UNITED STATES
NUCLEAR REGULATORY COMMISSION
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# SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

# DIFFERENTIAL PRESSURE SENSORS AND SETPOINTS

# FOR RE02, RE18, AND RE23

# GPU NUCLEAR CORPORATION

# OYSTER CREEK NUCLEAR GENERATING STATION

# DOCKET NO. 50-219

## 1.0 INTRODUCTION

The Oyster Creek Nuclear Generating Station reactor protection system (RPS) and engineered safety features actuation system (ESFAS) start certain actions when a differential pressure passes through a predetermined value that is the setpoint. GPU Nuclear Corporation, the licensee for Oyster Creek, has addressed upgrading the original differential pressure sensors in certain applications.

The original differential pressure switches had mercury-wetted contacts. The licensee replaced the RE02, RE18, AND RE23 series switches, due to seismic qualification requirements, with snap-action Static-O-Ring differential pressure switches. These replacement switches exhibited excessive drift for their several applications.

On May 27, 1986 (Reference 1), the licensee addressed an analog trip system for the reactor water level low function. The licensee also discussed differential pressure gauges in parallel with the reactor water level low-low differential pressure switches. On July 20, 1988 (Reference 2), the licensee documented a change in the RE02 series switches. They had replaced RE02A, B, C, and D with an analog trip and indicating system. The licensee had also scheduled RE18A, B, C, and D and RE23A, B, C, and D for replacement.

An October 13, 1989, letter (Reference 3) addressed Static-O-Ring differential pressure switches. On May 29, 1990 (Reference 4), the licensee addressed the calculation of setpoints and allowable drift. This evaluation included the test instrument inaccuracies. The licensee provided additional details for RE02A, B, C, and D, and RE18A, B, C, and D setpoints and instrument zeros on February 6, 1991 (Reference 5).

The licensee provided additional information and setpoint bases for these instruments on December 6, 1991 (Reference 6).

This report is an evaluation of the licensee's resolution for the setpoint drift issue for the subject (RE02, RE18, and RE23 series) differential pressure switches.

## 2.0 REVIEW CRITERIA

The Integrated Plant Safety Assessment Report (Reference 7) for Oyster Creek contains the requirement for this review in section 4.28. This section refers to the requirement of 10CFR50.36 c.1.ii(A). That regulation requires setpoints to be chosen by the licensee so automatic corrective actions occur to correct the most severe anticipated abnormal events before exceeding a safety limit. Thus, the licensee should identify the margin between a setpoint and the allowable safety limit and demonstrate that the margin is adequate. Basically, an adequate margin exceeds the expected instrument drift between calibrations. However, there are other factors that affect this margin (such as testing equipment accuracy, static pressure effect, and ambient temperature effects).

The requirement for sensors RE02A, B, C, and D, core spray actuation and main steam isolation valves closure on low-low reactor water level, and RE18A, B, C, and D, automatic depressurization on low-low reactor water level, are to cause actuation as the measured variable decreases through the setpoint. Because the setpoint is at the extreme low end of the range, the setpoint should be high enough so the setpoint minus the instrument uncertainties remains greater than the instrument zero. This assures trip operation as the parameter value passes though the setpoint. Safety limits are not exceeded when the difference between the setpoint and the technical specification defined safety limit is greater than the maximum accumulated instrument uncertainties, including inherent time delays. The requirement for sensors RE23A, B, C, and D, main steam isolation valve closure on low steam pressure, is different. The setpoint, 825 psig, is mid-scale in a 25 psig to 1400 psig range, and operates as the pressure decreases through the setpoint. The setpoint should be low enough to prevent instrument drift form causing a setpoint trip from a normally expected operating pressure. The setpoint should be high enough to assure a timely trip as the reactor pressure passes through the setpoint. The instrument drift should not cause the actuation point to decrease below the technical specification limit. With the setpoint properly chosen, no safety limit will be exceeded.

## 3.0 EVALUATION

To meet the NRC criteria for acceptance, the licensee should have evidence that the setpoint, in combination with an associated instrumentation and instrument uncertainties, will not drift beyond (or below) the technical specification limit before the next calibration. References 4, 5, and 6 provide the basis for this determination.

Attachment II of Reference 4, Group I, lists the RE02 trips in loops 4 (MSIV Closure Containment Isolation), 5 (Core Spray/Containment Spray Initiation), and 6 (IC/SBGTS) for reactor low-low level. The licensee specifies the setpoint at 92.8 inches increasing (all inch specifications are for water

column heights). An increasing (in inches) differential pressure is a decreasing water level. The calibration tolerance is +1.0 inch and, wh calibrated, the setpoint is between 92.8 inches and 93.8 inches. Reference 5 reports this tolerance as ±0.5 inches, which leaves the setpoint between 92.3 inches and 93.3 inches as-left and between 91.8 inches and 93.8 inches as-found. The calcu ted drift of +1.04 inches is greater than the historical 0.96 inch drift and greater than the tolerance on the as-found allowable drift. Thus, an acceptable setpoint is the maximum accumulation of the sum of the setpoint, the calibration as-found tolerance, and the calculated drift. This figure is 94.84 inches. This is less than the technical specification limit, 95.56 inches, and the instrument zero, 96.3 inches.

