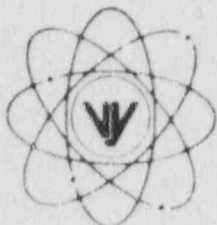


VERMONT YANKEE NUCLEAR POWER CORPORATION



P.O. Box 157, Governor Hunt Road
Vernon, Vermont 05354-0157
(802) 257-7711

November 18, 1996

BVY 96-147

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Reference: (a) License No. DPR-28 (Docket No. 50-271)

Subject: Reportable Occurrence No. LER 96-022-01

As defined by 10CFR50.73, we are reporting the attached Reportable Occurrence as LER 96-022, supplement 01.

Sincerely,

VERMONT YANKEE NUCLEAR POWER CORPORATION

Robert J. Wanczyk
Plant Manager

cc: USNRC Region 1 Administrator
USNRC Resident Inspector - VYNPS
USNRC Project Manager - VYNPS

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FACILITY NAME (1) VERMONT YANKEE NUCLEAR POWER STATION		DOCKET NUMBER (2) 05000271	PAGE (3) 01 OF 06						
TITLE (4) Combination of poor man-machine interface, an inadequate procedure, inadequate Operating Experience Review results in a common cause failure mechanism, and an Emergency Diesel Generator to exceed Tech Spec outage time.									
EVENT DATE (5) MONTH DAY YEAR 09 13 96			LER NUMBER (6) YEAR SEQUENTIAL NUMBER REVISION NUMBER 96 -- 022 -- 01						
REPORT DATE (7) MONTH DAY YEAR 11 18 96			OTHER FACILITIES INVOLVED (8) FACILITY NAME DOCKET NO.(S) N/A 05000						
OPERATING MODE (9) N POWER LEVEL (10) 00 THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 5: CHECK ONE OR MORE (11)									
		20.2201(b)	20.2203(a)(2)(v) X						
		20.2203(a)(1)	20.2203(a)(3)(i) 50.73(a)(2)(ii) 50.73(a)(2)(x)						
		20.2203(a)(2)(i)	20.2203(a)(3)(ii) 50.73(a)(2)(iii) 73.71						
		20.2203(a)(2)(ii)	20.2203(a)(4) 50.73(a)(2)(iv) OTHER						
		20.2203(a)(2)(iii)	50.36(c)(1) X 50.73(a)(2)(v) (Specify in Abstract below or in NRC Form 366A)						
		20.2203(a)(2)(iv)	50.36(c)(2) 50.73(a)(2)(vii)						
LICENSEE COMMENT FOR THIS LER (12)									
NAME ROBERT J. WANCZYK, PLANT MANAGER		TELEPHONE NO. (Include Area Code) 802-257-7711							
COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)									
CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NFRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NFRDS
B	EK	BKR	G080	Y	NA				
NA					NA				
SUPPLEMENTAL REPORT: EXPECTED (14)					EXPECTED SUBMISSION DATE (15)		MO	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE) X NO									

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On September 13, 1996 while shutdown for refueling Vermont Yankee (VY) discovered that the "A" Emergency Diesel Generator (EDG) output breaker was non-functional. The breaker was found in its normally open position, however its closing springs were discharged, rendering the breaker incapable of closing. The breaker closing spring charging mechanism had failed to charge the springs due to a failure of the charging mechanism ratcheting pawls. The location of the failure indicates that the failure occurred following the August 19 EDG breaker closing sequence. The EDG had been started and its output breaker closed on August 19, 1996 and again on August 20. This indicates that the breaker, and therefore the EDG, had been inoperable for approximately 25 days. This is contrary to the maximum time of 7 days allowed by VY Technical Specifications. This Technical Specification non-conformance and associated common cause failure mechanism result from the combined effects of inadequate maintenance requirements for the subject breaker, component aging, a weak breaker cubicle design (inadequate visual cues), inadequate operating experience review, and the failure to proceduralize EDG breaker condition verification. VY is inspecting similar breakers, implementing a modification, and upgrading appropriate procedures to allow operators to confirm proper breaker condition following EDG operation. As the "B" EDG and the emergency Alternating Current (AC) power source were at all times available during this event, and the failure of a single EDG is bounded by our current plant accident and transient analyses, this event did not result in plant operation which endangered either the health or safety of the public.

