

INPO SOERS, SERs, SENS, OES
SEN 174

STATUS: CLOSED UNIT: 0 SYSTEM: XX INITIATED: 11/10/97 CLOSED: 10/24/00
IN BY: HENRY JOYCE ADMINISTRATOR: JAMES PULVERMACHER
NUMBER OF OPEN ACTIONS: 0 NUMBER OF CLOSED ACTIONS: 6

MSS #:
ISSUE MANAGER: BRIAN OGRADY
TOTAL NUMBER OF ACTIONS: 6

LOSS OF NONVITAL BUS CAUSES DUAL UNIT SCRAM AND DEGRADED AUXILIARY FEEDWATER SYSTEM

DESCRIPTION:

***** SEE E-MAIL CONF "NP-INPO-NETWORK-IS" FOR FULL TEXT *****

Subject: SEN 174, Loss of Nonvital Bus Causes Dual Unit Scram and Degraded Auxiliary Feedwater System

November 10, 1997

Description

On September 6, 1997, both McGuire units automatically scrambled from 100 percent power when the alternate supply breaker to nonsafety-related 120-volt AC instrument and control power bus KXA opened, stripping control power to several important plant components in each unit. The loss of nonvital power caused Unit 1 main feedwater pumps to trip, resulting in a turbine trip and automatic reactor scram. The loss of nonvital power on Unit 2 caused the main steam isolation valves to close, resulting in an automatic reactor scram on high pressurizer pressure. About an hour later, power was restored to bus KXA, and affected secondary systems were subsequently returned to service.

At the time of the event, bus KXA was energized from its alternate transformer power supply while the inverter battery was undergoing an equalizing charge. This alternate alignment is normally used only during this annual equalizing charge. The breaker supplying the bus that was feeding both units opened because a loose cable connection on the load side of the breaker generated enough heat to actuate the thermal trip unit. No preventive maintenance had ever been performed on the breaker. Station personnel believe that the loose connection had existed since construction.

Power was lost to various equipment in each unit. The most significant effects were in Unit 1 and included the following:

o Power was lost to the solenoid-operated recirculation valves for all three auxiliary feedwater (AFW) pumps and to the main control board indication for these valves. To provide adequate pump cooling, the motor-driven AFW pumps require a minimum of 100 gallons per minute (gpm) flow, and the turbine-driven AFW pump requires 200 gpm. As water level is recovered in the steam generators and the operator manually throttles back AFW flow, the recirculation valves are designed to open automatically to provide the minimum flow through each pump. However, these valves fail closed by design. With power lost to both the solenoid valves and their associated indicators on the main control board, the AFW pumps were operated for 20 to 60 minutes with both recirculation valves and main flow control valves closed. However, leakage through the flow control valves resulted in approximately 12 gpm flow through each pump. Only because of this leakage and the limited period of operation was AFW pump damage caused by overheating precluded.

o Pressurizer power-operated relief valve automatic control was lost, but manual operability was not affected.

o Normal and excess letdown flow capability was lost, potentially affecting the ability to prevent overfilling the pressurizer.

o Capability to perform normal containment air releases was lost, resulting in slight containment pressurization.

Significant aspects of this event include the following:

o An installation deficiency on the alternate power supply breaker resulted in both units experiencing simultaneous automatic scrams and lost availability.

o The design of the AFW power supply represents a common cause failure mechanism where a loss of power to the nonsafety-related bus resulted in both a loss of power to the AFW pump recirculation valve solenoids and the associated indication on the main control board.

o There was no procedure specific to the loss of nonvital buses for the operators to use during the event. Consequently, with the loss of recirculation valve position indication, operators were not aware of the potential for damaging the AFW pumps. A list of loads supplied by the nonsafety-related bus was not readily available for operators.

o Operators had received classroom training on the effects of a loss of nonvital buses in initial licensed operator training. However, they had not received subsequent simulator training on a loss of nonvital buses during continuing training. The need for a procedure to help mitigate this transient had been identified, and a draft written, but a final procedure had not been issued.

