# CONFORMANCE TO REGULATORY GUIDE 1.97
# MILLSTONE NUCLEAR POWER STATION, UNIT NO. 2

A. C. Udy

Published February 1985

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

## ABSTRACT

This EG&G Idaho, Inc., report provides a review of the submittals for Regulatory Guide 1.97, Revision 2, for Unit No. 2 of the Millstone Nuclear Power Station. Any exception to the guidelines of Regulatory Guide 1.97 are evaluated and those areas where sufficient basis for acceptability is not provided are also 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.


Pocket No. 50-336
TAC No. 51107

CONTENTS

# CONFORMANCE TO REGULATORY GUIDE 1.97
# MILLSTONE NUCLEAR POWER STATION, UNIT NO. 2

## 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).

Northeast Utilities, the licensee for the Millstone Nuclear Power Station, provided a response to the generic letter on April 15, 1983 (Reference 4). The response to Section 6.2 of the generic letter was submitted on February 29, 1984 (Reference 5), and revised on April 9, 1984 (Reference 6).

This report provides an evaluation of this material.

## 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.

Furthermore, 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. Furthermore, 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 licensee's submittals based on the review policy described in the NRC regional meetings.

## 3. EVALUATION

The licensee provided a response to Item 6.2 of the NRC generic letter 82-33 on February 29, 1984. This was revised on April 9, 1984. The response describes the licensee's position on post-accident monitoring instrumentation. This evaluation is based on this material.

### 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 licensee states that in several instances, satisfactory instrumentation already exists and that additional instrumentation will be installed to comply with the provisions of Regulatory Guide 1.97, except for those instances where deviations are justified.

Therefore, it is concluded that the licensee has provided an explicit commitment on conformance to the guidance of Regulatory Guide 1.97, except for those deviations that were justified by the licensee 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. Pressurizer level

2. Pressurizer pressure

3. Reactor coolant system (RCS) hot leg water temperature

4. RCS cold leg water temperature

5. Steam generator pressure

6. Steam generator level

7. Auxiliary feedwater flow

8. Containment pressure

9. Degrees of subcooling

10. Containment hydrogen concentration

11. Containment radiation.

All of the above instrumentation meets the Category 1 requirements consistent with the requirements for Type A variables, with the exceptions as listed in Section 3.3.

## 3.3 Exceptions to Regulatory Guide 1.97

The licensee identified the following deviations from the recommendations of Regulatory Guide 1.97.

### 3.3.1 Environmental Qualification

The following Category 2 variables do not have environmentally qualified instrumentation, and no upgrading has been proposed.

- Containment sump water level--narrow range
- Residual heat removal (RHR) system flow
- RHR heat exchanger outlet temperature
- Accumulator tank pressure

- Flow in high pressure injection system
- Flow in low pressure injection system
- Containment spray flow
- 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
- Status of standby power

Environmental qualification has been clarified since Revision 2 of Regulatory Guide 1.97 was issued. The clarification is in the environmental qualification rule, 10 CFR 50.49. It is concluded that the guidance of Regulatory Guide 1.97 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 (RCS) Soluble Boron Concentration

The range of the instrumentation supplied by the licensee for this variable is 0 to 2050 parts per million. The range recommended in the regulatory guide is 0 to 6000 parts per million. The licensee's justification for this deviation from the recommended range is that the boron concentration is not expected to exceed the technical specification limit of 1720 parts per

million, and that if a higher range is needed, the post-accident sampling system can be used.

The licensee takes exception to the guidance of Regulatory Guide 1.97 with respect to post-accident sampling capability. This exception 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 RCS Cold Leg Water Temperature

Regulatory Guide 1.97 recommends redundant instrumentation for this variable with a range from 50 to 750°F. The licensee has supplied one wide range channel for each cold leg, with a range from 0 to 600°F.

The licensee identifies one wide range temperature instrument in each of the hot legs and cold legs. Millstone Unit 2 is a two loop unit. Thus, there is redundancy in that the coolant temperature delivered to the core and leaving the reactor is measured by independent instruments. However, the licensee should verify that each channel of instrumentation, including power supplies, is independent and redundant.

The licensee states that the range of 0 to 600°F is adequate to monitor cold leg fluid temperature following all design basis accident scenarios. This is based on the safety analysis of the plant. Based on this statement, we find the existing range acceptable.

