EGG-EA-6794

TECHNICAL EVALUATION REPORT

CONFORMANCE TO REGULATORY GUIDE 1.97
JOSEPH M. FARLEY NUCLEAR PLANT, UNIT NOS. 1 AND 2

Docket Nos. 50-348/364

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ABSTRACT

This EG&G Idaho, Inc., report reviews the submittals for Regulatory Guide 1.97 for Unit Nos. 1 and 2 of the Joseph M. Farley Nuclear Plant and identifies areas of nonconformance to the regulatory guide. Exceptions to Regulatory Guide 1.97 are evaluated and those areas where sufficient basis for acceptability is not provided are identified.

Docket Nos. 50-348 and 50-364
TAC Nos. 51088 and 51089

FOREWORD

This report is supplied as part of the "Program for Evaluating Licensee/Applicant Conformance to R.G. 1.97," being conducted for the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Division of PWR Licensing-A, by EG&G Idaho, Inc., NRR and I&E Support Branch.

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Docket No. 50-348 and 50-364
TAC No. 51088 and 51089

CONTENTS

CONFORMANCE TO REGULATORY GUIDE 1.97
JOSEPH M. FARLEY NUCLEAR PLANT, UNIT NOS. 1 AND 2

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).

Alabama Power Company, the licensee for the Joseph M. Farley Nuclear Plant, Unit Nos. 1 and 2, provided responses to the Regulatory Guide 1.97 portion of the generic letter for Unit No. 2 on June 29, 1984 (Reference 4) and for Unit No. 1 on March 30, 1984 (Reference 5). Additional information was provided on April 10, 1985 (Reference 6) and August 8, 1986 (Reference 7).

This report provides an evaluation of these submittals.

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 to 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 sensor location

6. Power supply

7. Location of display

8. Schedule of installation or upgrade.

Furthermore, the submittal should identify deviations from Regulatory Guide 1.97 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 submittals based on the review policy described in the NRC regional meetings.

3. EVALUATION

The licensee provided responses to NRC Generic Letter 82-33 on June 29, 1984 (Unit 1), March 30, 1984 (Unit 2), April 10, 1985 and August 8, 1986 (Units 1 and 2). This evaluation is based on these submittals.

3.1 Adherence to Regulatory Guide 1.97

The licensee stated that compliance with Regulatory Guide 1.97 is indicated on their review checklist which summarizes each variable's compliance with the Regulatory Guide 1.97 provisions. That compliance report presents justification, modifications or ongoing evaluations that are provided as resolutions for any identified 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 (wide range)

2. RCS hot leg temperature (wide range)

3. RCS cold leg temperature (wide range)

4. Steam generator level (wide range)

5. Steam generator level (narrow range)

6. Pressurizer level

7. Containment pressure (normal range)

8. Main steamline pressure

9. Refueling water storage tank level

10. Containment water level

11. Condensate storage tank level

12. Auxiliary feedwater flow

13. Core exit temperature

14. Core subcooling monitor

The above instrumentation meets Category 1 requirements consistent with the requirements for Type A variables, except as noted in Section 3.3.

3.3 Exceptions to Regulatory Guide 1.97

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

3.3.1 Environmental Qualification Requirement Deviation

In References 4 and 5, the licensee has indicated that environmental qualification is not applicable for the following Category 1 and 2 instrumentation. However, no justification was submitted for this deviation. In Reference 7, the licensee stated that the instrumentation listed, along with the associated instrument loop components, are located outside areas that constitute a harsh environment.

Main steamline pressure
Refueling water storage tank level
Condensate storage tank level
Plant vent stack flow
Condenser steam jet air ejector radiation
Plant vent effluent radiation
Accessible area radiation
Main steam effluent radiation
Turbine driven auxiliary feedwater effluent radiation
Heating, ventilating and air conditioning emergency damper position--control room
Pressurizer heater breaker position
Status of standby power and other energy sources important to safety.

Based on the licensee's justification that the instrumentation listed is located in a mild environment, we find this deviation acceptable.

Deviations other than environmental qualification for these variables are listed elsewhere in this report.

3.3.2 Neutron Flux (Intermediate Range)

The installed neutron flux instrumentation does not completely meet the redundancy requirements of Regulatory Guide 1.97. Both intermediate range instrument loops are ultimately powered from the same DC power supply train (Train A). The power to the instrument loops is provided by separate inverters, and the outputs of these inverters are physically separated and backed up by diesel generator A. In addition, an alternate source of power, other than the inverters, is provided to both instrument loops from a Solatron voltage regulator. The licensee is installing a third channel of wide range instrumentation to resolve ambiguity between the existing instrumentation should one loop fail. This new instrumentation loop, however, will be powered from the same power supply train (Train A) as the two existing neutron flux monitoring loops. The licensee also states that the existing electrical independence of the neutron monitors is consistent with the design criteria of the reactor protection system.

There is a very low probability of a fault occurring that would fail the complete electrical train A (ac and dc). In the event this loss should occur, only the intermediate range of neutron flux instrumentation would be lost. No single failures such as inverters, batteries, battery chargers, 4160 volt bus faults or dc bus faults would disable all the neutron flux instrumentation. Based on this evaluation, we conclude that the existing configuration of this variable is acceptable.

