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SUBJECT: LER 87-012-01:on 871128,potential for control valve failure in nonsafe mode due to overpressurized solenoid valve.

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	RES/DE/EIB	1	1	RES/DRPS DIR	1	1
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March 4, 1988 10 CFR 50.73

U. S. Nuclear Regulatory Commission
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Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Reportable Occurrence 87-012-01

In accordance with the requirements of 10 CFR 50.73, "Licensee Event Report System," the attached Licensee Event Report for reportable occurrence 87-012-01 is being submitted.

Reportable occurrence 87-012-01 is being supplied to correct two (2) typographical errors on reportable occurrence 87-012-00. The first was an incorrect submission date, item 7 on the LER form. The date should have read 02-08-88 and not 02-08-87. The date now reflects the date of this submittal. The second error occurred on page 8 of the submittal. The LER was incorrectly identified as LER 88-01 on this page. Please note, change bars have been added to the right hand margin for your convenience.

We apologize for any inconvenience these errors may have caused you.

Sincerely,

D C Hintz

D. C. Hintz
Vice President - Nuclear Power

TJW/jms
Attach.
cc - INPO Records Center
Mr. Robert Nelson
US NRC, Region III

IE22
1/1

NRC Form 366 (9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Kewaunee Nuclear Power Plant	0 5 0 0 0 3 0 5	1 OF 0 8

TITLE (4) Potential for Control Valve Failure in the Non-Safe Mode Due to Overpressurized Solenoid Valves

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)
1 1	2 8	8 7	8 7	— 0 1 2	— 0 1	0 3	0 4	8 8	NA	0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9): N

POWER LEVEL (10): 1 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR § (Check one or more of the following) (11)

20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	X OTHER (Specify in Abstract below and in Text, NRC Form 366A)
20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (AREA CODE)
Sherry Bernhoft - Technical Support Engineer	4 1 4 3 8 8 - 2 5 6 0

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
B	J M	S O L	A 4 9 9	Y					

SUPPLEMENTAL REPORT EXPECTED (14)

		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO	N/A			

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

On November 28, 1987, with the plant at full power, two independent, containment isolation control valves failed to close from the control room during performance of their inservice testing (IST). The two valves, MU-1010-1 and RC-507, failed to close because their respective solenoid valves were unable to block the instrument air flow to the control valves when deenergized. The solenoid valves, which have a maximum operating pressure differential (MOPD) of 70 psi, were found to have their corresponding air line regulators set at 80 psi. This resulted in the solenoid valves being overpressurized. These solenoid valves had been replaced as a part of a recent design change during which time the incorrect models, with too low an MOPD, were purchased and installed.

A field walkdown of other safety related solenoid valves in the plant and their air regulator settings was performed. No other cases were found where the air regulator setting would have prevented the solenoid from operating properly. However, other cases were found where the solenoid valves had an MOPD less than instrument air pressure.

Planned corrective actions include replacing solenoid valves and establishing a program to formalize instrument air regulator settings.

This event is being reported in the "other" category because of its potential interest to other licensees.

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Description of Event

On November 28, 1987 with the plant at full power, two control valves (FCV) failed to close from the control room during performance of their quarterly inservice timing test (IST). The two valves which failed to close are MU-1010-1, the pressurizer relief tank make-up isolation valve, and RC-507, the reactor coolant drain tank pump discharge header isolation valve. Both valves serve a containment isolation (JM) function. They are air to operate, normally open, and fail closed on loss of instrument air or electrical power. These control valves failed to close because their respective solenoid valves (SOL) had been overpressurized and were unable to block the instrument air (LD) flow path to the control valve when deenergized. During a management review of the IST results, it was concluded that other safety related control valves and damper actuators were potentially vulnerable to the same failure.

The IST valve timings were attempted at 0030 hrs for MU-1010-1 and 0040 hrs for RC-507 on November 28. When repeated attempts to close the valves using the control room switch were unsuccessful, the control room operators took action to ensure containment integrity was satisfied. For MU-1010-1, there is an inside containment check valve, MU-1011, and in the case of RC-507, the redundant containment isolation control valve, RC-508, was immediately closed. At 0120 the instrument air supply to both solenoid valves was locally isolated. Upon loss of air MU-1010-1 and RC-507 went to their closed, fail safe, condition.

