CONFORMANCE TO REGULATORY GUIDE 1.97
CLINTON POWER STATION UNIT NO. 1

R. VanderBeek

Published October 1984

EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

Prepared for the
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
Under DOE Contract No. DE-AC07-76ID01570
FIN No. A6493

8411030022XA

ABSTRACT

This EG&G Idaho, Inc., report provides a review of the submittal for the Clinton Power Station Unit No. 1, and identifies areas of full conformance to Regulatory Guide 1.97, Revision 2. Any exception to these guidelines are evaluated and those areas where sufficient basis for acceptability is not provided are identified.

FOREWORD

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

The U.S. Nuclear Regulatory Commission funded the work under authorization B&R 20-19-40-41-3.

Docket No. 50-461

CONTENTS

CONFORMANCE TO REGULATORY GUIDE 1.97
CLINTON POWER STATION UNIT NO. 1

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 1 to NUREG-0737, "TMI Action Plan Requirements" (Reference 3).

The Illinois Power Company, applicant for the Clinton Power Station Unit No. 1, provided a response to the generic letter on September 9, 1983 (Reference 4). This report provides an evaluation of this submittal.

2. REVIEW REQUIREMENTS

Section 6.2 of NUREG-0737, Supplement 1, sets forth the documentation to be submitted in a report to the NRC describing how the applicant meets the guidance of 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.

Further, the submittal should identify deviations from the guidance in 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 matter. At these meetings, it was noted that the NRC review would only address exceptions taken to the guidance of Regulatory Guide 1.97. Further, where licensees or applicants explicitly state that instrument systems conform to the provisions of the guide it was noted that no further staff review would be necessary. Therefore, this report only addresses exceptions to the guidance of Regulatory Guide 1.97. The following evaluation is an audit of the applicant's submittal based on the review policy described in the NRC regional meetings.

3. EVALUATION

The applicant provided a response to the NRC Generic Letter 82-33 on September 9, 1983. This evaluation is based on the information provided within the applicant's submittal.

3.1 Adherence to Regulatory Guide 1.97

The applicant has committed within his submittal to the requirements of Revision 3 to Regulatory Guide 1.97 (Reference 5); has identified the post-accident monitoring instrumentation that provides indication of the guide variables; and has identified the deviations from the guidance of Regulatory Guide 1.97, Revision 3, and given the supporting justification or alternatives for these deviations.

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 applicant has classified the following instrumentation channels as Type A variables:

1. Primary containment and drywell hydrogen concentration
2. Reactor pressure vessel (RPV) pressure
3. RPV water level
4. Suppression pool bulk average water temperature
5. Suppression pool water level
6. Drywell pressure.

The above variables are included as Type B, C, D or E variables. All of the above variables are identified by the applicant as conforming to Regulatory Guide 1.97.

3.3 Exceptions to Regulatory Guide 1.97

The applicant identified the following exceptions to the requirements of Regulatory Guide 1.97, Revision 3.

3.3.1 Neutron Flux

The applicant has identified a deviation from Regulatory Guide 1.97 for the neutron flux measurement. A Category 1 classification is recommended by Regulatory Guide 1.97 for this measurement. The applicant has not provided Category 1 quality assurance or environmentally and seismically qualified instrumentation. The justification provided by the applicant for this deviation is that the Clinton neutron flux monitoring system is of a similar design to those used in most BWR's. A Category 1 system which meets all the criteria of Regulatory Guide 1.97 is an industry development item. The applicant commits to following the industry developmental activities and will upgrade or replace the existing system when a fully qualified and proven neutron flux monitoring system becomes available. The applicant has indicated that the neutron monitoring detectors are powered from a Class 1E power source, but the SRM/IRM drive mechanisms and all neutron monitoring displays are powered from station power.

Based on the applicant's commitment to upgrade or replace this instrumentation with Category 1 neutron flux instrumentation when qualified instrumentation becomes available, we find the existing instrumentation acceptable on an interim basis.

3.3.2 Reactor Pressure Vessel Water Level

Regulatory Guide 1.97 recommends Category 1 instrumentation for this variable with a range from the bottom of the core support plate to the lesser of the top of the vessel or the centerline of the main streamline. For the Clinton reactor, the range should be from 197.6 to 636.5 inches above the vessel bottom.

There are five ranges of reactor vessel water level instrumentation provided in the Clinton design. These ranges and the associated control room indication are: (1) shutdown range; one indicator; (2) upset range; one recorder (this is a dual pen recorder which also displays a narrow range channel); (3) narrow range; three indicators and one recorder (the recorder is shared with the upset range channel as noted above); (4) wide range; one indicator and two recorders; and (5) fuel zone range; one indicator and one recorder. These ranges are shown in FSAR Figure 7.7-1 and are discussed in FSAR Section 7.7.1.1.3.1.2.

