

# ACCELERATED DISTRIBUTION DEMONSTRATION SYSTEM

## REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR: 9205010170    DOC. DATE: 92/04/24    NOTARIZED: NO    DOCKET #  
 FACIL: 50-316 Donald C. Cook Nuclear Power Plant, Unit 2, Indiana M 05000316  
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 BLIND, A.A.                      Indiana Michigan Power Co. (formerly Indiana & Michigan Ele  
 RECIP. NAME                      RECIPIENT AFFILIATION

SUBJECT: LER 92-004-00: on 920113, AB EDG (DG2AB) failed to reach rated speed within time limit required by TSS. Caused by inadequate design margin in starting air sys. Schrader-Bellows valves in DG2AB. w/original Hunt-Trimline POVs.

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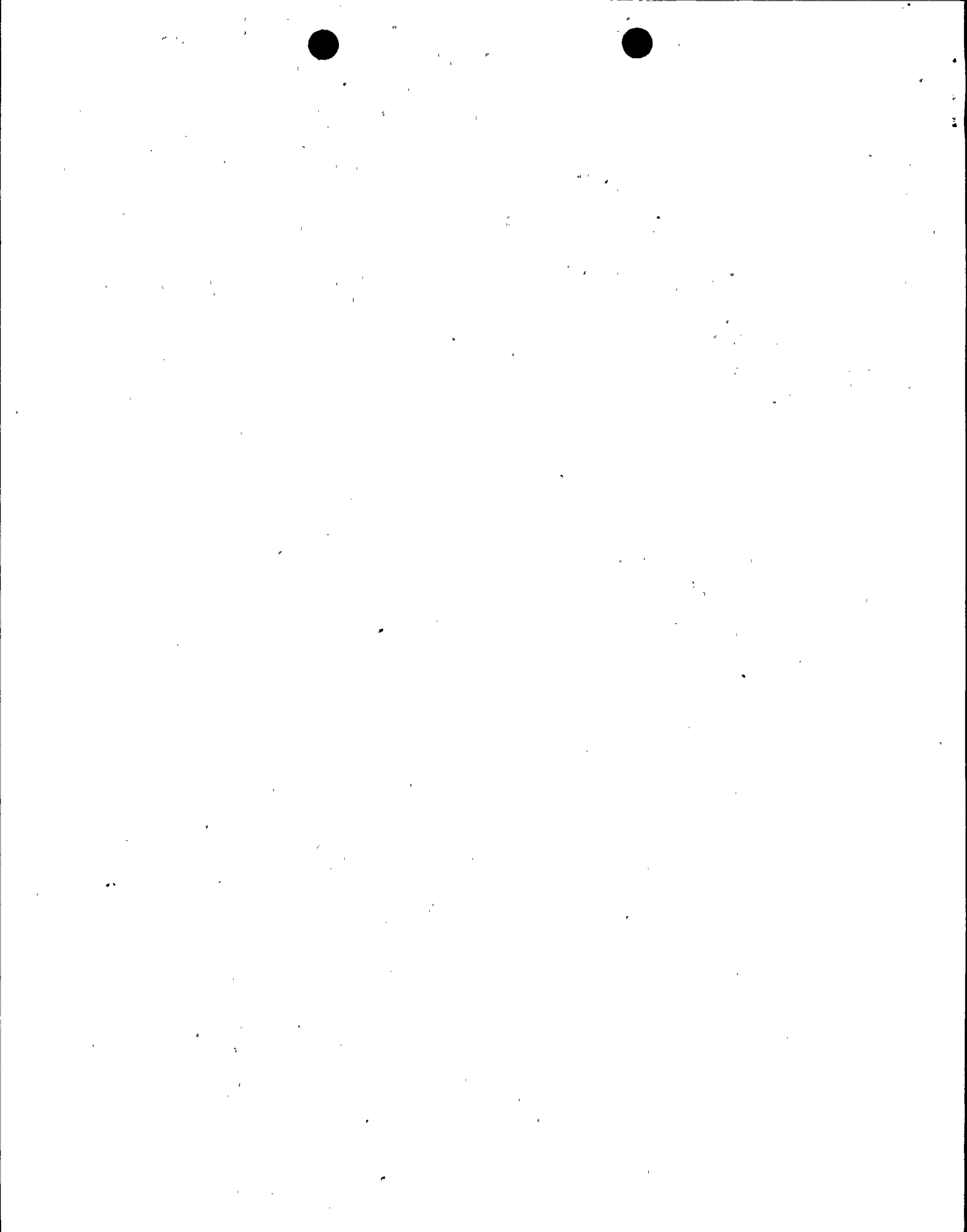
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April 24, 1992

