ATTACHMENT 3

ORNL/NOAC-237
LETTER REPORT

REVIEW OF THE OPERATING EXPERIENCE FOR

FERMI UNIT 2 FOR 1987 -1988

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NUCLEAR REGULATOR COMMISSION

APRIL 22, 1988

SUMMARY AND CONCLUSIONS

This document presents the results of a study of the operating experience of Enrico Fermi Unit 2 covering a time period from January 1987 through mid-February 1988. This work was performed at the request of NRC's Office for Analysis and Evaluation of Operational Data (AEOD). The objectives of the review were (1) to identify any operational problem areas evidenced by LERs submitted during this time period; (2) to focus on and characterize personnel errors and any other human factor related deficiencies; and (3) to evaluate Fermi's LERs for the purpose of identifying any events as precursors to core damage as is done under AEOD's Accident Sequence Precursor (ASP) Program.

The review methodology used in this study included reading each LER submitted in the time period of interest, utilizing the Sequence Coding and Search System to help sort and characterize the data, and reviewing other sources of operational data for any events of interest. A total of 56 LERs for 1987 and 7 LERs for 1988 were read and reviewed in detail. A brief description of each event is listed in Appendix A of this report.

The review of the LERs identified one potential operational problem area - procedures/experience. Procedural errors and inadequacies were involved in 16 LERs. Misuse of procedures, such as failing to perform all of the steps of a procedure or using the wrong procedure, was a cause in an additional five LERs. Procedural problems resulted in five RPS actuations and ten ESF actuations.

This area of potential concern is not necessarily a new or unidentified problem. On December 24, 1985 NRC Region III issued a letter seeking information from Detroit Edison Company on plans to improve the regulatory performance of Fermi Unit 2 because of a series of operational problems that were attributed to ineffective management systems. The actions taken by the licensee included retraining of personnel, revision of procedures, and an independent review of the management and operation of the Fermi facility.

The procedure errors reported during the time period covered by this analysis resulted from trying to use existing procedures in situations that were not expressly addressed in the procedure, from errors in the procedures introduced by those preparing them, and from personnel failing to follow procedures exactly. An example of each type of error is presented as follows.

341/87-007. (Mode 3, 0% power, 87/03/17)

In order to establish shutdown cooling, it was necessary to pre-warm the Residual Heat Removal System (RHR) from an alternate injection line. As a result the RHR was being drained using a four-inch line while being fed with a one-inch line. This caused steam flashing in the RHR system. The resulting level transient caused an RPS and ESF actuation. The cause of this event was an inadequate procedure which did not describe this operational mode.

341/87-022. (Mode 1, 38% power, 87/06/01)

The Control Center Heating, Ventilating and Air Conditioning System shifted to recirculation mode when a fuse was removed in order to replace a solenoid valve. A licensed utility personnel did not adequately identify all equipment affected by removing the fuse when preparing the work package. The licensed utility person was counseled.

341/87-036. (Mode 4, 0% power, 87/08/02)

Due to operator error while attempting to fill and vent the RHR system, a level three scram signal was received due to low reactor pressure vessel water level. Six steps in the procedure were not performed that were required prior to an attempt to fill and vent the RHR system. The personnel involved in this incident were counseled.

Procedures are not necessarily expected to cover every conceivable situation. Therefore when these procedural errors are coupled with the number of personnel errors (even though the number of personnel errors by themselves are not excessive), it may indicate a potential problem with the level of experience of the Fermi staff. In LERs in which the cause was procedural problems, the corrective action was to revise procedures, train personnel, or both. However, determination of this type of problem cannot be made through a review of LERs alone. Additional review of the success of the licensee's corrective actions should be made onsite.

The review of LERs for personnel errors identified 45 LERs citing personnel as a cause of the event. As stated previously this is not an excessive number of occurrences. A review of the events indicates that three categories of activity/cause pairs represent half of the personnel errors. These pairs include testing/intrinsic errors, maintenance/intrinsic errors, and testing/description inadequacy.

The ASP project has identified only one (1) event to date as a potential precursor to core damage for 1987 and 1988. The final selection of 1987 and 1988 events is not yet complete. Although the probability of core damage has not been calculated for the event chosen (341/87-006), it appears that this probability will

be low and that the event will not be a significant precursor. A summary of this event is provided below.

> 341/87-006. (Mode 1, 16% power, 87/02/11)
> The HPCI pump turbine failed because the governor bearing oil supply valve was closed and the governor bearing failed. Also, the thrust bearing oil supply valve was repositioned. It was necessary to declare RCIC inoperable in order to perform a surveillance of the repaired HPCI system. It is postulated that the valves were inadvertently mispositioned during maintenance. The surveillance procedure was revised to include a check of the oil pressure.

A preliminary review of all LERs for this study was performed to determine potential ASP events. Only two other events appeared to have the potential for being a precursor (341/87-012 and 341/87-045). One of these events (341/87-045) involves the complete loss of LPCI and will probably be chosen as an ASP event. Event 341/87-012 appears to be similar to event 341/87-006; however, this event involves failure of isolation instrumentation only and HPCI and RCIC were available throughout the event.

REVIEW OF OPERATING EXPERIENCE FOR FERMI UNIT 2 FOR 1987 - 1988

1.0 INTRODUCTION

1.1 Objective of Review

The Nuclear Operations Analysis Center (NOAC) was requested by NRC's Office for Analysis and Evaluation of Operational Data (AEOD) to conduct a brief review of the operating experience of Fermi Unit 2 for 1987 -1988. The review is to provide support and data in preparation for meetings with NRC Regional staff. The objectives of this review are (1) to identify any operational problem areas evidenced by the review of LERs; (2) to focus on and characterize personnel errors and any other human factor related deficiencies; and (3) evaluate Fermi's LERs for the purpose of identifying any events as precursors to core damage as is done under AEOD's Accident Precursor Program (ASP).

1.2 Review Methodology

The principal data source used in conducting this review was licensee event reports (LERs). A total of 56 LERs for 1987 and 7 for 1988 were read and reviewed in detail to analyze personnel errors and screen for ASP purposes. The Sequence Coding and Search System (SCSS) LER database was searched to categorize and sort LERs for subsequent review of ESF actuations, RPS actuations, and equipment performance.

The areas reviewed which form the structure of this report include:

- LER reportability categories
- Events of safety significance
- Reactor Protection System (RPS) and Engineered Safety System Actuations (Includes Personnel Errors Associated with RPS and ESF Actuations)
- Personnel Errors (Non-RPS/ESF)
- System/Component Performance

Any recurring problems or trends in these respective areas were identified.

1.3 General Information on Fermi Unit 2

The following data represents general design information:

Reactor type:	BWR	Design Electrical Rating:	1093 MWe
NSSS Vendor:	GE	Condenser Cooling:	Once Thru
AE:	Sargent & Lundy	Initial Criticality:	6/21/85
Utility:	Detroit Edison	1st Electrical Generation:	9/21/86
Licensed Thermal Power:	3292 (MWt)		

2.0 ANALYSIS OF LERS AS FUNCTION OF REPORTABILITY CODES

The reportability categories for which LERs were submitted for 1987 through early 1988 for Fermi 2 were examined and compared to those for all BWRs. The results are presented in Table 2.1 which indicate that Fermi appears to be submitting LERs for the same reasons as other BWRs. The distribution of reportability categories is nearly identical for Fermi as compared to all BWRs. The highest percentage of LERs submitted are for the purposes of reporting ESF actuations (53% for Fermi versus 55% for all BWRs) and reporting shutdowns/tech spec violations (29% for Fermi and 28% for all BWRs).

The five (5) LERs reported under "unanalzyed conditions" are 87-019, 87-045, 87-050, 87-052, and 88-004. The four (4) LERs submitted under 'events that could prevent fulfillment of a safety function" are 87-013, 87-030, 87-039, and 87-045. Summaries of these events are included in Appendix A.

Table 2.1 COMPARISON OF REPORTABILITY CATEGORIES FOR FERMI AND ALL BWRs

Reportability Category	Percentage of LERs* BWRs	Fermi
ESF Actuations (50.73 a 2 iv)	55	53
Shutdowns/tech spec violations (50.73 a 2 i)	28	29
Preventing fulfillment of safety function (50.73 a 2 v)	9	7
Other (Part 21, Voluntary, etc.)	6	5
Unanalyzed conditions (50.73 a 2 ii)	5	8
Single cause affecting multiple trains (50.73 a 2 vii)	3	5
External threat (50.73 a 2 iii)	<1	2
Limiting conditions for operations (50.36 c 2)	<1	0
Violation of tech spec safety settings (50.36 c 1)	<1	0
Physical security system threatened (73.71 c)	<1	0
Excess exposure to individual (20.405 a 1 i)	<1	0
Other exposures/property damage	<1	0

* Note: Percentages will be >100 since more than 1 reportability category can be assigned to one LER.

3.0 FERMI EVENTS SELECTED AS POTENTIAL PRECURSORS TO CORE DAMAGE AND EVENTS REPORTED TO CONGRESS

3.1 ASP Events

The Accident Sequence Precursor (ASP) project at NOAC, which is sponsored by AEOD, has identified only one (1) event to date as a potential precursor to core damage for 1987 and 1988. The final selection of 1987 and 1988 events is not yet complete. Although the probability of core damage has not been calculated for the event chosen (341/87-006), it appears that this probability will be low and that the event will not be a significant precursor. A summary of this event is provided below.