o No preventive maintenance activities had been established for the auxiliary control power system bus or associated breakers because both units would have to be shut down to deenergize the bus. On-line preventive maintenance was considered but not performed because of personnel safety issues.

o A similar event occurred at Unit 2, on September 6, 1987, involving a loss of power to the other nonvital bus (KXB), resulting from an overcurrent fault in an instrument air compressor. However, the investigation into that event concentrated on venting similar compressor motor faults. An opportunity was missed to identify the risk of being in the alternative alignment and the need for preventive maintenance, operating procedures, and training. The potential for damage to the AFW pumps, the common-cause failure was identified as a concern during station blackout (potential foreventual loss of battery power); however, operator actions for other nonvital bus failure scenarios were not addressed in abnormal operating procedures.

o During work preparation and planning activities, station personnel focused on minimizing risks to losing the alternate power supply during the maintenance activity. Placing the bus on its alternate power supply was not considered a significant risk.

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evolution and the prejob brief primarily emphasized protecting bus KXA from being bumped by station personnel. The prejob brief did not adequately inform the operators of the necessary contingency actions needed if bus KXA was lost.

The event described in this significant event notification (SEN) was screened significant by INPO. The documents referenced below are sufficiently detailed such that INPO does not intend to publish a separate significant event report (SER); therefore, utilities should review this event

notification and implement corrective actions where necessary to avoid similar events.

References 1. NRC Licensee Event Report (LER) 369/97-09, "Reactor Trip on Both Units Due to an Equipment Failure and Operation Prohibited by Technical Specifications Due to Failure to Comply with Required Action Statement," October 6, 1997

2. NRC LER 370/87-16, revision 1, "Reactor Trip Due to Overcurrent Faults in an Instrument Air Compressor Motor - Caused Loss of Power to a Main Turbine Control System Relay," December 16, 1987

Plant Information Unit: McGuire Nuclear Station Unit 1 (Duke Power Company) Year Commercial: December 1, 1981 Reactor Type (Size): PWR (1,180 MWe) Reactor Manufacturer: Westinghouse Turbine Manufacturer: Westinghouse Plant Designer: Duke Power Company

Event Date: September 6, 1997

Equipment Information Name and Size: Two Motor-Driven Centrifugal Pumps (450 gpm capacity) One Steam-Driven Centrifugal Pump (900 gpm capacity)

Event Criteria Unusual Plant Transient

Installation Deficiency Maintenance Deficiency Procedure Deficiency Training Deficiency Design Deficiency

Cause Categories Construction (improper installation) Work Organization/Planning (maintenance not scheduled/performed) Written Procedure (lack of procedure)

Training/Qualification (lack of training) Design Configuration (inappropriate layout of systems or subsystems)

Malfunctioning Systems The 240/120-volt AC auxiliary control power system was classified as A(1) due to failing the plant level performance criterion for reactor trips.

Attachments

This document is based on technical information provided by Duke Power Company (McGuire Nuclear Station Unit 1). Utilities and participants are requested to provide feedback on similar occurrences and solutions at their plants or on their equipment to the information contact listed below.

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Keywords Auxiliary Feedwater System, Auxiliary Feedwater Pump, Loss of AC Power, Electrical Distribution System, Bus

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STATUS UPDATE:

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(20001024 WE1384 JRP1) Changes to plant Abnormal Operating Procedures have been submitted and will be tracked under the referenced Condition Reports.