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Docket No. 50-316

Document Control Manager:

In accordance with the criteria established by  
10 CFR 50.73 entitled Licensee Event Report System, the  
following report is being submitted:

92-004-00

Sincerely,

A. A. Blind  
Plant Manager

/sb

Attachment

c: D. H. Williams, Jr.  
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LICENSEE EVENT REPORT (LER)

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1) <b>DONALD C. COOK NUCLEAR PLANT - UNIT 2</b>	DOCKET NUMBER (2) <b>0 5   0 0   0 3   1 6</b>	PAGE (3) <b>1 OF 0 6</b>
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TITLE (4) **EMERGENCY DIESEL GENERATOR INOPERABILITY DUE TO INADEQUATE DESIGN MARGIN IN STARTING AIR SYSTEM**

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
0 1	1 3	9 2	9 2	0 0 4	0 0	0 4	2 4	9 2		0 5   0 0   0 0
										0 5   0 0   0 0

OPERATING MODE (9) <b>1</b>	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)									
POWER LEVEL (10) <b>0 9   0</b>	<input type="checkbox"/> 20.402(b)	<input type="checkbox"/> 20.405(c)	<input type="checkbox"/> 50.73(a)(2)(iv)	<input type="checkbox"/> 73.71(b)						
	<input type="checkbox"/> 20.405(a)(1)(i)	<input type="checkbox"/> 50.38(c)(1)	<input type="checkbox"/> 50.73(a)(2)(v)	<input type="checkbox"/> 73.71(c)						
	<input type="checkbox"/> 20.405(a)(1)(ii)	<input type="checkbox"/> 50.38(c)(2)	<input type="checkbox"/> 50.73(a)(2)(vii)	<input type="checkbox"/> OTHER (Specify in Abstract below and in Text, NRC Form 366A)						
	<input type="checkbox"/> 20.405(a)(1)(iii)	<input checked="" type="checkbox"/> 50.73(a)(2)(i)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)							
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LICENSEE CONTACT FOR THIS LER (12)

NAME <b>G. A. WEBER - PLANT ENGINEERING SUPERINTENDENT</b>	TELEPHONE NUMBER
	AREA CODE   NUMBER <b>6 1   6 4   6 5   - 5 9   0 1</b>

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)

YES (If yes, complete EXPECTED SUBMISSION DATE)	<input checked="" type="checkbox"/> NO	EXPECTED SUBMISSION DATE (15)
		MONTH   DAY   YEAR 

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

On January 13, 1992, at 2006 hours, the Unit 2 AB Emergency Diesel Generator (DG2AB) failed to reach rated speed within the time limit required by Technical Specifications (10.38 vs. 10 seconds). Based on a review of previous test results, it is believed that the engine may have been incapable of automatically starting within the required (10 second) time limit for an unknown period between December 23, 1991 and January 13, 1992.

A Minor Modification, which was completed in the fourth quarter of 1991, installed new pilot operated valves (POVs) in the Starting Air System on each of the plant's four Emergency Diesel Generators (EDGs). During routine testing on December 16, 1991, the time response of one of the new POVs installed on DG2AB was found to be abnormally slow. The POV was replaced, tested, found acceptable, and placed in service. A regularly scheduled operability test was successfully performed on December 23, 1991. The problem recurred on January 13, 1992. Investigation of the second event revealed that the valves required a higher pilot air pressure than that provided in the Starting Air System to operate consistently. In the case of DG2AB, the resulting degradation in Starting Air System performance was sufficient to cause the starting time limit to be exceeded.

The original POVs were re-installed in all four EDGs. Efforts are underway to systematically upgrade/redesign the Starting Air System to address obsolescence and aging concerns.



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TEXT CONTINUATION

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FACILITY NAME (1)  DONALD C. COOK NUCLEAR PLANT - UNIT 2	DOCKET NUMBER (2)  0 5   0 0   0 3   1 6	LER NUMBER (6)			PAGE (3)		
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER			
		9   2	-   0   0   4	-   0   0	0   2	OF	0   6

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Conditions Prior to Occurrence

Unit 2 in Mode 1 (Power Operation), at 90 percent power.