Instrument and Controls (I&C) personnel were called in to troubleshoot and repair. They discovered that the outlet pressure gage on the instrument air line regulator (RG), i.e., the air pressure to which the solenoid valve is exposed, was reading approximately 80 psi for both MU-1010-1 and RC-507. However, the nameplate data on the solenoid valves indicated that they were only rated for a maximum operating pressure differential (MOPD) of 70 psi. Normally, the in-plant instrument air line header pressure is maintained between 105 and 108 psi. Air regulators are installed upstream of solenoid valves to allow adjusting the air supply pressure to within the proper operating range for the associated control valve.

During troubleshooting activities, the I&C personnel reduced the regulator settings and unisolated the instrument air supply line to the solenoid valves. Both MU-1010-1 and RC-507 immediately reopened and remained failed in the open position even with this lower air pressure on the solenoids. The instrument air supply lines were again isolated and the solenoid valves were rebuilt. The solenoid rebuild included replacing the internal core assembly and spring. Following the rebuild, the two control valves were satisfactorily retested and returned to service at 2116 on November 28. To ensure continued proper operation of the control valves, the regulator settings were left lowered. The internals were removed from the solenoid valves for MU-1010-1 and RC-507 and were inspected. The inspection revealed that one of the assemblies had a slightly larger impression in the rubber sealing surface on the bottom face of the core assembly where it blocks the orifice to port No. 1 (see attached sketch). No other apparent indications of degradation were found.

While in the field the I&C personnel also found that the solenoid for valve RC-508, the inline redundant containment isolation valve for RC-507, was rated for an MOPD of 70 psi and had an air regulator setting of approximately 80 psi. However RC-508 had successfully completed its valve timing test that day. To preclude the possibility of a future solenoid valve failure, the regulator was reset to 60 psi, and the control valve was satisfactorily retested.

For a direct acting solenoid valve, the MOPD as marked on the component nameplate is the maximum differential between the inlet and outlet sides against which the solenoid valve can dependably operate. In other words, the MOPD is the maximum differential pressure which the spring can dependably overcome to block the air flow path to the control valve when the solenoid valve is deenergized. When a deenergized solenoid valve is exposed to an air pressure greater than its MOPD, the core will tend to be forced off of its seat allowing air pressure from port No. 2 to ports No. 1 and No. 3 (see attached sketch).

All three solenoids valves that have been discussed were replaced in September 1987 under a design change (DCR-1544) to upgrade their level of environmental qualification. The IST performed on November 28th was the first valve timing test attempted since their initial installation testing and turnover for plant operation. It was decided to investigate if other safety related control valves and damper actuators could be vulnerable to the same failure.

Therefore, on December 11 and 12 a field walkdown was performed which inspected all of the QA-1* and containment isolation solenoid valves. The information recorded during the walkdown included the solenoid valve and regulator nameplate data and the regulator setting. No other applications were identified where the regulator setting could have prevented the solenoid valve from operating properly. However, other cases were found where the solenoid valve had an MOPD less than instrument air pressure.

Cause of Event

Control valves MU-1010-1 and RC-507 failed to close on November 28, 1987 due to the incorrect model number solenoid valves having been purchased and installed as part of DCR-1544. The design and engineering services for DCR-1544 were performed for Wisconsin Public Service Corporation (WPSC) by Fluor Engineers, Inc. On December 1, 1987 WPSC notified Fluor of the control valve operational problems which at that time were suspected to be related to the replaced solenoid valves. In response, Fluor established the resources to review their activities relating to DCR-1544.

*QA-1 is defined as those "structures, systems, and components that prevent or mitigate the consequences of postulated accidents that could cause undue risk to the health and safety of the public" (ACD 9.4).

Fluor's scope of work for DCR-1544 was to prepare a work package for each of the solenoid valves to be replaced. Development of the work packages included performing a field survey of the existing solenoid valves to verify exact model number and mounting configuration. With this information, Flour prepared the purchase requisition form, prints, installation procedures and first and second level reviews. Once these packages were completed they were forwarded to the WPSC responsible engineer.

The Flour design engineer had available to him only the model number of the originally installed solenoid valve from the field data which was an ASCO Model Number LB83146. This model number solenoid valve, as described in ASCO catalog revision number 26 (late 1960's vintage), had an MOPD of 100 psi as did the installed solenoid valves. However, when looking up the technical data, the Flour design engineer referred to revision number 30A of the ASCO catalog. This revision to the catalog specified an MOPD of 70 psi. It turned out that at some point there was a change in the spring/core assembly but not in the valve enclosure size. This change resulted in the model numbers being similar, but the MOPD ratings being different.

