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# TECHNICAL EVALUATION REPORT

## CONFORMANCE TO REGULATORY GUIDE 1.97: PILGRIM

Alan C. Udy

EG&G Idaho

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Docket No. 50-293

Alan C. Udy

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EG&G Idaho, Inc.
Idaho National Engineering Laboratory
Idaho Falls, Idaho 83415

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SUMMARY

This EG&G Idaho, Inc. report documents the review of the Regulatory Guide 1.97, Revision 3, submittals for the Pilgrim Nuclear Power Station and identifies areas of nonconformance to the regulatory guide. Exceptions to Regulatory Guide 1.97 are evaluated and areas where sufficient basis for acceptability is not provided are identified.

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## PREFACE

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 Technology, by EG&G Idaho, Inc, Regulatory and Technical Assistance Unit.

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# CONFORMANCE TO REGULATORY GUIDE 1.97: PILGRIM

## 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).

The Boston Edison Company, the licensee for the Pilgrim Nuclear Power Station, provided a response to Section 6.2 of the generic letter on November, 1, 1984 (Reference 4). This submittal addresses Revision 3 of Regulatory Guide 1.97 (Reference 5). The licensee provided additional information on February 10, 1987 (Reference 6), April 11, 1989 (Reference 7), January 11, 1990 (Reference 8), and January 15, 1990 (Reference 9). On April 5, 1990, the licensee provided an updated response to the compliance issues related to Regulatory Guide 1.97 (Reference 10). Reference 10 superseded the previous submittals.

This report, based on the recommendations of Regulatory Guide 1.97, Revision 3, compares the instrumentation proposed by the licensee's submittals with these recommendations.

## 2. REVIEW REQUIREMENTS

Item 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 documentation should provide the following information for each variable shown in the applicable table of Regulatory Guide 1.97.

1. instrument range
2. environmental qualification
3. seismic qualification
4. quality assurance
5. redundance and sensor location
6. power supply
7. location of display
8. schedule of installation or upgrade

The submittals should identify any deviations taken from the regulatory guide recommendations. They should also provide supporting justification or alternatives for the deviations identified.

After issuing 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 address only the exceptions taken to Regulatory Guide 1.97. It was also noted that when licensees or applicants explicitly state that instrument systems conform to the regulatory guide, no

further staff review would be necessary. Therefore, this report addresses only those exceptions to Regulatory Guide 1.97 identified by the licensee. 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 responses to Item 6.2 of NRC Generic Letter 82-83 on November 1, 1984, February 10, 1987, April 11, 1989, January 11, 1990, and January 15, 1990. A superseding submittal was made on April 5, 1990. The responses describe the licensee's position on post-accident monitoring instrumentation. This evaluation compares the Reference 10 material, supplemented by the earlier submittals, to the recommendations of Revision 3 of Regulatory Guide 1.97.

### 3.1 Adherence to Regulatory Guide 1.97

The licensee documented their review of the Pilgrim Nuclear Power Station post-accident monitoring instrumentation. The licensee's review compares the instrumentation characteristics against the recommendations of Regulatory Guide 1.97, Revision 3 (Reference 5). The licensee's report has three divisions: (a) instrumentation that meets the recommendations of the regulatory guide, (b) instrumentation that the licensee will modify to meet the recommendations of the regulatory guide, and (c) instrumentation that the licensee has determined appropriate. The licensee committed to the modifications noted in their report. Therefore, we conclude that the licensee provided an explicit commitment on conformance to Regulatory Guide 1.97. Exceptions to and deviations from the regulatory guide noted in Section 3.3.

### 3.2 Type A Variables

Regulatory Guide 1.97 does not specifically identify Type A variables, i.e., those variables that provide the information required to permit the control room operator to take specific, manually-controlled safety actions. The licensee classifies the following instrumentation as Type A.

1. drywell atmosphere temperature

2. containment and drywell hydrogen concentration

3. containment and drywell oxygen concentration

4. primary containment pressure - drywell

5. primary containment pressure - suppression pool

6. reactor coolant system pressure

7. coolant level in reactor vessel

8. suppression pool water level

9. suppression pool water temperature

These variables, with exceptions as noted in Section 3.3, either meet or will be upgraded to meet the Category 1 recommendations, consistent with the requirements for Type A variables.

## 3.3 Exceptions to Regulatory Guide 1.97

The licensee identified deviations and exceptions from Regulatory Guide 1.97. The following paragraphs discuss these deviations and exceptions.