341/87-006. (Mode 1, 16% power, 87/02/11)

> The HPCI pump turbine failed because the governor bearing oil supply valve was closed and the governor bearing failed. Also, the thrust bearing oil supply valve was repositioned. It was necessary to declare RCIC inoperable in order to perform a surveillance of the repaired HPCI system. It is postulated that the valves were inadvertently miss-positioned during maintenance. The surveillance procedure was revised to include a check of the oil pressure.

There were two other precursors chosen by the ASP project for Fermi Unit 2 which occurred prior to the time period covered by this review. Both of these events were in 1986. The first of these (341/86-045) was an important precursor. The second of these events (341/86-048) was not a significant precursor. A summary for each of these events is provided below.

> 341/86-045. (Mode 5, 0% power, 86/11/17)
> An overpressurization of the test return-line piping to the condensate storage tank (CST) caused a low-pressure expansion joint to fail. All CST water was lost to the safety systems. Recovery of HPCI and RCIC required transfer of the suction line from the CST to the suppression pool (readily switchable) in the case of a LOOP, LOCA or a transient.

341/86-048. (Mode 2, 5% power, 86/12/24)
Calibration activities for an RCIC system header flow instrument channel resulted in two occurrences of the RCIC system being declared inoperable. The second occurrence resulted in only slightly degraded flow capability. During these occurrences, the HPCI system was also inoperable. The HPCI system had been inoperable for a scheduled system outage. No recovery was possible for HPCI. RCIC was assumed recoverable locally.

A preliminary review of all LERs (56 from 1987 and 7 from 1988) for this study was performed to determine potential ASP events. Only two other events appeared to have the potential for being a precursor (341/87-012 and 341/87-045). One of these events (341/87-045) involves the complete loss of LPCI and will probably be chosen as an ASP event. A summary of these two events is provided below.

341/87-012. (Mode 1, 30% power, 87/04/10)
A blown fuse rendered several HPCI and RCIC isolation instruments inoperable. A failed trip unit caused the fuse to blow. HPCI and RCIC were available for service throughout the event.

341/87-045. (Mode 4, 0% power, 87/09/08)
An incorrect fuse was removed and power was lost to bus 72CF. (The motor control center 72CF provides power and control to seven LPCI valves.) A utility licensed operator identified the wrong fuse to be removed. When the operator in the field removed the fuse, DC control power was lost to bus 72C. This loss also revealed a design error in the DC control logic for the LPCI swing bus source breakers (i.e. the bus would not swing over to Division II under all LOSP plus single failures).

Although event 341/87-012 appears to be similar to event 341/87-006 this event involves failure of isolation instrumentation only and HPCI and RCIC were available throughout the event.

For event 341/87-045, it was necessary to review section 8 of the FSAR to determine if other systems or trains were powered by bus 72CF. It appears that this event involves the complete loss of LPCI, and would probably be chosen as an ASP event. However, LPCI was unavailable for only 5 minutes and the recovery of the system was probable if LPCI were needed. Accordingly, it is considered that this event would also have a low probability of core damage.

3.2 Abnormal Occurrences Reported to Congress

For the time period of interest, no Fermi events were selected as abnormal occurrences reportable to Congress. However, in late 1985 Fermi was cited for "serious deficiencies in management or procedural controls in major areas" that were collectively considered as an abnormal occurrence (NUREG-0090, Vol. 8 No.4, "Report to Congress on Abnormal Occurrences, October - December 1985."

In late 1985 Fermi began to experience a series of operational problems, some of which resulting from personnel errors. Subsequently, additional problems occurred due to a combination of equipment failures and personnel errors. The principal cause was attributed to ineffective management systems resulting in this series of operational and equipment problems, and the several personnel errors and violations of technical specifications.

Detroit Edison instituted a number of measures to improve performance involving the retraining of personnel and revision of procedures. The plant remained shut down from October 1985 until NRC authorized resumption of operations in July 1986 to address these problems as well as for maintenance and other modifications.

4.0 ANALYSIS OF RPS AND ESF ACTUATIONS

LERs reporting either RPS or ESF actuations for Fermi Unit 2 were compared to LERs reporting RPS or ESF actuations for BWRs with start dates in the same time frame as Fermi Unit 2 (specifically, Perry Unit 1, Riverbend Unit 1, and Shoreham). This comparison was made for events occurring during the January 1987 through mid-February 1988. The LERs for Fermi Unit 2 were then reviewed to identify repetitive causes for RPS and ESF actuations to see if lessons learned from previous actuations were satisfactorily implemented.

4.1 Observations About Fermi Unit 2 RPS Actuations

Table 4.1 lists the number of LERs reporting RPS actuations for the four units examined. Fermi 2 reported 16 RPS actuations in the 15 LERs reporting RPS actuations. This number is fairly typical of RPS actuations for BWRs in the early phases of operation based on a comparison to units at a similar stage of operation.

The causes of RPS actuations at Fermi Unit 2 are presented in Table 4.2. The number of causes in the table is greater than the number of RPS actuations because some actuations were the result of multiple causes. These causes were primarily due to equipment failures, personnel errors, and procedural errors; however, no one cause was dominant. The equipment failures did not repeat during the time period examined. The only two equipment failures that were even similar involved two leaks that occurred in separate systems at separate times and forced the unit to shut down.

The personnel errors and procedural errors occurred primarily when personnel were confronted with off-normal situations. These include the personnel errors of commission and misunderstanding and deficient procedures. The LERs reporting these errors are summarized below.

341/87-007. (Mode 3, 0% power, 87/03/17)
In order to establish shutdown cooling, it was necessary to pre-warm the Residual Heat Removal System (RHR) from an alternate injection line. As a result the RHR was being drained using a four-inch line while being fed with a one-inch line. This caused steam flashing in the RHR system. The resulting level transient caused an RPS and ESF actuation. The cause of this event was an inadequate procedure.

Table 4.1 Comparison of RPS Actuations Reported in LERs from Units of Similar Start Dates as Fermi Unit 2

Unit	Number of LERs Reporting RPS Actuations
Perry 1	22
Fermi 2	15
Riverbend 1	11
Shoreham	3

Table 4.2 Causes of RPS Actuations at Fermi Unit 2

Causes of Actuations	Number of Actuations
Equipment Failures	
Leaks	2
Loose metal strip	1
Arcing motor-generator	1
Failed vibration monitor	1
Personnel Errors *	
Commission	3
Fundamental misunderstanding	2
Ergonomics	2
Procedural Errors	
Deficient procedures	4
Incorrect procedures	1
Design Errors	1
TOTAL CAUSES OF RPS ACTUATIONS	18

* Personnel Errors

Commission - personnel perform undesired tasks/activities.

Fundamental misunderstanding - personnel do not understand the consequences of their actions.

Ergonomics - personnel work in a position not designed for normal human activity or work without the proper tools for the task.

341/87-008. (Mode 1, 18% power, 87/03/01)
A partial loss of power to the turbine control system caused the steam bypass valves to close. An automatic scram occurred. This event was caused by an error committed by the utility-licensed NASS while attempting to reset the governor trouble alarm. An inadequacy in the procedure also contributed to the event.

341/87-011. (Mode 1, 31% power, 87/04/06)
While performing a surveillance procedure on the APRM B Channel, an RPS actuation and ESF isolation occurred. The I&C technician inadvertently removed the trip reference card for the A Channel. The technician was counseled and the procedure will be revised.

341/87-017. (Mode 1, 18% power, 87/05/13)
A FW pump turbine tripped due to excessive vibrations. The vibrations were exaggerated because the turbine-casing drain valve was closed. The valve was closed during startup of the turbine due to an inadequate procedure. The procedure has been revised and the turbine will be repaired.

341/87-035. (Mode 2, 3% power, 87/07/31)
As a result of leakage from a FW check valve in excess of 4.2 liters per minute, the reactor was being shutdown when reactor level oscillations caused an increase in reactor power due to positive reactivity. The operator was not able to switch the IRMs upscale quickly enough to prevent a scram. The check valve was fixed, and a review of the operating procedure will be made. Clarification of the use of the turbine bypass valves for pressure reduction during normal shutdown sequences will be incorporated. Additional training in plant depressurization will be given.

341/87-036. (Mode 4, 0% power, 87/08/02)
Due to operator error while attempting to fill and vent the RHR system, a level three scram signal was received due to low reactor pressure vessel water level. Six steps in the procedure were not performed that were required prior to an attempt to fill and vent the RHR system. The personnel involved in this incident were counseled.

341/87-056. (Mode 1, 75% power, 87/12/31)
During modifications for the temporary installation of a monitor and printer, a wire contacted the cabinet and the indicated FW flow was reduced by 50%. The FW system increased FW flow and the reactor scrammed on high reactor water level. During the recovery, the RWCU pumps tripped--a gravity drain path was established. This event was caused by a non-licensed utility personnel error.

341/88-004. (Mode 1, 49% power, 88/01/10)
A FW pump failed because the speed-control power-supply failed. The over-voltage trip for the power supply had been set improperly by a contractor and had drifted into the normal operating range.

