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ComEd

November 26, 1996

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Licensee Event Report #96-011-01, Docket #050-373 is a supplemental report updating the Assessment of Safety Consequences section. Based on this supplemental information, this event has been determined to be not reportable and this LER is being submitted as a voluntary report.

Respectfully,

D. J. Ray
Station Manager
LaSalle County Station

Enclosure

cc: A. B. Beach, NRC Region III Administrator
M. P. Huber, NRC Senior Resident Inspector - LaSalle
C. H. Mathews, IDNS Resident Inspector - LaSalle
F. Niziolek, IDNS Senior Reactor Analyst
INPO - Records Center

JE22

NRC FORM 366 (5-92) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 05/31/95

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1):	DOCKET NUMBER (2)	PAGE (3)
LaSalle County Station Unit One	05000373	1 of 8

TITLE (4)

Pneumatic valves with less-than-designed effective diaphragm area results in inadequate valve closing forces which may affect containment isolation.

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 NAME	DOCKET NUMBER
									LaSalle County Station Unit Two	05000374
09	28	96	96	011	01	11	26	96	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	4
POWER LEVEL (10)	000

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

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(iii)	☐ 73.71(b)
☐ 20.2203(a)(1)	☐ 20.2003(a)(3)(ii)	☐ 50.73(a)(2)(iv)	☐ 73.71(c)
☐ 20.2203(a)(2)(i)	☐ 20.2003(a)(4)	☐ 50.73(a)(2)(v)	☒ OTHER
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)	☐ 50.73(a)(2)(vii)	Voluntary Report
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(viii)(A)	(Specify in Abstract below
☐ 20.2203(a)(2)(iv)	☐ 50.73(a)(2)(i)	☐ 50.73(a)(2)(viii)(B)	and in Text, NRC Form 366A)
☐ 20.2003(a)(2)(v)	☐ 50.73(a)(2)(ii)	☐ 50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Mark Smith, Component Engineer	(815) 357-6761 Extension 2323

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)

				EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
☐	YES (If yes, complete EXPECTED SUBMISSION DATE)	☒	NO				

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

While developing an Air Operated Valves (AOV) preventative maintenance program, inconsistent testing data were obtained for valves with WKM 70-13-1 pneumatic actuators. The inconsistent results appeared to be related to incorrect effective diaphragm areas (EDA) for the AOV actuators. This occurred in the February-April 1996 time frame.

Two problems associated with the EDA of the actuators of the WKM valves were identified. The first was related to the actual versus the manufacturer's published EDA of the actuator. The second problem was stretching of the diaphragm during valve travel resulting in a reduced EDA.

In March 1996, LaSalle Station's AOV Component Engineer contacted Anchor/Darling Valve Company regarding the published versus the actual EDA and the stretching of the diaphragms. On September 20, 1996, after conducting testing, Anchor/Darling Valve Company acknowledged a reduction of the EDA for the WKM 70-13-1 pneumatic operators.

There are a total of 36 (18 per unit) WKM AOVs addressed in this LER. Thirteen valves per unit are installed in systems which are part of the Primary Containment Isolation System (PCIS) and five valves per unit are in the Reactor Core Isolation Cooling System (RCIC).

The updated assessment of the safety consequences concludes that the valves had sufficient margin to perform their design function. This condition is not reportable and the LER is determined to be a voluntary report.

PLANT AND SYSTEM IDENTIFICATION

General Electric - Boiling Water Reactor

Energy Industry Identification System (EIIS) codes are identified in the text as [XX].

A. CONDITION PRIOR TO EVENT

Unit(s): 1/2 Event Date: 09/28/96 Event Time: 1650 Hours
Reactor Mode(s): 4/5 Mode(s) Name: Cold Shutdown/Refuel Power Level(s): 0%/0%

B. DESCRIPTION OF EVENT

During the Unit 1 refueling outage (February-April 1996), the station performed actuator and valve testing on five WKM AOVs in the RCIC (Reactor Core Isolation Cooling) system and one AOV in the RF (Reactor Building Floor Drain) system. The RCIC valves were selected for testing as part of the development of the AOV Preventative Maintenance Program, and the RF valve was tested following corrective maintenance due to a packing leak. The RCIC valves that were tested do not perform a containment isolation function during a Design Basis Accident, but the single RF valve that was tested is one of the primary containment isolation valves.

