CONFORMANCE TO REGULATORY GUIDE 1.97
PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT NOS. 1 AND 2

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ABSTRACT

This EG&G Idaho, Inc., report provides a review of the Prairie Island Nuclear Generating Plant, Unit Nos. 1 and 2, submittals for Regulatory Guide 1.97, and identifies areas of nonconformance. Any exception to the guidelines is 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.

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CONTENTS

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

Northern States Power Company, the licensee for the Prairie Island Nuclear Generating Plant, provided a response to the generic letter on April 15, 1983 (Reference 4). On September 15, 1983, the response (Reference 5) to the Regulatory Guide 1.97 portion of Generic Letter No. 82-33 (Section 6.2) was provided. Additional information was provided on January 18, 1985 (Reference 6) and on June 6, 1985 (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 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 the NRC Generic Letter 82-33 on April 15, 1983. An additional submittal of September 15, 1983, described the licensee's position on post-accident monitoring instrumentation. Additional information was provided on January 18, 1985 and on June 6, 1985. This evaluation is based on these submittals.

3.1 Adherence to Regulatory Guide 1.97

Reference 5 states that "the schedule for completing implementation of all the Regulatory Guide 1.97 requirements was agreed to in a June 24, 1983 meeting." Therefore, it is concluded that the licensee has provided an explicit commitment of conformance to Regulatory Guide 1.97, except as 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 pressure

2. Refueling water storage tank level.

This instrumentation meets the Category 1 recommendations consistent with the requirements for Type A variables.

3.3 Exceptions to Regulatory Guide 1.97

The licensee identified the following exceptions to the requirements of Regulatory Guide 1.97.

3.3.1 Incomplete Qualification of Category 2 Instrumentation

The following lists Category 2 variables for which the licensee does not have environmentally qualified instrumentation.

- Containment effluent radioactivity--noble gases from identified release points
- Effluent radioactivity--noble gas effluent from condenser air ejector exhaust
- Containment effluent radioactivity--noble gases from identified release points
- Effluent radioactivity--noble gases (inside buildings or areas where penetrations and hatches are located)
- Residual heat removal system flow
- Residual heat removal heat exchanger outlet temperature
- Accumulator isolation valve position (sensor)
- Accumulator isolation valve position (status lights)
- Boric acid charging flow
- Primary system safety relief valve position
- Pressurizer heater status
- Safety/relief valve status
- Auxiliary feedwater flow
- Heat removal by the containment fan heat removal system

- Containment atmosphere temperature
- Makeup flow-in
- Letdown flow-out
- Volume control tank level
- Component cooling water temperature to engineered safety feature system components
- Component cooling water flow to engineered safety feature system
- Emergency ventilation damper position
- Status of standby power and other energy sources important to safety
- Air header pressure
- Reactor shield building annulus--noble gases and vent flow rate
- Condenser air removal system exhaust--noble gases and vent flow rate
- Vent from steam generator safety relief valves--noble gases and vent flow rate, duration and mass of steam

Environmental qualification has been clarified by the Environmental Qualification Rule, 10 CFR 50.49. The licensee states, in Reference 6, that the environmental qualification of this post-accident monitoring instrumentation will be addressed as part of the 10 CFR 50.49 review program. We find this commitment acceptable.

3.3.2 Reactor Coolant System Soluble Boron Concentration

Regulatory Guide 1.97 recommends instrumentation for this variable with a range from 0 to 6000 parts per million. The licensee has provided instrumentation for this variable with a range from 0 to 3000 parts per million. The licensee's justification for this deviation from the recommended range is that the supplied range is considered adequate, and that the normal cold shutdown concentration is 2000 parts per million.

The licensee also indicates that the sample is taken from the letdown line, which is isolated on certain containment isolations. When this continuous monitor is not available, the post-accident sampling system provides the needed information.

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 their review of NUREG-0737, Item II.B.3.

3.3.3 Reactor Coolant System Cold Leg Water Temperature
Reactor Coolant System Hot Leg Water Temperature

Regulatory Guide 1.97, Revision 2, specifies a range of 50 to 750°F for these variables. The instrumentation provided for these variables has a range from 50 to 700°F. Since Revision 3 of Regulatory Guide 1.97 (Reference 8) lists the range as 50 to 700°F for these variables, we find that this is acceptable.

3.3.4 Radiation Level in Circulating Primary Coolant

Regulatory Guide 1.97 recommends instrumentation for this variable for the detection of a breach. The licensee has provided radiation monitoring on the letdown line. The letdown line, however, is isolated during an accident. The licensee also has a post-accident sampling system which provides the capability to determine primary coolant activity.