SCREENED BY :

REGULATORY REPORTABLE.....(Y/N):
TS LCO ENTRY(Y/N):
REVIEW REQUIRED(Y/N):

DATE:

TS VIOLATION.....(Y/N):
OPERABILITY IMPACT PER TS.(Y/N):
SIGNIFICANCE (A B C D):

COMMITMENT.....(Y/N): N

10 CFR 21.....(Y/N):
ACTION(A N P R W):
OPERABILITY DETERMINATION.(Y/N):

SUP. .ING DETERMINATIONS:

ACTION NUMBER 1

DO.		DUE DATE: 01/10/98	PRIORITY: -100	EXTENSIONS MADE: 0
CREATED : 11/10/97	OER	TOM SHELLEY	RECEIVED: 11/14/97	EIS TOM JESSESSKY
WORK DONE: 12/10/97		KELLY HOLT	APPROVED: 01/06/98	TOM JESSESSKY
VERIFIED : 01/07/98		HENRY JOYCE	CLOSED : 01/07/98	TODD COOPER

Evaluate for applicability to PBNP in accordance with NP 5.3.2. Identify and initiate any necessary corrective actions. coordinate response with Operations.

(11/12/97 TPS) Issued to Group: EIS
Per Conversation with Kelley Holt. Kelley will evaluate the McGuire station event against PBNP's configuration. Note action item has a 60 day due date.

(11/14/97 TJJ) Received Action into Group: EIS
Responsible Person: KJH:KELLY HOLT Due Date: 01/10/98

(12/10/97 KJH) Passed to TOM JESSESSKY for acceptance of work.

(01/06/98 TJJ) Passed to HENRY JOYCE for Verification.
Point beach has four safety-related instrument bus trains for each Unit, which are normally supplied from static inverters. These instrument busses are designed to be automatically transferred to a non safety-related backup supply upon an inverter failure. An 8-hour LCD is in effect whenever a safety related instrument bus is being supplied from the backup source. The backup source is designed to be used only to prevent the loss of power to an instrument bus in the event of an inverter failure. The backup source supplies power only until the affected busses are manually aligned to an inverter supply. Safety related alternate inverters are available to take the place of the normal inverters during routine maintenance or repair of the normal inverters. A swing safety-related battery is available to take the place of any of the normal safety-related batteries to allow for discharge testing or equalizing charges.

Point Beach has two non safety-related instrument busses for each unit. These busses are supplied from offsite power through transformers. One of these busses for each unit is supplied from a bus with a diesel backup supply.

Tabulations of the loads supplied from the safety-related and non safety-related busses are available to control room personnel. Operators receive training on the effects of the loss of power to these busses.

All of the instrument bus breakers have been replaced within the last four years. Connections were torqued upon breaker placement. A program is in place to perform breaker testing every five years. An analysis to determine the effects of the loss of power to many instrument bus loads was completed as part of the breaker replacement effort.

A detailed analysis of the effects of the loss of power to each instrument bus at Point Beach is not available to Operations personnel. A new action item could be initiated to complete this analysis and provide additional Operator training, if necessary. The PLA should review the operations evaluation to determine if Operations needs the detailed analysis.

This evaluation item is complete. No further actions required (with possible exception noted in paragraph above).

(01/07/98 HAJ) PLA Closure of Item.
see update field. Need for further action will be determined based on Operations response.

(10/22/98 TPS) After communicating with the new system engineer (J. Malloy), and Tom Garotit it was recognized that the initial response within action item #1 from the system engineer was adequate in identifying that no immediate corrective action was required outside of a non essential "recommendation" that a loss of instrument buss would be "beneficial" to the operators.

Both the new system engineer and the electrical crew DSS (Tom Garot) agree that a recommendation for a procedure to be developed to support the loss of an instrument buss is important but is not necessary to support closure of this SEN evaluation.

To generate the development of such a procedure a procedure feed back form has been generated by this evaluator to track the recommendation:

"Develop a procedure for operator response to a loss of instrument buss. Reference SEN 174 event."

ACTION NUMBER 2

DONE		DUE DATE: 01/10/98	PRIORITY: 3	EXTENSIONS MADE: 0
CREATED : 11/10/97	OER	JIM SCHWEITZER	RECEIVED: 12/05/97	OPS JOHN ANDERSON
WORK DONE: 08/17/98		THOMAS GAROT	APPROVED: 08/18/98	RICHARD MENDE
VERIFIED : 10/02/98		TODD COOPER	CLOSED : 10/02/98	MICHAEL ROACH

Evaluate for applicability to PBNP in accordance with NP 5.3.2. Identify and initiate any necessary corrective actions. Coordinate response with Engineering.

