

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

A. C. Udy

Published November 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. A6483

8411280477 XA

## 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 exceptions to the 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 20-19-10-11-3.

Docket Nos. 50-282 and 50-306  
TAC Nos. 51122 and 51123

## CONTENTS

ABSTRACT . . . . .	ii
FOREWORD . . . . .	ii
1. INTRODUCTION . . . . .	1
2. REVIEW REQUIREMENTS . . . . .	2
3. EVALUATION . . . . .	4
3.1 Adherence to Regulatory Guide 1.97 . . . . .	4
3.2 Type A Variables . . . . .	4
3.3 Exceptions to Regulatory Guide 1.97 . . . . .	4
4. CONCLUSIONS . . . . .	16
5. REFERENCES . . . . .	18

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

1. INTRODUCTION

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.

This report provides an evaluation of these submittals.

## 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 licensee 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 of 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 regulatory 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 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. 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 in conformance to the guidance of Regulatory Guide 1.97, except as noted in Section 3.3.

#### 3.2 Type A Variables

In that 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 classified the following instrumentation channels as Type A variables.

1. Reactor coolant system pressure
2. Refueling water storage tank level.

These variables are also included as Type B, C and D variables and meet Category 1 requirements 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 tank level
- 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 ESF System
- Component cooling water flow to ESF 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, subsequent to the issuance of Regulatory Guide 1.97, by the environmental qualification rule, 10 CFR 50.49. It is concluded that the guidance of the regulatory guide has been superseded by a regulatory requirement. Any exception to this rule is beyond the scope of this review and should be addressed in accordance with 10 CFR 50.49.

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

### 3.3.3 Reactor Coolant System Cold and 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 6) 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. We find that this

instrumentation is adequate to monitor the post-accident reactor coolant activity and therefore, this is 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  $10^{+5}$   $\mu\text{Ci/cc}$  for this variable. The licensee has provided instrumentation with a range of  $10^{-4}$  to  $10^{+2}$   $\mu\text{Ci/cc}$  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 should 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  $10^{-2}$   $\mu\text{Ci/cc}$ . The licensee has provided instrumentation for this variable with a range from  $10^{-4}$  to  $10^{+4}$   $\mu\text{Ci/cc}$ .

The licensee has not provided justification for the deviation from the recommended range. The licensee should provide the justification for this deviation.

### 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 has not provided instrumentation for this variable. The licensee notes that a study, expected to have been complete by July 1, 1984, would determine the location and range requirements.

The information provided by the licensee for this variable is incomplete. The licensee should either commit to install instrumentation for this variable that meets Regulatory Guide 1.97 recommendations or provide a justification for not doing so.

### 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  $10^3$   $\mu\text{Ci/cc}$ . The licensee has provided instrumentation for this variable with a range of  $10^{-4}$  to  $10^4$   $\mu\text{Ci/cc}$ . The licensee justifies this deviation based on existing technical specification requirements.

The licensee should show why the two lower decades ( $10^{-6}$  to  $10^{-4}$   $\mu\text{Ci/cc}$ ) of range are not needed for the detection of breach, and submit this as part of their justification.

### 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 7), 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

Regulatory Guide 1.97 recommends instrumentation for this variable with a range of 10 to 90 percent volume. The licensee has provided instrumentation for this variable that indicates 0 to 100 percent. However, 0 percent is equal to 58 percent of the accumulator volume. The licensee did not state what 100 percent indication corresponds to in percent of volume.

The licensee should relate the instrument range to the tank volume, and show that the range is adequate to indicate to the operators that the accumulators have performed their safety function.

### 3.3.12 Reactor Coolant <sup>P</sup>~~S~~ump 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 has not provided justification for this deviation.

The current to the pressurizer heaters is recommended by Regulatory Guide 1.97, Table 2, for the purpose of determining the operating status of the heaters. It is not enough to monitor the circuit breaker position to know how much energy is being used and to determine if there are inoperable heaters. The licensee should provide Category 2 instrumentation to monitor the current to the pressurizer heaters.

#### 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 has provided instrumentation for the variable with a range of 0 to 300°F. 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 7 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, there is a potential, under accident conditions, for this instrumentation to go off-scale.

The licensee should provide additional justification to show that the 300°F range limit provides adequate information to the operator during and following an accident.

### 3.3.16 Steam Generator Level

Regulatory Guide 1.97 recommends redundant instrumentation for this variable. The licensee has provided only one channel of instrumentation for each steam generator.

The licensee offered no justification for this deviation. The licensee should provide redundant Category 1 steam generator level channels with a range identical to the existing channels.

### 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 has provided 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. Thus, the licensee is deviating from the recommended range of 0 to 110 percent of design flow by supplying a range of 0 to 100 percent of design flow.