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 Effluent Radioactivity--Noble Gas Effluent from Condenser Air Ejector Exhaust

Regulatory Guide 1.97 recommends a range of 10^{-6} to 10^{+5} μCi/cc for this variable. The licensee has provided instrumentation with a range of 10^{-4} to 10^{+2} μCi/cc for this variable. The licensee notes that the air ejector exhaust is routed to the shield building exhaust, which is monitored by instrumentation that includes the recommended range. Based on this, and since the regulatory guide does not require this variable when the effluent is discharged through a common plant vent, we find that this instrumentation is acceptable.

3.3.6 Containment Hydrogen Concentration

Regulatory Guide 1.97 recommends instrumentation for this variable with a range of 0 to 10 percent, and capable of operating from 10 psia to maximum design pressure. The licensee has instrumentation for this variable that meets the range requirements. The deviation identified by the licensee is that the sensor has not been tested from 10 psia to normal atmospheric pressure. It has been environmentally qualified to the requirements of 10 CFR 50.49. The licensee is performing qualification testing, as outlined in Reference 6, to show that the sensors are capable of operating at subatmospheric pressures (10 psia).

3.3.7 Containment Effluent Radioactivity-Noble Gases from Identified Release Points

Regulatory Guide 1.97 recommends instrumentation for this variable with a range from 10^{-6} to 10^{-2} μCi/cc. The licensee's instrumentation for this variable has a range from 10^{-4} to 10^{+4} μCi/cc. They state, in

Reference 6, that this instrumentation refers to the shield building vents, which are the only accident release point for either unit.

The licensee states that the instrumentation will respond to 1×10^{-5} uCi/cc, and that releases of less magnitude than this are below technical specification limits with no significant release taking place. Releases related to an accident would be above this level. The licensee also notes that grab samples are taken routinely, and this is the alternate method of obtaining information for this variable. The minimum sensitivity for the grab sample is 1×10^{-8} uCi/cc.

Based on the licensee's justification, we find that the range supplied is adequate.

3.3.8 Radiation Exposure Rate

Regulatory Guide 1.97 recommends instrumentation for this variable with a range of 10^{-1} to 10^{4} R/hr. The licensee did not provide information on the instrumentation for this variable in Reference 5. The licensee notes, in Reference 6, that a study of post-accident plant radiation levels has been completed, and as a result, approximately 30 instruments covering the recommended range of 10^{-1} to 10^{4} R/hr would be installed. We find this committment satisfactory.

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

Regulatory Guide 1.97 recommends instrumentation for this variable with a range of 10^{-6} to 10^{3} uCi/cc. The licensee has provided instrumentation for this variable with a range of 10^{-4} to 10^{4} uCi/cc. The licensee states, in Reference 6, that this instrumentation refers to the shield building vents, which are the only accident release points for either unit.

The licensee states that the instrumentation will respond to 1×10^{-5} uCi/cc, and that releases of less magnitude than this are below technical specification limits with no significant release in taking place. Releases related to an accident would be above this level. The licensee also notes that grab samples are taken routinely, and this is the alternate method of obtaining information for this variable. The minimum sensitivity for the grab sample is 1×10^{-8} uCi/cc.

Based on the licensee's justification, we find that the range supplied is adequate.

3.3.10 Residual Heat Removal Heat Exchanger Outlet Temperature

Revision 2 of Regulatory Guide 1.97 recommends instrumentation for this variable with a range of 32 to 350°F to monitor system operation. Revision 3 of Regulatory Guide 1.97 raised the lower limit of the range from 32°F to 40°F. The licensee has provided instrumentation for this variable with a range of 100 to 400°F.

The Prairie Island Operation Manual (Reference 9), Section B15-1.3.2 and 6 states that the design outlet temperature is 133.5°F. This temperature is maintained by a control room operated flow control valve that bypasses a portion of the reactor coolant around the heat exchanger. Thus, the outlet temperature will be above the minimum range of the instrumentation and the indication will remain on scale. Therefore, we find that this deviation from the recommended range is acceptable.

3.3.11 Accumulator Tank Level and Pressure

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable with a range of 10 to 90 percent volume. The licensee has provided pressure instrumentation that meets the recommendations of the regulatory guide and Category 3 level instrumentation that indicates 0 to 100 percent. However, 0 percent is equal to 1235.25 cubic feet of the accumulator volume of 2000 cubic feet. The 100 percent indication

corresponds to 1295 cubic feet. The licensee states that this information is used to verify that the water volume required by technical specifications is maintained before an accident. Proper operation of the accumulator during an accident is observed by the operator by observing the accumulator tank pressure decrease with the reactor coolant system pressure and by verifying the level instrumentation is off scale.

