CONFORMANCE TO REGULATORY GUIDE 1.97
ARKANSAS NUCLEAR ONE, UNIT NO. 1

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ABSTRACT

This EG&G Idaho, Inc., report reviews the submittals for Regulatory Guide 1.97 for Unit No. 1 of Arkansas Nuclear One 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.

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 Systems Integration by EG&G Idaho, Inc., NRC Licensing Support Section.

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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).

Arkansas Power and Light Company, the licensee for Arkansas Nuclear One, Unit No. 1, provided a response to the Regulatory Guide 1.97 portion of the generic letter on June 25, 1984 (Reference 4). Additional information was submitted on May 31, 1985 (Reference 5).

This report provides an evaluation of those 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 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 sensor 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 submittals based on the review policy described in the NRC regional meetings.

3. EVALUATION

The licensee provided a response to NRC Generic Letter 82-33 on June 25, 1984. Additional information was submitted on May 31, 1985. This evaluation is based on those submittals.

3.1 Adherence to Regulatory Guide 1.97

The licensee states that, based on the information presented in their submittal, Arkansas Nuclear One, Unit No. 1, will conform with the recommendations of Regulatory Guide 1.97, Revision 3 (Reference 6), by the end of the next two refueling outages. Therefore, we conclude 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) hot leg water temperature

2. RCS pressure

3. Containment hydrogen concentration

4. Steam generator level

5. Steam generator pressure

6. Condensate storage tank level

7. Borated water storage tank level.

These variables meet the Category 1 recommendations consistent with the requirements for Type A variables.

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 RCS Soluble Boron Concentration

The licensee has not provided indication with the recommended range for this variable. The licensee states that the letdown line for the boronometer is isolated following an accident, and that the Post-Accident Sampling System (PASS) for ANO-1 was designed to provide boron concentration measurement capability. The licensee states that the range and the design criteria for the PASS is consistent with guidance provided for Item II.B.3 of NUREG-0737.

The licensee deviates from Regulatory Guide 1.97 with respect to this variable. This deviation 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

The licensee has taken exception to the Category 1 and the range (50 to 700°F) recommendations of Regulatory Guide 1.97 for this variable. The licensee's instrumentation is Category 3 with a range of 50 to 650°F. The licensee states that there must be reactor coolant system (RCS) flow through the steam generators for this variable to represent core conditions. Also, due to the proximity of the cold leg resistance temperature detectors (RTD) to the high pressure injection (HPI) nozzles, HPI flow may significantly affect the cold leg temperature indication particularly in the absence of forced RCS flow. Incore temperature monitors are defined by the licensee as the key variable for this function as it provides a more direct indication of core cooling independent of whether or not coolant flow exists in the loops. The licensee states that RCS cold leg temperature serves as a backup variable and is accordingly qualified to Category 3 recommendations.

Based on the licensee's justification, we find the existing Category 3 RCS cold leg water temperature instrumentation adequate.

The licensee justified the range deviation by stating that the maximum saturation temperature for the steam generators is 600°F (maximum pressure of 1200 psig, based on the highest main steam safety valve setting of 1000 psig), an upper range of 650°F for the RCS cold leg water temperature instrumentation should provide adequate margin to account for any reasonable variation in the maximum pressure of the steam generators.

We find the existing temperature range adequate for the intended purpose with the core exit temperature instrumentation used as a diverse method of determining RCS heat removal. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.3 Degrees of Subcooling

Regulatory Guide 1.97 recommends instrumentation with a range of 200°F subcooling to 35°F superheat for this variable. The licensee has instrumentation with a range of 0 to 200°F subcooled for this variable. The licensee states that during situations that may result in superheated conditions in the RCS, incore temperature and hot leg RTD's will be monitored against RCS pressure to determine the degree of superheat or subcooling, and that the safety parameter display system (SPDS) computers will plot the core exit temperature versus pressure on a grid with the saturation curve so that the operator can tell at a glance the thermodynamic status of the reactor coolant. Therefore, the licensee states that a range of 0 to 200°F subcooled on the subcooled margin monitor is adequate to meet the intent of Regulatory Guide 1.97.