The six valves discussed above were all originally designed by WKM. The design is currently manufactured by Anchor/Darling Valve Company. Actuator testing prior to returning the valves to service revealed that inconsistencies existed between the manufacturer's published bench set data and the data recorded by the mechanics. After further in-house testing and verification that the other actuator components were functioning as designed (e.g., spring rate design versus actual), it was determined that the published EDA for the WKM AOV actuators was incorrect.

All AOVs operate in much the same manner. The diaphragm, which is a flexible, nylon-reinforced rubber material, is sandwiched at its outer diameter between the upper and lower diaphragm casings. A stem is mounted to the center of the diaphragm via a diaphragm plate, and this stem protrudes from the center of the lower casing. The diaphragm plate moves inside the casing much like a piston, with the diaphragm providing an air-tight seal between the top and bottom of the casing halves. When air pressure is applied through an opening in the casing to [either side of] the diaphragm, the flexible diaphragm/plate/stem assembly moves away from the applied air, resulting in linear travel of the protruding stem. For most AOV applications, the diaphragm/plate/stem assembly is spring-mounted within the actuator, and the force of compressing this spring works in the opposite direction of the force due to the applied air to the diaphragm. In application, the stem that protrudes from the diaphragm casing is coupled to a valve stem, such that the valve is opened and/or closed based upon a combination of air pressure and spring force.

For installation, AOVs are bench set. Bench setting consists of applying air pressure to the actuator in accordance with manufacturer's published values, and adjusting the actuator's spring [compressive force] to achieve a relationship between air pressure and valve stem travel. The lower bench set values and the upper bench set values should correlate to the valve being stroked through its full range of travel (closed to open or vice-versa). With no air on the actuator's diaphragm, the force remaining in the actuator's spring, and hence the valve to which it is attached, is enough to keep the valve in its designed position (either open or closed). The force of the spring is adjusted to be the product of the actual EDA and the lower bench set air pressure value. If the actual EDA is less than what the manufacturer publishes, then the closing (or opening) forces installed in the valve(via spring/spring adjustment) will be less than required. This is the problem with WKM AOVs at LaSalle.

During bench set testing of the WKM 70-13-1 actuator/valve assemblies (using diagnostics), the controlled air test pressures did not correlate to the designed valve stem travel. Similar testing at the LaSalle Station on other (i.e., not manufactured by Anchor/Darling Valve Company) AOVs yielded predictable results regarding the accuracy of the manufacturer's recommended bench-set air pressures and valve stem travel. However, when bench-set testing was performed on the WKM AOVs, it was identified that the valves did not complete their predicted travel within the bench set pressure span. Typically, this is indicative of a stiffer-than-expected spring force. However, additional testing with a known (measured) spring force, supply air pressure, and output load, identified concerns related to the manufacturer's published actuator EDA. Also, the WKM 70-13-1 actuator's diaphragm height was found to be incorrect in relationship to the upper internal actuator casing dimensions. The as-delivered upper-half of the diaphragm casing was deeper than the lower half. During valve operation, as the diaphragm moved into the upper (i.e., deep) casing, the diaphragm material would begin to stretch prior to contacting the upper stop within the casing, thereby reducing the EDA. Therefore, LaSalle personnel concluded that two problems existed with the WKM AOVs: 1) Incorrect published EDA; and 2) A changing EDA as the diaphragm stretched within its casing.

After consultation with Anchor/Darling Valve Company, design changes were made to account for the effective diaphragm area reduction for the referenced valves. The design changes corrected the problems with the published versus the actual EDA and the stretching of the diaphragm. Upon completion of maintenance work and testing, the RF valve (i.e., the only containment isolation valve in the test group) passed the required local leak rate testing (LLRT) and stroke time testing and it was placed back into service. A review of Unit 1 and Unit 2 10 CFR 50 Appendix J LLRT test results and IST stroke time tests for the PCIS valves with WKM actuators confirmed that all the valves had also successfully passed these tests.