The design engineer then contacted ASCO for advisement on which solenoid valve model was a direct nuclear grade replacement for the LB83146 model. ASCO recommended that model number NP8314C13E solenoid valve be used, which has an MOPD of 70 psi.

The design engineer recognized a discrepancy between the MOPD and the nominal instrument air header pressure and questioned ASCO on the significance of this difference. He received a letter from ASCO which stated in part; "This 3 way valve is rated for a maximum operating pressure differential of 70 psi. However, if 100 psi should be applied at the port (2) while the valve is deenergized, the core will tend to be forced off the seat due to a higher than normal pressure, and allow pressure to vent (port 1 and probably port 3). If 100 psi is applied while the valve is energized, the valve core is sealing port (3) closed, and would remain so. The pressure would continue to port (2). If the valve would now become deenergized, it would act as deenergized as described above."

The design engineer and engineering supervisor discussed this letter and concluded that if the solenoid were exposed to 100 psi instrument air pressure when deenergized, there would be some air leakage from port No. 2 to port No. 1 which would begin to pressurize the control valve diaphram, but there would also be some venting to atmosphere via port No. 3. It was theorized an equalization point would be reached below the pressure required for control valve actuation. Their conclusion was heavily biased by their belief that the existing solenoid valves were actually rated for 70 psi and had been operating successfully for approximately 13 years.

Based on the aforementioned interpretation, the design engineer and supervisor did not feel the ASCO letter was of relevance to the design process. Hence, the design review package made available for the second level reviewer did not include a reference to the ASCO correspondence. Therefore, an independent assessment of the interpretation was not performed.

Analysis of Event

This LER is being submitted because of its potential interest to other licensees. The failure of the two control valves in and of itself is not reportable in accordance with 10 CFR 50.73. However, during our review of this incident the concern of relying on a possibly non-safety related air pressure regulator to prevent the overpressurization and failure of a safety related solenoid valve was identified. We feel that this is a failure mode that has not received the emphasis deserved and may not have been considered in all applications during plant activities.

Containment integrity requirements were still satisfied when MU-1010-1 and RC-507 failed to close. In the case of MU-1010-1, there is an inside containment isolation check valve, MU-1011, and in the case of RC-507, the redundant containment isolation valve, RC-508 was immediately closed. When repeated attempts to close MU-1010-1 and RC-507 from the control room were unsuccessful, operators locally isolated and DANGER tagged the instrument air supply to the solenoid valves. Upon loss of air both control valves went to their fail safe, closed position.

Since this common failure had the potential to affect other safety related control valves and damper actuators, a comprehensive field inspection was performed on December 11 and 12, 1987. Excluded from this walkdown were solenoid valves known to have an MOPD of 110 psi or greater since they would not be subject to over-pressurization by the plant instrument air system. The inspection covered 130 solenoid valves. For each, the solenoid valve and regulator nameplate data and regulator settings were recorded. From the group inspected; 21 of the solenoids were identified as having an MOPD of greater than 110 psi; 4 were identified as being inline process valves; 1 was no longer in service; and 14 were later determined not to have a safety related function.

Of the remaining solenoid valves, 63 are Johnson, model no. V-24, with a MOPD of 30 psi or ASCO, model no. NP8320AI76E with an MOPD of either 25 or 35 psi. The Johnson V-24 model valves, air regulators and an inline relief valve set at 25 psi are a part of the original plant equipment. Quality Control and purchase order records indicate that these components were supplied as a package to QA-1 standards with appropriate qualification documentation. When the Johnson solenoids fail due to natural end of life they are replaced by the ASCO nuclear grade model and the regulators and relief valves are left intact. The Johnson V-24's and the 35 psi ASCO's are acceptable because the QA-1 air regulators are adequately qualified and will protect the downstream solenoid valves from overpressurization. Of these 63 solenoid valves, 8 ASCO's that have an MOPD equal to the relief valve setpoint of 25 psi will be replaced during the spring 1988 refueling outage.

The other 27 solenoid valves will be corrected during the upcoming 1988 spring refueling outage. Currently, it is planned to replace the existing solenoid valves with ones that have an MOPD in excess of the instrument air header maximum operating pressure. However, in some cases a replacement solenoid valve with an adequate MOPD is not available. In these cases, action will be taken to ensure the air regulators are QA-1 qualified.

