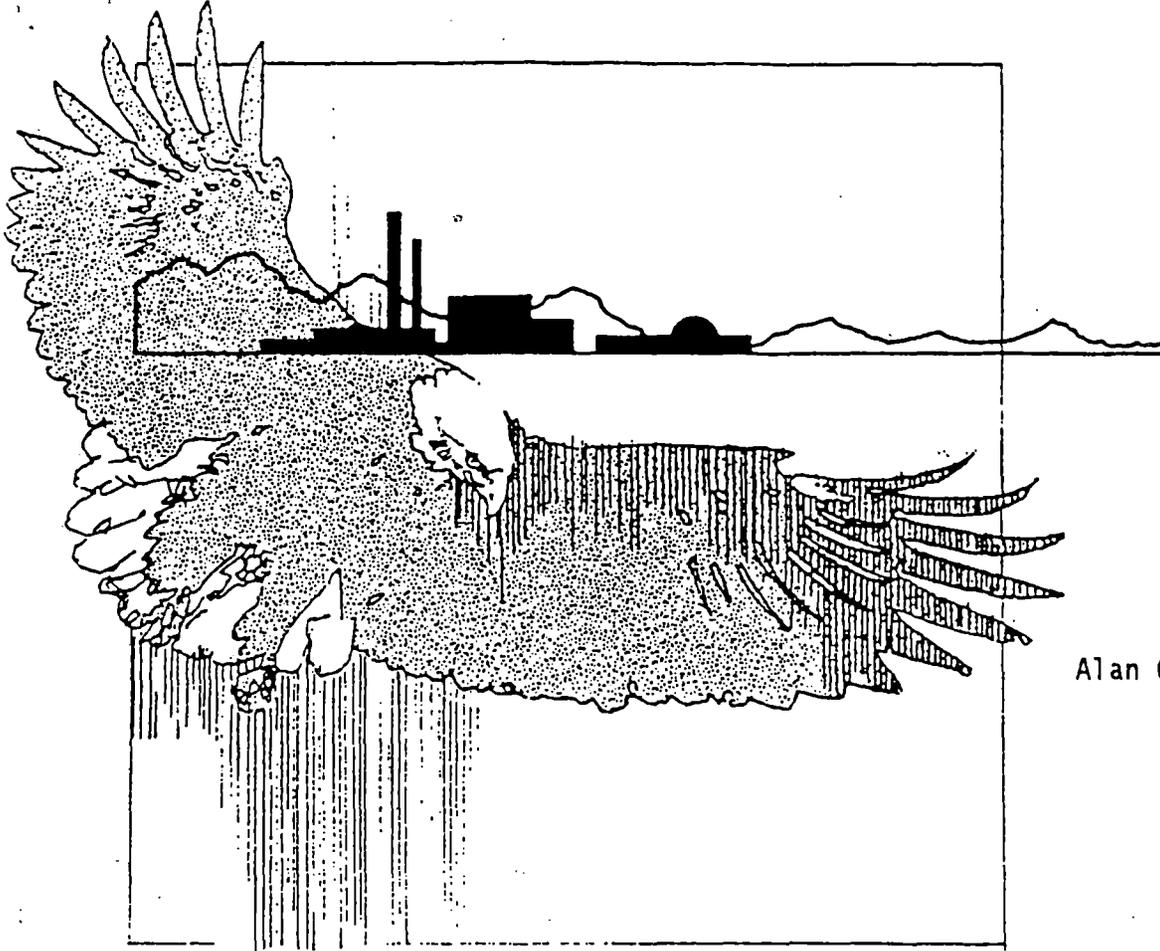


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Evaluation of Utility Response to
Supplement 1 to NRC Bulletin 90-01:
North Anna-1/-2 and Surry-1/-2



Enclosure 2

Lockheed
Idaho Technologies Company

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TECHNICAL EVALUATION REPORT

Evaluation of Utility Response to Supplement 1 to
NRC Bulletin 90-01: North Anna-1/-2 and Surry-1/-2