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

3.3.12 Reactor Coolant Pump Status

Regulatory Guide 1.97 recommends monitoring the motor current for this variable. The licensee has provided both motor circuit breaker status and kilowatt usage (0 to 6000 kw). The power used by a reactor coolant pump is a direct relation to the pump current. Therefore, we find that measuring the reactor coolant pump power rather than current is acceptable.

3.3.13 Pressurizer Level

Regulatory Guide 1.97 recommends instrumentation for this variable with a range covering from the top to the bottom of the vessel. The instrumentation provided for this variable does not indicate the volume in the hemispherical ends of the vessel. The level indication is provided for the cylindrical portion of the pressurizer. We find that this deviation is acceptable.

3.3.14 Pressurizer Heater Status

Regulatory Guide 1.97 recommends Category 2 instrumentation to monitor the heater current to determine the operating status of the pressurizer heaters. The licensee has supplied commercial grade ON/OFF indication for each of five heater banks. The licensee, in Reference 7, also commits to install instrumentation to monitor the power used by the pressurizer heater

banks that are supplied power by essential power. This power indication is a direct relation to the current drawn by these heaters, and will assist the operator in maintaining the load on the diesel generators within the diesel generator rating.

Based on our review and judgement, we find this deviation of measuring heater input power rather than current acceptable, because the heater power has a known relation to the heater current.

3.3.15 Quench Tank Temperature

Regulatory Guide 1.97 recommends instrumentation for this variable with a range of 50 to 750°F. The licensee is providing instrumentation for the variable with a range of 0 to 350°F (Reference 7). The licensee justifies this deviation by noting that the range is consistent with the maximum containment temperature, as the pressurizer relief tank has a rupture disc that relieves to the containment atmosphere.

Section B4-1.3.5 of Reference 9 states that the pressurizer relief tank has a full capacity rupture disc that relieves pressure at 85 psig. Saturated steam at this pressure has a temperature of 328°F. Thus, under accident conditions, this instrumentation will not go off-scale.

The range covers the anticipated requirements for normal operation, anticipated operational occurrences and accident conditions. This range relates to the tank rupture disc relief pressure of 85 psig that limits the temperature of the tank contents to saturated steam conditions under 350°F. Thus, we find that this deviation from the regulatory guide is acceptable.

3.3.16 Steam Generator Level

Regulatory Guide 1.97 recommends Category 1 instrumentation for this variable. As such, redundant instrumentation channels are required. The licensee has provided one channel of Category 1 instrumentation for each

steam generator, and a second channel that is Category 1 except in the area of environmental qualification.

The licensee states in Reference 7, that the non-qualified instrumentation will be replaced with fully qualified instrumentation. We find this committment acceptable.

3.3.17 Auxiliary Feedwater Flow

Regulatory Guide 1.97 recommends instrumentation for this variable with a range of 0 to 110 percent of design flow. The licensee identified, in Reference 5, instrumentation to monitor the auxiliary feedwater flow with a range from 0 to 200 gpm. Each auxiliary feedwater pump has a rated flow of 200 gpm. In Reference 6, the licensee states that the instrumentation will be reranged to 0 to 250 gpm. We find this committment to meet the regulatory guide recommendation acceptable.

3.3.18 Condensate Storage Tank Water Level

Regulatory Guide 1.97 recommends redundant, seismically qualified instrumentation for this variable. The licensee is proposing an additional channel for each of the two tanks, so that each control room can monitor the level in either unit's tank. Therefore, sufficient redundancy is inherent in the licensee's proposal. The existing channels are not seismically qualified. The licensee states, in Reference 6, that both the existing and the new instrumentation will be seismically qualified. We find this acceptable.

3.3.19 Containment Spray Flow

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable with a range of 0 to 110 percent of design flow to monitor the operation of the containment spray system. The licensee does not have flow monitoring instrumentation for this variable.

The licensee utilitizes the following alternate instrumentation in the control room to monitor the operation of the containment spray system.

- o Refueling water storage tank level
- o Caustic additive standpipe level
- o Containment spray pump on/off status
- o Containment spray system valve position
- o Residual heat removal (RHR) heat exchanger inlet temperature
- o RHR heat exchanger outlet temperature

The alternate instrumentation provided by the licensee is adequate to monitor this variable. Therefore, we find this deviation acceptable.

