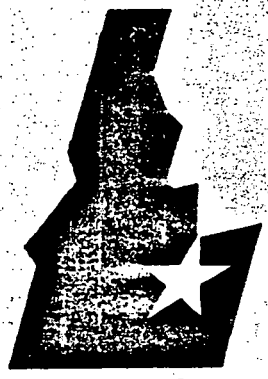

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April 1986

INFORMAL REPORT

CONFORMANCE TO REGULATORY GUIDE 1.97, DUANE ARNOLD ENERGY CENTER

A. C. Udy

Prepared for the
U.S. NUCLEAR REGULATORY COMMISSION

XA

EG&G Idaho

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DUANE ARNDLD ENERGY CENTER

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ABSTRACT

This EG&G Idaho, Inc., report reviews the submittal for Regulatory Guide 1.97, Revision 2, for the Duane Arnold Energy Center. Any exceptions to Regulatory Guide 1.97 are evaluated and those areas where sufficient basis for acceptability is not provided are identified.

Docket No. 50-331
TAC No. 51087

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 PWR Licensing-A, by EG&G Idaho, Inc., NRR and I&E Support Branch.

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CONFORMANCE TO REGULATORY GUIDE 1.97
DUANE ARNOLD ENERGY CENTER

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).

Iowa Electric Light and Power Company, the licensee for the Duane Arnold Energy Center, provided a response to Section 6.2 of the generic letter on July 3, 1985 (Reference 4). Schedular information was provided on October 16, 1985 (Reference 5).

This report provides an evaluation of that 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 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.

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. 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 July 3, 1985. The response describes the licensee's position on post-accident monitoring instrumentation. This evaluation is based on that material. Schedular information was provided on October 16, 1985.

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 compares the provided instrumentation to the instrumentation recommended by the regulatory guide, identifies instrumentation that will be modified to meet the regulatory guide, and gives justification for instrumentation that the licensee has determined appropriate for Duane Arnold. The licensee has scheduled those modifications to be made for completion during the Cycle 10 refueling outage. 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 the information required to permit the control room operator to take specific manually controlled safety actions. The licensee states that all safety systems accomplish their safety functions by automatic control. Therefore, there are no specific manually controlled safety actions. Because of this, the licensee does not have any Type A variables.

3.3 Exceptions to Regulatory Guide 1.97

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

3.3.1 Neutron Flux

Regulatory Guide 1.97 recommends Category 1 instrumentation for this variable. The licensee states that the source range monitor and intermediate range monitor drive mechanisms and controls, the flexible portions of the detector cabling and the power sources [reactor protection system (RPS) power supplies] are not Category 1. The licensee states that the present instrumentation is acceptable due to the large number of independent channels and the operator instructions to insert the detectors immediately following a SCRAM, before adverse environmental conditions would cause drive mechanism failure. The RPS power supplies have Class 1E protection.

In the process of our review of neutron flux instrumentation, we note that the mechanical drives of the detectors for boiling water reactors have not satisfied the environmental qualification requirements of Regulatory Guide 1.97. A Category 1 system that meets all the criteria of Regulatory Guide 1.97 is an industry development item. Based on our review, we conclude that the existing instrumentation is acceptable for interim operation. The licensee should follow industry development of this equipment, evaluate newly developed equipment, and install Category 1 instrumentation to cover the recommended range when it becomes available.

3.3.2 Coolant Level in Reactor

Regulatory Guide 1.97 recommends Category 1 instrumentation for this variable with a range from the bottom of the core support plate to the centerline of the main steamline. The licensee relates this to -153 inches (below the top of active fuel) to 276 inches (above the top of active fuel). The licensee has Category 1 instrumentation, except from 218 to 276 inches. This portion of the range is covered by a single channel of floodup range instrumentation.

The licensee states that no operator actions are required above 218 inches, nor is confirmation of automatic or operator action required.

The licensee indicates that the instrument taps are located at 218 inches. Any extension of the range covered by Category 1 instrumentation would require additional instrument taps in the reactor vessel. Additionally, the floodup range (used for refueling) is calibrated for ambient conditions not operating conditions, but it will establish any trend in water level on that range. Overlap with the wide range instruments is provided.

As previously stated, all manual and automatic safety functions are initiated in the range covered by the safety-related wide range level instrumentation. The licensee has concluded that the existing reactor coolant level instrumentation meets the intent of the regulatory guide and that only a marginal improvement in plant safety would be achieved by installing a redundant floodup range channel.

We find that a second floodup range channel, with both channels upgraded to Category 1, would not result in a significant increase in plant safety. We conclude that the single non-Class 1E floodup range channel is acceptable.

