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*Idaho  
National  
Engineering  
Laboratory*

**Evaluation of Utility Response to  
Supplement 1 to NRC Bulletin 90-01:  
San Onofre-2/-3**

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TECHNICAL EVALUATION REPORT

Evaluation of Utility Response to Supplement 1 to  
NRC Bulletin 90-01: San Onofre-2/-3

Docket Nos. 50-361 and 50-362

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### SUMMARY

This report documents the Lockheed Idaho Technologies Company review of the Southern California Edison Company submittals for Unit Nos. 2 and 3 of the San Onofre Nuclear Generating Station that respond to Supplement 1 to NRC Bulletin 90-01. 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 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: San Onofre-2/-3

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 identified transmitters installed in a safety-related system. These same actions apply to 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 Southern California Edison Company, the licensee for Unit Nos. 2 and 3 of the San Onofre Nuclear Generating Station, responded to Supplement 1 of NRC Bulletin 90-01 with a letter dated March 4, 1993 (Reference 3). The licensee provided additional information and justification on February 11, 1994 (Reference 4). 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 with a submittal dated March 4, 1993. The licensee supplemented that information on February 11, 1994. Those responses were compared to the Bulletin Reporting Requirements and Requested Actions as described below. The licensee has 48 Rosemount transmitters that are subject to the Requested Actions of the Supplement. The enhanced surveillance monitoring program applies to Rosemount Model 1153, Series B and D, and Model 1154 transmitters manufactured before July 11, 1989.

#### 3.1 Evaluation of Licensee Response to Reporting Requirements

The licensee states they will comply with 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 monitoring interval for the transmitters included in the response to Requested Action 1.b could exceed the Supplement-imposed 24-month limit. This is because the 24-month refueling cycle at Unit Nos. 2 and 3 at San Onofre may vary slightly from a fixed 24-month interval. However, the licensee states, in Reference 4, that they will not exceed the 24-month limit without prior concurrence from the NRC.

The licensee described the specific actions taken to effect the Requested Actions and the associated schedule for completion. 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 identified a total of 48 transmitters in the scope of this review. The following sections discuss the licensee response.

### 3.2.1 Licensee Response to Requested Action 1.a

The licensee states there are 32 Rosemount transmitters from this transmitter classification at the San Onofre Nuclear Generating Station. Of these 32 transmitters, 22 exceed the psi-month maturity criterion established by Rosemount and endorsed by the NRC. The licensee states they will monitor these 32 transmitters in the enhanced surveillance monitoring program monthly, for the life of the transmitter. This commitment, regardless of the maturity of the transmitter, satisfies the requirements of the Supplement and is acceptable.

Reference 4 modified this commitment. A total of eight Rosemount transmitters (four at each unit) monitor the wide-range pressurizer pressure. Each of these eight transmitters has achieved the psi-month maturity threshold established by Rosemount and endorsed by the NRC. None show symptoms of the loss of fill-oil. These transmitters provide signals for indication, input to the subcooling margin monitors, and setpoint comparison for the low pressure trip of the RPS and safety injection of the ESF actuation system.

The wide-range pressure transmitters have redundancy and diversity. The pressurizer of each unit has four Rosemount wide-range transmitters. Non-Rosemount transmitters provide pressurizer pressure signals to the core protection calculators. The core protection calculators initiate a reactor trip at full power, low pressure conditions. A high containment pressure also actuates safety injection. The containment pressure signals come from non-Rosemount transmitters, feeding individual trip modules.

Alternate indication is also available. Each unit has six channels of 1500 psia to 2500 psia non-Rosemount instrumentation; four safety-related and

two not safety-related. Each unit has four channels of low-range pressurizer pressure indication (zero to 750 psia). Two of these channels use non-Rosemount transmitters. Additionally, four narrow-range Rosemount Model 1154 transmitters provide pressurizer pressure signals to the ATWS Diverse Scram System. These are independent of any other indication of pressurizer pressure.

The licensee can determine subcooling manually using any available pressurizer pressure and reactor coolant temperature instrumentation channels. The onset of inadequate core cooling has alternate indication, the core exit thermocouples, reactor vessel level instrumentation, and pressurizer level instrumentation.

Based on the details and the satisfactory operational history of these eight wide-range pressurizer pressure transmitters, the change to an enhanced surveillance monitoring program with an interval of 24-months is acceptable. The licensee states they will not exceed the 24-month surveillance interval limit without prior NRC concurrence. The remaining 24 transmitters in this transmitter classification will continue with monthly monitoring. The licensee commitments for the transmitters in this transmitter classification are acceptable.

### 3.2.2 Licensee Response to Requested Action 1.b

The licensee states they have four mature Rosemount transmitters from this transmitter classification at the San Onofre Nuclear Generating Station. Mature, as used here, means the transmitter exceeds the psi-month maturity threshold established by Rosemount and endorsed by the NRC. The licensee states they include these transmitters in the enhanced surveillance monitoring program, monitored each refueling cycle. However, with a 24-month refueling cycle, the surveillance for these four transmitters could occasionally exceed the 24-month limit for surveillance imposed by the Supplement. In Reference 4, the licensee clarifies this situation. The licensee will not exceed the 24-month surveillance interval without prior NRC concurrence.

Each unit has four transmitters monitoring the low-range of the pressurizer pressure. Two of these four (total of four out of eight at the station) are the subject Rosemount transmitters. The other transmitters (two at each unit) were manufactured by Foxboro. Thus, transmitters of diverse manufacture monitor this function. These transmitters are calibrated between 100 psig and 750 psig. Thus, they are operable in modes 3, 4, and 5. In each refueling cycle, the pressure is atmospheric. The transmitter output is offscale low. During power operation (modes 1 and 2), the pressure is about 2250 psig and the low-range signal is offscale high. The wide-range pressure transmitters are operable during any mode of operation.

