Pelton, David

From: Hamer, Mike
Sent: Monday, May 24, 2004 1:21 PM
To: Devincentis, Jim; Pelton, David; Sienel, Beth; Mannai, David; Desilets, Mike; Lindsay, Edward; Duda, Ed; Kowal, Chris; Rusin, Richard; Hockenberry, Dale
Subject: CR-VTY-2004-01655 & CR-VTY-2004-00700 PROs

The PROs for;

CR-VTY-2004-01655: "Calibration of Drive Flow Summers results in Potentially Non-conservative APRM and RBM Set-points"

and

CR-VTY-2004-00700: "While Troubleshooting a 4KV Breaker on BUWS2-7, the Driving Pawl on the Breaker Broke Off"

are both complete, and have been determined to be "Not Reportable", see attached.

PRO-0400700 - Breaker Driving ...

PRO-0401665 - Non-conservative...

A-202

INTEROFFICE MEMORANDUM
LICENSING
POTENTIALLY REPORTABLE OCCURRENCE REPORT

TO: MIKE DESILETS, TECHNICAL SUPPORT MANAGER

FROM: MIKE HAMER, LICENSING

SUBJECT: CR-VTY-2004-00700: WHILE TROUBLESHOOTING A 4 KV BREAKER ON BUS-2-7, THE DRIVING PAWL ON THE BREAKER BROKE OFF

DATE: MAY 20, 2004

PRO NUMBER: PRO-0400700

EVENT DESCRIPTION:

On 03/26/04, during functional testing of a 4KV breaker on BUS-2-7, when the two actuation springs were de-energized simultaneously, and the sprocket rotated counterclockwise as required, the breaker spring charging motor driving pawl on the breaker failed catastrophically, separating into two pieces. The breaker was no longer able to charge its closing springs. The primary concern of this condition is that it would have prevented operators from closing the breaker after a Loss of Normal Power load shedding sequence had occurred. The breaker was tagged out of service for troubleshooting and was not installed back into the cubicle. A WOR 04 -60712 was generated to repair failed breaker and a different breaker was installed into the cubicle.

The following regulations were considered when determining reportability of this event.

10CFR21.21 "Notification of failure to comply or existence of a defect and its evaluation.

(a) Each individual, corporation, partnership, dedication entity, or other entity subject to the regulations in this part shall adopt appropriate procedures to:

(1) Evaluate deviations and failures to comply to identify defects and failures to comply associated with substantial safety hazards as soon as practicable, and, except as provided in paragraph (a)(2) of this section, in all cases within 60 days of discovery, in order to identify a reportable defect or failure to comply that could create a substantial safety hazard, were it to remain uncorrected, "

Event or Condition That Could Have Prevented the Fulfillment of a Safety Function

§50.73(a)(2)(v) "[The licensee shall report:] Any event or condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to:
(A) Shutdown the reactor and maintain it in a safe shutdown condition;
(B) Remove Residual Heat; or
(D)Mitigate the consequences of an accident."

Degraded or Unanalyzed Condition

§50.73(a)(2)(ii) "[The licensee shall report] Any event or condition that resulted in:
(A) The condition of the nuclear power plant, including its principal safety barriers, being seriously degraded; or
(B) The nuclear power plant being in an unanalyzed condition that significantly degraded plant safety."

DISCUSSION/BASES:

Breaker Testing and Analysis of Results:

The failed pawl, associated plate assembly and sprocket were sent to the vendor for failure analysis along with additional similar assemblies that were available for use. A multitude of tests were performed by Massachusetts Materials Research, Inc. (MMR) and documented in report number MMR Project 0430-25. The tests performed are detailed on page 2 of the report, that has been attached to CR-VTY-2004-00700. Among these tests were metallurgical evaluations that included determining the case depth and case hardness as well as an analysis of the micro structural condition of the driving pawls. Below are the results and conclusions of MMR testing and analyses.

1. On the breaker that failed, the fillet weld that attached the pawl support block to the plate protruded upward beyond the block, causing point contact with the corner of the pawl during functional testing.
2. The fracture surface was cut from the pawl tip portion of the failed pawl, and another segment was cut from the tip portion of the pawl parallel to the plane of fracture. The analyses revealed that the material was carburized (hardened) to a case depth of 0.045". Typically, when wear resistance is the desired attribute of a product that sustains moderate bearing loads, a case depth of 0.010 to 0.015 inches is sufficient.
3. No evidence of mechanical malfunction was found due to a foreign object becoming lodged in the pawl/sprocket mechanism.
4. The metallurgical condition of the new pawls is highly variable ranging from none to 0.045 inches.
5. Except for the failed pawl, no cracks were observed in any of the submitted pawls.