### 3.3.1 Seismic Qualification

Regulatory Guide 1.97 recommends seismic qualification for Category 1 instrumentation. The licensee identified the following Category 1 variables that needed more information before they could document them as meeting the requirements of Regulatory Guide 1.97. We note that seismic qualification for Category 2 instrumentation is optional.

1. neutron flux

2. coolant level in reactor

3. reactor coolant system (RCS) pressure

4. drywell pressure

5. primary containment pressure

6. primary containment isolation valve position

7. containment and drywell hydrogen concentration

8. containment and drywell oxygen concentration

9. drywell atmosphere temperature

In Reference 7, the licensee discusses the seismic design and qualification criteria from the time of original plant design up to the present requirement of IEEE Std 344-1975. Based on the licensee's statement that the applicable seismic specifications are applied to the Category 1 instrumentation, we find the licensee's instrumentation acceptable in meeting the seismic qualification requirements as discussed in the NRC regional meetings.

In References 9 and 10, the licensee provides additional clarification on seismic qualification. The licensee reviewed all Category 1 instrumentation and any Category 2 instruments that are part of a safety-related system. The evaluation classified the instrumentation as acceptable for seismic qualification if either of the following conditions exists. The licensee considers the instrumentation seismically qualified if purchased and installed under IEEE Standard 344-1975 and auditable qualification documentation exists. The licensee also considers the instrumentation seismically qualified if it meets the requirements of IEEE Standard 344-1987, Section 9, "Experience," and the "Seismic Qualification Utility Group Generic Implementation Procedure," Revision 1, dated November, 1988. Seismically qualified equipment is being installed for

Category 1 modifications. We find the licensee's description of their seismic qualification program acceptable.

3.3.2 Neutron Flux

Regulatory Guide 1.97 recommends Category 1 instrumentation for this variable. The licensee's existing instrumentation is not Category 1. The licensee proposed, in Reference 7, to base their position on neutron flux monitoring on the BWR Owners Group Regulatory Guide 1.97 subcommittee topical report for neutron flux instrumentation.

Regulatory Guide 1.97 recommends Category 1 neutron flux monitoring instrumentation to monitor reactivity control during post-accident situations. The regulatory guide specifies neutron flux as the key variable for determining the accomplishment of reactivity control. It is a key variable because it is a direct measurement and not an indirect or lagging indication. The regulatory guide specifically states that Category 1 instrumentation should meet the environmental qualification requirements of 10 CFR 50.49. 10 CFR 50.49 explicitly references Regulatory Guide 1.97, requiring environmental qualification of all Category 1 instrumentation. Initiating and post-reactor shutdown events could involve environmental conditions that are more extreme than the conditions considered for the existing neutron flux instrumentation. Neutron flux instrumentation supplied for monitoring post-accident conditions should, according to the regulatory guide, be capable of monitoring down to $10^{-6}$ percent of full reactor power. This instrumentation must satisfactorily operate in these extreme environmental conditions. The instrumentation (detectors) must be reliably in place immediately after initial shutdown, and be fully operable for an extended period, i.e., in the order of sixty days, following an accident.

In Reference 10, the licensee states that they have started a project to install neutron flux instrumentation that complies with the recommendations of Regulatory Guide 1.97. We find this commitment acceptable. We also conclude that the existing instrumentation is acceptable for interim operation.

3.3.3 Reactor Coolant System (RCS) Soluble Boron Concentration

Regulatory Guide 1.97 recommends instrumentation for this variable with a range from zero to 1000 parts per million. The licensee states that they use the post-accident sampling system for this variable. As the post-accident sampling system has this capability, we find this deviation acceptable.

3.3.4 Coolant Level in Reactor

Regulatory Guide 1.97 recommends 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 steamline. The licensee states that this range recommendation is equivalent to 186 inches to 604 inches above vessel bottom.

The licensee utilizes two sets of Category 1 instrumentation with overlapping ranges. They cover from 205 inches to 505 inches and from 432 inches to 532 inches. The licensee states that this combined range encompasses all automatic and manual safety actions for accident and post-accident conditions. Further, the licensee states that this range encompasses the active fuel and includes the high level trip setpoint of the emergency core cooling system.

Based on these considerations, we find the level range provided acceptable.

3.3.5 RCS Pressure

Regulatory Guide 1.97 recommends Category 1 instrumentation for this variable. Thus, the instrumentation should have at least two independent and redundant channels. Both redundant transmitters described in Reference 4 share the same vital instrument bus, Y2, as their power source. Additionally, both channels share a two channel recorder.