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DESCRIPTION OF EVENT

On September 13, 1996 at 2030, while shutdown for refueling VY discovered that the "A" EDG output breaker (EIS=BKR) was non-functional. The breaker was found in its normally open position, however its closing springs were discharged, rendering the breaker incapable of closing. The condition was discovered during a scheduled tagout. The breaker was tagged and a work order was initiated, and a troubleshooting and root cause plan was developed. The troubleshooting concluded that the breaker closing spring charging mechanism had failed to charge the springs due to a failure of the charging mechanism ratcheting pawls. The location of the failure indicates that the failure had occurred following the August 19 EDG breaker closing sequence. The EDG (EIS=EK) had been started and its output breaker closed on August 19 and 20. This indicates that the breaker, and therefore the EDG, had been inoperable for approximately 25 days. This is contrary to the maximum time of 7 days allowed by VY Technical Specifications.

On October 17, 1996, while still shut down, during the investigation into this event pursuant to corrective action number 1.g, VY personnel determined that past maintenance and inspection requirements allowed this cotter pin failure mechanism to challenge numerous breakers. Therefore VY expanded the scope of required inspection to include all similar breakers. It was determined that there were several cases wherein a variety of hinge pin cotter pin non-conformances threatened other breakers. The degraded hinge pin cotter pin non-conformances were therefore considered to have introduced a common cause failure mode to the breakers affected. 49 breakers were determined to be potentially affected. Of the 98 pin retention points potentially affected, 18 were found degraded or non-conforming (undersized). One additional cotter pin was discovered to be missing. 5 hinge pin retention points could not be fully verified. These five pins were limited to breakers which had no safety function to close. Each was inspected to verify the pins to be in place, however their orientation prevented verifying all critical aspects of the pin. In each of the five cases the incomplete inspection was due to the inability to view either the "head" of the cotter pin or one or more of its "legs." Each of the 5 pins was verified to be in place and work orders were initiated to require breaker removal to complete the inspection. Each of the 49 breaker charging assemblies was in its properly charged state prior to the inspection, and each ratcheting pawl hinge pin was in place to support spring recharging. Therefore all affected components were capable of performing their safety functions. A single Residual Heat Removal Service Water (RHRSW, EIS=BI) pump breaker, connected to the inoperable EDG side emergency bus, was found to be missing its hinge pin cotter pin, however the hinge pin was in its proper location and functional. The RHRSW pump would have started upon demand, however it could have failed to close upon a subsequent demand due to the same failure mechanism as the A EDG output breaker. Therefore, although the detailed breaker investigation revealed a potential for a common cause failure affecting a number of components, the manifestation in actual plant operational capability has not changed from the original report.

CAUSE OF EVENT

The root cause identified for this event was:

1. The mechanical failure of the charging mechanism hinge pin retaining device.

The root causes for the retaining device failure (cotter pin) were component aging and inadequate service requirements (and corresponding service) on the affected breakers.

The manufacturer has since identified a potential cotter pin failure mechanism due to in-service vibration, which should be addressed by routine inspection/replacement.

Contributing causes for this event were:

1. Inadequate operating experience review. Several operating experience sources cited a concern for breaker closing spring charging mechanism reliability, however recommended corrective actions were not implemented.

