8 JUNE 1988

<u>Date</u>	<u>Time</u>	<u>Total Time (hr-min)</u>
21 May	1734 - 1812	0 - 38
23 May	1044 - 1120	0 - 36
	1632 - 1700	0 - 28
25 May	1133 - 1322	1 - 49
26 May	0915 - 0930	0 - 15
	1228 - 1428	2 - 00
27 May	1507 - 1522	0 - 15
31 May	1214 - 1224	0 - 10
2 June	1737 - 1752	0 - 15
3 June	1439 - 1443	0 - 4
	1638 - 1642	0 - 4
6 June	1244 - 1256	0 - 12
	1316 - 1331	0 - 15
	1858 - 1930	0 - 32
8 June	1433 - 1438	0 - 5
	1717 - 1838	1 - 21
TOTAL.....		8 - 59

William D. Wentz
Facility Director

June 9, 1988
Date