The licensee states, in Attachment I of Reference 4, that they replaced one of the RE18 switches with an ITT Barton 580 differential pressure switch. They installed this switch during the 12R refueling outage for evaluation. The licensee plans an equivalent replacement for the three remaining RE18 sensors in the 13R refueling outage. This replacement is contingent on an acceptable operational history of the evaluation switch. Attachment II of Reference 4, Group I, lists the RE18 trips in loop 12. The RE18 trips actuate the automatic depressurization system on reactor low-low water level. An increasing (in inches) differential pressure represents a decreasing level. The licensee specifies the setpoint at 117.00 inches. The calibration tolerance is +2.0 inches and, when calibrated, the setpoint is between 117.0 inches and 119.0 inches. Reference 5 reports the as-left calibration tolerance as ±2.0 inches, with the setpoint as left between 115.0 inches and 119.0 inches. The historical drift, 7.80 inches, exceeds the calculated drift. Thus, the maximum calculated drift is the sum of the setpoint, the calibration tolerance, and historical drift. This figure is 126.8 inches. This slightly exceeds the technical specification limit, 126.4 inches and is one reason for replacing the differential pressure switches. With this change, the maximum accumulated setpoint should be within the technical specification limit. The setpoint is above the instrument zero, 13.0 inches.

The licensee states that this deviation does not create a challenge to safety. The licensee states the time delay caused by the worst-case degraded setpoint is insignificant. This is because of the rapidness of the water decrease for the required function. Additionally, with the one-out-of-two taken twice logic, there is a confidence that the system will actuate as intended. As setpoint drift is independent between switches, this is a reasonable assumption. This, combined with the switch upgrade and the setpoint drift monitoring program (Reference 3), gives assurance of proper system operation in the interim. Attachment II of Referer e 4, Group III, lists the RE23 trips in loop 1. The licensee identifies a setpoint of 854 psig on a scale of 25 psig to 1400 psig. The calibration tolerance is -2.0 psig and, when calibrated, the setpoint is between 852 psig and 854 psig. The historical drift is -17.36 psig. The licensee does not report a calculated drift for these instruments. Thus the acceptable setpoint is the maximum accumulation of the sum of the setpoint, the calibration tolerance, and the historical

drift. This figure is 834.64 psig. This is slightly above the technical specification limit, 834.6 psig.

The licensee states their setpoints are determined using their engineering standard ES-002, "Instrument Error Calculation and Setpoint Determination." ES-002 is, according to the licensee, based on Instrument Society of America (ISA) standard ISA-S67.04-1982, "Setpoints for Nuclear Safety-related Instrumentation Used in Nuclear Power Plants" (Reference 8). The NRC endorsed this industrial standard in Regulatory Guide 1.105, Revision 2, "Instrument Setpoints for Safety-related Systems" (Reference 9).

The staff has extracted some typical guidance from ISA S67.04-1982 and compared these with ES-002. The following lists some guidance from the ISA Standard, and the corresponding requirements from ES-002:

1. "The trip setpoint shall be chosen so that the corresponding allowable value is not exceeded due to the following: drift of that portion of the instrument channel which is tested when the setpoint is determined" [ISA-S67.04-1982, Paragraph 4.3.3(1)].

   ES-002 states drift is unrelated to input, environment, or load. This is for a non-accident environment. Section 5.2.2 addresses the relation between the allowable value and the setpoint. The margin between the setpoint and allowable value includes a provision for normal environmental instrument inaccuracies and drift. Accident environment induced uncertainties are addressed in Sections 6.1.1 and 6.3.4 of ES-002.

   However, the specific uncertainties to be included in the calculation are not identified.

2. "Instrument performance requirements shall be specified such that as long as the process variable exceeds the setpoint, the protective action of that instrument channel is not negated by saturation, foldover, or any other cause for the expected values of the process variables" (ISA-S67.04-1982, Section 5).

   This second item, no negation of the protective action by instrument saturation or foldover, is not evidenced in ES-002. This issue is a concern for the RE02 setpoint especially, with a setpoint of 92.8 inches (±0.5 inches), a technical specification limit of 95.56 inches, and an instrument zero of 96.3 inches. RE18 has a similar condition. Reference 6 lists the allowable value at ≥56 inches above the top of active fuel. 56 inches above the top of active fuel is also listed as the lower limit of the instrument range. The staff notes this response is inconsistent with the Reference 4 information on RE18.