In early May 1996, LaSalle's 10 CFR Part 21 Coordinator was notified regarding the test results indicating the reduced EDA for WKM actuators. An action item was issued to track and resolve the WKM EDA concerns. Due to the lack of official Anchor/Darling Valve Company correspondence regarding the actual versus the published EDA, it was considered that there was insufficient data available at the time to determine potential Part 21 applicability. Anchor/Darling Valve Company was notified regarding their need to address Part 21 issues related to WKM 70-13-1 valves.

In an effort to communicate the WKM EDA concerns, the Component Engineer discussed the AOV EDA issues at INPO during an AOV working meeting (May 7 and 8, 1996). Additionally, the Component Engineer discussed the WKM concerns with the other five ComEd Nuclear Facility peers at their Quarterly Peer Group Meeting (May 26, 1996).

In June 1996, Anchor/Darling Valve Company formally acknowledged their responsibility to review the EDA concern for 10 CFR Part 21 applicability. The LaSalle Component Engineer prepared and issued a letter to Anchor/Darling Valve Company detailing all of the concerns that LaSalle Station had identified with the WKM AOVs. Specifically, there were four items submitted to Anchor/Darling Valve Company due to concerns regarding the WKM actuators:

Evaluate the actual EDA versus the original design values.

Calculate the new bench range values for the LaSalle population based on original design specifications.

Evaluate the actuator casing inner dimensions with regard to the diaphragm molded heights for all actuator sizes.

Evaluate the current spring guide (plate) design to ensure proper spring alignment and provide appropriate part numbers, and material.

On August 16, 1996, Anchor/Darling Valve Company provided preliminary test results for the WKM 70-13-1 actuator. This was followed up with a trip by the AOV Component Engineer to the Anchor/Darling Valve Company facilities to review the test results, methodology and to discuss corrective actions. On September 20, 1996, Anchor/Darling Valve Company acknowledged the EDA reduction and provided their recommended corrective actions.

Due to the required valve changes and safety significance of the systems affected, LaSalle Station began gathering data to review operability. On September 28, it was determined that without implementation of design changes incorporating the Anchor/Darling Valve Company recommended corrective actions, the PCIS valve assemblies listed in Table 1 may not isolate as designed. Specifically, for the AOVs that close to perform their PCIS function, the spring may not be adjusted with enough force to close the valve under design conditions. Based on this condition, a four hour notification in accordance with 10 CFR 50.72(b)(2)(i) was made to the NRC on September 28, 1996 at 2035.

On October 4, 1996, LaSalle personnel issued a 10 CFR Part 21 notification regarding the EDA concerns related to the WKM Model 70-13-1 Pneumatic Actuators currently manufactured by the Anchor/Darling Valve Company.

The updated assessment of the Safety Consequences section concludes these valves had sufficient margin to perform their design function. This condition has been determined to be not reportable and this LER is a voluntary report.

C. CAUSE OF EVENT

The root cause of this event is the use of incorrect EDA (effective diaphragm area) by the Original Equipment Manufacturer (OEM) for actuator setup. The OEM at the time was WKM.

D. ASSESSMENT OF SAFETY CONSEQUENCES

The safety function of the valves listed in Table 1 for the IN(Drywell Instrument Nitrogen), RE(Drywell Equipment Drain Sump), RF(Drywell Floor Drain Sump), and B33(Reactor Recirc. Sample) systems is to isolate the containment in an accident. The E51(RCIC) valves have no specific safety function. 'As-Found' testing was performed on many of the WKM Air Operated Valves listed in Table 1. This testing was performed to determine the seating force generated by the installed actuator configurations. Except for the Unit 1 RCIC and RF valves previously noted, this testing was performed prior to any maintenance or corrective actions to restore margin lost due to the reduced EDA. The test data was compared to the actuator seating force required to close each valve at the limiting design condition. Comparison of the data concluded there was sufficient actuator force margin available for the tested valves to overcome the effects of a reduced EDA.

Discussion regarding specific test results are as follows:

1. The 1IN001A and 1IN001B valve 'As-Found' test actuator forces exceeded the design force required to close. Development of Design Change Package enhancements to restore margin lost due to the reduced EDA raised the design basis differential pressure for these valves. When the additional force required by the increased differential pressure is compared to the test results, the 'As-Found' test actuator forces continue to demonstrate sufficient margin to overcome the reduced EDA and exceed the design force required to close each valve.