Description of Event

The Starting Air Systems installed on the Cook Plant's four Emergency Diesel Generators each consist of two redundant starting air subsystems, and non-redundant fuel and turbocharger jet assist controls. Upon receipt of a start signal, redundant Solenoid Operated Valves (SV-1 and SV-2) energize to admit pilot air at a pressure of 40 psi (-0, +2) to the pilot (input port) of two redundant Pilot Operated Valves (POV-1 and POV-2). The two POVs in turn, each direct a 100 psi control air source to the actuators of two Starting Air Valves (SAV-1 and SAV-2, respectively). During an engine start, the SAVs admit 240 psi (nominal) air to the front and rear bank starting air headers. A distributor is geared to the engine such that the 240 psi starting air is admitted to each of the engine's twelve cylinders in their normal firing sequence. The engine fuel racks are opened during the start sequence, and, as the engine is turned, it begins to fire, accelerating the engine to rated speed (514 rpm). At 95 percent of rated speed (488 rpm), SV-1 and SV-2 are automatically de-energized. The 40 psi pilot air source is vented from the POVs, which, via the 100 psi control air, closes the SAVs. If the engine has not accelerated to 95 percent of rated speed within 10 seconds (+1/-1) the engine (including the fuel supply, jet assist, and SAVs) is tripped and an incomplete start is signalled.

Beginning with events starting in March of 1991, it was becoming apparent that the reliability of the Emergency Diesel Generators was becoming compromised by a series of age-related component failures in the pneumatic portion of the engine control system. Many of the pneumatic components are out of production and spare parts are becoming increasingly difficult to obtain. Minor Modifications (MM) 12-MM-253 and 12-MM-241 were initiated to replace a number of these components, including POV-1 and POV-2. Although neither POV-1 nor POV-2 had exhibited a failure up to that point in time, they were replaced due to obsolescence. The original POV-1 and -2 were manufactured by Hunt-Trimline. The replacement valves were manufactured by Schrader-Bellows. The Minor Modifications were installed on all four engines between October 24, 1991 and December 18, 1991. The POVs associated with DG2AB were replaced on October 24, 1991.

On September 12, 1991, also in response to the pneumatic control reliability problems, Data Sheet (DS) 14 was added to the EDG Surveillance Test Procedures (\*\*1-OHP 4030.STP.027AB and \*\*1-OHP 4030.STP.027CD in Unit 1, and \*\*2-OHP 4030.STP.027AB and \*\*2-OHP 4030.STP.027CD in Unit 2). The purpose of this data sheet is to capture information for use in monitoring the condition of the pneumatic control components. The data sheet is performed with one of the two starting air subsystems isolated. Successful completion the data sheet verifies the ability of the unisolated subsystem to independently roll the diesel for a start. The monthly EDG Operability Test is also performed with one 240 psi starting air source isolated. Similar to DS-14, this demonstrates the ability of one starting air subsystem to roll/start the diesel.

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FACILITY NAME (1)  DONALD C. COOK NUCLEAR PLANT - UNIT 2	DOCKET NUMBER (2)  0   5   0   0   0   3   1   6	LER NUMBER (6)			PAGE (3)	
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER		
		9   2	-   0   0   4	-   0   0	0   3	OF 0   6

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Description of Event Continued

DS-14 is performed approximately 14 days after the surveillance test on one of the two subsystems (alternates each month). DS-14 and the operability run are performed on the two subsystems on an alternating basis, except that once per quarter the operability run is performed with both subsystems in service, which is the normal in-service alignment.

On December 16, 1991, at 0104 hours, DS-14 was performed on DG2AB with SAV-2 in service and the 240 psi supply to SAV-1 isolated. Operators stationed in the diesel room observed that approximately 5 seconds elapsed from the time the manual start push-button was depressed to the time SAV-2 changed positions and initiated the engine roll. The normal time response is less than 2 seconds. A decision was made to perform \*\*2 OHP 4030 STP.027AB to verify this delay did not impact EDG operability. The surveillance test was successfully completed, with 240 psi air aligned to both SAVs, at 1817 on December 16, 1991. An investigation was initiated into the cause of the delay. DG2AB remained OPERABLE.

Troubleshooting of the delay in SAV-2 revealed that the associated pilot-operated valve, POV-2, had malfunctioned. The valve was replaced on December 18, 1991 with an identical Schrader-Bellows valve. On December 19, 1991, DS-14 was successfully performed with SAV-2 in service, indicating that the malfunction was corrected. In addition, the regularly scheduled surveillance test was successfully performed on December 23, 1991.