The wide range level instrumentation (i.e., the indicator 1B21-R604 and recorders 1B21-R623A and 1B21-R623B, and their associated transmitters 1B21-N081A, B, and C) complies with the Category 1 requirements of Regulatory Guide 1.97. The safety related wide range instrumentation monitors reactor coolant level from approximately 360 inches to 580 inches with respect to the vessel bottom. This range covers from just above the top of the active fuel (TAF) to near the top of the steam dryer skirt. Thus, the Regulatory Guide 1.97 recommended range for reactor vessel coolant level, except for the upper 56 inches (between the top of the dryer skirt and the centerline of the main steamlines) and the lower 162 inches (between the bottom of the core support plate and the TAF) is covered by the three safety related channels of wide range level instrumentation.

The fuel zone range extends from approximately 208 inches to 408 inches with respect to the vessel bottom. Thus, there is some overlap (about 48 inches) between the wide range and the fuel zone range. The fuel zone range level instrumentation covers all but approximately the lower 10 inches of the lower portion of Regulatory Guide 1.97 recommended range. The bottom of the active fuel (BAF) is at 208.56 inches. Therefore, the Clinton water level instrumentation extends to the BAF at the lower end. The purpose for prescribing the bottom of the core support plate as the lower end of the recommended reactor coolant level range in Regulatory Guide 1.97 is to ensure that the operators are provided with a reliable indication of core coverage (and therefore capability for heat removal from the fuel). The level instrumentation at Clinton complies with the intent of Regulatory Guide 1.97 in this regard.

The two redundant channels of fuel zone range level instrumentation (indicator 1B21-R610 and recorder 1B21-R615), however, do not comply with the Category 1 requirements of Regulatory Guide 1.97. The fuel zone instrumentation is seismically qualified from a reactor coolant pressure boundary standpoint (i.e., the transmitters and sensing lines will remain intact during and following a seismic event); however, its operability (including control room indication) following a seismic event cannot be assured. In addition, both fuel zone level channels are powered from the same 120 Vac non-Class 1E power source, and are not environmentally qualified. The NRC staff has determined that the degree of seismic qualification provided for the fuel zone range instrumentation is acceptable. The basis for this is that all manual and automatic initiated safety functions occur in the range monitored by the redundant safety related wide range level instrumentation. The staff will, however, require that the redundant fuel zone range level instruments be supplied from separate power sources such that a single failure (including the failure of any higher level distribution or load center) will not cause the loss of all fuel zone range reactor coolant level indication. The staff has determined, however, that non-Class 1E power sources for the fuel zone instrumentation are acceptable. The applicant will be required to make the necessary modifications prior to initial criticality.

Subsequent to the issuance of Generic Letter 82-33, the NRC issued the environmental qualification rule, 10 CFR 50.49. The rule requires qualification of all equipment in Categories 1 and 2 of Regulatory Guide 1.97, as stated in the statement of considerations accompanying the final rule. The equipment specified must be qualified in accordance with the subsection (g) schedule. The fuel zone range reactor vessel level instrumentation at Clinton would be required to be qualified prior to operation under this schedule since their operating license is not scheduled to be issued until after March 31, 1985. It is concluded that the guidance of Regulatory Guide 1.97 has been superseded by a regulatory requirement. Any exception to the rule is beyond the scope of this review, and therefore, will not be addressed here. The equipment qualification review for Clinton is scheduled to be completed by the NRC's Equipment Qualification Branch (EQB) by the end of

1985. Therefore, with the exception of the common power supply, the staff concludes that the fuel zone range level instrumentation is acceptable.

The remaining portion of the recommended reactor coolant range to be discussed is the upper 56 inches between the upper end of the wide range level instrumentation and below the centerline of the main steamline. This portion of the range is not monitored by redundant instruments. The upset range recorder which displays level between approximately 520 inches (this is instrument zero-near the bottom of the steam dryer skirt) and 700 inches (below the vessel head flange; about 64 inches above the centerline of the main steamlines) provides the only control room level indication over this range. A shutdown range indicator also covers this range, but can only be used during cold shutdown conditions (the shutdown range channel is calibrated for 0 psig and 120°F). The upset range channel, like the fuel zone range channels, is seismically qualified from a pressure boundary standpoint, but is not environmentally qualified or powered from a Class 1E source. Environmental qualification of this instrument will also be addressed by the EQB under 10 CFR 50.49.