4.2 Observations About Fermi Unit 2 ESF Actuations

Table 4.3 lists the number of LERs reporting ESF actuations for the four units examined. Fermi 2 reported 42 ESF actuations in the 33 LERs reporting ESF actuations. As was the case with the RPS actuations, this number is typical for ESF actuations for BWRs in the early phases of operation based on a comparison to units at a similar stage of operation.

The causes of the ESF actuations at Fermi Unit 2 are presented in Table 4.4. The number of causes of ESF actuations in the table is less than the number of actuations because a number of causes resulted in multiple actuations. The dominant causes of ESF actuations were personnel errors and procedural errors. As with the RPS actuations, equipment failures were in a variety of systems and did not recur.

As with the RPS actuations, the personnel errors and procedural errors associated with ESF actuations occurred primarily when personnel were confronted with off-normal situations. These include the personnel errors of commission and misunderstanding and deficient procedures. The LERs reporting these errors are summarized below.

341/87-007. (Mode 3, 0% power, 87/03/17)
In order to establish shutdown cooling, it was necessary to pre-warm the Residual Heat Removal System (RHR) from an alternate injection line. As a result the RHR was being drained using a four-inch line while being fed with a one-inch line. This caused steam flashing in the RHR system. The resulting level transient caused an RPS and ESF actuation. The cause of this event was an inadequate procedure.

341/87-008. (Mode 1, 18% power, 87/03/01)
A partial loss of power to the turbine control system caused the steam bypass valves to close. An automatic scram occurred. This event was caused by an error committed by the utility-licensed NASS while attempting to reset the governor trouble alarm. An inadequacy in the procedure also contributed to the event.

341/87-011. (Mode 1, 31% power, 87/04/06)
While performing a surveillance procedure on the APRM B Channel, an RPS actuation and ESF isolation occurred. The I&C technician inadvertently removed the trip reference card

for the A Channel. The technician was counseled and the procedure will be revised.

Table 4.3 Comparison of ESF Actuations Reported in LERs from Units of Similar Start Dates as Fermi 2

Unit	Number of LERs Reporting ESF Actuations
Perry 1	44
Fermi 2	33
Shoreham	12
Riverbend 1	10

Table 4.4 Causes of ESF Actuations at Fermi Unit 2

Causes of Actuations	Number of Actuations
Equipment Failures	
Leaks	2
Loose metal strip	1
Tripped motor-generator	1
Failed vibration monitor	1
Failed vent valve	1
Failed trip unit	1
Personnel Errors *	
Commission	7
Ergonomics	4
Fundamental misunderstanding	1
Manufacturing defect	1
Communication	1
Procedural Errors	
Deficient procedures	6
Incorrect procedures	4
Design Errors	5
Unknown	1
TOTAL CAUSES OF ESF ACTUATIONS	37

* Personnel Errors

Commission - personnel perform undesired tasks/activities.

Ergonomics - personnel work in a position not designed for normal human activity or work without the proper tools for the task.

Fundamental misunderstanding - personnel do not understand the consequences of their actions.

Communication - breakdown in oral communication among to or more individuals.

341/87-017. (Mode 1, 18% power, 87/05/13)
A FW pump turbine tripped due to excessive vibrations. The vibrations were exaggerated because the turbine-casing drain valve was closed. The valve was closed during startup of the turbine due to an inadequate procedure. The procedure has been revised and the turbine will be repaired.

341/87-020. (Mode 1, 14% power, 87/05/28)
A cognitive non-licensed, utility personnel error caused an actuation of the Division II Emergency Diesel Generators. The repairman was apparently working in the wrong relay cabinet. The repairman was counseled and advised of the proper technique for performing resistance measurements.

341/87-023. (Mode 1, 44% power, 87/06/11)
RCIC isolated during a functional test because a repairman left a volt-ohm meter connected across a relay in the "D" channel of the isolation logic. After successfully completing the functional test, the repairman was counseled.

341/87-033. (Mode 2, 1% power, 87/07/29)
The RWCU was isolated (an ESF actuation) when this system was being used to help set the closed limit switch for the outboard feedwater check valve. A licensed utility operator used an incorrect procedure (Section 4.1 of SOP 23.707) instead of the correct procedure (Section 4.16 of SOP 23.707). The operator involved will be disciplined.

341/87-035. (Mode 2, 3% power, 87/07/31)
As a result of leakage from a FW check valve in excess of 4.2 liters per minute, the reactor was being shutdown when reactor level oscillations caused an increase in reactor power due to positive reactivity. The operator was not able to switch the IRMs upscale quickly enough to prevent a scram. The check valve was fixed, and a review of the operating procedure will be made. Clarification of the use of the turbine bypass valves for pressure reduction during normal shutdown sequences will be incorporated. Additional training in plant depressurization will be given.

341/87-036. (Mode 4, 0% power, 87/08/02)
Due to operator error while attempting to fill and vent the RHR system, a level three scram signal was received due to low reactor pressure vessel water level. Six steps in the procedure were not performed that were required prior to an attempt to fill and vent the RHR system. The personnel involved in this incident were counseled.

341/87-037. (Mode 4, 0% power, 87/08/04)
The inboard MSIVs closed inadvertently during a transfer of the RPS bus power sources. The closure was caused by an

inadequacy in a procedure which did not instruct the operator to energize the inboard MSIVs' AC solenoid after transferring bus power sources. The operating procedure was revised.

341/87-042. (Mode 4, 0% power, 87/09/28)
The Control Center Heating, Ventilation and Air Condition System spurious shifted from normal to the chlorine mode. This shift was most likely caused by the use of a two-way radio. Signs have been posted stating that radios should not be used in the area, construction radios have been removed, and operations radios have been put under the control of operations personnel. A new design for the chlorine detectors is being developed. Reference LER 341/87-032.

341/87-055. (Mode 1, 66% power, 87/12/10)
An isolation of RCIC occurred while the RCIC steam line was being warmed. The isolation valves closed on high differential steam line pressure. The isolation was due to an inadequacy in the system operating procedure. This procedure was revised.

341/88-002. (Mode 4, 0% power, 88/01/04)
All four outboard MSIVs closed due to (1) an I&C technician failing to re-energize the DC solenoids for these valves, and (2) another technician misinterpreted a procedure. The procedure will be revised.

341/88-004. (Mode 1, 49% power, 88/01/10)
A FW pump failed because the speed-control power-supply failed. The over-voltage trip for the power supply had been set improperly by a contractor and had drifted into the normal operating range.

341/88-007. (Mode 1, 64% power, 88/02/14)
The radwaste building ventilation shutdown and the control center heating ventilation and air condition system shifted to the recirculation mode due to personnel error during repair of a radwaste monitor. The event was caused by an improper review of the system functions prior to performing work. The personnel were disciplined.

5.0 Review of Enrico Fermi Unit 2 Personnel Errors

A review of 63 LERs (56 from 1987 and 7 from 1988) identified 45 LERs that identified personnel errors as the cause of the event. Table 5.1 provides a breakdown of the type of personnel activity being performed at the time the error was made versus the cause for the personnel error.

A review of Table 5.1 indicates that three categories of activity/cause pairs represent half (~51%) of the personnel errors. The events for these three activity/cause pairs are reviewed in the following sections.

5.1 Review of Testing/Intrinsic Errors

For the review period, a total of 7 LERs reported personnel errors that were associated with testing activities. There were no significant consequences from any of these errors. The types of errors made are:

341/87-011. (Mode 1, 31% power, 87/04/06)
While performing a surveillance procedure on the APRM B Channel, an RPS actuation and ESF isolation occurred. The I&C technician inadvertently removed the trip reference card for the A Channel. The technician was counseled and the procedure will be revised.

341/88-004. (Mode 1, 49% power, 88/01/10)
A FW pump failed because the speed-control power-supply failed. The over-voltage trip for the power supply had been improperly set by a contractor and drifted into the normal operating range.

341/87-019. (Mode 4, 0% power, 87/05/23)
A test frequency for a Standby Gas Treatment surveillance test was incorrectly entered into the surveillance scheduling computer program. As a result the test interval was exceeded by approximately 41 days. The test was performed successfully. The computer program was revised to indicate the correct test interval of 18 months instead of 24 months.

341/88-003. (Mode 4, 0% power, 88/01/05)
The Tech Spec setpoints for the RHR valve-leakage monitor were incorrect due to personnel error during preparation of the calculations that determined this setpoint.

341/87-021. (Mode 1, 32% power, 87/06/07)
Operations personnel failed to demonstrate that reactor coolant system leakage be within allowable limits. The surveillance test interval was exceeded by one hour. The test was successfully completed.

Table 5.1 Personnel Activity Versus Cause For Personnel Errors At Unit 2

Personnel Activity	CAUSE: Intrinsic Human Error[1]	Task Description Inadequacy[2]	Ergonomics	Training	Sum
Testing/ Calibration	8	7	2	1	18
Maintenance	8	1	2	0	11
Operations	3	4	0	0	7
Administration	3	3	0	1	7
Installation	0	1	0	1	2
TOTALS:	22	16	4	3	45

[1]There were 9 licensed operator errors and 12 personnel errors involving other utility personnel.

[2]Inadequate procedures were involved in 13 events and misinterpretetion of verbal or written instructions were involved in the other 3 events.