In summation, the excessively deep case and the hard brittle phase observed in the corners of the failed pawl material resulted in low ductility and low toughness in the material. Therefore, especially in the corners, the material is limited in its ability to sustain impact bending strains. The physical root

cause for the failure of the breaker during functional testing is due to the following two deficiencies discovered during testing and analysis.

1. The improper carburization (case hardening – too deep) that was imparted to the pawl during manufacture.
2. The protrusion of the fillet weld on the support block above the profile of the block, that caused point contact on the back side of the pawl during rapid breaker actuation.

These anomalies synergistically resulted in a combination of bending and torsional forces on the pawl during breaker actuation. I later confirmed through a discussion with the Vice President of NLI QA, that if one of these anomalies had not been present in the failed breaker, it is highly unlikely that the driving pawl would have failed. This may be considered an isolated occurrence, as this mode of failure has not occurred at any other facility supplied with these parts or breakers. A Service Information Letter (SIL) will be forthcoming after further analysis and investigation. The Component Engineer for breakers at VY, Chris Kowal, will be kept abreast of future developments. An OE search for the same type of failure did not reveal any instances of this event occurring at another facility.

Determination of Reportability:

Two separate breaker functions must be considered when determining reportability.

First is the trip function of the breaker. This condition would not have prevented the breaker from tripping open on demand to protect the associated cabling and circuitry it was designed to protect. There is no reportability issue associated with this function of the breaker.

The second function to consider is the manual closing function. For all design bases accident scenarios, manual breaker actions are not credited when determining reportability. The condition discovered was that after the failure of the breaker spring charging motor driving pawl, the breaker was no longer able to charge its closing springs. This condition would prevent operators from re-closing the breaker after a Loss of Normal Power (LNP) load shedding sequence had occurred. An Operability Evaluation was completed that considered all breaker applications of this breaker type. After review of each separate application, it was determined that the following conditions could have existed if the breaker had been installed in the various applications listed below:

1. In the Service Water system, normally, only two pumps are running that would be load shed. The redundant pump breakers would remain closed, or be able to be closed on demand, as their pawls would not have had the opportunity to fail before that moment.
2. Certain power supply paths that this breaker could have been used in, if lost, would not be needed for safe plant operation.
3. For RHR, CS, and RHR SW, simultaneous, multiple breaker failures would have to occur, after the load shedding sequence. This is not a credible event as this condition has been discovered in only one breaker throughout the nuclear industry as verified by the vendor and through the various breaker engineer user groups and OE sources, so there is reasonable assurance that an incidence of simultaneous multiple breaker failures would not occur.
4. Bus-8 and BUS-9 are not load shed during a LNP.

When considering Safety System Functional Failures in accordance with §50.73(a)(2)(v), consider §50.73(a)(2)(vi) that states;

"Events covered in paragraph (a)(2)(v) of this section may include one or more procedural errors, equipment failures, and/or discovery. However, individual component failures need not be reported pursuant to paragraph (a)(2)(v) of this section if redundant equipment in the same system was operable and available to perform the required safety function of design, analysis, fabrication, construction, and/or procedural inadequacies."

In the cases stated above, either redundant equipment was available, or the proposed extent of failure necessary to have an impact on safe shutdown is implausible due to the fact that this failure mechanism is most likely isolated occurrence. This condition did not cause a safety system functional failure, and as a result of this, did not significantly degrade plant safety.

When considering reportability in accordance with Part 21, the condition must have the capability of present a Substantial Safety Hazard, that is defined in §21.3 as a;

Loss of safety function to the extent that there is a major reduction in the degree of protection to public health and safety for any facility or activity licensed other than for export pursuant to Parts 30,40,50,60,61,70,71,72 of this chapter.

This isolated condition did not create a "substantial safety hazard" that would cause a major reduction in the degree of protection to the public health and safety as stated above in the Part 50.73 reportability evaluation. The safe shutdown capability of the plant was not impaired as a result of this condition.

§21.2(c) Scope states the following:

For persons licensed to operate a nuclear power plant under part 50 of this chapter, evaluation of potential defects and appropriate reporting of defects under §§ 50.72, 50.73 or § 73.71 of this chapter satisfies each person's evaluation, notification, and reporting obligation to report defects under this part ...

In concluding that the discovery of this condition during maintenance did not present a safety system functional failure, and did not significantly degrade plant safety it may be construed that a substantial safety hazard could not have existed.