The upset range instrument reference leg uses the reactor vessel head vent as a penetration. In order to comply with the single failure requirement of Regulatory Guide 1.97 an additional vessel penetration would be needed for a redundant reference column for a second upset range channel. The centerline of the main steamlines is used as the upper end of the Regulatory Guide 1.97 recommended range in order to provide the operator with an indication of whether the reactor coolant has reached, and spilled into, the main steamlines. We conclude that a single upset range channel is sufficient to provide this information. As previously stated, all manual and automatic safety functions are initiated in the range covered by the safety related wide range level instrumentation. The applicant 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 upset range channel. We concur that

a second upset range instrument channel would not result in a significant increase in plant safety. Based on the above, we conclude that the single non-Class 1E upset range level instrument channel is acceptable.

In conclusion, based on our review of the reactor coolant level instrumentation at Clinton for compliance with the guidance of Regulatory Guide 1.97 this instrumentation is acceptable with the exception of the redundant fuel zone level channels which are powered from a common supply. The applicant has committed to provide separate power supplies for these instruments prior to operation.

3.3.3 Drywell Sump Level
Drywell Drain Sumps Level

Exception has been taken by the applicant to Regulatory Guide 1.97 for the Drywell Sump Level and the Drywell Drain Sumps Level measurements. The applicant's position is that the Drywell Sump Level and Drywell Drain Sumps Level instrumentation should not be implemented as Regulatory Guide 1.97 Parameters. The supporting justification is that (a) the drywell pressure and temperature along with the primary containment area radiation can be used to provide indication of leakage in the drywell, (b) these variables are qualified to Category 1 or 2, and (c) the drywell sump systems are isolated for accident conditions.

The applicant has not provided acceptable justification for not providing instrumentation for these variables. The sump level instrumentation is the primary means to determine identified and nonidentified leakage rates. Operator actions are based on the source and extent of the leakage. The applicant should provide information describing how the level of drywell and the drywell drain sumps are ascertained during and following an accident.

3.3.4 Radioactivity Concentration or Radiation Level in Circulating Primary Coolant

Exception has been taken by the applicant to Regulatory Guide 1.97 for this measurement. The applicant's position is that the Radioactivity Concentration or Radiation Level in Circulating Primary Coolant monitoring instrumentation should not be implemented as a Regulatory Guide 1.97 parameter. The applicant indicates that the Post-Accident Sampling System (PASS) provides a means of obtaining samples of reactor coolant and primary containment atmosphere and that radiation monitors in the steam jet air ejector and main steamlines provide information on the status of fuel cladding when the plant is not isolated.

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

3.3.5 Effluent Radioactivity--Noble Gases

Exception has been taken by the applicant to Regulatory Guide 1.97 for this measurement. The guide specifies that the range should be 10^{-6} µCi/cc to 10^{3} µCi/cc. The applicant has instrumentation to monitor effluent radioactivity that is qualified to Category 2 with a low range of 10^{-4} µCi/cc. The applicant states that it is not practical or feasible from the standpoint of functional need to implement Category 2 instrumentation with a lower range of 10^{-6} µCi/cc. The justification is that any indication below 10^{-4} µCi/cc is not applicable to accident scenarios. The applicant has Category 3 instrumentation which provides a lower range capability of 10^{-7} µCi/cc; therefore, the applicant concludes that the Clinton design meets the intent of Regulatory Guide 1.97 for this parameter.

It is concluded that the applicant's design meets the intent and purpose of the Regulatory Guide recommendations and is acceptable.

3.3.6 Drywell Atmosphere Temperature

Exception has been taken by the applicant to Regulatory Guide 1.97 for this measurement. The guide specifies that the range should be 40° to 440°F. The applicant's monitoring instrumentation range is 40° to 350°F. The applicant states that the implemented range exceeds the Design-Basis Accident (DBA) limit of 330°F and to extend the upward bound would introduce greater departures from linearity.

Since the applicant's implemented design range exceeds the DBA limit, this deviation from Regulatory Guide 1.97 is acceptable and meets the intent of the guide.

3.3.7 Main Steamline Isolation Valves Leakage Control System Pressure

Exception has been taken by the applicant to Regulatory Guide 1.97 for this measurement. The guide specifies that the range should be 0 to 15 in. of water (narrow range) and 0 to 5 psid (wide range). The applicant's design monitors both the inboard and outboard system pressures and the instrumentation's ranges are 0 to 90 in. of water. The applicant states that system differential pressure can be ascertained from the existing instrumentation. Therefore, the applicant concludes that the Clinton design meets the intent of Regulatory Guide 1.97 for this parameter.

It is concluded that the applicant's design is adequate to meet the intent and purpose of the Regulatory Guide recommended instrumentation and is acceptable.