3.3.4 RCS Soluble Boron Concentration

Regulatory Guide 1.97 recommends Category 3 instrumentation, with a range of 0 to 6000 ppm, for this variable. The licensee takes credit for the post-accident sampling system to meet this recommendation.

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.

3.3.5 RCS Cold and Hot Leg Water Temperature

The maximum indication of the instrumentation for these variables is 700°F. This is 50°F less than the Regulatory Guide 1.97, Revision 2, range guidelines (50 to 750°F).

Regulatory Guide 1.97, Revision 3, (Reference 8) recommends a range of 50 to 700°F for these variables. The instrumentation supplied by the licensee meets this recommended range and is, therefore, acceptable.

3.3.6 Coolant Level in Reactor (Unit No. 2)

The licensee does not have usable instrumentation for this variable. As justification, the licensee states that they participated in a pilot project for a non-invasive reactor vessel level system. This unsuccessful demonstration led the licensee into a detailed review of commercially available reactor vessel level systems. The results of this ongoing review

indicate to the licensee that no commercially available reactor vessel level system has been accepted by the NRC for operational use.

It is our understanding that two systems are now commercially available for reading reactor vessel level in a pressurized water reactor. One system uses heated junction thermocouples (NUREG/CR-2627, Reference 9) and the other system uses differential pressure (NUREG/CR-2628, Reference 10).

The NRC is reviewing the acceptability of this variable as part of their review of NUREG-0737, Item II.F.2.

3.3.7 Degrees of Subcooling

The licensee has identified degrees of subcooling as a Type A variable. As such, it should meet Category 1 requirements. The licensee states that their core subcooling monitor meets Category 2 requirements.

The NRC is reviewing the acceptability of this variable as part of their review of NUREG-0737, Item II.F.2.

3.3.8 Containment Sump Water Level

The licensee has taken exception to the range recommended by Regulatory Guide 1.97 for the containment level instrumentation (bottom of containment to 600,000 gallon level equivalent). The licensee has instrumentation with a minimum level indication of 62,000 gallons. The licensee considers the existing range to be adequate since the minimum level indication is limited by physical installation restraints of the float type level measurement device and no operator actions are required below the 62,000 gallon level.

The reactor cavity sump level indication would provide a diverse method of determining a water level increase in the containment. Since no

operator action is required at less than the minimum indication available with the existing range, we find this to be an acceptable deviation from Regulatory Guide 1.97.

3.3.9 Containment Isolation Valve Position

The licensee has not provided redundancy for all of the containment isolation valves. Some isolation valves inside and outside containment for the same penetration are of the same train orientation and, therefore, redundant indication is not provided. The licensee submitted the following justification for this deviation. These valves are normally closed valves and remain closed in an accident condition until remotely opened by the operator. The power supply for these valves is for position indication as well as for power operation of the valve motor operators. The valves are part of a penetration which is redundant to another penetration. At least one of these redundant piping systems must be opened during certain accident conditions. Therefore, the power for both containment isolation valves on a penetration is from the same power supply to ensure that a single power supply failure will not inhibit both penetrations from operating. Both isolation valves for the redundant penetration are supplied power from another power source.

We find the licensee's justification acceptable. Furthermore, if during an accident condition, a single train of electrical power were to fail resulting in a loss of position indication, the operator could verify that the outside containment isolation valve is closed and containment integrity maintained. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.10 Radioactivity Concentration or Radiation Level in Circulating Primary Coolant

The licensee uses the post-accident sample system to measure this parameter. In a letter dated February 17, 1984, the licensee states that procedures exist which relate radionuclide concentrations to core damage. These procedures consider physical parameters such as core temperature and

sample locations. Alabama Power Company will implement a calculational method to assess the extent of core damage. This method will utilize the RCS post-accident sampling system in the determination of the status of fuel cladding and the magnitude of any core damage.

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

3.3.11 Containment Hydrogen Concentration

Regulatory Guide 1.97 recommends Category 1 instrumentation for this variable with a range of 0 to 10 percent. The licensee has installed Category 3 hydrogen analyzers that do not meet the range recommended by Regulatory Guide 1.97. The licensee considers this instrumentation acceptable because the operators energize the hydrogen recombiners based on loss of coolant accident (LOCA) indications. Hydrogen concentration is not a LOCA indication, it is used only as the basis for verifying the hydrogen removal capability of the hydrogen recombiners. In the event that the hydrogen analyzers are unavailable to provide containment hydrogen concentration, sufficient time is available to determine the containment hydrogen concentration utilizing the containment air post-accident sampling system (CAPASS).

The NRC has reviewed the acceptability of this variable as part of their review of NUREG-0737, Item II.F.1.6.

3.3.12 Residual Heat Removal (RHR) Heat Exchanger Outlet Temperature

Regulatory Guide 1.97, Revision 2, recommends a range for this variable of 32 to 350°F. Revision 3 changed the recommended range to 40 to 350°F. The licensee has supplied a range of 50 to 400°F. The instrumentation supplied has a range where the lower limit of the span does not conform to either revision of the regulatory guide. The licensee

states that the existing range of this instrumentation envelops the RHR system design parameters and no need exists for temperature indication below 50°F.

Based on the justification provided by the licensee, we conclude that the instrumentation supplied for this variable is adequate to monitor this variable during all accident and post-accident conditions, and is therefore, acceptable.