Docket Nos. 50-338, 50-339, 50-280, and 50-281

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SUMMARY

This report documents the Lockheed Idaho Technologies Company review of the Virginia Electric and Power Company submittals that respond to Supplement 1 to NRC Bulletin 90-01 for Unit Nos. 1 and 2 the North Anna Power Station and Unit Nos. 1 and 2 of the Surry Power Station. This NRC Bulletin provides information regarding the loss of fill-oil in certain pressure and differential pressure transmitters manufactured by Rosemount, Inc. This report finds the licensee complies with the requested actions and the reporting requirements of the Supplement.

FIN No. L1695, Task No. 11a
B&R No. 320-19-15-05-0
Docket Nos. 50-338, 50-339, 50-280, and 50-281
TAC Nos. M85414, M85415, M85449, and M85450

PREFACE

This report is supplied as part of the "Technical Assistance in Support of the Instrumentation and Controls Systems Branch." It is being conducted for the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Division of Reactor Controls and Human Factors, by Lockheed Idaho Technologies Company, National Nuclear Operations Analysis Department.

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Evaluation of Utility Response to Supplement 1 to
NRC Bulletin 90-01: North Anna-1/-2 and Surry-1/-2

1. INTRODUCTION

The NRC issued Bulletin 90-01 on March 9, 1990 (Reference 1). That Bulletin discussed certain Rosemount pressure and differential pressure transmitter models identified by the manufacturer as prone to fill-oil leakage. The bulletin requested licensees to identify whether these transmitters were or may later be installed in safety-related systems. Actions were detailed for licensee implementation for certain identified transmitters installed in a safety-related system. These same actions apply to those identified transmitters presently held in inventory for later installation in a safety-related system.

With the gradual leakage of fill-oil, the transmitter would not have the long term accuracy, time response, and reliability needed for its intended safety function. Further, this condition could go undetected over a long period. Redundant instrument channels are subject to the same degradation mechanism. This increases the potential for a common mode failure. Thus, this potential failure mechanism raised concern for the reliability of reactor protection systems (RPS), engineered safety features (ESF) actuation systems, and anticipated transient without scram (ATWS) mitigating systems. To achieve high functional reliability, there must be a low probability of component failure while operating, with any failures readily detectable.

Supplement 1 to NRC Bulletin 90-01 (Reference 2) was issued on December 22, 1992. The Supplement informed licensees of NRC staff activities regarding the subject transmitters, and noted continuing reports of transmitter failures. The NRC requested licensee action to resolve the issue. The Supplement also updated the information contained in the original bulletin. The licensee was requested to review the information and determine if it was applicable at their facility. Further, the licensee was requested to modify their actions and enhanced surveillance monitoring programs to conform with the direction given. Finally, the licensee was instructed to

respond to the NRC. The Requested Actions in Supplement 1 to NRC Bulletin 90-01 supersede the original NRC Bulletin 90-01 Requested Actions.

In responding to Supplement 1 to NRC Bulletin 90-01, the licensee is directed to address three items.

1. A statement either committing the licensee to take the NRC Bulletin 90-01, Supplement 1, Requested Actions or taking exception to those actions.
2. Addressing the actions committed to in the above statement, provide:
 - a. a list of the specific actions, including any justifications, to be taken to complete the commitment,
 - b. a schedule for completion, and
 - c. after completion, a statement confirming the actions committed to are complete.
3. A statement identifying the NRC Bulletin 90-01, Supplement 1, Requested Actions not taken, along with an evaluation providing the basis for exemption.

In implementing the replacement option of the NRC Requested Actions, plant shutdown exclusively for replacing the transmitters is not required. This allowance infers that replacements can be scheduled. With replacement in a timely manner, enhanced surveillance monitoring for interim operation is not required.