In Reference 6, the licensee outlined plans to provide redundant power sources from vital buses Y3 and Y4, and independent recording and indication for the two channels. Reference 10 indicates that these modifications are complete.

3.3.6 Drywell Sump Level
Drywell Drains Sump Level

Regulatory Guide 1.97 recommends Category 1 instrumentation for these variables. The licensee has supplied Category 3 instrumentation for these variables. The drywell sump systems isolate automatically at the primary containment penetration should an accident signal occur.

We conclude that the instrumentation supplied by the licensee will provide the appropriate monitoring of the parameters of concern. This conclusion is based on the following.

1. For small leaks, the instrumentation will not experience a harsh environment during operation and will show response to the leak.

2. For larger leaks, the sumps fill promptly and the sump drain lines isolate due to the increase in drywell pressure, thus negating the drywell sump level and drywell drains sump level instrumentation.

3. This instrumentation neither automatically starts nor alerts the operator to start operation of a safety-related system in a post-accident situation.

Therefore, we find the provided Category 3 instrumentation acceptable.

3.3.7 Primary Containment Isolation Valve Position

Regulatory Guide 1.97 recommends Category 1 position indication for these valves. The licensee's position indication for containment isolation valves meets these recommendations except as described below.

The core spray to reactor lines, residual heat removal (RHR) to drywell spray lines, the RHR to suppression pool spray lines, and low pressure coolant injection lines all have redundant isolation valves. The licensee provides redundant safety systems. The lines are redundant and train oriented. Therefore, each redundant line has two valves and associated indication and controls powered from the same power source. The regulatory guide does not require redundant indicating channels within a division of a boiling water reactor safety system. Therefore, the indication for these valves is acceptable. Similarly, we find the indication for the valves in the post-accident sampling system acceptable.

CV 5046 is a normally-closed remote-operated manual value. It controls the air supply to the drywell-to-torus vacuum breakers. In Reference 10, the licensee discusses administrative controls that prevent this valve from opening inadvertently. With these administrative controls, the exclusion of this valve from this regulatory guide recommendation is acceptable.

Position switches ZS8000 and ZS8001 control the valves that isolate the torus makeup line from the condensate storage tank. These control switches and their position indication are locally mounted in the residual heat removal (RHR) and core spray pump room "B," a potentially harsh environment. The power source and cabling for these two valves are not independent and redundant. The licensee states that these valves, indications, and controls are not safety-related. These valves are normally closed during power operation. A containment isolation signal does not close them. Because of the application of these valves and the administrative controls applied to these manually-operated valves, we determine that the deviations for these valves are acceptable.

The licensee does not consider the 580 control rod drive directional control valves part of this variable. These valves do not have position indication. These valves do not receive an automatic isolation signal. The valves are closed except when normal rod movement occurs. A scram does not require the use of these valves. They are not used in the post-accident situation. Based on this justification, we find the lack of position indication for these valves acceptable.

From the information provided, we find that the licensee deviates from a strict interpretation of the Category 1 redundancy recommendation. Only the active valves have position indication (i.e., check valves have no position indication or there is only a single isolation valve in a closed loop). Since the design uses redundant isolation valves, we find that the regulatory guide does not intend redundant indication per valve. Position indication of check valves is specifically excluded by Table 2 of Regulatory Guide 1.97. Therefore, we find the instrumentation for this variable acceptable. This applies to the following valves used with check valves: MO 1201-80, MO-1301-49, MO 2301-8, AO 5033A, AO 5033C, AO 5040A, AO 5040B, MO 1001-28A, MO 1001-28B, MO 1001-29A, and MO 1001-29B. It also applies to MO 4002, located on a closed cooling water line that penetrates the primary containment boundary.

Valves MO 1001-60 and MO 1001-63 are shut and electrically incapacitated by administrative controls during operation. Since these valves cannot then change position, excluding them from having position indication is acceptable.

There are twelve valves that connect the torus to outside systems, the residual heat removal system, reactor core isolation cooling system, high pressure coolant injection system, and core spray system. The licensee states that these lines terminate below the suppression pool water level. Because of this design, no gaseous release path exists. Accident recovery procedures require the use of these flow paths. Because of this, their exclusion from the regulatory guide recommendation is acceptable.

Residual heat removal system valves MO 1001-21 and MO 1001-32 receive primary containment isolation signals to assume their position. However, they are not containment isolation valves. Therefore, the exclusion of these valves from the regulatory guide recommendations is acceptable.