3.3.3 Drywell Sump Level
Drywell Drain Sumps Level

Regulatory Guide 1.97 recommends Category 1 instrumentation for these variables. The licensee has supplied Category 3 instrumentation for the sump leakage flow rate instead of sump level. This leakage is determined by the sump pump running time and time between pump starts. The pump is started by fixed position level switches. The drywell sump systems are automatically isolated at the primary containment penetration should an accident signal occur. The licensee states that drywell pressure, drywell temperature and primary containment area radiation also indicate reactor coolant system leakage.

We conclude that the alternate instrumentation supplied by the licensee will provide appropriate monitoring for the parameters of concern. This conclusion is based on (a) for small leaks, the alternate

instrumentation is not expected to experience harsh environments during operation, (b) for larger leaks, the sumps fill promptly and the sump drain lines isolate due to the increase in drywell pressure, thus negating the drywell sump flow and drywell drain sumps flow instrumentation, (c) the drywell pressure and temperature as well as the primary containment area radiation instrumentation can be used to detect leakage in the drywell, and (d) this instrumentation neither automatically initiates nor alerts the operator to initiate operation of a safety-related system in a post-accident situation. Therefore, we find the alternate Category 3 instrumentation provided acceptable.

3.3.4 Radiation Level in Circulating Primary Coolant

The licensee indicates that the critical actions to be taken in the event of an accident are to (a) shut down the reactor and (b) maintain the water level in the reactor vessel. This variable does not initiate any automatic or operator action and does not influence either critical action. The licensee indicates that radiation level measurements to indicate fuel cladding failure are provided by the following:

1. Main steamline radiation monitors

2. Drywell high range radiation monitors

3. Primary containment area radiation monitors

4. Post-accident sampling system.

The post-accident sampling system is being reviewed by the NRC as part of their review of NUREG-0737, Item II.B.3. Additionally, containment and drywell hydrogen concentration indicates the extent of fuel failure.

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 Containment and Dr well H drogen Concentration

Regulatory Guide 1.97 recommends instrumentation for this variable with a range from 0 to 30 percent. The licensee's instrumentation has a range of 0 to 20 percent.

The licensee states that the containment is inerted. Therefore, monitoring for the potential breach of containment includes monitoring the oxygen concentration with instrumentation that meets the recommendations of Regulatory Guide 1.97. The licensee states that both the lower flammability limit of hydrogen (4 percent) and the lower explosive limit of hydrogen (18 percent) are included in the range of the hydrogen concentration instrumentation supplied. The licensee states that the detection of a potential for a breach of containment is also monitored by the drywell pressure and the reactor coolant system pressure. The licensee states that the range of the hydrogen concentration instrumentation includes the range recommended by NUREG-0737, Item II.F.1.6.

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

3.3.6 Radiation Exposure Rate

Revision 2 of Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable with a range of 10^{-1} to 10^{4} R/h. The licensee indicates that there are Category 3 instruments with ranges that are typically 3 decades lower than the recommended range. As Revision 3 of Regulatory Guide 1.97 (Reference 5) recommends Category 3 instrumentation, we find the Category 3 instrumentation acceptable. The deviation from the range recommended is justified by the licensee as follows. The licensee states that access is not required to service safety-related equipment, and that should access be required, it is established by a combination of portable radiation survey instruments and post-accident sampling of the secondary containment atmosphere.

The licensee has not shown analysis of radiation levels expected for the monitor locations. The licensee should show that the existing radiation exposure rate monitors have ranges that encompass the expected radiation levels in their locations.

3.3.7 Effluent Radioactivity--Noble Gases

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable. The licensee's instrumentation is the Category 3. The licensee states that Category 3 instrumentation is sufficient for this variable because it does not serve a primary safety function, it is not a key variable and it does not indicate the need for contingency actions.

As this instrumentation is used as a backup variable, we find the use of Category 3 instrumentation for this variable acceptable.

3.3.8 Suppression Chamber Spray Flow
Drywell Spray Flow

The instrumentation for the variable low pressure coolant injection (LPCI) flow is used for these variables. This is a subsystem of the residual heat removal (RHR) system, with a valve proportioning the flow between the two sprays. The positions of the valves are controlled from and indicated in the control room. Pressure and temperature changes in the drywell and in the suppression pool determine the effectiveness of the spray. The licensee concludes that the LPCI flow, the RHR valve position, and suppression chamber and drywell temperature and pressure, accurately and reliably measure the effectiveness of the suppression chamber and the drywell sprays.

We find that this instrumentation will provide the flow indication for these variables. Therefore, we find this instrumentation acceptable.