(11/24/97 JGS) Issued to Group: EIS

Tom please assign this for evaluation. Information on the event is included in the parent document.

(12/05/97 KMY) Received Action into Group: EIS
Responsible Person: WAH:BILL HENNIG Due Date: 01/10/98

(10/97 WAH) Changed Responsible Person: From (WAH) to (HAJ)
Changed Responsible Group: From (EIS) To (OER).
Changed Responsible section: From (SEN) To (QAS).. Action item 2 is supposed to be assigned to Operations with the intention to coordinate with Engineering (Kelly Holt has been assigned action item 1). This is per direction of TJ Jessesky.

(12/11/97 FPH) Changed Responsible Person: From (HAJ) to (RGM)
Changed Responsible Group: From (OER) To (OPS).
Changed Responsible section: From (QAS) To (PRD)..

(12/15/97 TPS) Changed Responsible Person: From (RGM) to (TWG). Task assigned per "E" mail communication from engineering (K. Holt).

(05/15/98 SJN) Set Work Priority to 3. Significance level 3 assigned by the BST based on the guidance of NP 5.4.1, Attachment B. The reason for the assigned significance is that this item is an evaluation of a SEN.

(08/15/98 TWG) Have not seen evaluation on this issue. However, I recommend procedures be developed to restore power and recover equipment for the Non-vital 4160 + 480 volt busses and associated MCCs. We have AOPs in place for the vital busses and also for the DC system. The procedure upgrade project is developing System Operating Procedures for all the Vital and non-vital busses but these are designed for planned outages not off-normal events. The non-vital instrument busses 1+2 Y05 are powered from B-41s which are non-vital MCCs.

(08/17/98 TWG) Passed to RICHARD MENDE for acceptance of work.

(08/18/98 RGM) Passed to MICHAEL ROACH for Verification.
Completed review and provided recommendations.

(10/02/98 TAC) PLA Closure of Item.
Action #4 has been created and sent to OPS for the creation of the procedures discussed in this evaluation. No further actions were identified as being required. This action item may be closed.

ACTION NUMBER 3

DONE		DUE DATE: 01/10/98	PRIORITY: -100	EXTENSIONS MADE: 0
CREATED : 11/10/97	OER	HENRY JOYCE	RECEIVED: 11/13/97	TRPSA LARRY EPSTEIN
WORK DONE: 01/06/98		MARK RINZEL	APPROVED: 01/06/98	MARK RINZEL
VERIFIED : 01/08/98		HENRY JOYCE	CLOSED : 01/08/98	HENRY JOYCE

evaluate "Prevent Events" section of this SEN for training applicability.

(11/13/97 LDE) Received Action into Group: TRPSA
Responsible Person: LDE:LARRY EPSTEIN Due Date: 01/10/98

(12/03/97 MDR) Changed Responsible Person: From (LDE) to (MDR).

(12/03/97 MDR) TWR 97-337 has been issued and actions 1 + 2 under the TWR will evaluate Training needs/enhancements in the Operations and ESP areas. Recommendations for action will be made based on these evaluations.

(01/06/98 MDR) Passed to LARRY EPSTEIN for acceptance of work.

(01/06/98 MDR) Passed to HENRY JOYCE for Verification.
This item was evaluated for applicable and potential inclusion into Training programs under TWR 97-337. The results of this evaluation show that there is some applicability to PBNP and it warrants inclusion into the group meetings for both SEN and NES. This will be accomplished at the February group meetings as part of the OE discussions. Therefore, it is recommended that an action item be issued to R. Bauer, with a due date of 3/31/98, to ensure that the Prevent Events of SEN 174 are included in the upcoming SEN and NES group meetings/discussions. No further action is needed for this item and it may be closed.