3.3.13 Accumulator Tank Level and Pressure

The licensee has Category 3 accumulator tank level instrumentation that does not meet the recommended range. The justification submitted by the licensee for this deviation is that the accumulator tank level at the Farley Nuclear Plant was designed solely to verify compliance with the technical specification volume provisions. In the event of RCS depressurization, accumulator tank discharge is verified by monitoring accumulator tank pressure, which meets the Category 2 requirements.

The accumulators are passive and discharge for RCS breaks. The level and pressure measurement channels are not required to protect the integrity of the RCS boundary, to shutdown the reactor, to maintain it in a safe shutdown condition or to prevent or mitigate the consequences of an accident which could result in potential exposures. We find the qualified pressure instrumentation supplied for this variable adequate to determine that the accumulators have discharged. Therefore, the existing instrumentation is acceptable to monitor this variable.

3.3.14 Refueling Water Storage Tank Level

Regulatory Guide 1.97 recommends a range from the top to the bottom of the tank. The licensee does not meet this range and states that the maximum level indication of the existing instrumentation is one foot below the top of the tank. This level indication reads from 0 to 40 feet and envelopes the technical specification volume requirement, which the licensee states is sufficient to mitigate any design basis event. This

range is adequate to provide the operator with information for normal operations and to perform switchover from emergency core cooling system injection to recirculation.

Based on the licensee's justification, we conclude that the existing instrumentation for this variable (that reads 98 percent of the recommended range) is adequate to monitor this variable during all accident and post-accident conditions.

3.3.15 Pressurizer Level

Regulatory Guide 1.97 recommends a range from the bottom to the top for this variable. The instrumentation provided by the licensee does not read this full range. The licensee states that the volume measured represents approximately 89 percent of the pressurizer and is sufficient for the operator to take the required manual actions and to ensure the proper operation of the pressurizer.

The portion of the pressurizer level that is not indicated (approximately 11 percent) is the upper and lower hemispherical head region, where the volume to level ratio is not linear. We find this deviation minor and acceptable. The existing range is adequate to monitor this variable during all accident and post-accident conditions.

3.3.16 Pressurizer Heater Status

Regulatory Guide 1.97 recommends electric current instrumentation to determine the operating status of the pressurizer heaters. The licensee does not intend to provide specific instrumentation to read this current. The licensee states, in Reference 4 and 5, that the pressurizer heater status can be adequately determined by the use of pressurizer heater circuit breaker position and pressurizer pressure. Furthermore, the licensee states that the emergency response procedures do not utilize pressurizer heater current for accident mitigation.

In Reference 7, the licensee lists several additional means of determining pressurizer heater operation. In addition to these, the licensee states that heaters current can be monitored with the diesel generator megawatt and current indicators when the diesel generator is supplying power for the heaters and with the 4.16 KV bus incoming current indicator when being supplied from offsite power.

Based on the available current monitoring instrumentation and the diverse means of determining heater operation, we conclude that this is an acceptable deviation from Regulatory Guide 1.97.

3.3.17 Quench Tank Level

The range of the existing instrumentation for this variable does not meet the range recommended by Regulatory Guide 1.97 (top to bottom). The licensee's justification for this deviation is that only 5 percent of the total tank volume is not measured and the existing range is sufficient to provide the operator with the necessary information for accident monitoring.

We find the existing level range adequate to monitor the operation of this tank. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.18 Steam Generator Level

Regulatory Guide 1.97 recommends a range from the tube sheet to the separators for this variable. The licensee has instrumentation that reads from 12 in. above the tube sheet to the separators. The licensee states that the volume of the steam generator not measured is less than 2 percent of the volume recommended by the regulatory guide.

The steam generator is, in effect, empty at 12 in. above the tube sheet; therefore, this deviation is minor with respect to the overall range and system accuracy. The existing range is adequate to monitor this variable during all accident and post-accident conditions.

3.3.19 Steam Generator Pressure

The licensee has instrumentation for this variable with a range of 0 to 1200 psig. Regulatory Guide 1.97 recommends a range from atmospheric pressure to 20 percent above the lowest safety valve setting. Thus, the range should be to 1290 psig, as the licensee identifies the range as being 90 psig less than recommended. The licensee justifies the range deviation by stating that the highest actuation setpoint of the main steam safety valves is 1129 psig. Allowing for 3 percent accumulation the maximum credible steamline pressure is 1163 psig which is within the indicated range of the existing instrumentation.

Based on the licensee's statement that the maximum credible steamline pressure would be 1163 psig, this instrumentation would remain on scale during any accident or post-accident conditions. Therefore, we find this deviation acceptable.

3.3.20 Volume Control Tank Level

The licensee takes exception to the range recommended by Regulatory Guide 1.97 for this variable (top to bottom). The transmitters measure the full range between the instrument connections, however, these connections are not at the top and bottom of the tank. The justification submitted by the licensee is that for operational purposes, level indication at either end of the scale is considered full or empty. Also, the existing range of the volume control tank level envelops all automatic action of the level control system.

We find that the existing level indication is adequate to monitor the operation of this tank. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.21 High Level Radioactive Liquid Tank Level

Regulatory Guide 1.97 recommends a range of top to bottom for this variable. The transmitters for these tanks measure the full range between

the instrument connections; however, these connections are not at the top and bottom of the tank. The licensee's justification for this deviation is that at least 90 percent of the tank volume is measured and the range is sufficient to provide the operator with the necessary information for accident monitoring.