CONCLUSION: This event is **not reportable** as a LER in accordance with §50.73(a)(2)(v), §50.73(a)(2)(ii) or as a violation of Part 21.

RECOMMENDED: _____ , 5-20-04

Michael J. Hamer Date
Technical Specialist III
Licensing Department

APPROVAL: _____ , 5/24/04

Michael P. Desilets Date
Technical Support Manager

INTEROFFICE MEMORANDUM
LICENSING
POTENTIALLY REPORTABLE OCCURRENCE REPORT

TO: MIKE DESILETS, TECHNICAL SUPPORT MANAGER

FROM: MIKE HAMER, TECHNICAL SPECIALIST III

SUBJECT: CR-VTY-2004-01665: CALIBRATION OF DRIVE FLOW SUMMERS RESULTS IN POTENTIALLY NON-CONSERVATIVE APRM AND ROD BLOCK MONITORS

DATE: MAY 12, 2004

PRO NUMBER: PRO-0401665

EVENT DESCRIPTION:

On 05/05/04, during a review of the Cycle 24 Power/Flow map, a question was raised regarding the APRM Flow Biased Scram and Rod Block Monitor set-points. Investigation revealed that the APRM/FB Scram at lower flows were dictated by the thermal hydraulic stability analysis. The stability analysis assumed an APRM scram based on core flow. These core flow based set-points were converted to recirculation drive flow set-points using a core to drive flow correlation developed by General Electric Nuclear Energy (GE). This correlation was checked for applicability to Vermont Yankee through use of plant data. The resulting drive flow based trip setpoint from the stability analysis were input to the new digital APRM scram cards acquired from GE for ARTS/MELLLA operation. It should be noted that the A/M analysis does not credit the APRM Rod Block or the RBM in any safety analysis.

During power ascension, core and drive flow data are taken and the drive flow summers are checked/adjusted to ensure an accurate drive flow is provided to the APRMs and RBMs for flow biasing the APRM setpoint. OP 2429 is utilized by Reactor Engineering to develop appropriate adjustments to the drive flow calibration. At VY, the drive flow calibration attempts to ensure that drive flow is approximately equal to, but less than, core flow at all flows. This has been found to have the effect of forcing the drive flow summers to be higher than actual drive flows at lower flows. This potentially causes the APRM/FB scram, the APRM/FB rod block, and RBM Rod Block set-points to be higher (non-conservative) than Technical Specification Table 3.1.1 requirements.

The following regulation was considered when determining reportability of this event.

Operation or Condition Prohibited by Technical Specifications

§50.73(a)(2)(i)(B) "[The licensee shall report:] Any operation or condition which was prohibited by the plant's Technical Specifications except when: (exceptions do not apply)

DISCUSSION/BASES:

Although the potential to exceed Technical Specifications may have existed, this did not occur. Table 3.1.1. for the APRM High Flux (flow bias) references note 4 that states; "The actual scram setting is conservatively set in relation to the Allowable Value."

The Operability Evaluation completed to address this condition cites ISA Standard RP67.04.02-2000 that provides the following guidance pertaining to the determination of the Allowable Value;

> "The allowance between the allowable value and the trip set-point should contain that portion of the instrument channel being tested for the surveillance interval (monthly, quarterly, or refueling) and should contain no more than
>
> a) drift (based on surveillance interval);
> b) instrument calibration uncertainties for the portion of the instrument channel tested; and
> c) instrument uncertainties during normal operation that are measured during testing.

The non-conservative error that is introduced into the drive flow converters is not a result of drift, is not an instrument calibration uncertainty, nor is it a normal instrument uncertainty that can be measured during testing. The error is a result of a non-conservatism that is introduced during the drive flow to core flow correlation per OP 2429. Therefore, this non-conservative error has no effect on the Allowable Value that is contained in the TS.

Additionally, GE was contacted to perform a thermal hydraulic stability analysis that would assess the changes to the APRM flow bias scram resulting from the drive flow error introduced by the VY calibration procedure. They concluded that there is no impact on the MCPR operating limits with a maximum expected drive flow error of 5% introduced (based upon current calibration data.

CONCLUSION: This event is **not reportable** as an LER pursuant to §50.73(a)(2)(i)(B).

RECOMMENDED: _____, 5-12-04

Michael J. Hamer — Date
Technical Specialist III
Licensing Department

APPROVED: _____, 5/21/04

Michael P. Desilets — Date
Technical Support Manager