(01/08/98 HAJ) PLA Closure of Item.
see update field and NUTRK TWR 97-337

REFERENCES: TWR 97-337

ACTION NUMBER 4

DONF		DUE DATE: 12/31/98	PRIORITY: 4	EXTENSIONS MADE: 0
CR	: 10/02/98	OER TODD COOPER	RECEIVED: 10/22/98	OPS BRIAN OGRADY
WO.	NE: 06/24/99	STEPHEN GUCWA	APPROVED: 06/24/99	JOHN ANDERSON
VERIFIED	: 06/24/99	JOHN ANDERSON	CLOSED : 08/04/99	TODD COOPER

Based on the evaluation conducted in child records #1 + #2, develop procedures, for off-normal events, to restore power and recover equipment for non-vital 4160 + 480 V busses and associated MCCs. Document actions taken in response to this item.

(10/22/98 TPS) Received Action into Group: OPS
Responsible Person: TPS:TOM SHELEY Due Date: 12/31/98

(10/22/98 TPS) Set Work Priority to 4. INPO SEN for evaluation.

(10/22/98 TPS) After communicating with the new system engineer (J. Malloy), and Tom Garot it was recognized that the initial response within action item #1 from the system engineer was adequate in identifying that no immediate corrective action was required outside of a non essential "recommendation" that a loss of instrument buss and recovery procedure for non vital AC busses would be "beneficial" to the operators.

The differences between PBNP and the McGuire station is that PBNP safety related instrument busses are supplied by safeguards power and battery backup and McGuire's were not.

Although there is an alternative non safety related (non battery supported power supply to support instrument bus auto transfers, this system is not employed unless a safeguards inverter fails. If this transfer occurs a TS declaration of a LCO would be required.

(10/22/98 TPS) Passed to JOHN ANDERSON for acceptance of work.

(10/27/98 RGM) Returned to TOM SHELEY for additional work.

(10/27/98 RGM) I believe that ANSI requires procedures for these type of anticipated operational occurrences and as such, this item should not be closed.

(10/28/98 TPS) Changed Responsible Person: From (TPS) to (SGG). Attempts to close this action to procedure feed back submittal (not required for SEN closure) was not accepted. This is a AOP issue and needs to be resolved or corrected by the EOP / AOP procedure group.

/24/99 CAW1) Passed to JOHN ANDERSON for acceptance of work.

(06/24/99 JRA1) Passed to JOHN ANDERSON for Verification.
See CR update for additional information that justifies that all SEN corrective actions have been completed.

SEN 174 action item #4 identified a need to develop a procedure for off-normal events to restore power and recover equipment for non vital 4160 and 480 V busses and associated MCC's. This action came out of SEN 174 action item # 2. After discussing action item #2 closure with the responsible person (Tom Garot) he agreed that his recommendation was more of an operators opinion rather than an action that must be completed to address the SEN 174 event (MCGuire station loss of non safeguards / non battery supply inverters and critical control perimeters were lost). Tom agreed that the submittal of a procedure feed back form would be adequate to support his recommendation.

A procedure feed back has been submitted to:

Develop an operations procedure for off-normal events to restore power and recover equipment for non vital 4160 and 480 V busses and associated MCC's.

This action can be closed.

ADDITIONAL INFORMATION:

Operations has evaluated this item and has determined that it is a long-term project that will take three years to complete.

It is recommended that this action item be closed and two more created. One action item will go to Operations for tracking purposes. The other action item should go to Engineering for support of this project.

(06/24/99 JRA1) Passed to TODD COOPER for Final Close Out.
Verified.

(08/04/99 TAC) PLA Closure of Item.
Additional child records opened as required by Issue Manager.