We find that the existing range is adequate to monitor the operation of this tank during all accident and post-accident conditions. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.22 Radioactive Gas Holdup Tank Pressure

The licensee takes exception to the range recommended by Regulatory Guide 1.97 for this variable (0 to 150 percent design pressure). The licensee has instrumentation for this variable that reads from 0 to 100 percent of the design pressure of the tank (150 psig). The licensee states that the existing range is acceptable because it covers up to the design pressure of the tanks and because relief valves are installed on each tank to prevent the tank pressure from exceeding the design value of 150 psig.

Based on the justification provided by the licensee, we conclude that the instrumentation provided for this variable is adequate to monitor the operation of this tank and is, therefore, acceptable.

3.3.23 Radiation Exposure Rate

In References 4 and 5, the licensee identified two deviations for this variable. First, of the plant areas which are accessible post-accident, only the control room has a permanently installed radiation monitor. Second, the range of the radiation level indication of the control room radiation monitor is 10^{-4} to 10^{1} R/hr. The range specified by Regulatory Guide 1.97 for this variable is 10^{-1} to 10^{4} R/hr.

In Reference 7, the licensee identified permanently installed monitors in areas required for post-accident access. The ranges of these

instruments are less than recommended by the regulatory guide, however the licensee states that the ranges are adequate since additional shielding has been installed in these areas and portable monitoring instruments would be used to assess radiation levels before entry into these areas.

The licensee has shown an analysis of radiation levels expected for the monitor locations. The existing radiation exposure rate monitors have ranges that encompasses the expected radiation levels in their location. Based on this, and the fact that personnel would not be permitted into the area without portable monitoring if the upper limit of the range is exceeded, we find the instrumentation provided for this variable acceptable.

3.3.24 Plant and Environs Radiation (Portable Instrumentation)

Regulatory Guide 1.97 recommends a range of 10^{-3} to 10^{4} rads/hr, for beta radiation and low energy photons. The licensee states that the maximum indication of the existing portable instrumentation is below the recommended maximum level. The licensee's justification for this deviation is that their portable instrumentation has sufficient range to monitor the radiation levels in areas of the plant where post-accident access is necessary by plant personnel.

This instrumentation is portable and would not be used to assess levels of radiation greater than the range provided by the licensee. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.25 Plant and Environs Radioactivity (Portable Instrumentation)

The licensee does not have a portable multichannel gamma-ray spectrometer, as recommended by Regulatory Guide 1.97, Revision 2, for this variable. Regulatory Guide 1.97, Revision 3, states that portable instrumentation should be provided for isotopic analysis of plant and environs radioactivity. The licensee has also not provided portable instrumentation for isotopic analysis. However, the licensee does have two non-portable multichannel analyzers (MCA) located in the counting room of

the plant. The MCAs are equipped with a germanium-lithium detector to provide isotopic analysis of the plant and environ samples. The MCAs have the capability to analyze samples in less than 15 minutes from the time the sample is delivered to the MCAs. The MCAs located in the plant are used during normal plant operations, are accessible post-accident, and are instruments familiar to plant personnel.

The licensee states that a portable multichannel gamma-ray spectrometer would not enhance the capability to perform isotopic analysis. A portable device can only provide "scoping" of the radionuclide content and cannot provide a quantitative measurement. The existing non-portable MCAs at the Farley Nuclear Plant would provide a quantitative measurement of the radionuclide content.

The two existing multichannel analyzers are sufficient to provide for isotopic analysis and an adequate and timely assessment of radioactive releases at this station. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.26 Wind Speed

Regulatory Guide 1.97, Revision 2, recommends a range of 0 to 30 meters/second (67 mph) for this variable. The licensee has instrumentation with a range of 0 to 22 meters/second (50 mph). The licensee justifies this deviation by stating that their existing wind speed instrumentation has historically provided reliable indications that are representative of meteorological conditions in the plant vicinity.

Regulatory Guide 1.97, Revision 3, recommends instrumentation with a range of 0 to 22 meters/second (50 mph) for this variable. Since the existing instrumentation meets the Regulatory Guide 1.97, Revision 3 requirement, this deviation is acceptable.

3.3.27 Accident Sampling (Primary Coolant, Containment Air and Sump)

The minimum quantifiable concentrations of boron, chlorides, dissolved hydrogen, total gas and oxygen do not meet Regulatory Guide 1.97 range

guidelines. The licensee states that analysis below the minimums identified would serve no useful purpose for accident analysis, mitigation or recovery.

The minimum quantifiable concentrations of oxygen and hydrogen in the containment air do not satisfy Regulatory Guide 1.97 range guidelines. The licensee's justification for this deviation is that the minimum quantifiable concentrations represent the minimum detectable concentrations. In addition, the licensee states that analysis below the identified minimums would serve no useful purpose for accident analysis, mitigation or recovery.

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

4. CONCLUSIONS

Based on our review, we find that the licensee conforms to, or is justified in deviating from Regulatory Guide 1.97.

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, 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. Alabama Power Company letter, R. P. McDonald to Director, Nuclear Reactor Regulation, NRC, "Regulatory Guide 1.97 Compliance," June 29, 1984.

5. Alabama Power Company letter, F. L. Clayton, Jr. to Director, Nuclear Reactor Regulation, NRC, "Regulatory Guide 1.97 Compliance," March 30, 1984.