The Virginia Electric and Power Company, the licensee for Unit Nos. 1 and 2 of the North Anna Power Station and Unit Nos. 1 and 2 of the Surry Power Station, responded to Supplement 1 of NRC Bulletin 90-01 with a letter dated March 16, 1993 (Reference 3). The licensee provided additional information on October 14, 1993 (Reference 4), and July 12, 1994 (Reference 5). This technical evaluation report evaluates the completeness of those submittals.

It also determines whether proposed surveillance methods are adequate to determine fill-oil loss-caused degradation of the transmitter. Finally, this report addresses the interval of surveillance proposed by the licensee for any transmitters included in the enhanced surveillance monitoring program.

Many Rosemount transmitter failures have been attributed to the use of stainless steel "O"-rings between the sensing module and the process flanges. Rosemount improved the manufacturing process for transmitters manufactured after July 11, 1989. Those improvements included a limit of the torque applied to the flange bolts. This limits the stress caused in the sensing module by the "O"-ring. Post-production screening, including pressure testing of the sensing module for this potential latent defect, was also implemented at that time. Therefore, as described in Supplement 1 of NRC Bulletin 90-01, those Rosemount transmitters manufactured after July 11, 1989, are not subject to this review.

2. NRC SPECIFIED REQUESTED ACTIONS

The NRC staff specified the following Requested Actions of licensees of operating reactors.

1. Review plant records and identify the following Rosemount transmitters (if manufactured before July 11, 1989) that either are used in or may be used in either safety-related or ATWS mitigating systems.

- Rosemount Model 1153, Series B
- Rosemount Model 1153, Series D
- Rosemount Model 1154

Following identification, the licensee is to establish the following:

- a. For those identified transmitters having a normal operating pressure greater than 1500 psi, and are installed as part of reactor protection trip systems, ESF actuation systems, or ATWS mitigating systems, either replace the transmitter in an expedited manner, or monitor monthly, for the life of the transmitter, using an enhanced surveillance program.

If the identified transmitter exceeds the 60,000 psi-month or the 130,000 psi-month criterion (depending on the range code of the transmitter) established by Rosemount, enhanced surveillance on a refueling (not exceeding 24 months) basis is acceptable. Under this option, justification must be based on the service record and the specific safety function of the transmitter. That justification can be based on high functional reliability provided by redundancy or diversity.

- b. For those identified transmitters having a normal operating pressure greater than 1500 psi, and are installed as part of a safety-related system other than reactor protection trip systems, ESF actuation, or ATWS mitigating systems, either replace the transmitter or monitor quarterly, for the life of the transmitter, using an enhanced surveillance program.

If the identified transmitter exceeds the 60,000 psi-month or the 130,000 psi-month criterion (depending on the range code of the transmitter) established by Rosemount, enhanced surveillance on a refueling (not exceeding 24 months) basis is acceptable. Under this option, justification must be based on the service record and the specific safety function of the transmitter. That

justification can be based on high functional reliability provided by redundancy or diversity.

c. For boiling water reactors (BWR)--

For those identified transmitters having a normal operating pressure greater than 500 psi and less than or equal to 1500 psi, and are installed as part of reactor protection trip systems, ESF actuation systems, or ATWS mitigating systems, either replace the transmitter, or monitor monthly with an enhanced surveillance monitoring program, until the transmitter reaches the designated (by Rosemount) psi-month criterion (60,000 psi-month or 130,000 psi-month, depending on the transmitter range code).

For transmitters that provide signals to the RPS or ATWS trips for high pressure or low water level, the enhanced surveillance must be monthly. For other transmitters in this classification, enhanced surveillance on a refueling (not exceeding 24 months) basis is acceptable. Under this option, justification must be based on the service record and the specific safety function of the transmitter. That justification can be based on high functional reliability provided by redundancy or diversity.

For pressurized water reactors (PWR)--

For those identified transmitters having a normal operating pressure greater than 500 psi and less than or equal to 1500 psi, and are installed as part of reactor protection trip systems, ESF actuation systems, or ATWS mitigating systems, either replace the transmitter, or monitor with an enhanced surveillance monitoring program, until the transmitter reaches the designated (by Rosemount) psi-month criterion (60,000 psi-month or 130,000 psi-month, depending on the transmitter range code) on a refueling (not exceeding 24 months) basis.