3.3.4 RCS Hot Leg Water Temperature

Regulatory Guide 1.97 recommends redundant instrumentation for this variable with a range from 50 to 750°F. The licensee has supplied one wide range channel for each hot leg, with a range from 150 to 750°F.

The licensee identifies one wide range temperature instrument in each of the hot legs and cold legs. Millstone Unit 2 is a two loop unit. Thus there is redundancy in that the coolant temperature delivered to the core and

leaving the reactor is measured by independent instruments. However, the licensee should verify that each channel of instrumentation, including power supplies, is independent and redundant.

The licensee states that 212°F is the saturation temperature at atmospheric pressure, and therefore the 150°F lower range provides sufficient margin to monitor the approach to saturation in a cold shutdown situation in the event of a loss of shutdown cooling. In addition, the RCS cold leg water temperature and the residual heat removal (RHR) heat exchanger outlet temperature are measured down to 0°F. Therefore, this deviation in the lower limit of the range for this variable is acceptable.

3.3.6 RCS Pressure

Regulatory Guide 1.97 recommends redundant Category 1 instrumentation with a range from 0 to 4000 psig for this Combustion Engineering unit. The licensee has supplied instrumentation for this unit as follows:

- Redundant 0 to 1600 psig channels, Category 1

- Redundant 1500 to 2500 psig channels, Category 1

- One 0 to 3000 psig channel, not Category 1.

The redundant ranges overlap such that redundancy is provided from 0 to 2500 psig. The licensee "considers the upper range of 3000 psig adequate for all design basis events."

Redundancy is needed for pressures above 2500 psig. The pressure range of 0 to 3000 psig is adequate to monitor all expected pressures based on the licensee's design basis event analysis. The licensee should commit to install

redundant Category 1 instrumentation in accordance with the resolution of the anticipated transient without scram (ATWS) issue.

3.3.6 Coolant Level in Reactor

Revision 2 of Regulatory Guide 1.97 recommends instrumentation for this variable with a range from the bottom of the core to the top of the vessel. The licensee is supplying instrumentation with a range from the top of the core to the top of the vessel and notes that it deviates from the recommendation of Revision 2 of the regulatory guide. This is acceptable, as it exceeds the range recommended by Revision 3 of the regulatory guide (bottom of the hot leg to the top of the vessel).

3.3.7 Containment Sump Water Level

Regulatory Guide 1.97 recommends measuring the sump level with wide range instruments up to the height equivalent to 600,000 gallons. The licensee has instrumentation for this variable that measures from -22 ft. 6 in. to -15 ft. 5 in. This is equivalent to 565,000 gallons.

The licensee refers to a previous letter where it was shown that the maximum post-accident containment water volume will not exceed 563,800 gallons. As the range exceeds the maximum expected water volume, we find this deviation acceptable.

3.3.8 Radiation Level in Circulating Primary Coolant

The licensee states that the post-accident sampling system can provide this information with an isolated nuclear steam supply system.

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

3.3.9 Containment Hydrogen Concentration

Regulatory Guide 1.97 recommends that this instrumentation remain functional for containment pressures from -5 psig to the maximum design pressure. The licensee states that the hydrogen analyzers are designed for operation with a positive containment pressure up to 10 psig. Further, they state that the "containment will not see a negative pressure under any FSAR analyzed accident conditions."

The licensee states that the pressure range is being addressed under Item II.F.1 of NUREG-0737. This does not require an operating pressure envelope. Therefore, the licensee should provide a complete justification for this deviation, including the basis for the statement of not having a negative containment pressure, or they should provide instrumentation capable of functioning over the recommended pressure range.

3.3.10 Radiation Exposure Rate

The licensee takes exception to the instrument range recommended by Regulatory Guide 1.97 ($10^1$ R/hr to $10^4$ R/hr). Currently installed area radiation monitors cover a lesser range up to 10 or $10^3$ R/hr. The licensee's justification for this deviation is that the existing area radiation monitors provide for adequate employee protection, that these monitors can be augmented by portable monitors, and that these monitors do warn of changing or unusually high radiological conditions.

From a radiological standpoint, if the radiation levels reach or exceed the upper limit of the range, personnel would not be permitted to the areas except of life saving. We therefore find the proposed ranges for the radiation exposure rate monitors acceptable.