The valve removed from DG2AB was disassembled and inspected on site. No cause for the valve's sluggish in-service response could be determined. It was returned to the vendor (Schrader-Bellows) for further evaluation. The vendor was unable to identify a problem with the valve.

On January 13, 1992, at 0310 hours, DS-14 was performed on DG2AB with SAV-1 in service and the 240 psi supply to SAV-2 isolated. On the first try the diesel rotated only one turn. A second roll was attempted and the diesel responded normally. The failure on the first attempt prompted another investigation. At 2006 hours, after troubleshooting and minor adjustments to the 40 psi pilot air source, an operability run was attempted with the 240 psi air source aligned to both SAVs. The engine started and ran but took 10.38 seconds reach rated speed. The engine was declared INOPERABLE as a result of exceeding its Technical Specification start time limit of 10 seconds.

This failure was the second failure on the 2AB Diesel Generator in the last 20 start attempts. In accordance with Technical Specifications, this resulted in the diesel being placed on the accelerated frequency testing schedule.

While investigating the January 13 event, it was noted that both POV-1 and POV-2 responded sluggishly to the 40 psi pilot air source pressure. The valves were removed from the engine and bench tested using a 40 psi pilot air source pressure. The sluggish response was again observed and quantified.

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FACILITY NAME (1)  DONALD C. COOK NUCLEAR PLANT - UNIT 2	DOCKET NUMBER (2)  0 5 0 0 0 3 1 6 9 2 - 0 0 4 - 0 0 0 4 OF 0 6	LER NUMBER (6)			PAGE (3)	
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER		

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Description of Event Continued

This behavior was discussed with Schrader-Bellows engineering personnel. They stated that the valves were rated to operate with a pilot air pressure between 35 psi and 150 psi. However, when being used to switch a 100 psi control air source, with a 40 psi pilot air pressure, the valves would need to be cycled on the order of once or twice a minute to obtain the desired response times. In their application as part of the EDG Starting Air System, the POVs were intended to be cycled only once to twice per month.

As immediate corrective action two options were considered. The first was to increase the POV pilot air pressure from 40 psi to 55 psi. Bench testing was performed which demonstrated the valves would operate quickly and consistently at this pressure. However, further evaluation of this option revealed that the 55 psi pressure would exceed the rating of several other components in the system.

The second option was to replace the Schrader-Bellows model with the originally installed Hunt-Trimline model, seven of which had been retained after being removed from service under 12-MM-253. A eighth valve was also available as a spare. Each of the Hunt-Trimline POVs was bench tested, inspected, and determined to be in good condition. A check of their maintenance history confirmed there were no previous failures of these valves.

The decision was made to reinstall the Hunt-Trimline valves on all the Emergency Diesel Generators. Minor Mod 12-MM-268 was initiated to replace the valves. On January 15, 1992, the Hunt-Trimline POVs were cleaned, tested to verify proper operation, and reinstalled on DG2AB. An operability run was successfully performed in accordance with Surveillance Test Procedure 2-OHP 4030.STP.027AB. On January 16, 1992, at 0406 hours, DG2AB was declared OPERABLE.

A schedule was developed to reinstall the Hunt-Trimline POVs in the remaining three EDGs (1AB, 1CD, and 2CD) in conjunction with other planned maintenance activities. The timetable was accelerated when, on January 26, 1992, a similar failure was observed on DG1CD. SAV-2 failed to respond to a start signal. Investigation revealed that the associated POV did not cycle at all upon application of the 40 psig pilot pressure. Upon observing the failure of DG1CD to roll on SAV-2, Operations realigned the diesel to SAV-1 and successfully completed the operability test.

On January 27, 1992, at 1251 hours the diesel was removed from service and the Hunt-Trimline valves were reinstalled. At 2312 hours, an operability run was successfully performed on DG1CD. By January 31, 1992 the Hunt-Trimline valves were reinstalled on the remaining two engines (1AB and 2CD).

Cause of Event

This event was caused by a failure to adequately verify the suitability of the Schrader-Bellows valve for use as a starting air system pilot valve. The published vendor information for these valves stated that the minimum required



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FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)		
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER			
DONALD C. COOK NUCLEAR PLANT - UNIT 2	0   5   0   0   0   3   1   6	9   2	-   0   0   4	-   0   0	0   5	OF	0   6

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Cause of Event Continued

pilot air pressure is 35 psi when used in conjunction with a control air pressure of up to 100 psi, and 50 psi when used in conjunction with a control air pressure of up to 200 psi. In our application these valves use a 40 psig pilot air pressure to control a 100 psi control air pressure. These pressures were judged to be within the manufacture's specifications. However, the published specifications failed to stipulate that higher pilot air pressures would be required to obtain satisfactory valve response if the valves were not frequently cycled.