2. The 1IN017, 1IN074, 1IN075, and 2IN017 valve 'As-Found' test actuator forces did not meet the original design force required to close. Development of Design Change Packages to restore margin lost due to the reduced EDA for these valves found the differential pressure used for the original calculation to be overly conservative. When the revised differential pressure in the updated calculation is applied, the 'As-Found' test actuator forces demonstrate sufficient margin to overcome the reduced EDA and exceed the design force required to close each valve.

3. Unit 1 RE Inboard Isolation Valve 1RE024 was not tested due to required corrective maintenance not related to the reduced EDA. The redundant Primary Containment Isolation Valve for the penetration, 1RE025, was tested and demonstrated sufficient margin to overcome the reduced EDA at the limiting design condition. Based on these results, the penetration would have sealed even if the 1RE024 actuator did not have sufficient margin to overcome the effects of the reduced EDA.

4. Due to refuel outage maintenance activities that were started prior to official acknowledgement of the EDA reduction by Anchor/Darling Valve Co., 'As-Found' testing could not be performed for some of the valves affected. Unit 2 IN Valves 2IN001A, 2IN001B, 2IN074, and 2IN075 valves were disassembled for maintenance prior to implementation of the 'As-Found' test plan. Valve assemblies with the same design, function, and bench settings tested on Unit 1 demonstrated sufficient margin to overcome the effects of the reduced EDA. Based on these results it is believed similar test results would have been obtained for the Unit 2 valves.

5. Unit 2 refuel outage activities have prevented the completion of 'As-Found' testing on Reactor Recirc Sample Valves 2B33F019 and 2B33F020. The valves are scheduled for testing during the current refuel outage. Testing is expected to provide acceptable results based on the data obtained for the Unit 1 valves performing the same function. If the 'As-Found' test results are not satisfactory, the LER will be updated to address the safety significance of the findings.

6. The 1RF013 'As-Found' test was performed with the margin enhancements incorporated in the actuator configuration during the previous Refueling Outage. While the test results were acceptable, they are not indicative of the actuator force available prior to the enhancements. There are no previous diagnostic test records available to determine the actual capability of the actuator. As previously noted, the Appendix J LLRT test results and IST stroke time tests for this valve were acceptable. Assuming a worst case scenario where the valve would not have closed, the redundant Primary Containment Isolation Valve for the penetration, 1RF012, was tested and demonstrated sufficient margin to overcome the reduced EDA at the limiting design condition. Based on these results, the penetration would have sealed even if the 1RF013 actuator did not have sufficient margin to overcome the effects of the reduced EDA.

7. The Unit 1 RCIC valve 'As-Found' tests were performed with the margin enhancements incorporated into the actuator configuration during the previous Refueling Outage. While the test results were acceptable they are not indicative of the actuator force available prior to the enhancements. There

are no previous diagnostic test records to determine the actual capability of the RCIC actuators. The Unit 2 RCIC valve 'AS-Found' tests were performed with the original design actuator configuration and demonstrated sufficient margin to overcome the effects of the reduced EDA. It is believed similar test results would have been obtained for the Unit 1 RCIC valves.

In conclusion, 'As-Found' test results indicate the installed actuator configurations had sufficient margin to overcome the effects of the reduced EDA when the concern was reported on 09/28/96. The same conclusion can be made for untested valves based on like design, function and bench settings. Also, all the PCIS valves had satisfactory Appendix J LLRTs performed at 40PSI and met IST timing requirements. There is no safety consequence of this event.

E. CORRECTIVE ACTIONS

1. LaSalle is implementing design change packages (DCP) to compensate for the reduced EDA and restore the valves design specifications. These DCPs will be completed prior to Unit 1 and Unit 2 startup from the current outages.

2. 10 CFR Part 21 notification on the deficiency of WKM 70-13-1 Pneumatic Actuators currently manufactured by the Anchor/Darling Valve Company was issued on October 4, 1996.

F. PREVIOUS OCCURRENCES

LER NUMBER	TITLE
None	

G. COMPONENT FAILURE DATA

BS&B manufactured the original design of these air operators. Subsequently, other valve manufacturers have owned the design and have manufactured them. Chronologically, the affected designs have been manufactured by:

BS&B (Black, Sivalls and Bryson)
WKM Valve Division, ACF Industries
Muesco
A/DV (Anchor/Darling Valve Company)

The actuator model is 70-13-1.