341/87-022. (Mode 1, 38% power, 87/06/01)
The Control Center Heating, Ventilating and Air Conditioning System shifted to recirculation mode when a fuse was removed in order to replace a solenoid valve. A licensed utility personnel did not adequately identify all equipment affected by removing the fuse. The licensed utility person was counseled.

341/87-053. (Mode 1, 49% power, 87/10/24)
The drywell pressure Division I, Channel A was inoperable for longer than 2 hours without inserting a half-trip signal during a response time surveillance test of this channel. The time constraint was violated because there was a failure to recognize the discrepancy between the two hour tech spec limit and the estimated six to eight hours needed to perform the surveillance test. As a result, a checklist was developed as a guide for the performance of this surveillance test.

341/87-033. (Mode 2, 1% power, 87/07/29)
The RWCU was isolated (an ESF actuation) when this system was being used to help set the closed limit switch for the outboard feedwater check valve. A licensed utility operator used an incorrect procedure (Section 4.1 of SOP 23.707) instead of the correct procedure (Section 4.16 of SOP 23.707). The operator involved will be disciplined.

Note that licensed operators committed 4 of these personnel errors that occurred during testing or calibration, and that the other personnel errors were committed by an I&C technician, and 2 unknown personnel (probably engineers acting in design capacities).

5.2 Review of Maintenance/Intrinsic Errors.

For the review period, a total of 8 LERs reported personnel errors that involving maintenance activities. There were no significant consequences from any of these errors. The types of errors made are:

341/87-020. (Mode 1, 14% power, 87/05/28)
A cognitive non-licensed, utility personnel error caused an actuation of the Division II Emergency Diesel Generators. The repairman was apparently working in the wrong relay cabinet. The repairman was counseled and advised of the proper technique for performing resistance measurements.

341/87-006. (Mode 1, 16% power, 87/02/11)
The HPCI pump turbine failed because the governor bearing oil supply valve was closed and the governor bearing failed. Also, the thrust bearing oil supply valve was repositioned. It was necessary to declare RCIC inoperable in order to perform a surveillance of the repaired HPCI system. It is postulated that the valves were inadvertently miss-positioned during maintenance. The surveillance procedure was revised to include a check of the oil pressure.

341/87-023. (Mode 1, 44% power, 87/06/11)
RCIC isolated during a functional test because a repairman left a volt-ohm meter connected across a relay in the "D" channel of the isolation logic. After successfully completing the functional test, the repairman was counseled.

341/88-007. (Mode 1, 64% power, 88/02/14)
The radwaste building ventilation shutdown and the control center heating ventilation and air condition system shifted to the recirculation mode due to personnel error during repair of a radwaste monitor. The event was caused by an improper review of the system functions prior to performing work. The personnel were disciplined.

341/87-056. (Mode 1, 75% power, 87/12/31)
During modifications for the temporary installation of a monitor and printer, a wire contacted the cabinet and the indicated FW flow was reduced by 50%. The FW system increased FW flow and the reactor scrammed on high reactor water level. During the recovery, the RWCU pumps tripped--a gravity drain path was established. This event was caused by a non-licensed utility personnel error.

341/88-002. (Mode 4, 0% power, 88/01/04)
All four outboard MSIVs closed due to (1) an I&C technician failing to re-energize the DC solenoids for these valves, and (2) another technician misinterpreted a procedure. The procedure will be revised.

341/87-036. (Mode 4, 0% power, 87/08/02)
Due to operator error while attempting to fill and vent the RHR system, a level three scram signal was received due to low reactor pressure vessel water level. Six steps in the procedure were not performed that were required prior to an attempt to fill and vent the RHR system. The personnel involved in this incident were counseled.

341/87-045. (Mode 4, 0% power, 87/09/08)
An incorrect fuse was removed and power was lost to bus 72C (supplies power to 1 train of RBCCW, EECW, and LPCI). A utility licensed operator identified the wrong fuse to be removed. When the operator in the field removed the fuse power was lost to bus 72C. This loss revealed a design error in the DC control logic for the LPCI swing bus source breakers (i.e. the bus would not swing over to Division II under all LOSP plus single failures).

Note that licensed operators committed 2 of these personnel errors, while other utility personnel were responsible for the other six personnel errors.

5.3 Review of Testing/Description Inadequacy

For the review period, a total of 7 LERs reported personnel errors made during testing activities due to deficient procedures or communications. There were no significant consequences from any of these errors. The types of errors made are:

341/87-001. (Mode 1, 10% power, 87/01/26)
While performing calibration activities for the Reactor Water Cleanup System an automatic ESF isolation occurred. This event was caused by a shared personnel error by the Nuclear Assistant Shift Supervisor (NASS) and the repairman and resulted from a lack of communication between them. The NASS assumed that the repairman was going to adjust the needle-zero for a temperature gage while the repairman thought (because adjusting the needle-zero may change the instrument calibration) that the instrument was also to be recalibrated.

341/87-029. (Mode 1, 47% power, 87/06/15)
When one EDG is unavailable, tech specs require that the circuits between the offsite power network and the Class 1E distribution system were operable. This was not done because of a misinterpretation of the surveillance requirement (only step 5 was performed when steps 5 and 6 should have been performed).

341/87-003. (Mode 1, 20% power, 87/02/02)
The allowed test interval expired for performing the leak rate testing for the primary containment hatch airlock. The airlock was immediately tested and failed the test. This event was caused by a non-licensed, utility, personnel error which involved the incorrect logging of the airlock leak rate testing as complete, and resulted from inadequacies in the procedure. The airlock was repaired and the surveillance procedure was revised.

341/87-014. (Mode 4, 0% power, 87/04/26)
An informational pressure test was being performed on various reworked instrument lines. Due to leakage, the lines became pressurized and caused an RPS actuation. This event was attributed to the lack of a procedure. An existing procedure will be revised to include information pressure testing.

341/87-015. (Mode 4, 0% power, 87/04/16)
The boric acid storage tank outlet valve was opened prior to closing the test tank outlet valve during the performance of a surveillance test. This action cross connected the test tank and the storage tank. The steps in the procedure were performed out of sequence. This event was caused by cognitive non-licensed, utility personnel errors.

341/87-028. (Mode 4, 0% power, 87/06/27)
During the performance of a surveillance test on the Emergency Equipment Cooling Water System an automatic initiation was received. The EECW pumps were already running so the only response was isolation of the non-essential loads. The control room operator manually restored cooling to the non-essential loads; then the surveillance test was completed successfully. The procedure was in error because of an inadequate temporary change. The person responsible for the temporary change (non-licensed utility) had just returned to day shift after working night shift.

341/88-001. (Mode 4, 0% power, 88/01/03)
The average power range monitors (APRM) were set at 34% power instead of 20% power or less due to a calibration error. The calibration error was caused by an inadequate procedure.

Note that misinterpretation of procedures occurred 2 times, there was 1 occurrence where no procedure existed, and that the other 4 events involved inadequate procedures.

6.0 ANALYSIS OF COMPONENT FAILURES

Component failures, including system and train failures, reported in LERs for Fermi Unit 2 were analyzed to identify recurring problems and to identify events of safety significance. Section 6.1 presents the review of component failures and Sections 6.2 and 6.3 present the review of system occurrences and train occurrences, respectively. These reviews cover the time period from January 1987 through mid-February 1988.

6.1 Review of Fermi Unit 2 Component Failures

Table 6.1 lists components and the number of times LERs reported their failure at Fermi Unit 2. A total of 37 component types contributed to 69 component failures. In a review of these component failures, none were considered unusual or significant in themselves. In addition, no trends were noted.

6.2 Review of Fermi Unit 1 System Occurrences

The number of system occurrences reported in LERs for Fermi 2 is listed in Table 6.2. The LERs were reviewed to determine the type of failures for each system occurrence. The occurrences were categorized into two categories: actual failure and potential failure.

The actual failure category includes occurrences in which the system failed to perform its intended function or, because of some defect, would have failed if an actual demand had existed. The potential failure category includes occurrences in which the system might or could have failed but no demand existed or the circumstances that would guarantee failure did not exist.

Four systems (residual heat removal, condensate and feedwater, high pressure coolant injection, and reactor water cleanup) contributed the majority of system occurrences at Fermi 2. No one system was a dominant contributor to system occurrences and the number of occurrences for each system was not uncharacteristic of occurrences reported at other BWRs.

Six of the 21 occurrences that involve the four systems were potential failures. The condensate and feedwater system had the most actual failures (5). Two of the five failures involved failures in the "on" condition and resulted in overcooling the reactor core. While these types of failures are not unusual, the percentage of total condensate and feedwater system failures is rate of occurrence for this time period appears high. The five condensate and feedwater events are summarized below with the two overcooling events listed first.