- d. For those identified transmitters having a normal operating pressure greater than 500 psi and less than or equal to 1500 psi, and are installed as part of a safety-related system other than reactor protection trip systems, ESF actuation, or ATWS mitigating systems, either replace the transmitter or monitor with an enhanced surveillance monitoring program, until the transmitter reaches the designated (by Rosemount) psi-month criterion (60,000 psi-month or 130,000 psi-month, depending on the transmitter range code) on a refueling (not exceeding 24 months) basis.

- e. Those transmitters having a normal operating pressure greater than 500 psi and less than or equal to 1500 psi, and have accumulated sufficient psi-month operating history to exceed the criterion established by Rosemount, may be excluded from the enhanced surveillance monitoring program at the discretion of the licensee. However, the licensee should retain a high level of confidence that a high level of reliability is maintained and that transmitter failure due to loss of fill-oil is detectable.
 - f. Those transmitters having a normal operating pressure less than or equal to 500 psi may be excluded from the enhanced surveillance monitoring program at the discretion of the licensee. However, the licensee should retain a high level of confidence that a high level of reliability is maintained and that transmitter failure due to loss of fill-oil is detectable.
2. Evaluate the enhanced surveillance monitoring program. The evaluation is to ensure the measurement data has an accuracy commensurate with the accuracy needed to compare the data to the manufacturers drift data criteria. It is this comparison that determines the degradation threshold for loss of fill-oil failures of the subject transmitters.

The Supplement also states the NRC may conduct audits or inspections in the future to verify compliance with the established requirements.

3. EVALUATION

The licensee responded to Supplement 1 of NRC Bulletin 90-01 on March 16, 1993. The licensee provided additional information on October 14, 1993, and July 12, 1994. Those responses were compared to the Bulletin Reporting Requirements and Requested Actions as described below. Both North Anna and Surry have 2 PWR units. The licensee reports having Rosemount transmitters that are subject to the Requested Actions of the Supplement. Other Rosemount transmitters are outside the scope of the Supplement due to replacement or refurbishment. The licensee notes that one transmitter was replaced in the 7 month period between submitting Reference 3 and Reference 4. The replacement transmitter is outside the scope of the enhanced surveillance monitoring program due to its replacement.

3.1 Evaluation of Licensee Response to Reporting Requirements

The licensee states they will perform the Requested Actions detailed in Supplement 1 of NRC Bulletin 90-01. Included with that statement is clarification, interpretation, and the limits placed on that commitment. The licensee described the specific actions taken to implement the Requested Actions.

A statement that the Requested Actions are complete is included in the submittal. Reference 4 modifies that commitment for some transmitters in transmitter classification 1.b. The submittals identify where licensee actions are taken. The licensee evaluated deviations and provided justification to support any deviations from the Requested Actions of the Supplement.

The licensee submittals conform to the Reporting Requirements of Supplement 1 of NRC Bulletin 90-01.

3.2 Evaluation of Licensee Response to Requested Actions

Supplement 1 of NRC Bulletin 90-01 requested licensee action to resolve the issue of fill-oil leakage in Rosemount transmitters. In this Technical Evaluation Report, the Requested Actions and associated transmitter criteria are summarized in Section 2. The licensee response to the Supplement is discussed in the following sections.

3.2.1 Licensee Response to Requested Action 1.a

The licensee states there are Rosemount transmitters from this transmitter classification at both the North Anna and the Surry Power Stations. These transmitters monitor the reactor coolant system (RCS) pressure, flow, and level. Upon reaching the psi-month maturity threshold, a transmitter in this transmitter classification may participate in an enhanced surveillance monitoring program on a refueling basis (not to exceed 24-months) if supported by a satisfactory operational history and system design features such as redundancy and diversity. These transmitters were initially monitored both monthly and on a refueling basis. See Section 3.2.7 for a description of the monitoring methodologies. Monthly operational data checks compared the operational signals of redundant transmitters by computer monitoring.