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2. Plant procedures in their failure to require periodic verification of Safety Class 4kV breaker closing spring status.
3. Breaker cubicle design (man-machine interface, inadequate visual cues) in that it is impossible to verify that the breaker is in its standby configuration (breaker open with closing springs charged) without opening the cubicle access door.
4. Managerial Methods - Inadequate definition of job performance standards in that replacement part (cotter pin) evaluation was not properly described for affected craft personnel involved in the replacement of the applicable cotter pins.
5. Inadequate written procedures - The vendor recommended breaker inspection requirements did not cite a specific check of the subject cotter pins.

ANALYSIS OF EVENT

Following replacement of the defective "A" EDG breaker (Breaker description; GE TYPE AM-4.16KV-250-8HB, SERIAL# 0224A1223-019) with a spare, a breaker failure mode investigation was performed on the affected breaker. The spare breaker was installed within 24 hours of discovery of the failed EDG breaker.

The breaker was found with the closing springs discharged. The cotter pin and washer on the "inside" end of the latching pawl hinge pin were missing. No deficiencies were noted in a breaker inspection performed on the affected breaker on September 19, 1995. At some time after the inspection, the cotter pin on the "inside" end of the hinge pin and flat washer became separated. This missing hardware was not found during this investigation. An intrusive examination of the failed EDG circuit breaker was performed. The missing cotter pin was not found.

The hinge pin was out of position by 1-5/16" preventing the pawls from holding the ratchet wheel when the ratcheting motion was reversed. This prevented the wheel from turning and compressing the closing springs. When the breaker was given a close signal, the charging motor started, but as the pawls did not engage the ratchet wheel, the springs did not compress. The motor continued to run, became overheated, and eventually open-circuited the winding. This left the breaker racked in with the springs uncharged.

This hinge pin problem appears to be a common cause failure mode issue since other cases have been identified through NPRDS including a similar occurrence at Browns Ferry in 1988. Maine Yankee cited similar conditions in INPO OE 7572, November 1995. However the pawl problem at Maine did not prevent spring charging as the misalignment was not severe.

1. Numerous nuclear network items indicated that there was reason to be concerned with the ability to monitor breaker closing spring condition. In addition to those cited above, other operating experience includes:
 - a. INPO SEE-IN Documents EM13143, MI12897, MI15952, OE2042, OE7546
 - b. NRC Information Notice, INF 94-02.

Each document above identifies failures or potential failures of distribution breaker closing spring charging devices.

2. The formal evaluation and disposition of this type of information is currently being upgraded at VY as part of an overall Operating Experience Program upgrade project.
3. The corrective actions implemented as a result of this event will also address concerns relevant to the failure

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mechanisms cited in the above documents for VY emergency bus electrical distribution breakers.

A General Electric Service Advisory Letter, GE SAL Tab 073, No. 352.1, item 6, describes a change in hardware that is available. It replaces the hinge pin held in with washers and cotter pins on both ends, with a hinge pin that has a head on one end that is held in with a bolted disk. This upgrade may have prevented this event. The SAL states the change is to facilitate removal for maintenance. However recent communications with the vendor indicates that vendor internal documents have been found which indicate that the SAL may have been driven by cotter pin failures. Additionally the vendor has identified that more evidence has been found that cotter pins may fail due to in service vibration.

The following describes the recent operational history of the "A" EDG Breaker, identifying the maximum time for which the EDG may have been unavailable due to the inoperable closing spring charging mechanism.

- | | | |
|----|---------|--|
| 1. | 8-19-96 | Breaker closed at 05:40 hrs and the breaker re-charged the springs.
(failure occurred at some point following successful spring recharge) |
| 2. | 8-19-96 | Breaker opened at 14:23 hrs |
| 3. | 8-20-96 | Breaker closed at 13:34 hrs |
| 4. | 8-20-96 | Breaker opened at 16:05 hrs |
| 5. | 9-13-96 | Breaker found in uncharged condition. |

The only indication that the springs had failed to charge was the mechanical flag indicator located behind the compartment door. No procedures required verification of spring status. The springs were apparently in an uncharged condition for over three weeks without discovery.