6. Alabama Power Company letter, R. P. McDonald to Director, Nuclear Reactor Regulation, NRC, "Regulatory Guide 1.97 Compliance," April 10, 1985.

7. Alabama Power Company letter, R. P. McDonald to Director, Nuclear Reactor Regulation, NRC, "Regulatory Guide 1.97 Compliance", August 8, 1986.

8. 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.

9. Inadequate Core Cooling Instrumentation Using Heated Junction Thermocouples for Reactor Vessel Level Measurement, NUREG/CR-2627, ORNL/TM-8248, March 1982.

10. Inadequate Core Cooling Instrumentation Using Differential Pressure for Reactor Vessel Level Measurment, NUREG/CR-2628, ORNL/TM-8269, March 1982.

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8. Schedule of installation or upgrade.

Furthermore, the submittal should identify deviations from Regulatory Guide 1.97 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 submittals based on the review policy described in the NRC regional meetings.

3. EVALUATION

The licensee provided responses to NRC Generic Letter 82-33 on June 29, 1984 (Unit 1), March 30, 1984 (Unit 2), April 10, 1985 and August 8, 1986 (Units 1 and 2). This evaluation is based on these submittals.

3.1 Adherence to Regulatory Guide 1.97

The licensee stated that compliance with Regulatory Guide 1.97 is indicated on their review checklist which summarizes each variable's compliance with the Regulatory Guide 1.97 provisions. That compliance report presents justification, modifications or ongoing evaluations that are provided as resolutions for any identified 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 (wide range)

2. RCS hot leg temperature (wide range)

3. RCS cold leg temperature (wide range)

4. Steam generator level (wide range)

5. Steam generator level (narrow range)

6. Pressurizer level

7. Containment pressure (normal range)

8. Main steamline pressure

9. Refueling water storage tank level

10. Containment water level

11. Condensate storage tank level

12. Auxiliary feedwater flow

13. Core exit temperature

14. Core subcooling monitor

The above instrumentation meets Category 1 requirements consistent with the requirements for Type A variables, except as noted in Section 3.3.

3.3 Exceptions to Regulatory Guide 1.97

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

3.3.1 Environmental Qualification Requirement Deviation

In References 4 and 5, the licensee has indicated that environmental qualification is not applicable for the following Category 1 and 2 instrumentation. However, no justification was submitted for this deviation. In Reference 7, the licensee stated that the instrumentation listed, along with the associated instrument loop components, are located outside areas that constitute a harsh environment.

Main steamline pressure
Refueling water storage tank level
Condensate storage tank level
Plant vent stack flow
Condenser steam jet air ejector radiation
Plant vent effluent radiation
Accessible area radiation
Main steam effluent radiation
Turbine driven auxiliary feedwater effluent radiation
Heating, ventilating and air conditioning emergency damper position--control room
Pressurizer heater breaker position
Status of standby power and other energy sources important to safety.

Based on the licensee's justification that the instrumentation listed is located in a mild environment, we find this deviation acceptable.

Deviations other than environmental qualification for these variables are listed elsewhere in this report.

3.3.2 Neutron Flux (Intermediate Range)

The installed neutron flux instrumentation does not completely meet the redundancy requirements of Regulatory Guide 1.97. Both intermediate range instrument loops are ultimately powered from the same DC power supply train (Train A). The power to the instrument loops is provided by separate inverters, and the outputs of these inverters are physically separated and backed up by diesel generator A. In addition, an alternate source of power, other than the inverters, is provided to both instrument loops from a Solatron voltage regulator. The licensee is installing a third channel of wide range instrumentation to resolve ambiguity between the existing instrumentation should one loop fail. This new instrumentation loop, however, will be powered from the same power supply train (Train A) as the two existing neutron flux monitoring loops. The licensee also states that the existing electrical independence of the neutron monitors is consistent with the design criteria of the reactor protection system.

There is a very low probability of a fault occurring that would fail the complete electrical train A (ac and dc). In the event this loss should occur, only the intermediate range of neutron flux instrumentation would be lost. No single failures such as inverters, batteries, battery chargers, 4160 volt bus faults or dc bus faults would disable all the neutron flux instrumentation. Based on this evaluation, we conclude that the existing configuration of this variable is acceptable.

3.3.4 RCS Soluble Boron Concentration

Regulatory Guide 1.97 recommends Category 3 instrumentation, with a range of 0 to 6000 ppm, for this variable. The licensee takes credit for the post-accident sampling system to meet this recommendation.

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.

3.3.5 RCS Cold and Hot Leg Water Temperature

The maximum indication of the instrumentation for these variables is 700°F. This is 50°F less than the Regulatory Guide 1.97, Revision 2, range guidelines (50 to 750°F).

Regulatory Guide 1.97, Revision 3, (Reference 8) recommends a range of 50 to 700°F for these variables. The instrumentation supplied by the licensee meets this recommended range and is, therefore, acceptable.

3.3.6 Coolant Level in Reactor (Unit No. 2)

The licensee does not have usable instrumentation for this variable. As justification, the licensee states that they participated in a pilot project for a non-invasive reactor vessel level system. This unsuccessful demonstration led the licensee into a detailed review of commercially available reactor vessel level systems. The results of this ongoing review

indicate to the licensee that no commercially available reactor vessel level system has been accepted by the NRC for operational use.