Reference 5 notes that this method is no longer used because the transmitters either exceed their maturity threshold (psi-month) or have been replaced. All remaining transmitters have redundancy. Operators are stated to compare the redundant channels frequently. The enhanced calibration methodology trends the accumulated zero shift of the transmitters and tests for transmitter response to step changes in the process input. The enhanced surveillance monitoring program for these transmitters is acceptable.

3.2.2 Licensee Response to Requested Action 1.b

The Supplement requires monitoring transmitters in this transmitter classification quarterly for the life of the transmitter if the transmitter is not replaced. Upon reaching the psi-month maturity threshold, a transmitter in this transmitter classification may participate in an enhanced surveillance monitoring program on a refueling basis (not to exceed 24-months) if supported by a satisfactory operational history and system design features such as redundancy and diversity. The licensee states there are Rosemount transmitters from this classification at both the North Anna Power Station and the Surry Power Station.

Reactor Coolant System (RCS) Wide-range Pressure Transmitters

The RCS wide-range pressure transmitters at both North Anna and Surry exceed the psi-month operational maturity threshold. The licensee is monitoring these transmitters with enhanced surveillance testing at refueling outages. The licensee justified extending the surveillance interval from quarterly to refueling outages, as required by the Supplement. The justification included 8 years in service with no failures in 5 or more calibrations and pressure response tests. Therefore, we conclude that these transmitters are part of an acceptable enhanced surveillance monitoring program.

Charging Pump Makeup Flow Transmitters/North Anna Power Station

The Unit 1 charging pump makeup flow transmitter has been replaced. Thus, it is outside of the scope of the Supplement. The Unit 2 charging pump makeup flow transmitter has achieved its maturity threshold. It had weekly operational surveillance until the psi-month maturity threshold was reached. The makeup flow is stable for a given power level. Thus, the transmitter output was compared to previous readings at the same power level. This method is acceptable per Rosemount Technical Bulletin No. 4. The licensee now

monitors this transmitter with the refueling outage enhanced refueling calibration. The licensee states that operators are sensitive to the Rosemount issue in regards to this transmitter and can verify proper functioning by cross checks with other parameters such as pressurizer level and letdown flow. Therefore, we conclude that this transmitter is part of an acceptable enhanced surveillance monitoring program.

Charging Pump Makeup Flow Transmitters/Surry Power Station

Both the charging pump makeup flow transmitters exceed the psi-month maturity threshold. These transmitters, as at North Anna, have no redundant counterpart. Thus these transmitters are included in the enhanced refueling calibration surveillance monitoring program. These transmitters have been in service for over seven years and exhibit no symptoms of fill-oil loss. The licensee states that operators are sensitive to the Rosemount issue in regards to these transmitters and can verify proper functioning by cross checks with other parameters such as pressurizer level and letdown flow. Therefore, we conclude that these transmitters are part of an acceptable enhanced surveillance monitoring program.

In-containment High-head Safety Injection Flow Transmitters/Surry Power Station

The Rosemount transmitters that monitor the high-head safety injection flow inside containment at Surry are considered safety-related for pressure boundary purposes only. The licensee does not include these transmitters in the enhanced surveillance monitoring program. The purpose of the Supplement is to identify and repair, before the safety function of the transmitter is compromised, those Rosemount transmitters where the safety-related signal deteriorates due to the loss of fill-oil. Because no safety-related signal is involved, the exclusion of these transmitters from the enhanced surveillance monitoring program is acceptable.

Outside Containment High-head Safety Injection Flow Transmitters

For the three transmitters that monitor the high-head safety injection flow outside containment at both units at both stations, the licensee committed, in Reference 3, to either: a) provide enhanced calibration quarterly; b) replace the transmitters; or c) provide justification for a lengthened surveillance interval. Any of the stated options are acceptable (provided the justification provided for option c is adequate and satisfactory). The licensee clarified their actions for these transmitters in Reference 4.