The licensee has not provided justification for this deviation. The licensee should either re-range this instrumentation or provide justification for this deviation.

### 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 should clarify his position on seismic qualification for this instrumentation (both the existing and the new instrumentation), providing satisfactory justification if seismic qualification is not being applied.

### 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 justification for this deviation given by the licensee is that the containment parameters are considered adequate indications of spray effectiveness.

The Prairie Island station also utilizes a containment fan heat removal system. Its operation would also affect the containment temperature and pressure. Therefore, containment parameters alone will not monitor the operation of the containment spray. The licensee should install the recommended instrumentation.

### 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) inlet and outlet. We have not been able to determine the range of the inlet temperature instruments, as they may not be the same as the residual heat removal heat exchanger outlet temperature discussed in Section 3.3.10. The RHR 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, however the licensee should show that the RHR instrumentation Category and range is 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 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 licensee has not indicated the range of the local instrumentation. Therefore, we cannot evaluate the acceptability of the existing instrumentation. The licensee should verify that the range recommended by Regulatory Guide 1.97 is supplied by the existing instrumentation.

### 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  $10^4$   $\mu\text{Ci}/\text{cc}$ . The licensee has instrumentation for this variable with a range of  $10^{-1}$  to  $10^7$   $\mu\text{Ci}/\text{cc}$ . No justification was presented for this deviation; however, the licensee indicates that this is a vent that is common to the following Regulatory Guide 1.97 variables of noble gas and vent flow rate:

- Containment or purge effluent
- Reactor shield building annulus
- Auxiliary building
- Common plant vent
- All other identified release points.

Thus, it is a multipurpose vent. However, the range recommendation is the same. The licensee should provide satisfactory justification for having a minimum range of  $10^{-1}$   $\mu\text{Ci/cc}$  instead of the recommended  $10^{-6}$   $\mu\text{Ci/cc}$ .

#### 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 of up to 50 rads/hr, whereas the regulatory guide recommends a range of up to  $10^4$  rads/hr.

The licensee has not provided justification for this deviation. The licensee should provide satisfactory justification for this deviation.

#### 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 with the following exceptions:

1. For those variables listed in Section 3.3.1--environmental qualification should be addressed in accordance with 10 CFR 50.49.
2. Containment hydrogen concentration--the licensee should show that the sensors are capable of operating at subatmospheric pressures (Section 3.3.6).
3. Containment effluent radioactivity--noble gases from identified release points--the licensee should provide justification for the deviation in the range supplied (Section 3.3.7).
4. Radiation exposure rate--the licensee should either commit to install instrumentation for this variable that meets Regulatory Guide 1.97 recommendations or provide acceptable justification for not doing so (Section 3.3.8).
5. Effluent radioactivity--noble gases inside buildings or areas where penetrations or hatches are located--the licensee should show that the two decades of range from  $10^{-6}$  to  $10^{-4}$   $\mu\text{Ci/cc}$  are not needed for the detection of breach (Section 3.3.9).
6. Accumulator tank level--the licensee should supply additional justification for the deviation for this variable (Section 3.3.11).
7. Pressurizer heater status--the licensee should install Category 2 instrumentation to monitor the heater status (Section 3.3.14).
8. Quench tank temperature--the licensee should provide additional justification for the 0 to 300°F range (Section 3.3.15).

9. Steam generator level--the licensee should provide redundant channels of instrumentation for each steam generator (Section 3.3.16).
10. Auxiliary feedwater flow--the licensee should either re-range this instrumentation or provide justification for the deviation from the recommended range (Section 3.3.17).
11. Condensate storage tank level--the licensee should clarify the seismic qualification applied to this instrumentation, and justify any portion not qualified (Section 3.3.18).
12. Containment spray flow--the licensee should install the recommended instrumentation for this variable (Section 3.3.19).
13. Containment sump water temperature--the licensee should provide the range and category of the alternate instrumentation used for this variable (Section 3.3.20).
14. Radioactive gas holdup tank pressure--the licensee should verify that the existing local instruments have a range of 0 to 150 percent of design pressure (Section 3.3.22).
15. Reactor shield building annulus--noble gas level and vent flow rate--the licensee should provide satisfactory justification for the range deviation (Section 3.3.23).
16. Plant and environs radiation--the licensee should provide satisfactory justification for their deviation from the maximum recommended range for Beta particles (Section 3.3.25).

## 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. 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.
7. Prairie Island Operations Manual, Prairie Island Training Center, Northern States Power Company.
8. Northern States Power Company letter, D. Musolf to Director, Office of Nuclear Reactor Regulation, NRC, "Information Related to NUREG-0737, Item II. B.3, Post Accident Sampling System," December 3, 1982.