The guide tube ball valves in the TIP system are normally closed, fail-closed valves that are open only when the TIP system is in use. The position indication circuits for valves 736A, 736B, 736C, 736D, 737A, 737B, 737C, and 737D are Category 3. The TIP system is nonsafety-related, and

[illegible] containment atmosphere or reactor coolant outside of containment. The operator, in attendance when these valves are open, [illegible] the redundant squib actuated shear valve should the ball valve not indicate isolation when required. Based on this, we find this deviation acceptable.

In Table 2 of Reference 9, the licensee lists additional valves with environmental qualification as an open item. The environmental qualification rule, 10 CFR 50.49, clarifies the requirements. The valve position indication limit switches and associated cables should be environmentally qualified in accordance with 10 CFR 50.49 and Regulatory Guide 1.97.

3.3.8 Radiation Level in Circulating Primary Coolant

The licensee indicates that the post-accident sampling system provides radiation level measurements to indicate fuel cladding failure in the post-accident condition. The post-accident sampling system was reviewed and approved by the NRC as part of their review of NUREG-0737, Item II.B.3.

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

3.3.9 Containment and Drywell Hydrogen Concentration

Regulatory Guide 1.97 recommends instrumentation for this variable with a range from zero to 30 percent. The licensee's instrumentation has a range of zero to 10 percent. The licensee states that this range is sufficient because it meets the requirements of Item II.F.1.6 of NUREG-0737.

The NRC reviewed and approved this instrumentation as part of their review of NUREG-0737, Item II.F.1.6, finding it acceptable. We find this to be a good faith attempt [as defined in NUREG-0737, Supplement No. 1,

Section 3.7 (Reference 3)] to meet NRC requirements. Therefore, this instrumentation is acceptable.

3.3.10 Containment and Drywell Oxygen Concentration

Regulatory Guide 1.97 recommends Category 1 instrumentation for this variable. Category 1 criteria include Class 1E power sources for this instrumentation. The licensee indicates, in Reference 4, that this instrumentation does not comply with this requirement.

In Reference 6, the licensee states that independent, redundant Class 1E power sources (both onsite and offsite power) supply the redundant channels of this instrumentation. Based on this re-examination of the power sources for this instrumentation, we find the instrumentation provided for this variable acceptable.

3.3.11 Effluent Radioactivity

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable with a range of $10^{-6}$ $\mu$Ci/cc to $10^{3}$ $\mu$Ci/cc. The licensee indicates that the instrumentation does not satisfy the range and environmental qualification recommendations. The ranges identified in Reference 6 are.

| | |
|---|---|
| Main Stack | $1.2 \times 10^{-5}$ $\mu$Ci/cc to $9.9 \times 10^{3}$ $\mu$Ci/cc |
| Reactor Building Vent | $1.5 \times 10^{-6}$ $\mu$Ci/cc to $2.1 \times 10^{3}$ $\mu$Ci/cc |
| Turbine Building Vent | $1.7 \times 10^{-3}$ $\mu$Ci/cc to $1.7 \times 10^{2}$ $\mu$Ci/cc |

Reference 6 indicates that the turbine building vent has no normal effluents, thus it does not have an overlapping low range monitor. Normally used instrumentation monitors the other two release points. Thus, this instrumentation is on scale for normal and accident situations. Based on these discussions, we find the ranges acceptable.

Reference 6 indicates that Class 1E power supplies this instrumentation. This satisfies the power supply requirements.

In Reference 8, the licensee describes modifications made under a long-term schedule for the completion of the Regulatory Guide 1.97 modifications. The main stack and reactor building vent stack effluent monitors will have shielding installed. This shielding keeps the monitors in a mild environment. Cables that pass through potentially harsh environments will have those portions replaced with environmentally qualified cable. The turbine building effluent monitor will have environmental qualification upgrades under the same schedule.

Based on the licensee's description of instrumentation and commitments to upgrade this instrumentation, we find the provided instrumentation acceptable.

3.3.12 Condensate Storage Tank Level

Regulatory Guide 1.97 recommends instrumentation for this variable with a range from the top to the bottom. The licensee, in Reference 4, indicated that this instrumentation does not meet the recommended range. The licensee did not identify the actual range and the extent of the deviation.

In Reference 6, the licensee identifies the range as zero to 40 feet and states that corresponds to the bottom to the top of the tank range recommended. Therefore, the range provided is acceptable.