The licensee states the enhanced surveillance monitoring program with monitoring on the refueling cycle is appropriate for these Rosemount transmitters. While the refueling cycle may occasionally exceed the 24-month limit imposed by the Supplement, the licensee committed to obtain prior NRC concurrence before exceeding the 24-month surveillance interval. The increased surveillance interval is based on redundancy, because the wide-range transmitters also cover the same range. There is diversity because there are four redundant channels per unit, two transmitters manufactured by Rosemount and two manufactured by Foxboro. The Rosemount transmitters exceed the psi-month maturity criteria established by Rosemount and endorsed by the NRC, with no symptoms of loss of fill-oil. No RPS, ESF actuation or ATWS mitigation trips are actuated as a result of these transmitters. Therefore, there is a low safety significance associated with these transmitters. These transmitters provide interlocks, permissive signals, and alarms for the shutdown cooling suction isolation valves and the safety injection tank outlet isolation valves. The operator can override these interlocks manually. Therefore, we find these four transmitters with a 24-month surveillance interval enhanced surveillance monitoring program acceptable.

### 3.2.3 Licensee Response to Requested Action 1.c

The licensee states there are no Rosemount transmitters from this transmitter classification at the San Onofre Nuclear Generating Station.

#### 3.2.4 Licensee Response to Requested Action 1.d

The licensee states there are two Rosemount transmitters from this transmitter classification at the San Onofre Nuclear Generating Station. The licensee states these transmitters will be part of the enhanced surveillance monitoring program, with monitoring every 24 months. The licensee states the surveillance interval will not exceed the 24-month interval imposed by the Supplement without prior NRC concurrence. This commitment satisfies the requested actions of the Supplement and is, therefore, acceptable.

#### 3.2.5 Licensee Response to Requested Action 1.e

The licensee states there are six Rosemount transmitters from this transmitter classification at the San Onofre Nuclear Generating Station that meet the classification requirements for Requested Action 1.d., and exceed the psi-month maturity threshold. At the discretion of the licensee, these six transmitters are not part of an enhanced surveillance monitoring program. The Supplement permits this action. However, with this option, the Supplement requires the licensee to maintain 1) a high degree of confidence that these transmitters remain highly reliable and 2) the ability of readily detecting transmitter failure. The licensee submittal does not address how they maintain this confidence and ability. It is clear that the licensee must maintain this capability, by either continuing the enhanced surveillance monitoring program for these transmitters, or by some less prescribed methodology. With no information that shows the licensee is following the condition of these medium-pressure transmitters, the only possible conclusion is that the licensee should include these transmitters in their enhanced surveillance monitoring program. Further, the licensee should obtain NRC approval prior to removing these transmitters from the enhanced surveillance monitoring program. Consequently, the licensee should establish a methodology to maintain a high degree of confidence that these transmitters remain highly reliable and the ability to readily detect transmitter failure before excluding them from the enhanced surveillance monitoring program.



### 3.2.6 Licensee Response to Requested Action 1.f

The licensee states there are four Rosemount transmitters from this transmitter classification at the San Onofre Nuclear Generating Station. At the discretion of the licensee, these four transmitters are not part of an enhanced surveillance monitoring program. The Supplement permits this action. However, with this option, the Supplement requires the licensee to maintain 1) a high degree of confidence that these transmitters remain highly reliable and 2) the ability of readily detecting transmitter failure. The licensee submittal does not address how they maintain this confidence and ability. It is clear that the licensee must maintain this capability, by either continuing the enhanced surveillance monitoring program for these transmitters, or by some less prescribed methodology. With no information that shows the licensee is following the condition of these low-pressure transmitters, the only possible conclusion is that the licensee should include these transmitters in their enhanced surveillance monitoring program. Further, the licensee should obtain NRC approval prior to removing these transmitters from the enhanced surveillance monitoring program. Consequently, the licensee should establish a methodology to maintain a high degree of confidence that these transmitters remain highly reliable and the ability to readily detect transmitter failure before excluding them from the enhanced surveillance monitoring program.

### 3.2.7 Enhanced Surveillance Monitoring Program

The enhanced surveillance monitoring program of the licensee is based on the computerized data retrieval system. The procedure governing the enhanced surveillance monitoring program was issued on November 5, 1993. The licensee bases the enhanced surveillance monitoring program on the techniques described on page 6 of Rosemount Technical Bulletin Number 4. These techniques trend the actual output drift data for redundant transmitters or the zero and span calibration drift from calibration data. The licensee has described an acceptable enhanced surveillance monitoring program.

#### 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 either conforms to or has adequate justification for deviating from the requested actions of Supplement 1 to NRC Bulletin 90-01, except maintaining a high degree of confidence in the reliability of those Rosemount medium- and low-pressure transmitters excluded from the enhanced surveillance monitoring program and the ability to detect those potential failures. See Sections 3.2.5 and 3.2.6. For those medium- and low-pressure transmitters, the licensee should include them in the enhanced surveillance monitoring program. The licensee should obtain NRC concurrence prior to removing any of these transmitters from the enhanced surveillance monitoring program.

## 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, Southern California Edison Company (W. C. Marsh) to NRC, "Docket Nos. 50-361 and 50-362 San Onofre Nuclear Generating Station Units 2 and 3," March 4, 1993.
4. Letter, Southern California Edison Company (W. C. Marsh) to NRC, "Docket Nos. 50-361 and 50-362, Response to NRC Bulletin 90-01, Supplement 1, San Onofre Nuclear Generating Station Units 2 and 3," February 11, 1994.