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EVALUATION OF UTILITY RESPONSE TO
SUPPLEMENT 1 TO NRC BULLETIN 90-01:
SUSQUEHANNA-1/-2

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TECHNICAL EVALUATION REPORT

Evaluation of Utility Response to Supplement 1 to
NRC Bulletin 90-01: Susquehanna-1/-2

Docket Nos. 50-387 and 50-388

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SUMMARY

This report documents the EG&G Idaho, Inc., review of the Pennsylvania Power & Light Company submittals that respond to Supplement 1 to NRC Bulletin 90-01 for Unit Nos. 1 and 2 of the Susquehanna Steam Electric 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 identifies areas of non-conformance to the requested actions and the reporting requirements. Exceptions to the requested actions and the reporting requirements are evaluated.

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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 EG&G Idaho, Inc., DOE/NRC Support Programs Unit.

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Evaluation of Utility Response to Supplement 1 to
NRC Bulletin 90-01: Susquehanna-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 Pennsylvania Power & Light Company, the licensee for Unit Nos. 1 and 2 of the Susquehanna Steam Electric Station, responded to Supplement 1 of NRC Bulletin 90-01 with a letter dated March 4, 1993 (Reference 3). The licensee provided additional information in a letter dated May 31, 1994 (Reference 4). This technical evaluation report evaluates the completeness of these 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 provided a response to Supplement 1 of NRC Bulletin 90-01 on March 4, 1993. The licensee provided clarifying information on May 31, 1994. Those responses were compared to the Bulletin Reporting Requirements and Requested Actions as described below. 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 any future transmitters or sensor replacements will be made with components manufactured after July 1989. Such replacements would then be outside the scope of the Supplement.

3.1 Evaluation of Licensee Response to Reporting Requirements

The licensee states they have taken 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 Reference 3 submittal. The submittal identifies where licensee actions deviate from the Requested Actions of the Supplement. The submittal also provides evaluation and justification supporting the position that the action taken is appropriate. Reference 4 clarifies how the enhanced surveillance monitoring program will be discontinued at some future time due to the replacement of the subject transmitters.

The licensee submittals conform with 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 determined they have transmitters within the scope of this review. The licensee has no Rosemount model 1153, series D, or model 1154 transmitters installed at the Susquehanna Steam Electric Station. Some transmitters have been replaced and are outside the scope of the supplement. 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 no Rosemount transmitters from this transmitter classification at the Susquehanna Steam Electric Station.

3.2.2 Licensee Response to Requested Action 1.b

The licensee states there are three Rosemount transmitters from this transmitter classification at the Susquehanna Steam Electric Station. These transmitters provide a signal representing the containment instrument gas pressure for indication. An alarm is actuated should a low pressure occur. Each transmitter has accumulated an operating history that exceeds the psi-month maturity threshold recommended by Rosemount and endorsed by the NRC. These transmitters are included in the enhanced surveillance monitoring program. A fourth transmitter monitors the same process variable at one of the units. That transmitter was refurbished with a sensing module manufactured after July 11, 1989.

Because these transmitters exceed the maturity threshold, the licensee includes surveillance for these transmitters on an 18 month interval, instead of quarterly. The licensee justifies this extension in the monitoring

interval. The transmitters have a history of no symptoms of loss of fill-oil. Should a loss of fill-oil occur later, the result would be a lower indication than the actual pressure, a conservative indication. The alarm would occur at a higher actual pressure, again conservative. Should a transmitter signal be degraded, the performance of the containment instrument gas system is not affected. With these factors considered, monitoring these transmitters on an 18-month schedule is acceptable.

3.2.3 Licensee Response to Requested Action 1.c

The licensee states there are 31 Rosemount transmitters from this transmitter classification at the Susquehanna Steam Electric Station. Fifteen of these transmitters have accumulated an operating history that exceeds the maturity threshold recommended by Rosemount and endorsed by the NRC. Sixteen transmitters have not. All these transmitters are included in the enhanced surveillance monitoring program. None provide signals to the RPS or ATWS trips for high pressure or low water level. The surveillance interval for these transmitters is 18 months instead of monthly.

Five transmitters in the reactor water cleanup system (to detect leakage) exceed the maturity threshold. These transmitters have no symptoms of fill-oil loss. Based on their maturity, monitoring these transmitters every 18 months is acceptable.

Ten transmitters that monitor the main steam isolation valve (MSIV) leakage control systems exceed the maturity threshold. These transmitters have no symptoms of fill-oil loss. Based on their maturity, monitoring these transmitters every 18 months is acceptable.

The 16 non-mature Rosemount transmitters also monitor the MSIV leakage control systems. All have accumulated more than 64,000 psi-months of operation. One transmitter has anomalous indication, however, the transmitter has no symptoms of fill-oil loss. These transmitters have had five or more calibrations performed. No symptoms of loss of fill-oil are evident in the

calibration data for any of the transmitters. The licensee considers all the transmitter drift random in nature and magnitude.

The Rosemount transmitters in the MSIV leakage control systems are for indication only. The MSIV leakage control systems are manually operated. However, some transmitters provide input to permissive logic, preventing operation of the system under certain conditions. Multiple failures are needed to cause improper system operation. Some of these MSIV leakage control system Rosemount transmitters are mature.