At the time of the Reference 4 submittal, there were two remaining transmitters that do not exceed the psi-month maturity threshold. At North Anna, 1-SI-FT-1943-1 is expected to exceed the maturity threshold in 1995. At Surry, 2-SI-FT-2940A is expected to exceed the maturity threshold in 1994. All other Rosemount transmitters in this application have accumulated an operational history in excess of the psi-month maturity threshold.

All the transmitters in this transmitter classification participate in a calibration-based zero-accumulated drift trending program. This program is based on the drift limits of Rosemount Technical Bulletin No. 4. Calibrations have a nominal 18-month frequency. None of the transmitters in this application exhibit symptoms of fill-oil loss or excessive drift. The licensee indicates that these transmitters are redundant and diverse by design. The flow is also monitored inside containment. Based on the justification provided by the licensee, we find the enhanced surveillance monitoring program provided for these transmitters acceptable.

For 1-SI-FT-1943-1 at North Anna and 2-SI-FT-2940A at Surry, the licensee supplemented this monitoring with a monthly comparison of inter-channel drift between redundant transmitters. These transmitters normally operate at no flow. The licensee compares the drift between channels to the zero-span shift limits of Rosemount Technical Bulletin No. 4 to determine if additional investigation or calibration is needed. Comparison of the zero

reading of redundant transmitters monthly is acceptable in meeting the Supplement requirements for these transmitters.

3.2.3 Licensee Response to Requested Action 1.c

The licensee states there are Rosemount transmitters from this transmitter classification at both the North Anna and the Surry Power Stations. These transmitters monitor the narrow-range steam generator level and the main steamline flow and pressure. The transmitters in this classification will be monitored every refueling cycle (not exceeding 24 months) until they exceed the psi-month maturity threshold. This agrees with the Requested Actions of the Supplement and is, therefore, acceptable.

3.2.4 Licensee Response to Requested Action 1.d

The licensee states that Rosemount transmitters in this transmitter classification monitor the following at both the North Anna and the Surry Power Stations.

- a. Safety injection accumulator pressure.
- b. Steam flow to the turbine-driven auxiliary feedwater pump.
- c. Auxiliary feedwater flow.

The transmitters in this classification will be monitored every refueling cycle (not exceeding 24 months) until they exceed the psi-month maturity threshold. This agrees with the Requested Actions of the Supplement and is, therefore, acceptable.

3.2.5 Licensee Response to Requested Action 1.e

The licensee indicates that as Rosemount transmitters in transmitter classifications 1.c and 1.d exceed the psi-month maturity threshold, these

transmitters will be removed from the enhanced surveillance monitoring program. This is permitted by the Supplement.

The Supplement requires the licensee to maintain a high degree of confidence that these transmitters remain highly reliable. The licensee performs normal calibration testing that includes step response testing at every refueling outage. Step response testing identifies transmitters with sluggish response characteristics. If sluggish response is evident, further evaluation is conducted by the licensee to determine the acceptability of the transmitter for continued operation. This agrees with the Requested Actions of the Supplement and is, therefore, acceptable.

3.2.6 Licensee Response to Requested Action 1.f

The licensee indicates there are Rosemount transmitters from this classification at both the North Anna Power Station and the Surry Power Station. The Supplement requires the licensee to maintain a high degree of confidence that these transmitters remain highly reliable. The licensee performs normal calibration testing that includes step response testing at every refueling outage. Step response testing identifies transmitters with sluggish response characteristics. If sluggish response is evident, further evaluation is conducted by the licensee to determine the acceptability of the transmitter for continued operation. This agrees with the Requested Actions of the Supplement and is, therefore, acceptable.

3.2.7 Enhanced Surveillance Monitoring Program

The enhanced surveillance monitoring program consists of two parts -- monthly operational data monitoring and the trending of the zero drift data taken from calibration data nominally taken during refueling outages. As high-pressure transmitters achieve their psi-month maturity threshold, the monthly operational data monitoring is deleted for that transmitter.