3.3.11 Accumulator Tank Pressure

Regulatory Guide 1.97 recommends instrumentation with a range of 0 to 750 psig for this variable. The range provided is 0 to 250 psig. On the

basis that the design pressure of the accumulators is 250 psig, we find this deviation acceptable.

3.3.12 Refueling Water Storage Tank Level

Regulatory Guide 1.97 recommends instrumentation with a range from top to bottom for this variable. The range of the instrumentation supplied by the licensee is 4.3 to 100 percent. At 4.3 percent, the tank is essentially empty. Therefore, this is an acceptable deviation from Regulatory Guide 1.97.

3.3.13 Pressurizer Heater Status

Regulatory Guide 1.97 recommends Category 2 electric current instrumentation for this variable. The licensee has supplied circuit breaker position indication for this variable.

Section II.E.3.1 of NUREG-0737 requires a number of the pressurizer heaters to have the capability of being powered by the emergency power sources. Instrumentation is to be provided to prevent overloading a diesel-generator. Also, technical specifications are to be changed accordingly. The Standard Technical Specifications, Section 4.4.3.2, requires that the emergency pressurizer heater current be measured quarterly. These heaters, as required by NUREG-0737, should have the current instrumentation recommended by Regulatory Guide 1.97.

3.3.14 Quench Tank Level

Regulatory Guide 1.97 recommends instrumentation for this variable with a range from the top to the bottom of the tank. The tank is a horizontal cylindrical tank with an outside diameter of 60 in. The licensee's instrumentation measures the level for 20 in. on each side of the centerline of the tank. We calculate that this range covers 74 percent of the tank volume.

The licensee did not relate the existing range to the range that needs to be available in a post-accident condition. The licensee should show that the existing quench tank level instrumentation will adequately cover the maximum expected range, or provide instrumentation with the range recommended by Regulatory Guide 1.97.

3.3.15 Quench Tank Temperature

Regulatory Guide 1.97 recommends instrumentation for this variable with a range from 50 to 750°F. The licensee has provided instrumentation for this variable with a range of 0 to 300°F.

The licensee states that "the range of 0 to 300°F is sufficient to monitor normal as well as design basis accident scenarios." Based on this statement, we find this deviation acceptable.

3.3.16 Steam Generator Level

Regulatory Guide 1.97 recommends instrumentation with a range from the tube sheet to the separators for this variable. The licensee has provided instrumentation with a range from the top of the tube bundles to the separators. Thus, the length of the tube bundles is not measured.

The licensee states that "there are no instrument taps in the steam generator to allow direct wide range level measurement." They also say that there are "other methods of determining the level below the lower instrument tap using analytical methods."

The licensee has not provided justification showing why compliance cannot be accomplished. They have not stated what criteria are being applied to the analytical method. Therefore, we conclude that the licensee should provide the recommended instrumentation.

3.3.17 Heat Removal by the Containment Fan Heat Removal System

Regulatory Guide 1.97 recommends plant specific Category 2 instrumentation for this variable. The licensee has no instrumentation for this variable saying that it is not considered a part of the post-accident monitoring system.

The licensee should either provide instrumentation for this variable or provide additional justification showing why compliance is not needed.

3.3.18 Containment Atmosphere Temperature

Regulatory Guide 1.97 recommends instrumentation for this variable with a range from 40 to 400°F. The licensee has instrumentation for this variable with a range of 0 to 350°F.

The licensee states that "the maximum predicted containment temperature is less than 300°F." Based on this statement, we find the range supplied by the licensee for post-accident monitoring acceptable.

3.3.19 Containment Sump Water Temperature

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable with a range from 50 to 250°F. The licensee has no instrumentation for this variable saying it is not considered a part of the post-accident monitoring system.

The licensee should either provide instrumentation for this variable or provide justification showing why compliance cannot be accomplished.

3.3.20 Radioactive Gas Holdup Tank Pressure

Regulatory Guide 1.97 recommends instrumentation for this variable with a range from 0 to 150 percent of design pressure. The licensee has instrumentation for this variable that reads from 0 to 25 psig. We were

unable to determine what the design pressure of the tank is. However, Section 11.1.3.3.1 of the Final Safety Analysis Report (Reference 8), states that in normal operation, the tank is subjected to 140 psig maximum. This is beyond the range of the instrumentation. The licensee has not provided justification for this deviation, as they do not consider it part of the post-accident monitoring system.