Based on the above system and transmitter descriptions, we find monitoring these transmitters with surveillance every 18 months (instead of monthly) acceptable.

3.2.4 Licensee Response to Requested Action 1.d

The licensee states there are 32 Rosemount transmitters from this transmitter classification at the Susquehanna Steam Electric Station. Of these, 22 transmitters have accumulated a psi-month operating history greater than the maturity threshold recommended by Rosemount and endorsed by the NRC. Ten transmitters have not. All these transmitters are included in the enhanced surveillance monitoring program. Surveillance for these transmitters is done with an 18 month interval, within the 24 month interval required by the Supplement.

The monitoring established for these transmitters meets the requirements of the Supplement and is acceptable.

3.2.5 Licensee Response to Requested Action 1.e

In Reference 3, the licensee states that transmitters from each transmitter classification will remain in the enhanced surveillance monitoring program until the licensee determines that continued monitoring for possible

fill-oil leakage is not beneficial. The licensee clarified this statement in Reference 4. Rosemount transmitters will be excluded from the enhanced surveillance monitoring program sometime in the future, after a sufficient number of transmitters are replaced. With that replacement, and any remaining Rosemount pre-July 11, 1989, medium-pressure transmitters exceeding the maturity threshold criteria, continuation of the enhanced surveillance monitoring program is not required by the Supplement.

The Supplement requires the licensee to maintain a high degree of confidence that transmitters excluded from the enhanced surveillance monitoring program remain highly reliable. The licensee states this confidence is maintained through the enhanced surveillance monitoring program, until that program is discontinued. The enhanced surveillance monitoring program will be terminated due to the lack of transmitters remaining subject to the Supplement Requested Actions, through replacement or maturity. After the enhanced surveillance monitoring program is discontinued, the normal calibration program of the licensee will maintain that confidence. Operators and technicians participate in an awareness program that describes the fill-oil loss symptoms and the required corrective actions. Zero drift analysis, transmitter response times, and observance of any process signal noise changes are included in the calibration procedures. Should one of these symptoms be observed, the transmitter is subjected to further testing and evaluation to determine whether fill-oil loss is the cause.

3.2.6 Licensee Response to Requested Action 1.f

The licensee indicates there are Rosemount transmitters from this transmitter classification at the Susquehanna Steam Electric Station. The Supplement does not mandate that transmitters in this classification be included in an enhanced surveillance monitoring program. The licensee states that all Rosemount transmitters, including those in transmitter classification 1.f, will remain in the enhanced surveillance monitoring program until the licensee determines that continued monitoring for possible fill-oil leakage is not beneficial.

The Supplement requires the licensee maintain a high degree of confidence that transmitters in transmitter classification 1.f remain highly reliable. This confidence is maintained through the enhanced surveillance monitoring program. The enhanced surveillance monitoring program will be terminated due to the lack of transmitters remaining subject to the Supplement Requested Actions, through replacement or maturity. After the enhanced surveillance monitoring program is discontinued, the normal calibration program of the licensee will maintain that confidence. Operators and technicians participate in an awareness program that describes the fill-oil loss symptoms and the required corrective actions. Zero drift analysis, transmitter response times, and observance of any process signal noise changes are included in the calibration procedures. Should one of these symptoms be observed, the transmitter is subjected to further testing and evaluation to determine whether fill-oil loss is the cause.

3.2.7 Enhanced Surveillance Monitoring Program

The licensee established an enhanced surveillance monitoring program in response to NRC Bulletin 90-01. That program detects the possibility of fill-oil leakage by comparing the accumulated zero drift (as determined by regular calibrations) to the limits established by Rosemount.

The licensee states that measurement and test equipment (M&TE) used for calibrations provide signal indications accurate to three decimal places. This is one more decimal place than Rosemount used in the Technical Bulletin No. 4 examples. The licensee states the M&TE will always be at least as accurate as the instrument under test. In most cases, the M&TE accuracy is greater, up to four times more accurate than the tested instrument.

Based on the licensee description, the test instrument accuracies used for the enhanced surveillance monitoring program are acceptable for comparison to the Rosemount drift data. Comparison of the transmitter drift data to the Rosemount drift data allowance enables the licensee to distinguish between acceptable transmitters and transmitters where the signal has degraded due to the loss of fill-oil.

4. CONCLUSIONS

Based on our review, we find that the licensee has completed the reporting requirements of Supplement 1 of NRC Bulletin 90-01. Further, the licensee either conforms to or has adequate justification for deviating from 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, Pennsylvania Power & Light Company (H. W. Keiser) to NRC (C. L. Miller), "Response to NRC Bulletin 90-01, Supplement 1: Loss of Fill-Oil in Transmitters Manufactured by Rosemount," March 4, 1993, PLA-3934, Files R41-1A/R41-2.
4. Letter, Pennsylvania Power & Light Company (R. G. Byram) to NRC (C. L. Miller), "Response Clarification to NRC Bulletin 90-01, Supplement 1: Loss of Fill-Oil in Transmitters Manufactured by Rosemount," May 31, 1994, PLA-4123, Files R41-1A/R41-2.