CONFORMANCE TO REGULATORY GUIDE 1.97
OCONEE NUCLEAR STATION, UNIT NOS. 1, 2, AND 3

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Published May 1985

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Prepared for the
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
Under DOE Contract No. DE-AC07-761D01570
FIN No. A6483

ABSTRACT

This EG&G Idaho, Inc., report reviews the submittal for Regulatory Guide 1.97, Revision 2, for the Oconee Nuclear Station, Unit Nos. 1, 2 and 3. Any exceptions to the guidelines of Regulatory Guide 1.97 are evaluated and those areas where sufficient basis for acceptability is not provided are identified.

FOREWORD

This report is supplied as part of the "Program for Evaluating Licensee/ Applicant Conformance to RG 1.97," being conducted for the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Division of Systems Integration by EG&G Idaho, Inc., NRC Licensing Support Section.

The U.S. Nuclear Regulatory Commission funded the work under authorization B&R 20-19-10-11-3.

Docket Nos. 50-269, 50-270 and 50-287
TAC Nos. 51112, 51113 and 51114

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1. INTRODUCTION

On December 17, 1982, Generic Letter No. 82-33 (Reference 1) was issued by D. G. Eisenhut, Director of the Division of Licensing, Nuclear Reactor Regulation to all licensees of operating reactors, applicants for operating licenses and holders of construction permits. This letter included additional clarification regarding Regulatory Guide 1.97, Revision 2 (Reference 2), relating to the requirements for emergency response capability. These requirements have been published as Supplement No. 1 to NUREG-0737, "TMI Action Plan Requirements" (Reference 3).

Duke Power Company, the licensee for the Oconee Nuclear Station, provided a response to Item 6.2 of the NRC generic letter on September 28, 1984 (Reference 4). This response provides a comparison of the licensee's instrumentation to the recommendations of Revision 2 of Regulatory Guide 1.97.

This report provides an evaluation of this material.

2. REVIEW REQUIREMENTS

Section 6.2 of NUREG-0737, Supplement No. 1, sets forth the documentation to be submitted in a report to the NRC describing how the licensee complies with Regulatory Guide 1.97 as applied to emergency response facilities. The submittal should include documentation that provides the following information for each variable shown in the applicable table of Regulatory Guide 1.97:

1. Instrument range

2. Environmental qualification

3. Seismic qualification

4. Quality assurance

5. Redundance and sersor location

6. Power supply

7. Location of display

8. Schedule of installation or upgrade.

Furthermore, the submittal should identify deviations from the regulatory guide and provide supporting justification or alternatives.

Subsequent to the issuance of the generic letter, the NRC held regional meetings in February and March, 1983, to answer licensee and applicant questions and concerns regarding the NRC policy on this subject. At these meetings, it was noted that the NRC review would only address exceptions taken to Regulatory Guide 1.97. Furthermore, where licensees or applicants explicitly state that instrument systems conform to the regulatory guide, it was noted that no further staff review would be

necessary. Therefore, this report only addresses exceptions to Regulatory Guide 1.97. The following evaluation is an audit of the licensee's submittal based on the review policy described in the NRC regional meetings.

3. EVALUATION

The licensee provided a response to Item 6.2 of NRC Generic Letter 82-33 on September 28, 1984. The response describes the licensee's post-accident monitoring instrumentation. This evaluation is based on that material.

3.1 Adherence to Regulatory Guide 1.97

The licensee has provided a review of their post-accident monitoring instrumentation that compares the instrumentation characteristics against the recommendations of Regulatory Guide 1.97, Revision 2. The review lists the regulatory guide variables, showing compliance, deviations and references to justification for any deviations. Therefore, it is concluded that the licensee has provided an explicit commitment on conformance to Regulatory Guide 1.97. Exceptions to and deviations from the regulatory guide are noted in Section 3.3.

3.2 Type A Variables

Regulatory Guide 1.97 does not specifically identify Type A variables, i.e., those variables that provide information required to permit the control room operator to take specific manually controlled safety actions. The licensee classifies the following instrumentation as Type A.

1. Reactor coolant system (RCS) pressure
2. Incore thermocouple (core exit) temperature
3. Pressurizer level
4. Degrees of subcooling
5. Steam generator level (narrow range)
6. Steam generator pressure

7. Borated water (refueling water) storage tank level

8. High pressure injection flow

9. Low pressure injection (decay heat removal system) flow

10. Reactor building (containment) spray flow

11. Reactor building (containment) hydrogen concentration

12. Upper surge (condensate storage) tank level

The above variables either comply or will comply with the Category 1 requirements consistent with the requirements for Type A variables.