3.3.9 Suppression Pool Water Temperature

Regulatory Guide 1.97 recommends instrumentation for this variable with a range of 30 to 230°F. The licensee's instrumentation has a range of 20 to 220°F. This deviation is supported by the licensee's statement that the maximum calculated bulk temperature in the suppression pool is 197°F. Based on this, the instrument range, 20 to 220°F, is acceptable.

3.3.10 Drywell Atmosphere Temperature

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable with a range of 40 to 440°F. The licensee's instrumentation has a range of 0 to 350°F. This deviation is supported by the licensee's statement that the maximum post-accident drywell temperature is 340°F. Based on this, the instrument range, 0 to 350°F, is acceptable.

On page 43 of Reference 4, the licensee identifies this as Class 1E instrumentation that meets Category 1 recommendations. In Table 1 of Reference 4, variable D-7, this instrumentation is identified as Category 3, but meeting the recommendations of Category 2 instrumentation, except for environmental qualification.

The licensee should clarify the characteristics of the instrumentation for this variable. If there is a deviation from environmental qualification, it should be addressed in accordance with 10 CFR 50.49.

3.3.11 Main Steamline Isolation Valves' Leakage Control System

Regulatory Guide 1.97 recommends instrumentation for this variable with ranges of 0 to 15 inches water and 0 to 5 psid. The licensee's instrumentation has a range of -1 to +5 psig.

The licensee states that the main steamline isolation valve leakage control system is a unique design that is designed to operate between the limits of -1 to +5 psig. Exhaust blowers will maintain the slight negative pressure if no leakage is present. The maximum pressure is stated to be limited to 5 psig. Based on this design, the range of -1 to +5 psig is satisfactory for this variable.

3.3.12 Standby Liquid Control System (SLCS) Flow

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable. The licensee has elected not to implement this variable as recommended in Regulatory Guide 1.97. The justification given by the licensee is that the actual flow rate is irrelevant, that the entire contents of the SLCS storage tank is to be pumped. The SLCS pump outlet pressure and pump motor indicating lights provide indication that the SLCS pump is operating and the SLCS storage tank level gives indication that flow is occurring. Additionally, the licensee states that the neutron flux instrumentation response will show the results of the SLCS operation.

We find the above instrumentation valid as an alternative indication of SLCS flow.

3.3.13 SLCS Storage Tank Level

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable. The licensee's instrumentation meets the Category 2 recommendations except in the area of environmental qualification. The licensee states that Category 3 instrumentation is sufficient for this variable because it does not serve a primary safety function, it is not a key variable (but it is the key variable to show that SLCS flow is occuring), it is not needed to ensure design basis behavior, and it does not indicate the need for contingency actions. This justification is not acceptable.

Environmental qualification has been clarified by the Environmental Qualification Rule, 10 CFR 50.49. The licensee should therefore provide

the required justification for this deviation from Regulatory Guide 1.97 or provide instrumentation that is environmentally qualified in accordance with the provisions of 10 CFR 50.49 and Regulatory Guide 1.97.

3.3.14 Residual Heat Removal (RHR) Heat Exchanger Outlet Temperature

Revision 2 of Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable with a range of 32 to 350°F. The licensee's instrumentation meets the Category 2 recommendations except in the area of environmental qualification. The range supplied is 40 to 500°F. As Revision 3 of the regulatory guide recommends a range of 40 to 350°F, we find the provided range acceptable.

The licensee states that Category 3 instrumentation is sufficient for this variable because it does not serve a primary safety function, it is not a key variable, it is not needed to ensure design basis behavior and it does not indicate the need for contingency actions. However, this instrumentation is needed to determine quantitatively, the heat removed from containment. Therefore, this justification is not acceptable.

Environmental qualification has been clarified by the Environmental Qualification Rule, 10 CFR 50.49. The licensee should therefore provide additional justification for this deviation from Regulatory Guide 1.97 or provide instrumentation that is environmentally qualified in accordance with the provisions of 10 CFR 50.49 and Regulatory Guide 1.97.

3.3.15 Cooling Water Temperature to Engineered Safety Feature (ESF) System Components

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable with a range of 32 to 200°F. The licensee's instrumentation meets the Category 2 recommendations except in the area of environmental qualification. The range supplied is 0 to 100°F.

The licensee states that the maximum expected temperature of the cooling water system is less than the design temperature of 95°F, as the

source of cooling water for the ESF system components is the Cedar River. Based on this, the range of 0 to 100°F is acceptable.

The licensee states that Category 3 instrumentation is sufficient for this variable because it does not serve a primary safety function, it is not a key variable, it is not needed to ensure design basis behavior and it does not indicate the need for contingency actions. Additionally, it will be the temperature of the Cedar River, which will remain relatively constant during the course of an accident. This temperature can be determined by alternate methods without regard to an accident condition. Based on this, we find the use of Category 3 instrumentation for this variable acceptable.