3.3.13 Drywell Atmosphere Temperature

The licensee identifies this as a Type A variable. Thus, Regulatory Guide 1.97 recommends Category 1 instrumentation with a range of 40°F to 440°F. Category 1 criteria include environmental qualification. The licensee indicates that the provided instrument range is zero to 400°F. The Final Safety Analysis Report identifies a peak post-accident temperature of 340°F (as described in the emergency operating procedures). Because of this temperature limit, we find the provided range acceptable.

In Reference 7, the licensee states that this instrumentation is completely redundant and independent, including power sources, with full separation and isolation provided. Based on the licensee's description of the drywell atmosphere temperature instrumentation, we find the described instrumentation characteristics acceptable in meeting the Category 1 recommendations of Regulatory Guide 1.97. However, Reference 10 lists the environmental qualification of the instrumentation as an open item, with additional work identified to meet the environmental qualification rule (10 CFR 50.49) requirements. We conclude that the licensee has committed to provide the appropriate documentation that will verify the environmental qualification of this instrumentation.

3.3.14 Drywell Spray Flow

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable. The regulatory guide recommends a range of zero to 110 percent of design flow. The licensee does not provide a direct measure for this variable. The residual heat removal (RHR) flow elements monitor the drywell spray flow. This element is common to the drywell spray flow, the suppression chamber spray flow, the low pressure coolant injection system flow, and the suppression chamber cooling lines. The operator can determine that the drywell spray is obtaining flow from the RHR system by observing the position of the RHR system valves. The operator operates these valves manually from the control room. The position of these valves is monitored in the control room on Category 1 position indication. The operator can verify the effectiveness of this spray with pressure and temperature changes in the primary containment. The pressure and temperature instrumentation for the drywell have Category 1 instrumentation in the control room.

We find that the instrumentation described above will provide adequate indication for this variable. Therefore, this instrumentation is acceptable.

3.3.15 Main Steamline Isolation Valves' Leakage Control System Pressure

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable. The licensee states that Pilgrim-1 has no leakage control system on the main steamline isolation valves. Therefore, no instrumentation for this variable is required.

3.3.16 Reactor Core Isolation Cooling (RCIC) System Flow
Cooling Water Flow to Engineered Safety Feature System Components

Regulatory Guide 1.97 recommends environmentally qualified instrumentation for these variables with ranges from zero to 110 percent of design flow. The licensee identifies a deviation from the environmental qualification recommendation and the range. Reference 4 did not identify the extent of the deviation.

Reference 6 shows that the ranges provided exceed the recommended ranges. For RCIC flow, the range provided is zero to 500 gallons per minute. For cooling water flow, the range provided is zero to 3000 gallons per minute. The ranges satisfy the regulatory guide.

In lieu of environmentally qualified RCIC system flow, the licensee has proposed the use of reactor pressure vessel (PRV) water level monitors. The RPV water level instrumentation is Category 1. In lieu of environmentally qualified cooling water flow to engineered safety features system components, the licensee has proposed the use of primary containment pressure, RPV water level, and torus water temperature monitors. These variables have Category 1 instrumentation. The licensee also states that the RPV water level monitors the performance of the low pressure coolant injection system.

The RPV water level will not conclusively show that the RCIC system or the reactor building closed cooling water system are operating within each system's design limits. Similarly, primary containment pressure and torus

water temperature do not show conclusively that the reactor building closed cooling water system is operating within its design limits.

Reference 10 lists the environmental qualification of the RCIC flow and cooling water flow to engineered safety features system components as an open item, with additional work identified to meet the environmental qualification rule (10 CFR 50.49) requirements. We conclude that the licensee has committed to provide the appropriate documentation that will verify the environmental qualification of this instrumentation.

3.3.17 Standby Liquid Control System (SLCS) Flow

Regulatory Guide 1.97 recommends Category 2 flow instrumentation for this variable. The licensee does not monitor flow. Instead, there is Category 3 SLCS pump discharge header pressure indication. The pump discharge pressure indicator has a range of zero to 2000 psig. The instrumentation is used in a mild environment. The system design pressure is 1,500 psig. All SLCS valves, except check valves and the electrically detonate squib valves, are open and locked in that position during reactor operation. The operator can also verify system operation by monitoring the decrease in the SLCS storage tank level.

The licensee uses positive displacement pumps for the SLCS. Thus, high output pressure would indicate flow blockage and low or erratic pressure would indicate a line break. We find the above indications are a valid alternative indication of SLCS operation.