ACTION NUMBER 5

DONE		DUE DATE: 12/31/99	PRIORITY: 4	EXTENSIONS MADE: 0		
CF	: 08/04/99	OER	TODD COOPER	RECEIVED: 08/06/99	OPS	BRIAN OGRADY
WC	LINE: 08/06/99	TOM SHELEY	APPROVED: 08/12/99	BRIAN OGRADY		
VERIFIED	: 08/12/99	BRIAN OGRADY	CLOSED : 08/13/99	TODD COOPER		

LOSS OF NONVITAL BUS CAUSES DUAL UNIT SCRAM AND DEGRADED AUXILIARY FEEDWATER SYSTEM

Based on the decision of the Issue Manager in child record #4, develop procedures, for off-normal events, to restore power and recover equipment for non-vital 4160 + 480 V busses and associated MCCs. Document actions taken in response to this item.

(08/06/99 TPS) Received Action into Group: OPS
Responsible Person: TPS:TOM SHELEY Due Date: 12/31/1999

(08/06/99 TPS) Set Work Priority to 4. Action supports station and department goals.

(08/06/99 TPS) Passed to BRIAN OGRADY for acceptance of work.

(08/12/99 BJO1) Passed to BRIAN OGRADY for Verification.
Discussions with the new Operations Manager has identified that this there appears to be limited value in tracking an action item for developing procedures for recovery of non safety related busses if it has already been identified in action item #1#2 that no corrective action is required to support the SEN, and the action is only tracking a procedure feed back recommendation.

The recommendation for the development of recovery procedures for NON safety related buses is already being tracked in operations to support other concerns / investigations. Both CR 97-1992 #2 (no AOP for Seismic Events) priority #4, and CR 98-0050 #43 (loss of offsite power) priority #2. are targeting the need for such procedure development.

This action can be closed to both CR 97-1992 #2 and CR 98-0050 #43. An update has been placed in both CR's identifying a reference to SEN 174 #5 as a reference.

This item can be closed.

(08/12/99 BJO1) Passed to TODD COOPER for Final Close Out.
This item can be closed.

(08/13/99 TAC) PLA Closure of Item.
The needed procedure development will be tracked under CR 97-1992 #2 and CR98-0050 #43. No additional actions are required.

REFERENCES: TWR 97-337 CR 97-1992 #2 CR 98-0050 #43

ACTION NUMBER 6

DONE		DUE DATE: 09/15/00	PRIORITY: 4	EXTENSIONS MADE: 2		
CREATED	: 08/04/99	OER	TODD COOPER	RECEIVED: 08/05/99	SDE	MICHAEL ROSSEAU
WORK DONE:		MICHAEL ROSSEAU	APPROVED: 08/04/00	MICHAEL ROSSEAU		
VERIFIED	: 08/18/00	BRIAN OGRADY	CLOSED : 10/24/00	JAMES PULVERMACHER		

LOSS OF NONVITAL BUS CAUSES DUAL UNIT SCRAM AND DEGRADED AUXILIARY FEEDWATER SYSTEM

Based on the decision of the Issue Manager in child record #4, assist Operation in the development of procedures, for off-normal events, to restore power and recover equipment for non-vital 4160 + 480 V busses and associated MCCs. Document actions taken in response to this item.

(08/05/99 LJA1) Received Action into Group: SDE No Priority Assigned
Responsible Person: KJN1:KEN NETZEL Due Date: 12/31/1999

(08/30/99 KJN1) Set Work Priority to 4.

(12/20/99 KJN1) Changed the Due Date from: 12/31/1999 to 04/01/2000
This item will not be worked in the near term. All electrical personnel are working on modifications or higher priority NUTRK items.

(03/31/00 KJN1) Changed the Due Date from: 04/01/2000 to 09/15/2000

(08/04/00 MJR1) Passed to BRIAN OGRADY for Verification.
This action item states to assist OPS in the development of new AOPs for non-vital bus recovery. The OPS action item for SEN 174 was closed to CR 98-0050 #43. This action item may be closed with no further actions required as a NUTRK item is not necessary for one group to support another.

(08/18/00 BJO1) Passed to DAVID GARCIA for Final Close Out.
Close item

(10/24/00 JRP1) PLA Closure of Item.
Close to actions of the referenced Condition Report CR 98-0050.

REFERENCES: TWR 97-337

CR 98-0050

CR 98-0050 #43