Table 6.1 Summary of Component Failures at Fermi Unit 2

Component	Number of Failures
Miscellaneous Equipment Item	7
Miscellaneous Subcomponent	7
Seal	4
Fuse	4
Insulation	4
Door/ Cover/ Hatch	3
Card, Circuit	3
Indicator, Radiation	3
Pump, Unknown Type	2
Turbine	2
Motor	2
Valve, Vent, Unknown Material	2
Relay, Overvoltage	2
Bearing/ Bushing	1
Shaft/ Stem	1
Coupling	1
Demineralizer	1
Bus	1
Relay, Unknown Type	1
Switch, Position	1
Capacitor	1
Valve, Isolation/ Shutoff, Unknown Material	1
Valve, Solenoid	1
Exciter	1
Plug	1
Hanger	1
Terminal Block	1
Valve, Check, Unknown Material	1
Relay, Undervoltage	1
Circuit Breaker, AC	1
Cable/ Wire	1
Primary Element, Voltage	1
Battery	1
Valve, Bypass, Unknown Material	1
Indicator, Flux/ Neutron	1
Transmitter, Pressure	1
Power Supply, Electric	1
TOTAL NUMBER OF COMPONENT FAILURES	69

Table 6.2 Summary of System Occurrences at Fermi Unit 2

System	Actual Failure	Potential Failure	Total Occurrences
Residual Heat Removal	4	2	6
Condensate and Feedwater	5		5
High Pressure Coolant Injection	2	3	5
Reactor Water Cleanup	4	1	5
Reactor Core Isolation Cooling	1	2	3
Component Cooling Water	1		1
Recirculating Water	1		1
Standby Liquid Control	1		1
High Voltage AC (> 35KV)		1	1
Reactor Building HVAC		1	1
Secondary Containment HVAC - Standby Gas Treatment		1	1
TOTAL SYSTEM OCCURRENCES			31

341/87-002. (Mode 1, 29% power, 87/02/26)
A ground fault occurred in the iso-phase bus cooling duct because an assembly aid (left in after assembly was complete) failed and contacted the iso-phase bus. During the scram recovery the start-up level control valve failed to transfer to the automatic mode due to a failed relay on a control board in the Post Scram Feedwater Logic Sequencer.

341/87-056. (Mode 1, 75% power, 87/12/31)
During modifications for the temporary installation of a monitor and printer, a wire contacted the cabinet and the indicated FW flow was reduced by 50%. The FW system increased FW flow and the reactor scrammed on high reactor water level. During the recovery, the RWCU pumps tripped--a gravity drain path was established. This event was caused by a non-licensed utility personnel error.

341/87-017. (Mode 1, 18% power, 87/05/13)
A FW pump turbine tripped due to excessive vibrations. The vibrations were exaggerated because the turbine-casing drain valve was closed. The valve was closed during startup of the turbine due to an inadequate procedure. The procedure has been revised and the turbine will be repaired.

341/87-035. (Mode 2, 3% power, 87/07/31)
As a result of leakage from a FW check valve in excess of 4.2 liters per minute, the reactor was being shutdown when reactor level oscillations caused an increase in reactor power due to positive reactivity. The operator was not able to switch the IRMs upscale quickly enough to prevent a scram. The check valve was fixed, and a review of the operating procedure will be made. Clarification of the use of the turbine bypass valves for pressure reduction during normal shutdown sequences will be incorporated. Additional training in plant depressurization will be given.

341/88-004. (Mode 1, 49% power, 88/01/10)
A FW pump failed because the speed-control power-supply failed. The over-voltage trip for the power supply had drifted into the normal operating range.

The actual failures of the residual heat removal and the reactor water cleanup system (4 each) were primarily due to automatic isolation from a failed component or personnel error. This type of occurrence is very common in BWRs.

Only two of the high pressure coolant injection occurrences were actual failures. The first of these involved turbine bearing failure due to a loss of lube oil (LER 341/87-002). Both the high pressure coolant injection and the residual heat removal systems were out of service during a shutdown when the reactor pressure exceeded 150 psig (LER 341/88-005).

6.3 Review of Fermi Unit 2 Train Occurrences

The number of train occurrences reported in LERs for Fermi 2 is listed in Table 6.3. The LERs were reviewed to determine the type of failures for each train occurrence. As with the system occurrences, the train occurrences were categorized into two categories: actual failure and potential failure.

No system had a large number of train occurrences. Three of the top four systems in which train failures occurred were instrument systems (leak detection, ESF actuation, and nonnuclear instrumentation). These failures involved erroneous signals because of personnel or equipment failure. The two events involving the fourth system (lube oil) were separate and isolated. One involved loss of lube oil to the High pressure coolant injection turbine (LER 341/87-006). The second involved a lube oil problem on a feedwater pump (LER 341/87-017).

Table 6.3 Summary of Train Occurrences at Fermi Unit 2

System	Actual Failure	Potential Failure	Total Occurrences
Leak Monitoring	3		3
ESF Actuation	2		2
Lube Oil	2		2
Nonnuclear Instrumentation	2		2
Recirculating Water	1		1
Secondary Reactor Containment	1		1
DC Power		1	1
Emergency Power Generation		1	1
Fire Protection		1	1
Low Pressure Core Spray		1	1
Residual Heat Removal		1	1
TOTAL TRAIN OCCURRENCES			16

APPENDIX A: EVENT SUMMARIES FOR FERMI EVENTS INCLUDED IN THIS REVIEW

341/87-001. (Mode 1, 10% power, 87/01/26)
While performing calibration activities for the Reactor Water Cleanup System an automatic ESF isolation occurred. This event was caused by a shared personnel error by the Nuclear Assistant Shift Supervisor (NASS) and the repairman and resulted from a lack of communication between them. The NASS assumed that the repairman was going to adjust the needle-zero for a temperature gage while the repairman thought (because adjusting the needle-zero may change the instrument calibration) that the instrument was also to be recalibrated.

341/87-002. (Mode 1, 29% power, 87/02/26)
A ground fault occurred in the iso-phase bus cooling duct because an assembly aid (left in after assembly was complete) failed and contacted the iso-phase bus. During the scram recovery the start-up level control valve failed to transfer to the automatic mode due to a failed relay on a control board in the Post Scram Feedwater Logic Sequencer.

341/87-003. (Mode 1, 20% power, 87/02/02)
The allowed test interval expired for performing the leak rate testing for the primary containment hatch airlock. The airlock was immediately tested and failed the test. This event was caused by a non-licensed, utility, personnel error which involved the incorrect logging of the airlock leak rate testing as complete, and resulted from inadequacies in the procedure. The airlock was repaired and the surveillance procedure was revised.

341/87-004. (Mode 1, 18% power, 87/02/04)
During the performance of a process radiation monitor test, the Division I Control Center Heating Ventilation and Air Conditioning system shifted to the recirculation mode of operation. The repairman withdrew the radiation monitor to gain better access and caused the shift to the recirculation mode. The repairman was counseled.

341/87-005. (Mode 1, 17% power, 87/02/12)
A differential flow alarm was caused by leakage through an Reactor Water Cleanup System (RWCU) filter gasket and RWCU was isolated. The failed gasket was replaced.

341/87-006. (Mode 1, 16% power, 87/02/11)
The HPCI pump turbine failed because the governor bearing oil supply valve was closed and the governor bearing failed. Also, the thrust bearing oil supply valve was repositioned. It was necessary to declare RCIC inoperable in order to perform a surveillance of the repaired HPCI system. It is postulated that the valves were inadvertently miss-positioned during maintenance. The surveillance procedure was revised to include a check of the oil pressure.

341/87-007. (Mode 3, 0% power, 87/03/17)
In order to establish shutdown cooling, it was necessary to pre-warm the Residual Heat Removal System (RHR) from an alternate injection line. As a result the RHR was being drained using a four-inch line while being fed with a one-inch line. This caused steam flashing in the RHR system. The resulting level transient caused an RPS and ESF actuation. The cause of this event was an inadequate procedure.

341/87-008. (Mode 1, 18% power, 87/03/01)
A partial loss of power to the turbine control system caused the steam bypass valves to close. An automatic scram occurred. This event was caused by an error committed by the utility-licensed NASS while attempting to reset the governor trouble alarm. An inadequacy in the procedure also contributed to the event.

341/87-009. (Mode 4, 0% power, 87/03/25)
The Residual Heat Removal (RHR) system was operating in shutdown cooling mode when the inboard isolation valve closed. Shutdown cooling was restored in 35 minutes. The most probable cause was an intermittent failure of the master trip unit.

341/87-010. (Mode 4, 0% power, 87/04/03)
Discrepancies exist in the re-qualification of some licensed operators. These discrepancies include incomplete classroom training, missing some required biennial reactivity manipulations, performing shift duties without passing the re-qualification examination and errors in the license renewal applications. The problem was caused by inadequate administration of the past re-qualification program.

341/87-011. (Mode 1, 31% power, 87/04/06)
While performing a surveillance procedure on the APRM B Channel, an RPS actuation and ESF isolation occurred. The I&C technician inadvertently removed the trip reference card for the A Channel. The technician was counseled and the procedure will be revised.

341/87-012. (Mode 1, 30% power, 87/04/10)
A blown fuse rendered several HPCI and RCIC isolation instruments inoperable. A failed trip unit caused the fuse to blow. HPCI and RCIC were available for service throughout the event.

341/87-013. (Mode 4, 0% power, 87/04/21)
Various degrees of cracking had occurred on some fan motors for the reactor building cooling units. The cooling units were still operable. The cracking has been attributed to the weight of the oversized termination box along with the cable and conduit. Additionally motor vibration and over-tightening of the mounting bolts also contributed to the failure in some instances.

341/87-014. (Mode 4, 0% power, 87/04/26)
An informational pressure test was being performed on various reworked instrument lines. Due to leakage, the lines became pressurized and caused an RPS actuation. This event was attributed to the lack of a procedure. An existing procedure will be revised to include information pressure testing.