3.3.18 Standby Liquid Control System Storage Tank Level

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable. In Reference 9, the licensee states that the range of the provided Category 3 instrumentation is from zero (essentially empty) to 4,750 gallons. The licensee states, in Reference 6, that the range covers the range recommended by General Electric (the nuclear steam supply system

vendor). This recommended range is 9 inches to 121.25 inches. The provided range also covers the technical specification required levels. Nine inches is essentially the bottom of the tank.

Based on the licensee's justification, we find the range provided acceptable. The licensee states that Category 3 instrumentation is appropriate because the SLCS has less importance to safety than the reactor protection system and the engineered safeguards system. We understand that when in use, this instrumentation is in a mild environment.

Also in Reference 6, the licensee identified the power source for this instrumentation. The power source is a highly reliable instrument bus that is appropriate for this variable. Based on the licensee's description, we find the provided instrumentation acceptable.

3.3.19 High Radioactivity Liquid Tank Level

Regulatory Guide 1.97 recommends instrumentation for this variable with a range from top to the bottom of the tank. The licensee, in Reference 4, identified a possible deviation from this recommendation. In Reference 6, the licensee identified the range as zero to 144 inches, which meets the recommendations for level measurement in the 12 foot high radwaste tank. Thus, the provided instrumentation is acceptable.

3.3.20 Status of Standby Power

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable, with plant specific ranges. Category 2 criteria includes environmental qualification. The licensee identified the instrument ranges in Reference 7. Reference 8 states that the instrumentation is in both mild and potentially harsh post-accident environments. The licensee states that upgrades to the instrumentation and supporting equipment will include environmental qualification for the post-accident environment. The modifications are scheduled under the long term schedule for completion of the Regulatory Guide 1.97 project. We find this commitment acceptable.

3.3.21 Secondary Containment Area Radiation

The licensee states that they do not need the instrumentation for this variable. The licensee states that the plant noble gas effluent monitors are more useful and practical in detecting or assessing primary containment leakage. The licensee reports that the use of local radiation exposure rate monitors to detect breach or leakage through primary containment penetrations results in ambiguous indications. This is due to the radioactivity in the primary containment, the radioactivity in the fluids flowing in emergency core coolant system piping, and the amount and the location of fluid and electrical penetrations. The licensee concludes that the use of the plant noble gas effluent monitors is the proper way to accomplish the purpose of this variable.

We concur with the licensee that the use of the noble gas effluent monitors for this variable is acceptable.

3.3.22 Particulates and Halogens--All Identified Release Points
Airborne Radiohalogens and Particulates
Plant and Environs Radiation
Plant and Environs Radioactivity

Regulatory Guide 1.97 recommends Category 3 instrumentation for these variables. The licensee had not provided the information required by Section 6.2 of Supplement No. 1 to NUREG-0737 for these variables in Reference 4.

In Reference 6, the licensee provided information on this instrumentation. The licensee stated that the provided instrumentation meets the intent of the regulatory guide. As described, we find that the release points have appropriate monitoring instrumentation for particulates and halogens, with the possible exception of the range. In Reference 9, the licensee described the use of a multi-channel analyzer, radiation survey meters, procedures and analytical tools, including nomograms, that,

together, measure particulates and halogens for airborne radionuclide concentrations. The measurement capability is from $10^{-12}$ μCi/cc to $3.5 \times 10^{4}$ μCi/cc. This encompasses the range recommended by the regulatory guide. Air sampling stations continuously monitor the plant and environs. In Reference 7, the licensee identified the capability of their multichannel analyzer and portable instrumentation and sampling. In Reference 9, the licensee demonstrates that the capability of the analyzer is greater than the range recommended by the regulatory guide. However, the range is somewhat dependent on the radionuclides analyzed.

The licensee describes a deviation from the recommendations in that the high range radiation survey instruments measure up to $10^{3}$ R/hr rather than the recommended $10^{4}$ R/hr. Administrative restraints would prevent entry into areas where radiation levels could cause excessive personnel exposure. Therefore, we find the range for this portable instrumentation adequate and acceptable. Based on the licensee's description of these variables, and the noted deviation, we find the instrumentation provided for these variables acceptable.

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

The licensee's sampling system can sample and provide the analysis within the ranges recommended for this variable, except dissolved gas. For dissolved gas, the recommended range is zero to 2000 cc/kg. The range provided is zero to 400 cc/kg.