3.3 Exceptions to Regulatory Guide 1.97

The licensee identified the deviations and exceptions from Regulatory Guide 1.97. These are discussed in the following paragraphs.

3.3.1 Reactor Coolant System (RCS) Soluble Boron Concentration

Regulatory Guide 1.97 recommends instrumentation for this variable with a range from 0 to 6000 parts per million. The licensee has not provided on-line instrumentation for this variable and states that this variable is monitored by the post-accident sampling system laboratory analysis.

The licensee takes exception to Regulatory Guide 1.97 with respect to post-accident sampling capability. This exception goes beyond the scope of this review and is being addressed by the NRC as part of their review of NUREG-0737, Item II.B.3.

3.3.2 RCS Cold Leg Water Temperature

Regulatory Guide 1.97 Revision 2 recommends Category 1 instrumentation with a range of 50 to 750°F for this variable. The licensee has supplied Category 3 instrumentation with a range of 50 to 650°F. There is a deviation in both range and category. The licensee states that the variable is used as a backup for the key variables of hot leg temperature and core exit temperature. The licensee indicates that since the hot leg and cold leg RTD's are located in the coolant loops and not in the reactor vessel, either forced or natural circulation is required through the steam generators for their indication to be representative of actual core conditions. With circulation present, the 650°F high end of the range provides excess capacity on the steam generator pressure of 1050 psig (saturation temperature of approximately 553°F) for the Oconee design.

Based on the licensee's justification, we find the high end of 650°F to be adequate at this station. Since the licensee has supplied Category 1 core exit thermocouples and RCS hot leg water temperature, we find the justification for Category 3 backup RCS cold leg water temperature instrumentation acceptable.

3.3.3 Containment Pressure

Regulatory Guide 1.97 recommends a range of 10 psia to 3 times the design pressure for this variable. The licensee has supplied instrumentation with a range of -5 to 175 psig with the reactor building design pressure being 59 psig. This range is just 2 psig below the recommended upper limit. The licensee states that this range covers nearly 99 percent of the recommended range.

We find the justification provided by the licensee acceptable. The portion of the range not measured is insignificant.

3.3.4 Radiation Level in Circulating Primary Coolant

The licensee has supplied a Category 3 instrumentation with a range of 10^1 to 10^6 counts per minute which covers reactor coolant concentrations of approximately 10^{-3} to 10^3 μCi/ml. This monitor is in the reactor coolant letdown line and is isolated upon an ESF actuation signal.

This monitor was not designed to quantify accident conditions. Additional information for this variable is obtained by sampling and analysis by the post-accident sampling system.

Based on the alternate instrumentation provided by the licensee, we conclude that the instrumentation supplied for this variable is adequate, and therefore, acceptable.

3.3.5 Analysis of Primary Coolant (Gamma Spectrum)

The licensee identifies a deviation in the display location in that this analysis is done in the chemical laboratory with no direct display in the control room. The licensee further states that capabilities for making the recommended measurements are provided.

The licensee takes exception to Regulatory Guide 1.97 with respect to post-accident sampling capability. This exception goes beyond the scope of this review and is being addressed by the NRC as part of their review of NUREG-0737, Item II.B.3.

3.3.6 Radiation Exposure Rate

The licensee has provided Category 3 instrumentation for this variable instead of the recommended Category 2 instrumentation. The licensee states that the qualification is within the guidance provided for Category 3 instrumentation, and that the instrumentation is considered adequate for the intended monitoring function.

Revision 3 of Regulatory Guide 1.97 (Reference 5) recommends Category 3 instrumentation for this variable. Therefore, the instrumentation for this variable is acceptable.

3.3.7 Accumulator Tank Level and Pressure

Regulatory Guide 1.97 recommends environmentally qualified instrumentation for this variable with a range of 10 to 90 percent volume (for level) and 0 to 750 psig (pressure). The licensee has supplied instrumentation with no environmental qualification. The provided ranges are approximately 15 to 83 percent of the tank volume and 0 to 700 psig.

The licensee states that the primary function of both level and pressure instrumentation is to monitor the pre-accident status of the core flood tanks to assure that this passive safety system is prepared to serve its safety function. The licensee further states that the indicated level range envelops the technical specification level requirements.

The licensee states that the indicated pressure range covers approximately 0 to 117 percent of the operating pressure of the tanks. Because the purpose of this variable is to monitor and maintain core flood tank pressure during normal operation to technical specification limits, the range of this variable should provide some margin above that limit. Since the Oconee technical specification limit is 600 ± 25 psig, a high range value of 700 psig will provide greater than 10 percent excess range measurement capability.