341/87-015. (Mode 4, 0% power, 87/04/16)
The boric acid storage tank outlet valve was opened prior to closing the test tank outlet valve during the performance of a surveillance test. This action cross connected the test tank and the storage tank. The steps in the procedure were performed out of sequence. This event was caused by cognitive non-licensed, utility personnel errors.

341/87-016. (Mode 2, 0% power, 87/05/10)
A pressure transient in an instrument line caused a scram. The transient was induced in a reference instrument line when a repairman attempted to crack open its isolation valve. Previous training had reduced the number of these instances; however, multi-turn needle valves will be installed to improve the repairman's control.

341/87-017. (Mode 1, 18% power, 87/05/13)
A FW pump turbine tripped due to excessive vibrations. The vibrations were exaggerated because the turbine-casing drain valve was closed. The valve was closed during startup of the turbine due to an inadequate procedure. The procedure has been revised and the turbine will be repaired.

341/87-018. (Mode 1, 16% power, 87/05/20)
The packing for valve G33-F101 (RWCU reactor vessel bottom head drain line isolation valve) leaked and caused an increase in the drywell sump level. The reactor was shutdown in order to facilitate the repair.

341/87-019. (Mode 4, 0% power, 87/05/23)
A test frequency for a Standby Gas Treatment surveillance test was incorrectly entered into the surveillance scheduling computer program. As a result the test interval was exceeded by approximately 41 days. The test was performed successfully. The computer program was revised to indicate the correct test interval of 18 months instead of 24 months.

341/87-020. (Mode 1, 14% power, 87/05/28)
A cognitive non-licensed, utility personnel error caused an actuation of the Division II Emergency Diesel Generators. The repairman was apparently working in the wrong relay cabinet. The repairman was counseled and advised of the proper technique for performing resistance measurements.

341/87-021. (Mode 1, 32% power, 87/06/07)
Operations personnel failed to demonstrate that reactor coolant system leakage be within allowable limits. The surveillance test interval was exceeded by one hour. The test was successfully completed.

341/87-022. (Mode 1, 38% power, 87/06/01)
The Control Center Heating, Ventilating and Air Conditioning System shifted to recirculation mode when a fuse was removed in order to replace a solenoid valve. A licensed utility personnel did not adequately identify all equipment affected by removing the fuse. The licensed utility person was counseled.

341/87-023. (Mode 1, 44% power, 87/06/11)
RCIC isolated during a functional test because a repairman left a volt-ohm meter connected across a relay in the "D" channel of the isolation logic. After successfully completing the functional test, the repairman was counseled.

341/87-024. (Mode 1, 40% power, 87/06/25)
Arcing was observed from the slip rings of the motor-generator set exciter for the "B" reactor recirculation system pump. The arcing was due to a worn brush that was contacting the anode slip ring. The slip ring was resurfaced and the brushes replaced.

341/87-025. (Mode 3, 0% power, 87/06/25)
A pressure transient in an instrument line caused a scram and RHR and EDG actuation. The transient was induced in a reference instrument line when a repairman attempted to crack open its isolation valve. Previous training had reduced the number of these instances; however, multi-turn needle valves will be installed to improve the repairman's control. Reference LERs 341/87-016, 86-033, 85-073, 85-067, 85-030, 85-021, 85-015, 85-014, 85-005.

341/87-026. (Mode 3, 0% power, 87/06/25)
RWCU isolated due to heat migration while blowing down the reactor vessel via the RWCU without the RWCU pumps in service. This is an expected result. An evaluation of the need to revise the RWCU system operating procedure is being made.

341/87-027. (Mode 4, 0% power, 87/06/26)
An operator (under instruction but not yet licensed) failed to take timely action to report or control the increase in reactor coolant temperature and the reactor entered mode 3. The temperature was reduced after approximately 3.5 hours. No actions to reduce temperature were taken until approximately 3 hours after the reactor coolant temperature exceeded 200 degrees. Corrective actions consisted of disciplinary actions against personnel, proposed modifications to annunciators and displays, revision of procedures, issuance of guidance to plant personnel, examination of shift personnel on duty, and communication with all site personnel on this incident.

341/87-028. (Mode 4, 0% power, 87/06/27)
During the performance of a surveillance test on the Emergency Equipment Cooling Water System an automatic initiation was received. The EECW pumps were already running so the only response was isolation of the non-essential loads. The control room operator manually restored cooling to the non-essential loads; then the surveillance test was completed successfully. The procedure was in error because of an inadequate temporary change. The person responsible for the temporary change (non-licensed utility) had just returned to day shift after working night shift.

341/87-029. (Mode 1, 47% power, 87/06/15)
When one EDG is unavailable, tech specs require that the circuits between the offsite power network and the Class 1E distribution system were operable. This was not done because of a misinterpretation of the surveillance requirement (only step 5 was performed when steps 5 and 6 should have been performed).

341/87-030. (Mode 1, 40% power, 87/07/05)
HPCI failed to meet its time to rated flow criteria of 30 seconds. During diagnostic testing the HPCI experienced a pressure surge of 800 psig (design pressure 100 psig). A walkdown of the HPCI determined that only one hanger was damaged. The cause of the event was a slow acting check valve--when the HPCI pumps tripped during diagnostic testing the FW system overcame HPCI flow and over-pressured the HPCI system. The check valve was changed from a lift type to a swing type. The hanger was modified to withstand the greater analyzed stresses.

341/87-031. (Mode 1, 48% power, 87/07/20)
A false high vibration signal for the main turbine generator caused a turbine control valve fast closure which resulted in a scram. The false signal was caused by a loose shaft rider sensor connection due to a defective Weidmuller Terminal Block.

341/87-032. (Mode 1, 29% power, 87/07/26)
The Control Center Heating, Ventilation and Air Condition System spurious shifted from normal to the chlorine mode. This shift was caused by the use of a two-way radio. The surveillance procedure for Fire Detection Operability and Functional Test will be revised to provide for the use of two-way radios with a wired remotely located antenna.

341/87-033. (Mode 2, 1% power, 87/07/29)
The RWCU was isolated (an ESF actuation) when this system was being used to help set the closed limit switch for the outboard feedwater check valve. A licensed utility operator used an incorrect procedure (Section 4.1 of SOP 23.707) instead of the correct procedure (Section 4.16 of SOP 23.707). The operator involved will be disciplined.

341/87-034. (Mode 2, 2% power, 87/07/30)
Fire brigade practice sessions were not being held at intervals of one year as required. The cause of this event was a misinterpretation of the requirements.

341/87-035. (Mode 2, 3% power, 87/07/31)
As a result of leakage from a FW checkvalve in excess of 4.2 liters per minute, the reactor was being shutdown when reactor level oscillations caused an increase in reactor power due to positive reactivity. The operator was not able to switch the IRMs upscale quickly enough to prevent a scram. The check valve was fixed, and a review of the operating procedure will be made. Clarification of the use of the turbine bypass valves for pressure reduction during normal shutdown sequences will be incorporated. Additional training in plant depressurization will be given.

341/87-036. (Mode 4, 0% power, 87/08/02)
Due to operator error while attempting to fill and vent the RHR system, a level three scram signal was received due to low reactor pressure vessel water level. Six steps in the procedure were not performed that were required prior to an attempt to fill and vent the RHR system. The personnel involved in this incident were counseled.

341/87-037. (Mode 4, 0% power, 87/08/04)
The inboard MSIVs closed inadvertently during a transfer of the RPS bus power sources. The closure was caused by an inadequacy in a procedure which did not instruct the operator to energize the inboard MSIVs' AC solenoid after transferring bus power sources. The operating procedure was revised.

341/87-038. (Mode 4, 0% power, 87/08/15)
The Reactor Building Closed Cooling Water (RBCCW) system was being used to provide cooling water for the Division I and II Emergency Equipment Cooling Water (EECW) system. The return header isolation valve for the Division II EECW was stroked for post maintenance testing. As a result of the pressure transient the RBCCW pumps tripped and Division I EECW automatically actuated (an ESF actuation). The cause of this event is an RBCCW/EECW system design inadequacy that did not respond to pressure changes quickly enough. The design could not provide adequate pressure compensation.

341/87-039. (Mode 4, 0% power, 87/08/07)
The "A" backup manual scram breaker failed to trip when a transfer of RPS bus A power was made from the alternate to the normal power supply. The breaker had failed. This event was caused by inadequate instructions (Vendor's technical manual) and poor work practices during assembly of the undervoltage coil to the breaker by plant non-licensed utility personnel. The vendor's manual will be revised.

341/87-040. (Mode 4, 0% power, 87/08/27)
MG set A tripped and resulted in a loss of power to RPS bus A and a Division I isolation signal (Division II was tripped for an on-going surveillance test in the main steam line tunnel. The MSIVs and the main steam line drain valves closed. During trouble shooting, an electrician dropped a digital voltmeter lead. The resultant short caused isolation of several unspecified ESF systems. No cause has been determined for the MG trip.