Calibration procedures also provide for transmitter response testing, another indication of satisfactory transmitter performance.

In monthly operational monitoring, the transmitter signal is recorded on magnetic tape via the Emergency Response Facility (ERF) computer. The inputs to the ERF computer are calibrated to within ± 0.25 percent. This data accuracy is consistent with Rosemount requirements for enhanced surveillance monitoring. The magnetic tape is processed on a mainframe computer to convert the signal data into a personal computer (PC) database. The PC calculates the variation between redundant channels and compares the variation from the Rosemount established allowance for variation between channels. If a transmitter signal is outside the limit, the transmitter undergoes additional evaluation.

Pertinent calibration data from each calibration is extracted from calibration data sheets and entered into a PC database. The database program calculates the zero drift that has occurred. As drift data accumulates, any faulty transmitters are identified by comparison to Rosemount-established drift limits. The licensee notes their data has accuracy consistent with the Rosemount requirements. The licensee also performs normal calibration testing that includes step response testing at every refueling outage. Step response testing identifies transmitters with sluggish response characteristics. If sluggish response is evident, further evaluation is conducted by the licensee to determine the acceptability of the transmitter for continued operation.

4. CONCLUSIONS

Based on our review, we find the licensee has completed the reporting requirements of Supplement 1 of NRC Bulletin 90-01. Further, the licensee conforms to the requested actions of Supplement 1 to NRC Bulletin 90-01.

5. REFERENCES

1. NRC Bulletin No. 90-01: "Loss of Fill-oil in Transmitters Manufactured by Rosemount," March 9, 1990, OMB No. 3150-0011.
2. NRC Bulletin No. 90-01, Supplement 1: "Loss of Fill-oil in Transmitters Manufactured by Rosemount," December 22, 1992, OMB No. 3150-0011.
3. Letter, Virginia Electric and Power Company (W. L. Stewart) to NRC, "Response to NRC Bulletin 90-01, Supplement 1, Loss of Fill-Oil in Rosemount Transmitters," March 16, 1993, Serial No. 92-846.
4. Letter, Virginia Electric and Power Company (W. L. Stewart) to NRC, "Supplemental Response to NRC Bulletin 90-01, Supplement 1, Loss of Fill-Oil in Transmitters Manufactured by Rosemount," October 14, 1993, Serial No. 93-429.
5. Letter, Virginia Electric and Power Company (J. P. O'Hanlon) to NRC, "Supplemental Response to NRC Bulletin 90-01, Loss of Fill-Oil in Rosemount Transmitters," July 12, 1994, Serial No. 94-846A.

BIBLIOGRAPHIC DATA SHEET

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Washington, DC 20555

10. SUPPLEMENTARY NOTES

11. ABSTRACT (200 words or less)

This report documents the Lockheed Idaho Technologies Company review of the Virginia Electric and Power Company submittals that respond to Supplement 1 to NRC Bulletin 90-01 for the North Anna Power Station, Unit Nos. 1 and 2, and the Surry Power Station, Unit Nos. 1 and 2. This NRC bulletin provides information regarding the loss of fill-oil in certain pressure and differential pressure transmitters manufactured by Rosemount, Incorporated. This report finds the licensee conforms to the requested actions and the reporting requirements of the supplement.

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SUMMARY OF REVIEW

The staff completed its review of the licensee's response to Nuclear Regulatory Commission Bulletin 90-01, Supplement 1, submitted by the Virginia Electric Power Company for the Surry Power Station and North Anna Power Station. The staff finds the licensee's response for this item acceptable.

NARRATIVE DISCUSSION OF LICENSEE PERFORMANCE - FUNCTIONAL AREA

The initial response provided to the staff was supplemented with additional information to meet the requested actions.

Author: D. Spaulding
Date: November 4, 1994

ATTACHMENT 3