The accumulators are passive devices. Their discharge into the reactor coolant system (RCS) is actuated solely by a decrease in RCS pressure. We find that the ranges of the instrumentation supplied for this variable are adequate to determine that the accumulators have discharged. Therefore, the ranges of this instrumentation are acceptable for this variable.

The licensee has taken exception to the environmental qualification of this variable. Environmental qualification has been clarified by the Environmental Qualification Rule, 10 CFR 50.49. It is concluded that the guidance of Regulatory Guide 1.97 has been superseded by a regulatory requirement. Any exception to this rule is beyond the scope of this review and should be addressed in accordance with 10 CFR 50.49.

3.3.8 Boric Acid Charging Flow

The licensee does not have instrumentation for this variable. The licensee states that the charging system is not part of the emergency core cooling system (ECCS). Flow paths from the ECCS to the RCS include high pressure injection (HPI) and low pressure injection (LPI) and the Core Flood Tank. HPI and LPI flow rates are monitored, and the borated water storage tank, the reactor building sump, and the core flood tank levels are monitored. Therefore, we find that this variable is not applicable at the Oconee Station.

3.3.9 Pressurizer Level

Regulatory Guide 1.97 recommends instrumentation for this variable with a range from the top to the bottom of the pressurizer vessel. The licensee has instrumentation with a range that represents 11 to 84 percent of the pressurizer volume. The licensee states that the reactor coolant system can experience a reactor trip from full power without uncovering the level sensors in the lower shell while maintaining system pressure above the HPI system actuation setpoint; the reactor coolant system can experience a turbine trip without covering the level sensors in the upper shell. The pressurizer level instrumentation has a 0 to 400 inch range, which allows monitoring for continued safe operation of the pressurizer heaters.

The licensee's analysis covers normal operation of the pressurizer (reactor trip or turbine trip). The licensee does not show that the range is adequate for all anticipated transient or accident conditions. We conclude that the licensee should supply additional analyses to support this deviation from the recommended range.

3.3.10 Pressurizer Heater Status

Regulatory Guide 1.97 recommends instrumentation to monitor the current drawn by the pressurizer heaters. The licensee's instrumentation consists of on/off status lights for the pressurizer heater groups. The licensee states that the ON/OFF status of the pressurizer heaters provides adequate information. Additionally, the licensee indicates that RCS pressure can be monitored to determine the effectiveness of the heaters to maintain system pressure.

Section II.E.3.1, of NUREG-0737 requires a number of the pressurizer heaters to have the capability of being powered by the emergency power sources. Instrumentation is to be provided to prevent overloading a diesel generator. Also, technical specifications are to be changed accordingly. The Standard Technical Specifications, Section 4.4.3.2, require that the emergency pressurizer heater current be measured quarterly. These heaters, as required by NUREG-0737, should have the current instrumentation recommended by Regulatory Guide 1.97.

3.3.11 Quench Tank Level

Regulatory Guide 1.97 recommends instrumentation for this variable with a range from the top to the bottom of the tank. The licensee has an indicated range from 0 to 125 in. corresponding to a tank volume of approximately 15 to 96 percent. The licensee states that (a) the upper range meets the intended monitoring function, (b) no useful information would be gained by measuring from 0 to 15 percent, and (c) normal level (pre-accident) is maintained above 15 percent and post-accident conditions will only increase tank level.

Based on the justification provided by the licensee, we find this deviation from the regulatory guide acceptable.

3.3.12 Quench Tank Temperature

Regulatory Guide 1.97 recommends instrumentation for this variable with a range from 50 to 750°F. The instrumentation will be calibrated to a range from 50 to 325°F. The licensee states that the design temperature of the quench tank is 300°F. The tank design pressure is 55 psig, which is greater than the rupture disk pressure of 50 psig. The saturation temperature for 50 psig is 297°F. Thus, a range of 50-325°F will measure the expected maximum temperature in the quench tank.

Based on the licensee's justification, a range of 50 to 325°F will adequately monitor this variable. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.13 Steam Generator Level

Regulatory Guide 1.97 recommends Category 1 instrumentation with a range from tube sheet to separators. This is for U-tube steam generators. The Oconee steam generators are of once-through design, and as such the heat exchange area would be described as tube sheet to tube sheet. The licensee has Category 3 instrumentation that measures from tube sheet to tube sheet (0 to 630 in.) and Category 1 instrumentation that reads 0 to 388 in. The licensee states that the installed range of 0 in. to 388 in. is adequate during accident conditions for measuring steam generator level.