The licensee deviates from the recommended Regulatory Guide 1.97 post-accident sampling capability. The NRC has reviewed and approved the licensee's post-accident sampling facility as part of their review of NUREG-0737, Item II.B.3.

3.3.24 Instrumentation not Applicable at the Pilgrim Nuclear Station

Regulatory Guide 1.97 recommends instrumentation that is not applicable to the Pilgrim Nuclear Station. Section 6.1b of Supplement No. 1 to

NUREG-0737 excludes the variable BWR core temperature. Therefore, no instrumentation is required for this variable.

The Pilgrim Nuclear Station does not have an isolation condenser. Therefore, no instrumentation for the variables isolation condenser shell side water level and isolation condenser system valve position is required.

3.3.25 Suppression Chamber Spray Flow

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable. The regulatory guide recommends a range of zero to 110 percent of the design flow. The licensee does not provide a direct measure for this variable. The residual heat removal (RHR) flow element monitors the suppression chamber spray flow. This element is common to the drywell spray flow, the suppression chamber spray flow, the low pressure coolant injection system flow, and the suppression chamber cooling lines. The operator can determine that the suppression chamber spray is receiving the indicated flow by observing the position of the RHR system valves. The operator controls these valves manually from the control room. Category 1 position indication in the control room monitors the position of these valves. Temperature changes in the suppression chamber show the effectiveness of this flow. The pressure instrumentation for the suppression chamber meets Category 1 criteria.

We find that the instrumentation described above will provide adequate indication for this variable. Therefore, this instrumentation is acceptable.

3.3.26 Low Pressure Coolant Injection System Flow

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable. The regulatory guide recommends a range of zero to 110 percent of the design flow. The low pressure coolant injection (LPCI) system is a subsystem of the RHR system. The RHR flow element is common to the drywell

spray flow, the suppression chamber spray flow, the LPCI system flow, and the suppression chamber cooling lines. The operator can determine that the LPCI has flow by observing the position of the LPCI injection valves. The operator monitors the position of these valves in the control room by observing Category 1 position indication. The range of the flow instrumentation is zero to 20,000 gallons per minute. This range exceeds the zero to 15,840 gallons per minute design flow by 26.3 percent.

We find that the instrumentation described above will provide adequate indication for this variable. Therefore, this instrumentation is acceptable.

3.3.27 Radiation Exposure Rate

Regulatory Guide 1.97 recommends instrumentation with a range of $10^{-1}$ R/hr to $10^{4}$ R/hr for this variable. The licensee's instrumentation has a range of $10^{-5}$ R/hr to $10^{-1}$ R/hr. The licensee states that they can supplement the permanently installed instrumentation with portable instrumentation. Personnel use the portable instrumentation to survey areas required for servicing equipment important to safety. Stated personnel exposure limits are 25 R for health, safety, and property protection, and 75 R for life saving. The licensee states that personnel observe these limits.

From a radiological standpoint, personnel would not enter the monitored areas without portable monitoring if the radiation levels reached or exceeded the upper limit of the provided instrumentation. Based on the alternative instrumentation used to supplement the instrumentation installed for this variable, we find the range for the radiation exposure rate monitors acceptable.

3.3.28 Redundancy and Separation

Regulatory Guide 1.97 recommends protecting Category 1 instrument channels against potential single failures by applying the redundancy and

separation criteria of Regulatory Guide 1.75 up to and including any isolation devices. The Pilgrim Nuclear Station was designed and constructed before the guidance of Regulatory Guide 1.75 was available.

The licensee states that the redundancy and separation of Category 1 instrumentation meets or exceeds the definition established by Boston Edison specification E-347, Section 5.4, Boston Edison specification E-347A, Sections 5.2.3 and 5.2.4, and the Final Safety Analysis Report, Section 8.9.3. The licensee describes minimum horizontal and vertical separation. Where the prescribed separation is not possible, the licensee specifies barriers. The licensee describes the minimum separation distance for Class 1E enclosed raceways. The licensee states they provide a barrier qualified to IEEE Standard 384-1974 should wiring separation for redundant circuits internal to a control panel be impossible. We find this to be a good faith attempt [as defined in NUREG-0737, Supplement No. 1, Section 3.7 (Reference 3)] to meet NRC requirements. Therefore, the redundancy and separation is acceptable for those Category 1 variables not otherwise upgraded to meet Regulatory Guide 1.97 recommendations. This deviation does not preclude the use of redundant (i.e., two or more) channels of instrumentation for Category 1 or Type A variables.