The valves were purchased as commercial grade (Quality Class QA-S) items. As such, it was necessary to dedicate the valves for their intended use in accordance with a written plan. Corporate procedures covering dedication of commercial grade items contain EPRI NCIG-07 guidance, which lists response time as a critical characteristic. The plan included receipt inspection and bench testing to confirm their fit, form, and function. The plan failed to provide an adequate means of verifying the valves' response time, although satisfactory response time was demonstrated by the successful performance of an operability test following valve installation. Nor did the plan consider the effect of infrequent cycling.

Analysis of Event

This event was determined on April 9, 1992 to be reportable under the provisions of 10CFR50.73.a.2.i.B as an "...operation or condition prohibited by the plant's Technical Specifications" based on the unknown period of time that DG2AB may have been incapable of automatically starting within the required (10 second) time limit from December 23, 1991 to January 13, 1992. Although the engine actually failed to meet the Technical Specification surveillance requirement on only one occasion (January 13, 1992 at 2006 hours), the engine's starting system reliability could have been sufficiently degraded, when taking into account both the December 16, 1991 and January 13, 1992 events, to put in doubt the engine's ability to start per Technical Specification requirements during that period.

A reportability determination performed on March 9, 1992 had initially classified this event as being reportable under 10CFR50.73.a.v.A, based on the assessment that the installation of the Schrader-Bellows valves under 12-MM-253 on all four EDGs may have "...prevented the fulfillment of the safety function of ... a system needed to shutdown the reactor and maintain it in a safe condition." However, on April 9, 1992, when this assessment was presented to the Plant Nuclear Safety Review Committee (PNSRC) along with a draft LER for the Committee's approval, it was not accepted. The PNSRC concluded that, given the history of successful operability demonstrations that had been performed since the Schrader-Bellows valves had been installed on the other 3 engines, that the reliability of these engines was never significantly compromised. Even in the case of the January 26, 1992 event involving DG1CD, during which the associated POV-2 valve failed to actuate, the operability run was completed in accordance with Technical Specification requirements due to the redundant air starting system.



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		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER		
		9   2	-   0   0   4	-   0   0	0   6	OF 0   6

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Analysis of Event Continued

This event had no impact on the health and safety of the public, nor did it have a significant potential to do so. This conclusion is based on the following factors:

1. The Cook Plant EDGs are equipped with two redundant starting air subsystems, each of which is independently capable of starting the engine. Thus, the failure or slow response of one subsystem will not cause the engine to fail to start on demand or accelerate to rated speed within the required time limit. The surveillance test performed to demonstrate engine operability verifies the function of each subsystem on an alternating basis to ensure both subsystems are capable of functioning properly. In the case of DG2AB, the only actual failure attributable to the performance of the Schrader-Bellows valves was that which occurred on January 13, 1992, during which the engine started and ran, but did not achieve rated speed within the required time limit (10.38 seconds vs. 10 seconds).
2. In the unlikely event of a loss of offsite power concurrent with the failure of DG2AB to automatically start (ie, experience an incomplete start), the redundant Unit 2 engine, DG2CD, was available during most of the event period to provide power to the required ESF loads.

Corrective Action

The immediate corrective action was to replace Schrader-Bellows valves in DG2AB with the original Hunt-Trimline POVs. Prior to installation, the original valves were inspected and tested to verify proper operation. The installation was complete on January 15, 1992. The engine was retested and declared OPERABLE on January 16, 1992 at 0406 hours.

Based on the investigation of this event, it was determined prudent to also re-install the original valves in the other three engines. This action was completed on January 31, 1992.

To address the issue of aging and obsolescence of these and other engine pneumatic control components, efforts are underway to systematically inspect and repair or replace, as necessary, all components in the system. Potential design improvements are also under study and will be incorporated into the Strategic and/or Long Range Plan(s) for prioritization and scheduling.

To prevent reoccurrence of similar events in the future, the findings of this event will be disseminated to all corporate personnel responsible for preparation of dedication plans.

Failed Component Identification

None

Previous Similar Events

None