It is our understanding that two systems are now commercially available for reading reactor vessel level in a pressurized water reactor. One system uses heated junction thermocouples (NUREG/CR-2527, Reference 9) and the other system uses differential pressure (NUREG/CR-2628, Reference 10).

The NRC is reviewing the acceptability of this variable as part of their review of NUREG-0737, Item II.F.2.

3.3.7 Degrees of Subcooling

The licensee has identified degrees of subcooling as a Type A variable. As such, it should meet Category 1 requirements. The licensee states that their core subcooling monitor meets Category 2 requirements.

The NRC is reviewing the acceptability of this variable as part of their review of NUREG-0737, Item II.F.2.

3.3.8 Containment Sump Water Level

The licensee has taken exception to the range recommended by Regulatory Guide 1.97 for the containment level instrumentation (bottom of containment to 600,000 gallon level equivalent). The licensee has instrumentation with a minimum level indication of 62,000 gallons. The licensee considers the existing range to be adequate since the minimum level indication is limited by physical installation restraints of the float type level measurement device and no operator actions are required below the 62,000 gallon level.

The reactor cavity sump level indication would provide a diverse method of determining a water level increase in the containment. Since no

operator action is required at less than the minimum indication available with the existing range, we find this to be an acceptable deviation from Regulatory Guide 1.97.

3.3.9 Containment Isolation Valve Position

The licensee has not provided redundancy for all of the containment isolation valves. Some isolation valves inside and outside containment for the same penetration are of the same train orientation and, therefore, redundant indication is not provided. The licensee submitted the following justification for this deviation. These valves are normally closed valves and remain closed in an accident condition until remotely opened by the operator. The power supply for these valves is for position indication as well as for power operation of the valve motor operators. The valves are part of a penetration which is redundant to another penetration. At least one of these redundant piping systems must be opened during certain accident conditions. Therefore, the power for both containment isolation valves on a penetration is from the same power supply to ensure that a single power supply failure will not inhibit both penetrations from operating. Both isolation valves for the redundant penetration are supplied power from another power source.

We find the licensee's justification acceptable. Furthermore, if during an accident condition, a single train of electrical power were to fail resulting in a loss of position indication, the operator could verify that the outside containment isolation valve is closed and containment integrity maintained. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.10 Radioactivity Concentration or Radiation Level in Circulating Primary Coolant

The licensee uses the post-accident sample system to measure this parameter. In a letter dated February 17, 1984, the licensee states that procedures exist which relate radionuclide concentrations to core damage. These procedures consider physical parameters such as core temperature and

sample locations. Alabama Power Company will implement a calculational method to assess the extent of core damage. This method will utilize the RCS post-accident sampling system in the determination of the status of fuel cladding and the magnitude of any core damage.

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

3.3.11 Containment Hydrogen Concentration

Regulatory Guide 1.97 recommends Category 1 instrumentation for this variable with a range of 0 to 10 percent. The licensee has installed Category 3 hydrogen analyzers that do not meet the range recommended by Regulatory Guide 1.97. The licensee considers this instrumentation acceptable because the operators energize the hydrogen recombiners based on loss of coolant accident (LOCA) indications. Hydrogen concentration is not a LOCA indication, it is used only as the basis for verifying the hydrogen removal capability of the hydrogen recombiners. In the event that the hydrogen analyzers are unavailable to provide containment hydrogen concentration, sufficient time is available to determine the containment hydrogen concentration utilizing the containment air post-accident sampling system (CAPASS).

The NRC has reviewed the acceptability of this variable as part of their review of NUREG-0737, Item II.F.1.6.

3.3.12 Residual Heat Removal (RHR) Heat Exchanger Outlet Temperature

Regulatory Guide 1.97, Revision 2, recommends a range for this variable of 32 to 350°F. Revision 3 changed the recommended range to 40 to 350°F. The licensee has supplied a range of 50 to 400°F. The instrumentation supplied has a range where the lower limit of the span does not conform to either revision of the regulatory guide. The licensee

states that the existing range of this instrumentation envelops the RHR system design parameters and no need exists for temperature indication below 50°F.

Based on the justification provided by the licensee, we conclude that the instrumentation supplied for this variable is adequate to monitor this variable during all accident and post-accident conditions, and is therefore, acceptable.

3.3.13 Accumulator Tank Level and Pressure

The licensee has Category 3 accumulator tank level instrumentation that does not meet the recommended range. The justification submitted by the licensee for this deviation is that the accumulator tank level at the Farley Nuclear Plant was designed solely to verify compliance with the technical specification volume provisions. In the event of RCS depressurization, accumulator tank discharge is verified by monitoring accumulator tank pressure, which meets the Category 2 requirements.

The accumulators are passive and discharge for RCS breaks. The level and pressure measurement channels are not required to protect the integrity of the RCS boundary, to shutdown the reactor, to maintain it in a safe shutdown condition or to prevent or mitigate the consequences of an accident which could result in potential exposures. We find the qualified pressure instrumentation supplied for this variable adequate to determine that the accumulators have discharged. Therefore, the existing instrumentation is acceptable to monitor this variable.

3.3.14 Refueling Water Storage Tank Level

Regulatory Guide 1.97 recommends a range from the top to the bottom of the tank. The licensee does not meet this range and states that the maximum level indication of the existing instrumentation is one foot below the top of the tank. This level indication reads from 0 to 40 feet and envelopes the technical specification volume requirement, which the licensee states is sufficient to mitigate any design basis event. This

range is adequate to provide the operator with information for normal operations and to perform switchover from emergency core cooling system injection to recirculation.