341/87-041. (Mode 4, 0% power, 87/03/29)
A review of the Standby Gas Treatment (SGTS) system revealed that the Division II Accident Range Monitor (AXM) channel parameters were set at incorrect default values. This resulted in monitor readings in "counts per minute" rather than "microCuries per cubic centimeter". The cause of this event was inadequate AXM and system particulate, iodine and noble gas radiation monitor turn-over following preoperational testing. This resulted in inadequate surveillance and test/preventative maintenance procedures.

341/87-042. (Mode 4, 0% power, 87/09/28)
The Control Center Heating, Ventilation and Air Condition System spurious shifted from normal to the chlorine mode. This shift was most likely caused by the use of a two-way radio. Signs have been posted stating that radios should not be used in the area, construction radios have been removed, and operations radios have been put under the control of operations personnel. A new design for the chlorine detectors is being developed. Reference LER 341/87-032.

341/87-043. (Mode 4, 0% power, 87/09/02)
The Control Center Heating Ventilation and Air Conditioning (Division I) shifted from the normal mode of operation to the recirculation mode. Division I of the Standby Gas Treatment System (SGTS) automatically initiated. Investigation and analysis of this event is continuing in an effort to define the mechanism causing this event.

341/87-044. (Mode 4, 0% power, 87/09/03)
Ten test, vent and drain connections (TVDs) were not being verified as "locked closed" at least once every 31 days. This condition was caused by inadequacies in two surveillance procedures. The procedures did not receive adequate technical review or adequate research during their development.

341/87-045. (Mode 4, 0% power, 87/09/08)
An incorrect fuse was removed and power was lost to bus 72CF. (The motor control center 72CF provides power and control to seven LPCI valves.) A utility licensed operator identified the wrong fuse to be removed. When the operator in the field removed the fuse, DC control power was lost to bus 72C. This loss also revealed a design error in the DC control logic for the LPCI swing bus source breakers (i.e. the bus would not swing over to Division II under all LOSP plus single failures).

341/87-046. (Mode 4, 0% power, 87/08/20)
Raychem heat-shrinkable tubing was improperly installed on cables in the EECW, HPCI, RHR and containment (torus to reactor building vacuum breaker isolation valves) systems. This condition was caused by inadequacies in the training of Raychem installers, lack of inspection requirements and previous specification deficiencies. The training program will be upgraded.

341/87-047. (Mode 4, 0% power, 87/09/17)
A surveillance test was not performed on the Control Center Heating Ventilating and Air Conditioning (CCHVAC) chiller pump and valve. The equipment was out of service for maintenance activities and upon return to service these surveillance tests were not performed--these periodic tests became due during the maintenance activities. This event was caused by an inadequacy in the training and practices of the operators in the tracking of technical specification surveillances for out of service equipment.

341/87-048. (Mode 4, 0% power, 87/10/08)
The tech spec requirement to perform a channel check for the RPS drywell high pressure instruments was not being met. None of the RPS drywell high pressure channels were included in a surveillance procedure. The procedure was revised.

341/87-049. (Mode 4, 0% power, 87/09/25)
Three deficiencies in the fire protection program were identified: (1) re-qualification training was not being performed on schedule, (2) a fire protection valve was in its correct position, but not locked, and (3) a control room operator indicated to an NRC inspector that he would take actions contrary to approved procedures on activating the fire brigade upon receipt of a fire alarm. The cause of these deficiencies was inadequate training and an incomplete procedure (for the valve to be locked).

341/87-050. (Mode 4, 0% power, 87/09/26)
There were 10 cases, totaling 18 hours and 5 minutes, when the RWCU heat exchangers were bypassed, or when it could not be proven that they were not bypassed, while the reactor coolant temperatures were greater than 450 degrees without feedwater flow. The RWCU returns water to the loop "B" feedwater piping. The design temperature for this piping is 450 degrees and the normal operating temperature is 420 degrees. Therefore a condition outside the design basis occurred. These conditions were caused because the engineering department failed to identify this limitation so that proper restrictions could be included in the operating procedures. It was concluded that past operation in this mode has had no adverse effect on the feedwater system. The RWCU operating procedure has been revised.

341/87-051. (Mode 4, 0% power, 87/09/29)
The Emergency Equipment Cooling Water (EECW) and Emergency Equipment Service Water (EESW) systems actuated on a low differertial pressure signal sensed in the Reactor Building Closed Cooling Water (RBCCW) system. This occurred when a third RBCCW pump was put into service in preparation for switching pumps. This pressure transient is approximately 3 seconds long (the delay before EECW and EESW actuation is 1.5 seconds). This condition is considered a design deficiency. A longer time delay before ESF actuation will be incorporated into the actuation logic.

341/87-052. (Mode 1, 50% power, 87/10/17)
Four isolation valves for the primary containment radiation monitoring system (PCRM) skid were not identified as containment isolation valves and failed to provide isolation. The event was caused by a lack of communications within Detroit Edison and with the NRC. These valves were viewed as isolations in instrument lines. While Detroit Edison believed that the NRC was aware at the time of this position, no written documentation has been found that shows the NRC concurrence.

341/87-053. (Mode 1, 49% power, 87/10/24)
The drywell pressure Division I, Channel A was inoperable for longer than 2 hours without inserting a half-trip signal during a response time surveillance test of this channel. The time constraint was violated because there was a failure to recognize the discrepancy between the two hour tech spec limit and the estimated six to eight hours needed to perform the surveillance test. As a result, a checklist was developed as a guide for the performance of this surveillance test.

341/87-054. (Mode 1, 72% power, 87/12/17)
During calibration of the reactor building ventilation exhaust radiation monitor and upscale radiation signal was received. An I&C technician saw arcing between a jumper and a terminal as the jumper was positioned. The cause of this event was poor equipment accessibility. The location and design configuration of the terminals made it very difficult to install the jumpers. This allowed the jumper to touch an adjacent terminal and blow the power supply fuse.

341/87-055. (Mode 1, 66% power, 87/12/10)
An isolation of RCIC occurred while the RCIC steam line was being warmed. The isolation valves closed on high differential steam line pressure. The isolation was due to an inadequacy in the system operating procedure. This procedure was revised.

341/87-056. (Mode 1, 75% power, 87/12/31)
During modifications for the temporary installation of a monitor and printer, a wire contacted the cabinet and the indicated FW flow was reduced by 50%. The FW system increased FW flow and the reactor scrammed on high reactor water level. During the recovery, the RWCU pumps tripped--a gravity drain path was established. This event was caused by a non-licensed utility personnel error.

341/88-001. (Mode 4, 0% power, 88/01/03)
The average power range monitors (APRM) were set at 34% power instead of 20% power or less due to a calibration error. The calibration error was caused by an inadequate procedure.

341/88-002. (Mode 4, 0% power, 88/01/04)
All four outboard MSIVs closed due to (1) an I&C technician failing to re-energize the DC solenoids for these valves, and (2) another technician misinterpreted a procedure. The procedure will be revised.

341/88-003. (Mode 4, 0% power, 88/01/05)
The Tech Spec setpoints for the RHR valve-leakage monitor were incorrect due to personnel error during preparation of the calculations that determined this setpoint.

341/88-004. (Mode 1, 49% power, 88/01/10)
A FW pump failed because the speed-control power-supply failed. The over-voltage trip for the power supply had been improperly set by a contractor and drifted into the normal operating range.

341/88-005. (Mode 2, 0% power, 88/01/11)
The reactor vessel pressure exceeded 150 psig without HPCI or RCIC operable due to an error by the Nuclear Shift Supervisor. Individual was disciplined.