SAFETY SIGNIFICANCE

The VY EDG's provide emergency backup electrical power to vital plant loads. The EDG's are important components supporting numerous systems in their response to plant conditions mitigating the consequences of postulated accidents. However, VY safety systems are designed with redundancy and separation to prevent single isolated failures such as this from threatening public health or safety.

Throughout the period that the A EDG was inoperable the B EDG was available and VY's Alternate AC Source, a tie line to the Vernon Hydroelectric Station was available. The EDG's are themselves emergency backup power sources and would only be required should a loss of off-site electrical power occur. Further, the back-up device for the EDG's, the Vernon Tie-line, was available during the time which the "A" EDG was unknowingly inoperable. The failure of a single Emergency Diesel Generator, and its effect upon accidents with which VY is analyzed to cope, is considered in, and bounded by, VY Accident analyses. Additionally the "A" EDG output breaker could have been rapidly replaced, restoring the machine to a fully operable status, in the event that the "A" EDG was needed.

The other 4160 volt Engineered Safety Feature loads were also potentially affected, as each is supplied with power via breakers of similar design to the EDG output breaker and have received similar maintenance under similar controls which allowed the general degradation of closing spring charging mechanism hinge pin retaining cotter pins. Each of the breakers was inspected and found to be capable of performing its safety function.

Therefore it is concluded that there were no safety consequences resulting from this event.

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CORRECTIVE ACTIONS

1. Immediate

- a. The faulty EDG breaker was removed and a spare breaker was installed. (Complete)
- b. Operations verified that the closing springs on all 4kV breakers were charged. (Complete)
- c. Performance Engineering performed an initial inspection of the breaker, and an inspection of all Emergency Bus 4kV breakers. No other significant problems were noted (Completed 9/15/96). Note: this inspection preceded the determination that the cotter pin was the actual component failure and therefore focused on the charging motor itself.
- d. Maintenance performed extensive troubleshooting on the failed breaker (Complete).
- e. A Training Change Request has been initiated to ensure that this event is reviewed during Electrical Craft and Auxiliary Operator training. (Complete)
- f. Operations implemented an interim corrective action to verify closing spring status after any Safety Class 4kV breakers are closed. This action will end upon verification of proper installation of the affected pin assemblies via an inspection of a representative sample of breakers. See immediate corrective action "g" (Complete)
- g. Maintenance will examine a representative sample of 4kV breakers to verify the presence of the affected hinge pin, flat washer and cotter pins (action complete).
- h. Following corrective action number 1.g above, the sample was expanded to include 100% of similar breakers. The preliminary inspection is 100% complete. Several cotter pins, although verified in-place, require a maintenance window to remove the breakers for full viewing. 100% completion is being controlled by the work order process (This inspection is complete with the exception of the 5 pins which were inaccessible, they are expected to be inspected during the next scheduled refueling outage).

2. Long Term

- a. Maintenance will perform a detailed intrusive inspection of the failed breaker, post outage, and attempt to find the missing fastening components (action complete, parts not found).
- b. Maintenance will review the Operating Experience information cited in the "ANALYSIS" section. The current breaker PM process will be evaluated against information provided in the operating experience documents and changes made to the PM's as necessary (expected completion date: 6/30/97).
- c. Performance Engineering will design a modification to allow monitoring charged status of selected breaker (including EDG out put breakers) closing springs without opening the breaker compartment doors (expected completion date: 3/19/97).
- d. VY will implement the breaker modification (long term corrective action "c"). Plant operator rounds sheets will be changed to add a check of emergency bus breaker charging spring status using the installed modification (expected completion date: 5/19/97).

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- f. Technical Support Department will implement the Operating Experience Program upgrade currently in progress. The general programmatic upgrade currently in progress will meet corrective action requirements for contributing cause number 3 (expected completion date 12/31/96).

ADDITIONAL INFORMATION

VY has reported no similar events in the past five years.