Based on the licensee's justification, we conclude that the existing instrumentation for this variable (that reads 98 percent of the recommended range) is adequate to monitor this variable during all accident and post-accident conditions.

3.3.15 Pressurizer Level

Regulatory Guide 1.97 recommends a range from the bottom to the top for this variable. The instrumentation provided by the licensee does not read this full range. The licensee states that the volume measured represents approximately 89 percent of the pressurizer and is sufficient for the operator to take the required manual actions and to ensure the proper operation of the pressurizer.

The portion of the pressurizer level that is not indicated (approximately 11 percent) is the upper and lower hemispherical head region, where the volume to level ratio is not linear. We find this deviation minor and acceptable. The existing range is adequate to monitor this variable during all accident and post-accident conditions.

3.3.16 Pressurizer Heater Status

Regulatory Guide 1.97 recommends electric current instrumentation to determine the operating status of the pressurizer heaters. The licensee does not intend to provide specific instrumentation to read this current. The licensee states, in Reference 4 and 5, that the pressurizer heater status can be adequately determined by the use of pressurizer heater circuit breaker position and pressurizer pressure. Furthermore, the licensee states that the emergency response procedures do not utilize pressurizer heater current for accident mitigation.

In Reference 7, the licensee lists several additional means of determining pressurizer heater operation. In addition to these, the licensee states that heaters current can be monitored with the diesel generator megawatt and current indicators when the diesel generator is supplying power for the heaters and with the 4.16 KV bus incoming current indicator when being supplied from offsite power.

Based on the available current monitoring instrumentation and the diverse means of determining heater operation, we conclude that this is an acceptable deviation from Regulatory Guide 1.97.

3.3.17 Quench Tank Level

The range of the existing instrumentation for this variable does not meet the range recommended by Regulatory Guide 1.97 (top to bottom). The licensee's justification for this deviation is that only 5 percent of the total tank volume is not measured and the existing range is sufficient to provide the operator with the necessary information for accident monitoring.

We find the existing level range adequate to monitor the operation of this tank. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.18 Steam Generator Level

Regulatory Guide 1.97 recommends a range from the tube sheet to the separators for this variable. The licensee has instrumentation that reads from 12 in. above the tube sheet to the separators. The licensee states that the volume of the steam generator not measured is less than 2 percent of the volume recommended by the regulatory guide.

The steam generator is, in effect, empty at 12 in. above the tube sheet; therefore, this deviation is minor with respect to the overall range and system accuracy. The existing range is adequate to monitor this variable during all accident and post-accident conditions.

3.3.19 Steam Generator Pressure

The licensee has instrumentation for this variable with a range of 0 to 1200 psig. Regulatory Guide 1.97 recommends a range from atmospheric pressure to 20 percent above the lowest safety valve setting. Thus, the range should be to 1290 psig, as the licensee identifies the range as being 90 psig less than recommended. The licensee justifies the range deviation by stating that the highest actuation setpoint of the main steam safety valves is 1129 psig. Allowing for 3 percent accumulation the maximum credible steamline pressure is 1163 psig which is within the indicated range of the existing instrumentation.

Based on the licensee's statement that the maximum credible steamline pressure would be 1163 psig, this instrumentation would remain on scale during any accident or post-accident conditions. Therefore, we find this deviation acceptable.

3.3.20 Volume Control Tank Level

The licensee takes exception to the range recommended by Regulatory Guide 1.97 for this variable (top to bottom). The transmitters measure the full range between the instrument connections, however, these connections are not at the top and bottom of the tank. The justification submitted by the licensee is that for operational purposes, level indication at either end of the scale is considered full or empty. Also, the existing range of the volume control tank level envelops all automatic action of the level control system.

We find that the existing level indication is adequate to monitor the operation of this tank. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.21 High Level Radioactive Liquid Tank Level

Regulatory Guide 1.97 recommends a range of top to bottom for this variable. The transmitters for these tanks measure the full range between

the instrument connections; however, these connections are not at the top and bottom of the tank. The licensee's justification for this deviation is that at least 90 percent of the tank volume is measured and the range is sufficient to provide the operator with the necessary information for accident monitoring.

We find that the existing range is adequate to monitor the operation of this tank during all accident and post-accident conditions. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.22 Radioactive Gas Holdup Tank Pressure

The licensee takes exception to the range recommended by Regulatory Guide 1.97 for this variable (0 to 150 percent design pressure). The licensee has instrumentation for this variable that reads from 0 to 100 percent of the design pressure of the tank (150 psig). The licensee states that the existing range is acceptable because it covers up to the design pressure of the tanks and because relief valves are installed on each tank to prevent the tank pressure from exceeding the design value of 150 psig.

Based on the justification provided by the licensee, we conclude that the instrumentation provided for this variable is adequate to monitor the operation of this tank and is, therefore, acceptable.

3.3.23 Radiation Exposure Rate

In References 4 and 5, the licensee identified two deviations for this variable. First, of the plant areas which are accessible post-accident, only the control room has a permanently installed radiation monitor. Second, the range of the radiation level indication of the control room radiation monitor is 10^{-4} to 10^{1} R/hr. The range specified by Regulatory Guide 1.97 for this variable is 10^{-1} to 10^{4} R/hr.