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

3.3.4 Radiation Level in Circulating Primary Coolant

The licensee has chosen the following alternate instrumentation to monitor the radiation level in the RCS during accident and post-accident conditions:

- letdown line radiation monitor
- radiochemistry analyses
- post-accident sampling system

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

3.3.5 Containment Effluent Radioactivity--Noble Gases from Identified Release Points

Effluent Radioactivity--Noble Gases from Buildings or Areas Where Penetrations and Hatches are Located

Condenser Air Removal System Exhaust

Common Plant Vent

In Reference 4 the licensee states that the power supply for the gaseous effluent radiation monitoring system (GERMS) does not comply with the strict definition of a Category 2 power supply. In Reference 5 the licensee re-evaluated the existing power supplies. Based on this evaluation and operational experience with the system to date, the licensee considers the GERMS power supply to be a high-reliability power source, meeting the regulatory guide power supply requirements.

The GERMS auxiliary power is supplied from either ANO-1 or ANO-2 normal AC through an automatic, power-seeking transfer switch. Battery backup is provided for the system electronics. Based on this information, we conclude that the power supply for this variable is highly reliable and, therefore, acceptable.

3.3.6 Accumulator Tank (Core Flood Tank) Level and Pressure

The licensee has taken exception to supplying Category 2 instrumentation for the core flood tank pressure. The licensee states that the core flood tank pressure is the key variable for pre-accident status for assuring that this passive safety system is prepared to serve its function. The licensee states that the key variable necessary to determine whether the core flood tanks have fulfilled their safety function is core flood tank level. Therefore, core flood tank pressure is a backup variable and has accordingly been provided Category 3 instrumentation.

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 instrumentation provided for this variable is adequate to determine that the accumulators have discharged. Therefore, the instrumentation for this variable is acceptable.

3.3.7 Boric Acid Charging Flow

The licensee does not have instrumentation for this variable. Their nuclear steam supply system design does not include the charging system as part of the emergency core cooling system. The high pressure injection and low pressure injection are the flow paths to the RCS that are monitored and this is done with Category 2 instrumentation. Therefore, we find that this variable is not applicable at Arkansas Nuclear One, Unit No. 1.

3.3.8 Quench Tank Temperature

In Reference 4, the licensee indicates that quench tank temperature instrumentation does not exist. In Reference 5, the licensee states that this variable is monitored, however the existing range is 0 to 200°F.

Regulatory Guide 1.97 recommends instrumentation for quench tank temperature with a range of 50 to 750°F. The licensee has committed to upgrade the instrumentation to measure a range of 0 to 350°F.

The range covers the anticipated requirements for normal operation, anticipated operational occurrences and accident conditions. This range relates to the tank's rupture disk and the 100 psi tank design pressure that limits the temperature of the tank contents to saturated steam conditions under 350°F. Thus, we find this deviation from the regulatory guide acceptable.

3.3.9 Steam Generator Pressure

The licensee has instrumentation for this variable that does not meet the range recommended by the regulatory guide (0 to 20 percent above the lowest safety valve setting).

Control room indication of main steam pressure at the turbine as well as at the steam generators is provided. The steam generator outlet pressures are measured over the range from 0 to 1200 psig. Since the lowest safety valve setting is 1050 psig, the range should be to 1275 psig.

The main steamlines are provided with relief valves, atmospheric dump valves, and condenser dump valves to prevent overpressurization of the steamlines as well as for pressure control capability. The licensee has approximately 40 percent excess steam relief capacity with all safety valves and condenser dump valves operable. Technical specifications require 14 of the 16 main steam safety valves to be operable during power operation. The licensee states that fourteen safety valves will relieve approximately 110 percent of the rated steam flow. Combined with the condenser dump valves, these 14 safety valves will provide a total of approximately 25 percent excess steam relief capacity.