3.3.20 Containment Sump Water Temperature

Regulatory Guide 1.97 recommends instrumentation for this variable with a range of 50 to 250°F to monitor operation of this containment cooling system. The licensee does not have instrumentation for this variable. Their justification for this deviation is that this function is provided by the residual heat removal temperatures.

The Prairie Island station has temperature indication for residual heat removal (RHR) heat exchanger outlet. Temperature indication for the RHR heat exchanger inlet is being added.

The RHR heat exchanger inlet temperature will be the same as the sump temperature when the sump is the water source for the RHR system. We find this alternative instrumentation acceptable.

3.3.21 High Level Radioactive Liquid Tank Level

Regulatory Guide 1.97 recommends monitoring this variable in the control room; the licensee does not monitor this variable in the control room. As justification for this deviation, the licensee states that waste processing is done locally. Section 6.2(g) of NUREG-0737 Supplement No. 1 makes allowance for displays in locations other than control room control panels. Therefore, we find this deviation acceptable.

3.3.22 Radioactive Gas Holdup Tank Pressure

Regulatory Guide 1.97 recommends monitoring this variable with Category 3 instrumentation with a range of 0 to 150 percent of design pressure to indicate storage capacity. The licensee indicates that the waste gas holdup tanks are controlled locally in the auxiliary building, which is accessible following an accident. The range is 0 to 150 psig (the design pressure of the tanks). Section 6.2(g) of NUREG-0737, Supplement No. 1, makes allowance for displays in locations other than control room control panels. We find the local instrumentation acceptable. The waste gas compressors cannot pressurize the radioactive gas holdup tanks beyond 100 psig. Therefore, we find the range of 0 to 150 psig acceptable.

3.3.23 Reactor Shield Building Annulus--Noble Gas Radiation Level and Flow Rate

Regulatory Guide 1.97 recommends instrumentation for this variable with a range of 10^{-6} to 10^{4} uCi/cc. The licensee has instrumentation for this variable with a range of 10^{-4} to 10^{4} uCi/cc. The licensee indicates that this vent is the common release point for each unit.

The licensee states that the instrumentation will respond to 1×10^{-5} uCi/cc, and that releases of less magnitude than this are below technical specification limits with no significant release taking place. Releases related to an accident would be above this level. The

licensee also notes that grab samples are taken routinely, and this is the alternate method of obtaining information for this variable. The minimum sensitivity for the grab samples is 1×10^{-8} uCi/cc.

Based on the licensee's justification, we find that the range supplied is adequate.

3.3.24 Radiation Exposure Meters

Revision 2 of Regulatory Guide 1.97 recommends instrumentation for this variable. The licensee has not provided instrumentation for this variable, citing Revision 3 of the regulatory guide. Revision 3 of Regulatory Guide 1.97 (Reference 6) does not recommend this variable. Therefore, the licensee deviation from Revision 2 for this variable is acceptable.

3.3.25 Plant and Environs Radiation

Regulatory Guide 1.97 recommends portable instrumentation for this variable. The licensee has provided instrumentation for this variable that meets the recommendations of the regulatory guide, except the instrumentation for beta particles has a range identified in Reference 5 that goes up to 50 rads/hr, whereas the regulatory guide recommends a range of up to 10^4 rads/hr.

Reference 6 states that an additional portable instrument is onsite that has an upper range limit of 1.99×10^4 R/hr beta. This meets the regulatory guide recommendations.

4. CONCLUSIONS

Based on our review, we find that the licensee either conforms to or is justified in deviating from the guidance of 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, 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. Northern States Power Company letter, D. Musolf to Director, Office of Nuclear Reactor Regulation, NRC, "Supplement 1 to NUREG-0737-Response to Generic Letter 82-33," April 15, 1983.

5. Northern States Power Company letter, D. Musolf to Director, Office of Nuclear Reactor Regulation, NRC, "NUREG-0737 Supplement 1-Generic Letter 82-33, Regulatory Guide 1.97-Application to Emergency Response Facilities," September 15, 1983.

6. Northern States Power Company letter, D. Musolf to Director, Office of Nuclear Reactor Regulation, NRC, "Additional Information Related to Conformance with Regulatory Guide 1.97, Revision 2," January 18, 1985.

7. Northern States Power Company letter, D. Musolf to Director, Office of Nuclear Reactor Regulation, NRC, "Additional Information Related to Conformance with Regulatory Guide 1.97, Revision 2," June 6, 1985.

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. Prairie Island Operations Manual, Prairie Island Training Center, Northern States Power Company.

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