3.3.16 Cooling Water Flow to ESF System Components

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable. The licensee's instrumentation meets the Category 2 recommendations except in the area of environmental qualification.

The licensee states that Category 3 instrumentation is sufficient for this variable because it does not serve a primary safety function, it is not a key veriable, it is not needed to ensure design basis behavior and it does not indicate the need for contingency actions. We find this justification inadequate. This instrumentation does provide a leading indication of failure of safety-related equipment.

Environmental qualification has been clarified by the Environmental Qualification Rule, 10 CFR 50.49. The licensee should therefore provide the required justification for this deviation from Regulatory Guide 1.97 or provide instrumentation that is environmentally qualified in accordance with the provisions of 10 CFR 50.49 and Regulatory Guide 1.97.

3.3.17 High Radioactivity Liquid Tank Level

The licensee's recorders for this variable are located in the radwaste control room rather than in the main control room. The licensee presented the following as justification for this deviation.

1. The radwaste system does not operate during a design basis accident at Duane Arnold.

2. The lines that could add liquid waste into this tank are automatically isolated with an accident signal.

3. There are no emergency operating procedures requiring operation of the radwaste system.

4. Monitoring this variable is not necessary to maintain offsite release rates below the technical specification limits.

Based on the licensee's justification, we find that monitoring this variable in the control room of the Duane Arnold station is not necessary.

3.3.18 Reactor Building Area Radiation

The licensee states that the instrumentation for this variable is not needed, as the noble gas effluent monitors are more useful and practical in detecting or assessing primary containment leakage. This is due to the radioactivity in the fluids flowing in the emergency core cooling systems piping, and the large number of piping and electrical penetrations and hatches between the primary containment and the reactor building. For the Mark I containment, the recommended range is 10^{-1} to 10^{4} R/h. The licensee has not shown how the recommended range is met by the noble gas effluent monitors.

We conclude that the licensee should supply additional justification for not implementing this variable.

3.3.19 Noble Gas and Vent Flow Rate--Secondary Containment, Turbine Building and Common Plant Vent

Regulatory Guide 1.97 recommends Category 2 instrumentation for these variables. The licensee's instrumentation is Category 3. The licensee states that this instrumentation is acceptable for these variables for detection and assessment of releases and long-term surveillance. They state that this instrumentation does not serve a primary safety function, that it is not a key variable, that it is not required to ensure design basis behavior and that it does not indicate the need for contingency actions. Based on the licensee's justification, we find the deviation from Category 2 to Category 3 instrumentation acceptable.

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

The licensee's sample system can obtain samples and provide the analyses within the ranges recommended for this variable from the reactor coolant and the containment air. The licensee has not shown that samples can be taken from the containment, auxiliary building and emergency core coolant system (ECCS) sumps. The licensee states that the drywell sump systems are isolated automatically by a Group 2 isolation signal to establish containment integrity. The suppression pool and the reactor coolant are sampled. The drywell sump systems overflow to the suppression pool.

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

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. Neutron flux--the licensee's present instrumentation is acceptable on an interim basis until Category 1 instrumentation is developed and installed (Section 3.3.1).

2. Radiation exposure rate--the licensee should show, by analysis, that the ranges supplied exceed the expected radiation levels at the monitor locations (Section 3.3.6).

3. Drywell atmosphere temperature--the licensee should clarify the qualifications of the supplied instrumentation; environmental qualification should be addressed in accordance with 10 CFR 50.49 (Section 3.3.10).

4. Standby liquid control system storage tank level--environmental qualification should be addressed in accordance with 10 CFR 50.49 (Section 3.3.13).

5. Residual heat removal heat exchanger outlet temperature--environmental qualification should be addressed in accordance with 10 CFR 50.49 (Section 3.3.14).

6. Cooling water flow to ESF system components--environmental qualification should be addressed in accordance with 10 CFR 50.49 (Section 3.3.16).

7. Reactor building area radiation--the licensee should supply additional justification for this exception (Section 3.3.18).

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. Iowa Electric Light and Power Company letter, R. W. McGaughy to H. R. Denton, NRC, "Regulatory Guide 1.97," July 3, 1985, NG-85-2423, File: A-370.

5. Iowa Electric Light and Power Company letter, R. W. McGaughy to H. R. Denton, NRC, "Plans and Schedules for Implementation of Plant Instrumentation Upgrades for Regulatory Guide 1.97 and Generic Letter 84-23," October 16, 1985, NG-85-4481, File A-107d, A-370.

6. 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.

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13. ABSTRACT (200 words or less)

This EG&G Idaho, Inc. report reviews the submittal for the Duane Arnold Energy Center 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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