In Reference 7, the licensee identified permanently installed monitors in areas required for post-accident access. The ranges of these

instruments are less than recommended by the regulatory guide, however the licensee states that the ranges are adequate since additional shielding has been installed in these areas and portable monitoring instruments would be used to assess radiation levels before entry into these areas.

The licensee has shown an analysis of radiation levels expected for the monitor locations. The existing radiation exposure rate monitors have ranges that encompasses the expected radiation levels in their location. Based on this, and the fact that personnel would not be permitted into the area without portable monitoring if the upper limit of the range is exceeded, we find the instrumentation provided for this variable acceptable.

3.3.24 Plant and Environs Radiation (Portable Instrumentation)

Regulatory Guide 1.97 recommends a range of 10^{-3} to 10^{4} rads/hr, for beta radiation and low energy photons. The licensee states that the maximum indication of the existing portable instrumentation is below the recommended maximum level. The licensee's justification for this deviation is that their portable instrumentation has sufficient range to monitor the radiation levels in areas of the plant where post-accident access is necessary by plant personnel.

This instrumentation is portable and would not be used to assess levels of radiation greater than the range provided by the licensee. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.25 Plant and Environs Radioactivity (Portable Instrumentation)

The licensee does not have a portable multichannel gamma-ray spectrometer, as recommended by Regulatory Guide 1.97, Revision 2, for this variable. Regulatory Guide 1.97, Revision 3, states that portable instrumentation should be provided for isotopic analysis of plant and environs radioactivity. The licensee has also not provided portable instrumentation for isotopic analysis. However, the licensee does have two non-portable multichannel analyzers (MCA) located in the counting room of

the plant. The MCAs are equipped with a germanium-lithium detector to provide isotopic analysis of the plant and environ samples. The MCAs have the capability to analyze samples in less than 15 minutes from the time the sample is delivered to the MCAs. The MCAs located in the plant are used during normal plant operations, are accessible post-accident, and are instruments familiar to plant personnel.

The licensee states that a portable multichannel gamma-ray spectrometer would not enhance the capability to perform isotopic analysis. A portable device can only provide "scoping" of the radionuclide content and cannot provide a quantitative measurement. The existing non-portable MCAs at the Farley Nuclear Plant would provide a quantitative measurement of the radionuclide content.

The two existing multichannel analyzers are sufficient to provide for isotopic analysis and an adequate and timely assessment of radioactive releases at this station. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.26 Wind Speed

Regulatory Guide 1.97, Revision 2, recommends a range of 0 to 30 meters/second (67 mph) for this variable. The licensee has instrumentation with a range of 0 to 22 meters/second (50 mph). The licensee justifies this deviation by stating that their existing wind speed instrumentation has historically provided reliable indications that are representative of meteorological conditions in the plant vicinity.

Regulatory Guide 1.97, Revision 3, recommends instrumentation with a range of 0 to 22 meters/second (50 mph) for this variable. Since the existing instrumentation meets the Regulatory Guide 1.97, Revision 3 requirement, this deviation is acceptable.

3.3.27 Accident Sampling (Primary Coolant, Containment Air and Sump)

The minimum quantifiable concentrations of boron, chlorides, dissolved hydrogen, total gas and oxygen do not meet Regulatory Guide 1.97 range

guidelines. The licensee states that analysis below the minimums identified would serve no useful purpose for accident analysis, mitigation or recovery.

The minimum quantifiable concentrations of oxygen and hydrogen in the containment air do not satisfy Regulatory Guide 1.97 range guidelines. The licensee's justification for this deviation is that the minimum quantifiable concentrations represent the minimum detectable concentrations. In addition, the licensee states that analysis below the identified minimums would serve no useful purpose for accident analysis, mitigation or recovery.

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

4. CONCLUSIONS

Based on our review, we find that the licensee conforms to, or is justified in deviating from Regulatory Guide 1.97.

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, 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. Alabama Power Company letter, R. P. McDonald to Director, Nuclear Reactor Regulation, NRC, "Regulatory Guide 1.97 Compliance," June 29, 1984.

5. Alabama Power Company letter, F. L. Clayton, Jr. to Director, Nuclear Reactor Regulation, NRC, "Regulatory Guide 1.97 Compliance," March 30, 1984.

6. Alabama Power Company letter, R. P. McDonald to Director, Nuclear Reactor Regulation, NRC, "Regulatory Guide 1.97 Compliance," April 10, 1985.

7. Alabama Power Company letter, R. P. McDonald to Director, Nuclear Reactor Regulation, NRC, "Regulatory Guide 1.97 Compliance", August 8, 1986.

8. 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.

9. Inadequate Core Cooling Instrumentation Using Heated Junction Thermocouples for Reactor Vessel Level Measurement, NUREG/CR-2627, ORNL/TM-8248, March 1982.

10. Inadequate Core Cooling Instrumentation Using Differential Pressure for Reactor Vessel Level Measurment, NUREG/CR-2628, ORNL/TM-8269, March 1982.

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13. ABSTRACT (200 words or less)

This EG&G Idaho, Inc. report reviews the submittals for the Joseph M. Farley Nuclear Plant, Unit Nos. 1 & 2, and identifies areas of non-conformance to Regulatory Guide 1.97. Any exceptions to these guidelines are evaluated.

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