3.3.8 Standby Liquid Control System (SLCS) Flow

Exception has been taken by the applicant to Regulatory Guide 1.97 for the SLCS Flow measurement. The applicant states that the SLCS Flow can be adequately monitored by (a) the decrease in the level of the boric acid

storage tank, (b) the reactivity change in the reactor as measured by neutron flux and concentration of boron, (c) the SLC pump motor contactor indicating lights (or motor current) or (d) the squib valve continuity indicating lights.

Based on the above justification, we find that the applicant's design meets the intent of Regulatory Guide 1.97 for this measurement.

3.3.9 Standby Liquid Control System (SLCS) Storage Tank Level

Exception has been taken by the applicant to Regulatory Guide 1.97 for the SLCS storage tank level measurement. A Category 3 classification has been assigned to this variable instead of the recommended Category 2. The applicant provides the justification that the SLCS instrumentation will be operating in a mild environment.

The applicant conforms to all the criteria (power supply, range, etc.) identified under Category 2 instrumentation, except for equipment qualification, and the SLCS tank level instrumentation is in a mild environment, therefore, this justification is acceptable.

3.3.10 Cooling Water Flow to ESF System Components

Exception has been taken by the applicant to Regulatory Guide 1.97 for this measurement. The guide specifies that the range should be 0 to 110 percent design flow and the purpose is to monitor operation. The applicant states that, for Division 1 and Division 2 cooling water, Clinton will utilize the flow transmitters on the shutdown service water supply to the Division 1 and Division 2 RHR heat exchangers, in conjunction with proper valve alignment, as indication of flow to the Division 1 and Division 2 ESF system components. For Division 3, Clinton will utilize shutdown service water pump discharge pressure, in conjunction with the shutdown service water

pump performance curves and proper valve alignment, as indication of flow to the Division 3 ESF system components. The applicant concludes that the Clinton design meets the intent of Regulatory Guide 1.97 for this measurement. We find the instrumentation provided by the applicant for this variable acceptable.

3.3.11 Radiation Exposure Meters

Exception has been taken by the applicant to Regulatory Guide 1.97 for the radiation exposure meter Type E measurement. The applicant's position is that Regulatory Guide 1.97 (in a footnote) states "it is unlikely that a few fixed-station area monitors could provide sufficiently reliable information to be of use in detecting releases from unmonitored containment release points ... the decision to install such a system is left to the licensee."

The applicant therefore has chosen not to implement the measurement. Based on the applicant's full implementation of the Area Radiation Exposure Rate measurement which functions in the detection of significant releases and the containment area radiation measurement which provides an identical means of measurement, the applicant's decision to not implement fixed Radiation Exposure meters for detecting releases from unmonitored containment release points is acceptable. Further, we note that the variable radiation exposure meters have been removed from Revision 3 of Regulatory Guide 1.97.

3.3.12 Drywell Pressure

Regulatory Guide 1.97 recommends instrumentation for this variable with a range of -5 to 3 psig and 0 to 110 percent of design pressure. The applicant, in providing information on the range of this variable, has done so in a way that a deviation could be thought to exist. The range provided by the instrumentation, 10 to 50 psia, is inclusive of both specified ranges. Thus, this instrumentation is acceptable.

3.3.13 Primary Containment Isolation Valve Position

The applicant states that "with the exception of some check, pressure relief and test valves, all containment isolation valves have position indication." Check valves are specifically excluded from this variable by the regulatory guide. The test valves are under administrative control, and their position is known. The effect of the pressure relief valves can be observed on drywell and containment pressure instruments; these are Category 1. Therefore, we find that the instrumentation supplied for this variable is acceptable.

3.3.14 Status of Standby Power

The instrumentation for this variable meets the requirements of Regulatory Guide 1.97 except for the DC Division 3 bus current. This division is monitored locally, with control room alarms.

Reference 3 makes allowance for the monitoring of variables in other than a control room location. We find that this instrumentation is acceptable.

4. CONCLUSIONS

Except for those deviations identified in the applicant's submittal, the applicant has committed conformance to Regulatory Guide 1.97. Review of the identified deviations to the regulatory guide has resulted in the following conclusions.

1. Drywell sump level--the applicant should provide information describing how the level of the drywell sump is ascertained during and following an accident (Section 3.3.3).

2. Drywell drain sumps level--the applicant should provide information describing how the level of the drywell drain sumps are ascertained during and following an accident (Section 3.3.3).

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. Illinois Power Company Letter to NRC, P. M. Nelson to A. Schwencer, Chief, Division of Licensing, "Clinton Power Station, Unit 1--Compliance Report--Regulatory Guide 1.97," September 9, 1983.

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

38254