Based on the highest safety valve setting being 1100 psig, and an excess relief steam capacity of approximately 25 percent being maintained when as many as two safety valves are inoperable, we find the existing range to be adequate to monitor the steam generator pressure during all accident and post-accident conditions. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.10 Containment Atmosphere Temperature

The licensee deviates from the Category 2 and range (40 to 400°F) recommendations of Regulatory Guide 1.97. The instrumentation provided is Category 3 with a range of 0 to 300°F. The licensee states that the reactor building atmosphere temperature is not a key variable for accident monitoring; that the key variable for reactor building monitoring is reactor building pressure which is measured by Category 1 instrumentation; that the reactor building atmosphere temperature is a backup variable for reactor building accident monitoring and as such is measured by Category 3 instrumentation with a range of 0 to 300°F. This range is justified by the licensee based on a safety analysis which demonstrates that the worst case peak reactor building temperature would be 286.5°F [Final Safety Analysis Report (FSAR), Table 6-9].

The licensee indicates that the maximum containment temperature will be less than 287°F during all accident and post-accident conditions. Therefore, the range of 0 to 300°F is acceptable.

3.3.11 Containment Sump Water Temperature

The licensee has not provided instrumentation for this variable. In Reference 4 the licensee states that the FSAR accident analysis assumes saturated conditions for sump water during sump recirculation, and that because of this conservative assumption, adequate net positive suction head exists for reactor building spray and safety injection pumps at all feasible sump water temperatures. In Reference 5, the licensee indicates that the key variables for monitoring operation of the containment cooling systems are reactor building pressure and spray flow. Backup instrumentation is provided by reactor building temperature, cooling fan circuit breaker status and flow rate of cooling water to the cooling units. The licensee states that sump water temperature is not recorded or indicated because it is not required to mitigate the consequences of a design basis accident.

The temperature of the sump water is useful to the operator in determining the amount of containment heat removed during recirculation. Therefore, a means of determining the containment sump water temperature should be provided by the licensee.

3.3.12 Makeup Flow-In

Letdown Flow-Out

Volume Control Tank Level

The licensee takes exception to the Category 2 recommendations of the regulatory guide for these variables. Category 3 instrumentation is provided by the licensee. The licensee states that for accidents in which harsh environments are a result, the system containing this instrumentation (letdown and makeup portion of the makeup and purification system) is not required. Letdown is automatically isolated upon an engineered safety feature (ESF) system actuation.

As these variables are not utilized in conjunction with a safety system, we find that the instrumentation provided is acceptable.

3.3.13 Component Cooling Water Temperature to ESF System

The licensee has not provided a readout in the control room for this variable. The licensee states that the service water system is used for this variable.

The inlet temperature of the service water, by design, is based on a maximum temperature of 129.5°F from the emergency cooling pond. The average temperature of the pond (June through September) is 85°F. Furthermore, there is no control over the temperature of the service water.

The justification submitted by the licensee for this deviation is adequate. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.14 Component Cooling Water Flow to ESF System

Regulatory Guide 1.97 recommends a range of 0 to 110 percent design flow for this variable. The licensee uses pump pressure and valve position to monitor the operation of this system. The licensee states that the design flow to various ESF components varies from 6 gpm for the reactor building spray pump bearing coolers to 3000 gpm for the decay heat removal coolers. The licensee states that due to this wide range of design flows to ESF components, total loop flows would not be indicative of overall system performance. The licensee states proper system operation is shown by the correct service water header pressure and by knowing that the remote actuated valves supplying service water to ESF components are in their proper positions. Service water header pressure and remote actuated valve position indications are available in the control room and meet Category 2 requirements.

Based on the justification provided by the licensee, we find this instrumentation acceptable.

3.3.15 Radioactive Gas Holdup Tank Pressure

The licensee has not provided control room instrumentation for this variable. The licensee states that in the event of an accident which results in significant failed fuel or significant radioactive gas release, the manual transfer of radioactive gases to the radioactive gas holdup tanks would not be attempted. There are no automatic transfer operations involving the radioactive gas holdup tanks. The licensee states that the monitoring of the radioactive gas holdup tanks during post-accident conditions is not necessary since these tanks are not utilized for accident mitigation.

Since these tanks are not used for accident mitigation at this station, this exception from Regulatory Guide 1.97 is acceptable.