In the interim, failure of these solenoid valves with an MOPD of less than instrument air system pressure is unlikely. Of the components inspected, the regulator settings for all but 4 of the solenoid valves were below their MOPD. These 4, which serve the Feedwater Regulator Control Valves, are actually reverse acting solenoid valves and the increased air pressure would assist in their blocking air flow to the control valve thus completing feedwater isolation in the event it is required.

For the remaining solenoid valves, their continued operation is dependent on their associated air regulators maintaining the line pressure at or below their MOPD. The significance of relying on the air pressure regulator to prevent the over-pressurization of a safety related solenoid valve does not appear to be a criteria that was consistently considered in the original system design basis. In discussions with personnel involved in the original design of KNPP, there is a clear understanding that the instrument air system was not intended to be safety related. Hence the design criteria for components dependent upon it was to assume a fail safe condition on loss of instrument air. There is evidence that the converse condition was not consistently considered.

During the field inspections five types of air regulators were found. These are: Fisher Model No. 67FR, Johnson Model No. R130, C.A. Norgren Model No. R43-301-NNLA, Masoneilan Model No. 77, and Conoflow Model No. FH60XTK1. A review of plant documentation was performed to evaluate the functional operability of these air regulators and their potential to fail "high" thus causing the solenoid valve to overpressurize.

A review of QA records found that the Johnson, C.A. Norgren, Masoneilan and Conoflow regulators were supplied under QA-1 purchase orders. An evaluation of the ability to withstand a Design Basis Event with Safe Shutdown Earthquake exitation was performed for Fisher regulators. It was concluded in all cases that the probability of an air regulator failure was extremely low.

Both MU-1010-1 and RC-507 receive a train A containment isolation signal. Since these two valves are on the same train, the redundant containment isolation valves were operable, and no other cases were found during the field walkdown, this event does not fit the reporting criteria for 10 CFR 50.73.

Corrective Actions

The corrective actions taken as a result of this event include:

1) Performing a complete field verification of the QA-1 and containment isolation solenoid valves,

2) Following up with Fluor Engineers to determine the cause of incorrect model solenoid valves having been purchased and installed, and

3) Performing a review of the functional operability of the Instrument Air Regulators to document that they will not fail high and have a detrimental affect on the solenoid valves' performance.

Future actions planned include:

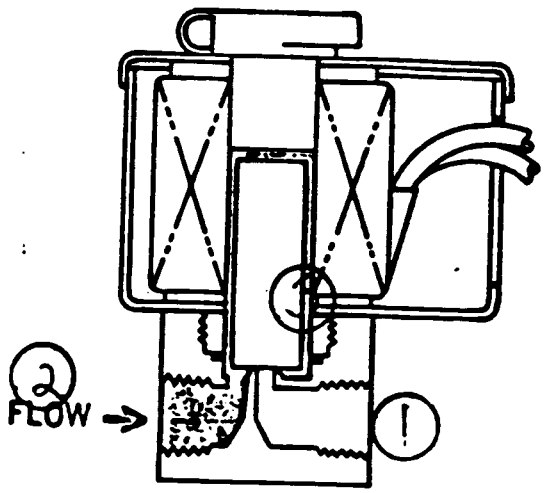
1) Replacement of the solenoid valves as discussed in analysis of event section, and

2) Establishing a program to formalize instrument air regulator settings.

Additional Information

There are no previous similar events.

The model No. of the solenoid valves which failed is ASCO NP8314C13E, with an MOPD of 70 psi.



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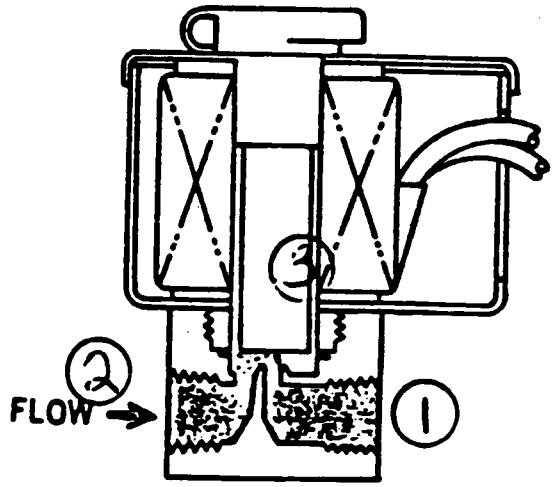

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