The licensee has not shown that the narrow range instruments will remain on scale for every analyzed transient or accident. Therefore, the narrow range is not acceptable. The licensee has not shown that the Category 3 wide range instruments will remain operational for every analyzed transient or accident. We conclude that the instrumentation provided is not acceptable for this variable. The licensee should provide the modifications necessary to provide wide range Category 1 steam generator level instrumentation.

3.3.14 Steam Generator Pressure

Regulatory Guide 1.97 recommends instrumentation for this variable with a range from 0 to 20 percent above the lowest safety valve setting. The instrumentation for this variable has a range of 0 to 1200 psig which corresponds to 14 percent above the lowest safety valve setting and 8 percent above the highest safety valve setting. The licensee provided an analysis that shows that the worst case steam generator pressure would be 1155 psig. Technical specifications limit the maximum plant power (and thus steam flow) in order to maintain excess relief capacity. The licensee states that the highest safety valve setting is 1105 psig, the steam relief capacity is 17 percent above the expected steam flow rate and excess relief capacity is maintained when safety valves are inoperable.

Based on this analysis, and the maximum range being 95 psi above the highest safety valve setting, we find the range of 0 to 1200 psig acceptable.

3.3.15 Safety/Relief Valve Positions or Main Steam Flow

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable. The licensee states that, as a result of their control room design review, the main steam safety valves (MSSV) are not required to mitigate the consequences of a design basis accident. Indirect indication is provided via steam generator pressure. The licensee states that the sound emitted when the valves operate provides an audible indication to the operators when the valves lift.

We conclude the licensee has not provided acceptable instrumentation for this variable. The licensee should provide the recommended instrumentation.

3.3.16 Containment Atmosphere Temperature

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable with a range of 40 to 400°F. The licensee has supplied Category 3 instrumentation with a range of 0 to 390°F on the plant computer and 0 to

300°F on the recorder. This is a deviation in both category and range. The licensee states that the worst case temperature in the reactor building is 286°F. The licensee further states that pressure and temperature are coupled such that as pressure is reduced the temperature is also reduced. Therefore, the licensee considers pressure the key variable with temperature as a Category 3 backup variable.

Based on the worst case DBA temperature in the reactor building remaining within the existing range, we find the present instrumentation range acceptable. Since the licensee uses this instrumentation as a backup variable and Regulatory Guide 1.97 allows Category 3 instrumentation for backup variables, we find this instrumentation acceptable.

3.3.17 Containment Sump Water Temperature

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable with a range of 50 to 250F. The licensee does not have instrumentation for this variable. Their justification is that (a) it is not required to mitigate the consequences of a design basis accident, (b) the minimum available net positive suction head is sufficient with no indication of sump temperature and (c) no automatic or manual actions are initiated based on this temperature.

The licensee has designated reactor building pressure as the key variable for containment cooling. Backup indication for containment cooling is provided by containment atmosphere temperature, heat removal by the containment fan heat removal system, containment spray flow, and RHR heat exchanger inlet and outlet temperature.

We find these alternative methods of monitoring proper operation of the containment cooling systems to be adequate. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.18 Makeup Flow-In
Letdown Flow-Out

Regulatory Guide 1.97 recommends instrumentation for these variables. The licensee, not considering these as post-accident instrumentation, has Category 3 instrumentation. The licensee states that these variables are not required in the mitigation of an accident, that the makeup system is bypassed and the letdown system is isolated by accidents requiring ESF actuation.

As this flow is isolated or bypassed as a result of an accident signal, we find that Category 3 instrumentation for this variable is acceptable.

3.3.19 Volume Control Tank Level

Regulatory Guide 1.97 recommends instrumentation for this variable with a range from the top to the bottom of the tank. The licensee has instrumentation which covers the linear portion of the tank (approximately 16 to 84 percent of tank volume). The licensee's justification for this deviation is that the tank level is maintained within the range of the instrument. This tank is isolated from the RCS by an accident signal.

The range supplied essentially covers the straight cylindrical shell, not monitoring the hemispherical ends of the tank where the level to volume ratio is not linear. Approximately 68 percent of the tank volume inclusive of the hemispherical ends is measured for level. Based on this and the licensee's justification for not requiring this instrumentation in a post-accident situation, we find this deviation in range acceptable.

3.3.20 Component Cooling Water Temperature to ESF System

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable with a range of 32 to 200F. The licensee has no provision for monitoring this variable in the control room.