3.3.16 Radiation Exposure Rate

The licensee deviates from the instrument range recommended by Regulatory Guide 1.97 (10^{-1} to 10^{4} R/hr) for this variable. ANO-1 currently has an area radiation monitoring system consisting of 20 area monitors: four with a range of 10^{-2} to 10^{3} R/hr and 16 with a range of 10^{-4} to 10^{1} R/hr. The licensee states that these ranges are based on background readings in the areas in which they are located. Should personnel entry be required in areas where these monitors have gone off scale or indicate a high radiation, the licensee states that a health physics escort would accompany personnel into these areas using portable instrumentation to assess radiation levels. The high range for portable instrumentation at ANO is 10^{3} R/hr. The licensee does not anticipate, even under emergency conditions, sending personnel into radiation fields of this magnitude.

From a radiological standpoint, if the radiation levels reach or exceed the upper limit of the range (10^{3} R/hr), personnel would not be permitted into the areas without further monitoring with portable instrumentation. Therefore, we find the ranges for the radiation exposure rate monitors acceptable.

3.3.17 Plant and Environ Radiation

Regulatory Guide 1.97 recommends portable instrumentation with a range of 10^{-3} to 10^{4} R/hr, photons; and 10^{-3} to 10^{4} rads/hr, beta radiation and low-energy photons. The licensee does not comply with the recommended range for this instrumentation and stated that the existing portable instrumentation can detect gamma dose rates from 10^{-3} to 10^{3} R/hr and beta dose rates from 10^{-3} to 50 rad/hr. The licensee does not anticipate encountering radiation fields greater than those which can be measured by their current equipment except under severe accident conditions. Even under accident conditions, the licensee does not anticipate sending individuals into greater than 10^{3} R/hr fields.

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.

3.3.18 Plant and Environs Radioactivity

The licensee has not provided portable instrumentation for isotopic analysis as recommended by Regulatory Guide 1.97 and stated that gamma spectroscopy can be performed using equipment in the health physics department and the radiochemistry department at the station, and in the Technical Analysis Laboratory in Little Rock. In addition, the licensee has an ND-60 spectrometer in the Emergency Offsite Facility which can be used for less defined analysis. The licensee states that it is not appropriate for this instrumentation to be portable due to rough handling it would encounter in the field and the limited amount of time field teams have to assess the release.

The existing laboratory equipment available at this station is adequate to provide isotopic analysis and a timely assessment of radioactive releases. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.19 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 estimates. The licensee has instrumentation with a range of -3 to 5°C temperature differences and 0 to 40° wind direction sigma. The licensee states that atmospheric stability is derived from the temperature differential indicated between 34 and 180 feet; that the -3 to 5°C temperature range covers the seven Pasquill stability classes vs. Delta-T as derived from Regulatory Guide 1.23 as specified in the ANO-1 FSAR. In addition to temperature differential, atmospheric stability can also be calculated for all seven classes using wind direction sigma.

Table 1 of Regulatory Guide 1.23 (Reference 7) 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 beyond -2 or +4°C does nothing to the stability classification. The licensee's instrumentation includes this range. Therefore, we find this an acceptable deviation from Regulatory Guide 1.97.

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 exception:

1. Containment sump water temperature--the licensee should provide instrumentation to monitor this variable (Section 3.3.11).

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. Arkansas Power and Light Company letter, John R. Marshall to Darrel G. Eisenhut, NRC, "NUREG-0737 Supplement 1, Regulatory Guide 1.97," June 25, 1984.

5. Arkansas Power and Light Company letter, J. Ted Enos to Director of Nuclear Reactor Regulation, "Response to Position Document Open Items," May 31, 1985, 1CAN058507

6. Instrumentation for Light-Wat. .cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident, Regulatory Guide 1.97, Revision 3, U.S. Nuclear Regulatory Commission (NRC), Office of Nuclear Regulatory Research, May 1983.

7. 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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13. ABSTRACT (200 words or less)

This EG&G Idaho, Inc. report reviews the submittals for the Arkansas Nuclear One, Unit No. 1, and identifies areas of nonconformance to Regulatory Guide 1.97. Exceptions to these guidelines are evaluated and those areas where sufficient basis for acceptability is not provided are identified.

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