The licensee should either provide the recommended range for this instrumentation or provide justification for not doing so.

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

The licensee's post-accident sampling system provides sampling and analysis as recommended by the regulatory guide, except that it does not have the capability to analyze for dissolved oxygen.

The licensee takes exception to the guidance of Regulatory Guide 1.97 with respect to post-accident sampling capability. This exception 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.

## 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. Environmental qualification--there are 14 Category 2 variables for which environmental qualification should be addressed in accordance with 10 CFR 50.49 (Section 3.3.1).

2. RCS cold leg water temperature--the licensee should verify that these channels are redundant (Section 3.3.3).

3. RCS hot leg water temperature--the licensee should verify that these channels are redundant (Section 3.3.4).

4. RCS pressure--the licensee should commit to install redundant Category 1 instrumentation with a range to coincide with the resolution of the ATWS issue (Section 3.3.5).

5. Containment hydrogen concentration--the licensee should provide additional justification for not complying with the recommended operating pressure envelope, or they should provide instrumentation capable of functioning over the recommended pressure range (Section 3.3.9).

6. Pressurizer heater status--the licensee should provide the recommended current measuring instrumentation (Section 3.3.13).

7. Quench tank level--the licensee should show that the existing range is adequate or provide the recommended range (Section 3.3.14).

8. Steam generator level--the licensee should provide the recommended instrumentation (Section 3.3.16).

9. Heat removal by the containment fan heat removal system--the licensee should either provide instrumentation for this variable or provide further justification showing why compliance is not needed (Section 3.3.17).

10. Containment sump water temperature--the licensee should either provide instrumentation for this variable or provide further justification showing why compliance cannot be accomplished (Section 3.3.19).

11. Radioactive gas holdup tank pressure--the licensee should either provide instrumentation with the recommended range for this variable or provide justification showing why compliance cannot be accomplished (Section 3.3.20).

## 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. Northeast Utilities letter, W. G. Counsel to D. G. Eisenhut, NRC, "Requirements for Emergency Response Capability (Generic Letter No. 82-33)," April 15, 1983, A02959.

5. Northeast Utilities letter, W. G. Counsel to Director of Nuclear Reactor Regulation, NRC, "Supplement 1 to NUREG-0737, Revision 2 to Regulatory Guide 1.97," February 29, 1984, A02959.

6. Northeast Utilities letter, W. G. Counsel to Director of Nuclear Reactor Regulation, NRC, ".Supplement 1 to NUREG-0737, Revision 2 to Regulatory Guide 1.97," April 9, 1984, A02959.

7. Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant Environs Conditions During and Following an Accident, Regulatory Guide 1.97, Revision 3, NRC, Office of Nuclear Regulatory Research, May 1983.

8. Final Safety Analysis Report, Millstone Nuclear Power Station, Unit No. 2.


38280

Millstone

Gerald Garfield, Esq.
Day, Berry & Howard
Counselors at Law
City Place
Hartford, Connecticut 06103-3499

Regional Administrator
USNRC, Region I
Office of Executive Director for Operations
631 Park Avenue
King of Prussia, Pennsylvania 19406

Mr. Charles Brinkman, Manager
Washington Nuclear Operations
C-E Power Systems
Combustion Engineering, Inc.
7910 Woodmont Avenue
Bethesda, Maryland 20814

Mr. Lawrence Bettencourt, First Selectman
Town of Waterford
Hall of Records - 200 Boston Post Road
Waterford, Connecticut 06385

Northeast Utilities Service Company
ATTN: Mr. Richard R. Laudenat, Manager
Generation Facilities Licensing
Post Office Box 270
Hartford, Connecticut 06101

Arthur Heubner, Director
Radiation Control Unit
Department of Environmental
Protection
State Office Building
Hartford, Connecticut 06116

Mr. John Shedolsky
Resident Inspector/Millstone
Box 811
Niantic, CT 06357

Office of Policy & Management
ATTN: Under Secretary Energy
Division
80 Washington Street
Hartford, Connecticut 06115

Superintendent
Millstone Plant
P. O. Box 128
Waterford, Connecticut 06385

Vice President-Nuclear Operations
Northeast Utilities Service Co.
P. O. Box 270
Hartford, Connecticut 06101