3. "Instrument calibration correction factors shall be identified and documented. Correction factors which have been incorporated in the

determination of the setpoint shall be separately identified" (ISA-S67.04-1982, Section 5).

ES-002 addresses correction factors in Sections 5.2.2b, 5.2.2d, 6.3.1, and 6.3.2.

4. Parameters used in determining the setpoints shall include "vibration, seismic acceleration and radiation exposure" [ISA-S67.04-1982, Paragraph 6 (2)].

   Of the parameters addressed in item 4, above, only radiation exposure is listed in item 6.3.3 (9) of ES-002. The vibration and seismic acceleration effects are not included in ES-002. Reference 6 states that the seismic effect on the instrument setpoint was not considered.

5. Parameters used in determining the setpoints shall include "the time response characteristics or other response characteristics of the instrument channel" [ISA-S67.04-1982, Paragraph 6(2)].

   Item 5 addresses instrument response time not causing exceeding the allowable value. The staff notes the licensee addresses this in Section 6.3.5 of ES-002. However, Reference 6 acknowledges that the licensee did not perform calculations for the RE18 instruments (as directed in Section 6.3.5 of ES-002), but used engineering judgement of the rate of water level decrease.

The licensee states that ES-002 is based on ISA-S67.04-1982. This brief overview shows that portions of ISA-S67.04-1982 are not included in ES-002. Indeed, even when a component of ISA-S67.04-1982 is included in ES-002, it may not be included in the licensee's basis for the setpoint selection.

## 4.0 CONCLUSIONS

The staff has concluded that the licensee's setpoints and hardware modifications attempt to meet the applicable guidance outlined in Section 4.28 of NUREG-0822, "Integrated Plant Safety Assessment Systematic Evaluation Program, Oyster Creek Nuclear Generating Station," and in their own setpoint standard ES-002. However, the licensee has not conclusively demonstrated the acceptability of the chosen setpoints. For RE02 and RE18 instruments, the licensee has not addressed instrument saturation and foldover that are possible with the setpoint near the limit of the range. For RE-18, the licensee used engineering judgement rather than analytical calculations to verify the rate of level decrease will not cause exceeding the safety limit. In addition, the licensee has not addressed environmental uncertainties, such as vibration and seismic effect, in the setpoint selection process.

Because the licensee has not conclusively shown adherence with Regulatory Guide 1.105, ISA-S67.04-1982, or their own requirement ES-002 (which is stated

to incorporate the ISA standard), the staff cannot conclude that the selected setpoints are or are not acceptable. Based on the inadequacy of the information received from the licensee we have terminated this review. It is recommended that the licensee review Regulatory Guide 1.105, ISA-S67.04-1982, and their ES-002, make the appropriate modifications to their setpoint methodology, and recalculate the setpoints for these instruments.

Based on the above, we consider SEP Topic V-1B-Section 4.28 of the IPSAR closed.

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## 5.0 REFERENCES


1. Letter, GPU Nuclear (R. F. Wilson) to NRC (J. A. Zwolinski), "Reactor Protection System Switch Replacement," May 27, 1986, RFW-0883

2. Letter, GPU Nuclear (E. E. Fitzpatrick) to NRC, "SEP Topic VII-1B, IPSAR Section 4.28, Trip Uncertainty and Setpoint Analysis Review of Operating Data Base," July 20, 1988.

3. Letter, GPU Nuclear (E. E. Fitzpatrick) to NRC, "IEB Bulletin 86-02; Static-O-Ring Differential Pressure Switches," October 13, 1989.

4. Letter, GPU Nuclear (J. C. DeVine, Jr.) to NRC, "Technical Specification Setpoints," May 29, 1990, 5000-90-1929.

5. Letter, GPU Nuclear (J. C. DeVine, Jr.) to NRC, "Response to Request for Additional Information -- Instrument Setpoints," February 6, 1991, 5000-91-2012, C320-91-2003.

6. Letter, GPU Nuclear (J. C. DeVine, Jr.) to NRC, "Response to Request for Additional Information Instrument Setpoints," December 6, 1991, 5000-91-2012, C320-91-2003.

7. NUREG-0822, "Integrated Plant Safety Assessment Systematic Evaluation Program, Oyster Creek Nuclear Generating Station," NRC January 6, 1983.

8. Standard, "Setpoints for Nuclear Safety-related Instrumentation Used in Nuclear Power Plants," Instrument Society of America S67.04-1982.

9. Regulatory Guide 1.105, "Instrument Setpoints for Safety-related Systems," Revision 2, February 1986.