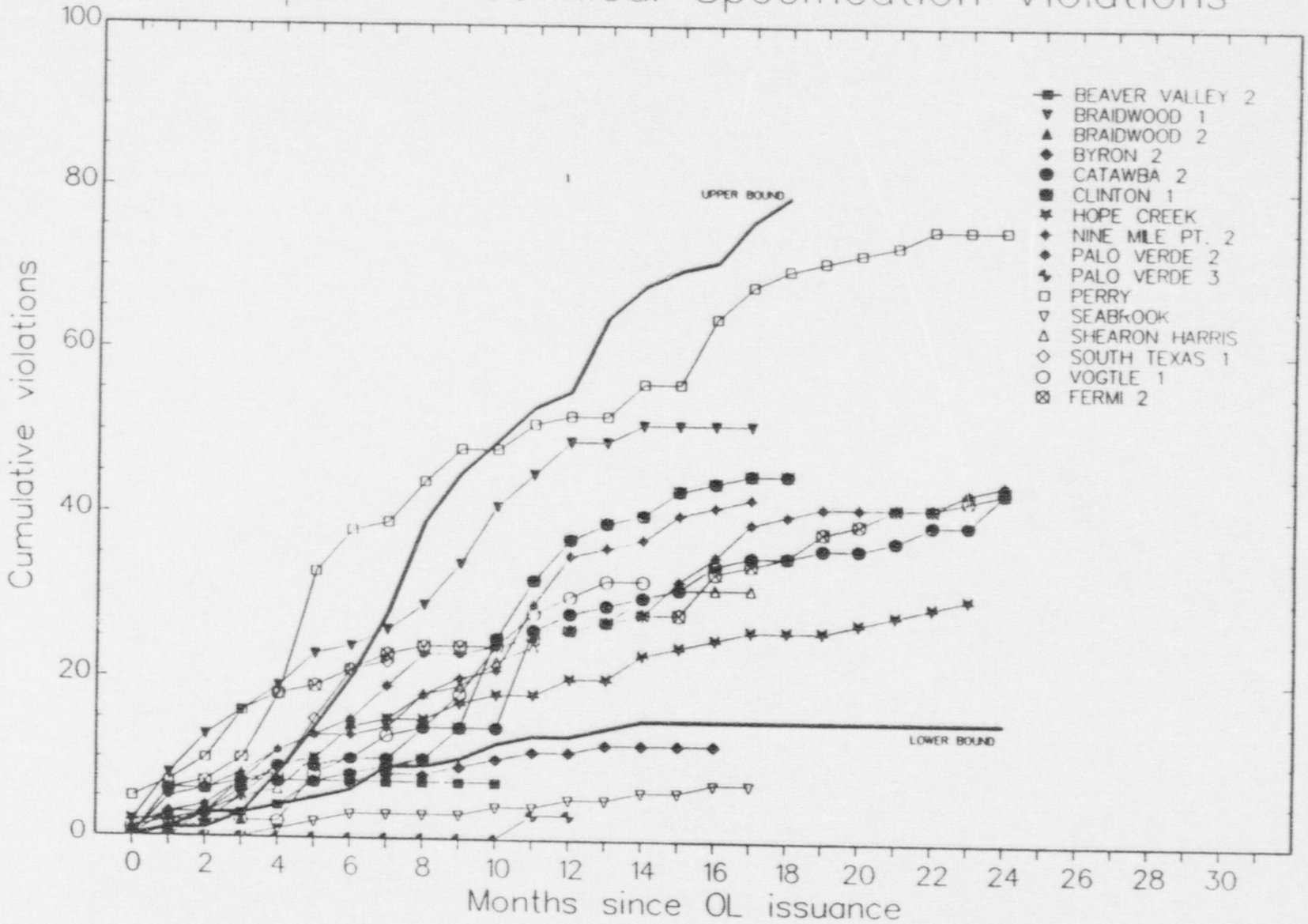
341/88-007. (Mode 1, 64% power, 88/02/14)
The radwaste building ventilation shutdown and the control center heating ventilation and air condition system shifted to the recirculation mode due to personnel error during repair of a radwaste monitor. The event was caused by an improper review of the system functions prior to performing work. The personnel were disciplined.

ATTACHMENT 4
SUMMARY OF RECENT 50.72 EVENT REPORTS FOR FERMI 2

DATE	RE NUMBER	CAUSE GROUP	DESCRIPTION
04/18/88	12046	Poor job planning	During plant mod. listed valve isolations did not agree with actual valve isolations when fuse pulled.
04/17/88	12037	Personnel error	Tech lifts wrong lead.
04/09/88	11988	?	RHR found isolated.
03/23/88	11831	Security	ENS phones out.
03/20/88	11807	Poor job planning	During surv. test EDG start due to omission in procedures of switch disconnect step.
03/18/88	11792	Poor job planning	During maint. RHR S/D valve closure when power supply deenergized.
03/18/88	11786	Security	---
03/17/88	11774	?	Instr. valve found closed.
03/11/88	11732	Equipment	SRV setpoint drift.
03/11/88	11722	Poor job planning	HVAC ESF actuation on backup battery failure due to length of mod. work.
3/07/88	11688	Security	---
02/29/88	11637	Personnel error	During bus shift RHR lost due to missed identification of valve on list of affected valves.
02/29/88	11633	Equipment	MSIVs fail LLRT.
02/28/88	11623	Equipment	Failed Swagelok fitting.
02/26/88	11612	Poor procedure	Degraded voltage mode test of EDG never included in procedure.
02/26/88	11607	Security	---
02/23/88	11578	?	HPCI iso. during test.

DATE	RE NUMBER	CAUSE GROUP	DESCRIPTION
02/22/88	11571	Security	ENS phone out.
02/22/88	11570	Security	---
02/14/88	11506	?	HVAC ESF actuation during troubleshooting.

Composite Technical Specification Violations



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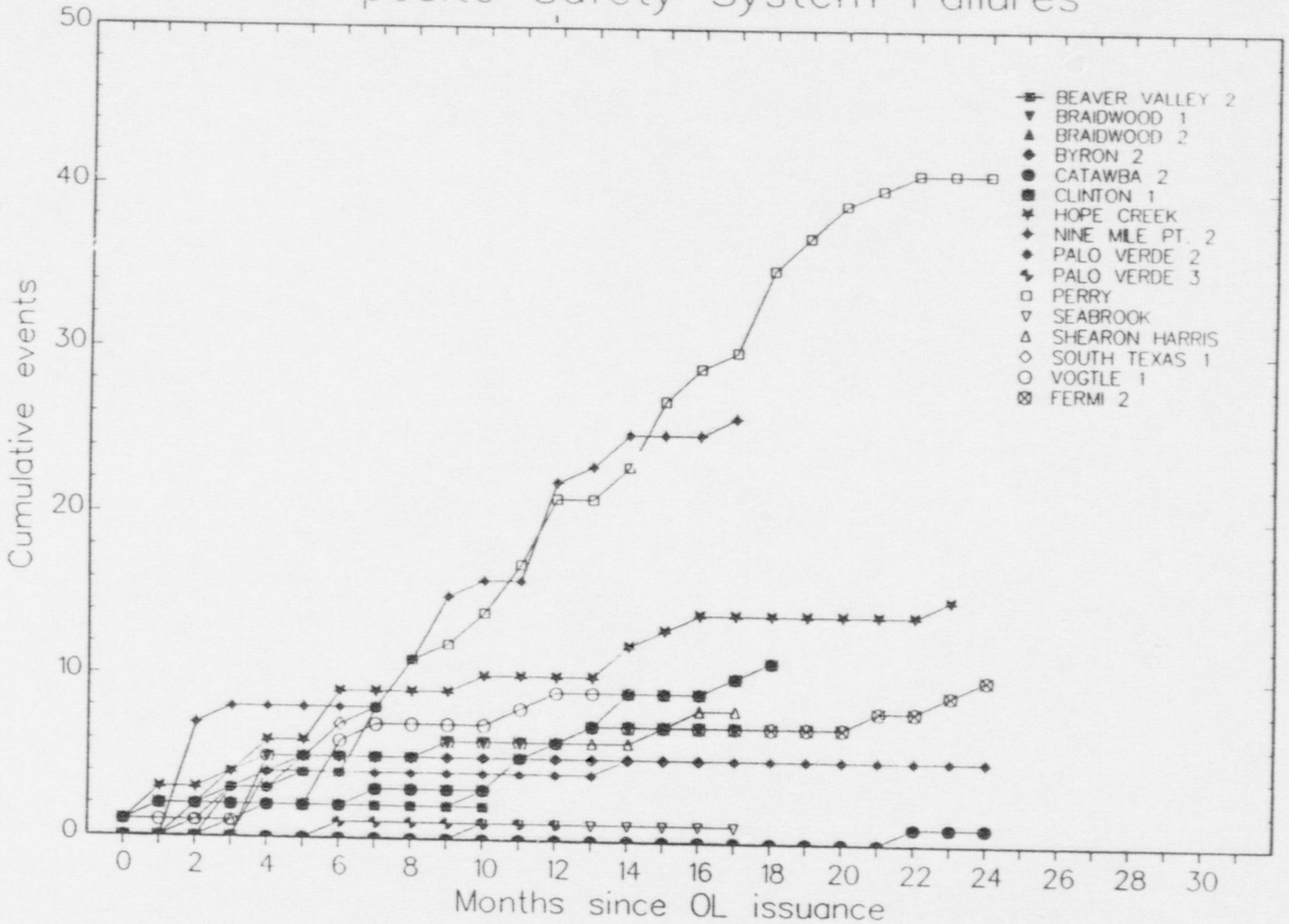
05/04/88

Composite Safety System Failures



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05/04/88

ATTACHMENT 2
BASIC EVENT CAUSE DISTRIBUTION 1987-1988

EVENT TYPE: Reactor Scrams

Basic Cause	1987 Mature	1987 New	1987 Fermi 2	1988 Mature	1988 New	1988 Fermi 2
Personnel Error	25%	27%	36%	23%	39%	---
Procedure	8%	14%	29%	13%	8%	---
Equipment	58%	47%	29%	50%	48%	100%

EVENT TYPE: ESF Actuations

Basic Cause	1987 Mature	1987 New	1987 Fermi 2	1988 Mature	1988 New	1988 Fermi 2
Personnel Error	32%	32%	31%	27%	34%	10%
Procedure	11%	17%	17%	17%	11%	30%
Equipment	45%	46%	23%	45%	44%	50%

EVENT TYPE: Technical Specification Violations

Basic Cause	1987 Mature	1987 New	1987 Fermi 2	1988 Mature	1988 New	1988 Fermi 2
Personnel Error	52%	66%	32%	48%	72%	25%
Procedure	25%	23%	64%	29%	17%	75%
Equipment	19%	9%	---	18%	11%	---

EVENT TYPE: Safety System Failures

Basic Cause	1987 Mature	1987 New	1987 Fermi 2	1988 Mature	1988 New	1988 Fermi 2
Personnel Error	14%	13%	25%	19%	7%	67%
Procedure	11%	13%	17%	2%	7%	---
Equipment	61%	62%	43%	62%	68%	33%