The cooling water to ESF components is provided by the Low Pressure Service Water System (LPSW). The inlet temperature of the LPSW, by design, is 75F maximum, from near the bottom of Lake Keowee. There is no temperature control of the LPSW. Based on this, we find this deviation from the regulatory guide acceptable.

3.3.21 Component Cooling Water Flow to ESF System

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable with a range of 0 to 110 percent design flow. The licensee uses line pressure in each of two headers as the primary indication of proper system and pump operation. Additional instruments provide backup indication of proper system operation in the control room. These include pump motor current, valve position indication (on valves operated in the control room), inlet or outlet cooling water flow (for certain ESF coolers) and flow and pressure alarms. Some of this backup instrumentation does not meet Category 2 recommendations, but the licensee states the instrumentation is adequate for the intended monitoring functions.

We find this combination of instrumentation adequate to monitor this variable. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.22 High Level Radioactive Liquid Tank Level

Regulatory Guide 1.97 recommends instrumentation for this variable with a range from top to the bottom of the tank. The range supplied by the licensee indicates 0 to 180 inches which corresponds to a tank volume of approximately 1 to 99 percent. The licensee states that the range is adequate for providing the tank level for all design basis events.

Based on the licensee's justification, and the portion of the tank not monitored being very small, we find this an acceptable deviation from Regulatory Guide 1.97.

3.3.23 Wind Speed

Regulatory Guide 1.97, Revision 2, recommends a range of 0 to 67 mph for this variable. The licensee has instrumentation with a range of 0 to 60 mph. The licensee states that the range of the installed instruments is adequate for the site meteorological conditions. The range exceeds the recommendation of Regulatory Guide 1.97, Revision 3 (0 to 50 mph).

Based on the licensee's justification, we find the existing wind speed range acceptable.

3.3 24 Estimation of Atmospheric Stability

Regulatory Guide 1.97 recommends instrumentation for this variable with a range of -5 to +10°C or an analogous range for alternative stability analysis. The licensee has supplied instrumentation with a range of -4 to +8°C. The licensee justifies this by stating that the instrument is adequate for the site meteorological conditions.

Table 1 of Regulatory Guide 1.23 (Reference 6) provides seven atmospheric stability classifications based on the difference in temperature per 100 meters elevation change. These classifications range from extremely unstable to extremely stable. Any temperature difference greater than +4°C or less than -2°C does nothing to the stability classification. The range supplied by the licensee encompasses this range. Therefore, we find that this instrumentation is acceptable to determine the atmospheric stability.

4. CONCLUSIONS

Based on our review, we find that the licensee either conforms to or is justified in deviating from Regulatory Guide 1.97, with the following exceptions:

1. Accumulator tank level and pressure--environmental qualification should be addressed in accordance with 10 CFR 50.49 (Section 3.3.7).

2. Pressurizer level--the licensee should supply additional analyses to support the deviation from the recommended range (Section 3.3.9).

3. Pressurizer heater status--the licensee should provide the instrumentation recommended by Regulatory Guide 1.97 (Section 3.3.10).

4. Steam generator level--the licensee should provide wide range Category 1 instrumentation for this variable (Section 3.3.13).

5. Safety/relief valve positions or main steam flow--the licensee should supply the recommended instrumentation (Section 3.3.15).

5. REFERENCES

1. NRC letter, D. G. Eisenhut to All Licensees of Operating Reactors, Applicants for Operating Licenses, and Holders of Construction Permits, "Supplement No. 1 to NUREG-0737--Requirements for Emergency Response Capability (Generic Letter No. 82-33)," December 17, 1982.

2. Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident. Regulatory Guide 1.97, Revision 2, U.S. Nuclear Regulatory Commission (NRC), Office of Standards Development, December 1980.

3. Clarification of TMI Action Plan Requirements, Requirements for Emergency Response Capability, NUREG-0737, Supplement No. 1, NRC, Office of Nuclear Reactor Regulation, January 1983.

4. Duke Power Company Letter, Hal B. Tucker to Director of Nuclear Reactor Regulation, NRC, "Revision 6 to the Response to Supplement 1 to NUREG-0737," September 28, 1984.

5. Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident, Regulatory Guide 1.97, Revision 3, NRC, Office of Nuclear Regulatory Research, May 1983.

6. Onsite Meteorological, Programs, Regulatory Guide 1.23 (Safety Guide 23), NRC, February 17, 1972, or Meteorological Programs in Support of Nuclear Power Plants, Proposed Revision 1 to Regulatory Guide 1.23, NRC, Office of Standards Development, September 1980.

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