Table 1 - Affected AOVs
Manufacturer/Supplier - W-K-M Controls
NOTE: Fail Mode for All Valves is "Close"

Tag/EPN	Valve Model	Actuator Size	Test Info **	Valve Noun Name
1B33F019*	70-18-9DRT	70	Pass	RR Inboard Process Sample Stop
1B33F020*	70-18-9DRT	70	Pass	RR Inboard Process Sample Stop
1E51F004	70-29-1DRT	70	Pass	RCIC Baro Condenser Cond Pump
1E51F005	70-29-1DRT	70	Pass	RCIC Baro Condenser Cond Pump
1E51F025	70-18-9DRT	70	Pass	RCIC Steam Supply Drain Pot Outlet Upstream Stop
1E51F026	70-18-9DRT	70	Pass	RCIC Steam Supply Drain Pot Outlet Downstream Stop
1E51F054	70-18-9DRT	70	Pass	RCIC Steam Supply Drain Pot Outlet Trap
1IN001A*	70-29-1DRTS	70	Pass	Drywell Suction Upstream Isolation
1IN001B*	70-29-1DRTS	70	Pass	Drywell Suction Downstream Isolation
1IN017*	70-29-1DRTS	35	Pass	Drywell Pneumatic to Drywell
1IN074*	70-29-1DRTS	35	Pass	DW Pneumatic Dryer Downstream Purge Outlet
1IN075*	70-29-1DRTS	35	Pass	DW Pneumatic Dryer Upstream Purge Outlet
1RE024*	70-29-1DRTS	70	Not tested	DW Equipment Drain Inboard Isolation
1RE025*	70-29-1DRTS	70	Pass	DW Equipment Drain Outboard Isolation
1RE026*	70-29-1DRTS	35	Pass	DW Equipment Drain Sump Recirc Valve
1RE029*	70-29-1DRTS	35	Pass	DW Equipment Drain Sump Discharge Valve
1RF012*	70-29-1DRTS	70	Pass	DW Floor Drain Inboard Isolation
1RF013*	70-29-1DRTS	70	Pass	DW Floor Drain Outboard Isolation
2B33F019*	70-18-9DRT	70	Sched	RR Inboard Process Sample Stop
2B33F020*	70-18-9DRT	70	Sched	RR Inboard Process Sample Stop
2E51F004	70-29-1DRT	70	Pass	RCIC Baro Condenser Cond Pump
2E51F005	70-29-1DRT	70	Pass	RCIC Baro Condenser Cond Pump
2E51F025	70-18-9DRT	70	Pass	RCIC Steam Supply Drain Pot Outlet Upstream Stop
2E51F026	70-18-9DRT	70	Pass	RCIC Steam Supply Drain Pot Outlet Downstream Stop
2E51F054	70-18-9DRT	70	Pass	RCIC Steam Supply Drain Pot Outlet Trap
2IN001A*	70-29-1DRTS	70	Not tested	Drywell Suction Upstream Isolation
2IN001B*	70-29-1DRTS	70	Not tested	Drywell Suction Downstream Isolation
2IN017*	70-29-1DRTS	35	Pass	Drywell Pneumatic to Drywell
2IN074*	70-29-1DRTS	35	Not tested	DW Pneumatic Dryer Downstream Purge Outlet
2IN075*	70-29-1DRTS	35	Not tested	DW Pneumatic Dryer Upstream Purge Outlet
2RE024*	70-29-1DRTS	70	Pass	DW Equipment Drain Inboard Isolation
2RE025*	70-29-1DRTS	70	Pass	DW Equipment Drain Outboard Isolation
2RE026*	70-29-1DRTS	35	Pass	DW Equipment Drain Sump Recirc Valve
2RE029*	70-29-1DRTS	35	Pass	DW Equipment Drain Sump Discharge Valve
2RF012*	70-29-1DRTS	70	Pass	DW Floor Drain Inboard Isolation
2RF013*	70-29-1DRTS	70	Pass	DW Floor Drain Outboard Isolation

* PCIS Valve

** Test Info. column is updated material