The licensee has scheduled some modifications to bring Category 1 instrumentation into compliance with aspects of Regulatory Guide 1.97. In these instances, the licensee should provide the redundancy and separation recommended by the regulatory guide for those portions of the instrumentation upgraded.

3.3.29 Interfaces

Section 9 of Table 1 of Regulatory Guide 1.97 recommends the use of qualified isolation devices wherever Category 1 or Category 2 instrumentation interface with instrumentation or control circuits that have less stringent design criteria. The licensee has not described any isolation devices other than "coordinated Class 1E fuses or breakers." The licensee has not described any isolation amplifiers.

The Regulatory Guide 1.97 recommendation for isolation devices is "the transmission of signals for other use should be through isolation devices that are designated as part of the monitoring instrumentation and that meet the provisions of this document."

The licensee has not identified which of the Category 1 and Category 2 instrument signals are diverted to "other use." Therefore, we are not able to conclude that the licensee has met the regulatory guide provision for interfaces. The licensee should ensure that qualified isolation devices are used to protect Category 1 and Category 2 instrumentation. Documentation of isolation device usage for Category 1 and Category 2 instrumentation should be available for NRC audit during the Regulatory Guide 1.97 implementation inspection.

3.3.30 Environmental Qualification

Regulatory Guide 1.97 recommends environmentally qualified instrumentation for Category 1 and Category 2 variables. Reference 9 lists variables for which the licensee has not addressed environmental qualification. The licensee listed the following Regulatory Guide 1.97 Category 1 and Category 2 variables open regarding environmental qualification, with additional work identified to meet the environmental qualification rule (10 CFR 50.49) requirements. The following variables are not discussed elsewhere in this report.

- primary system safety relief valve position
- core spray system flow
- residual heat removal (RHR) system flow
- RHR heat exchanger outlet temperature

- cooling water temperature to engineered safety features system components

- emergency ventilation damper position

- noble gases and vent flow rate for common plant vent

We conclude that the licensee has committed to provide the appropriate documentation that will verify the environmental qualification of this instrumentation.

3.3.31 Recording

Table 1 of Revision 3 of Regulatory Guide 1.97 contains specific criteria regarding recording. The licensee should record at least one channel of Category 1 variables. The licensee should record the effluent radioactivity monitors, area radiation monitors, and meteorological monitors. Recording may be by computer with display on demand if continuously updated. Likewise, data loggers and multipoint recorders are suitable if no significant transient response data would be lost by using them. If direct and immediate trend or transient information is essential for operator information or action, continuous, redundant, dedicated recorders should be provided.

The licensee has not addressed this provision of Regulatory Guide 1.97. The licensee should ensure that recording is provided in accordance with Regulatory Guide 1.97 criteria. Documentation of recording capabilities should be available for NRC audit during the Regulatory 1.97 implementation inspection.

3.3.32 Channel Availability

Regulatory Guide 1.97 recommends, for Category 1 instrumentation, that the instrument channels be available before an accident except as provided

in paragraph 4.11, "Exception," of IEEE Standard 279-1971, or as specified in technical specifications. For Category 2 instrumentation, Regulatory Guide 1.97 recommends that the out-of-service intervals be based on normal technical specification requirements on out-of-service intervals for the system it services or as specified in other requirements.

In Reference 10, the licensee lists this as an open item, yet to be addressed. The licensee should take steps to assure that their post-accident monitoring instrumentation is available in accordance with the provisions of Regulatory Guide 1.97.

3.3.33 Quality Assurance

Regulatory Guide 1.97 recommends that the licensee's instrumentation be a part of a quality assurance program, with lesser requirements imposed on Category 2 instruments.

In Reference 10, the licensee lists this as an open item, yet to be addressed. The licensee should take steps to assure that their post-accident monitoring instrumentation is part of a quality assurance program in accordance with the provisions of Regulatory Guide 1.97.

3.3.34 Servicing, Testing, and Calibration

Regulatory Guide 1.97 contains specific recommendations for periodic checking, testing, calibration, and calibration verification that are based on the recommendations of Regulatory Guide 1.118.

In Reference 8, the licensee lists this as an open item, yet to be addressed. The licensee should take steps to assure that their post-accident instrumentation is checked, tested, and calibrated under a surveillance program in accordance with Regulatory Guide 1.97 and Regulatory Guide 1.118.

## 4. CONCLUSIONS

Based on our review, we find that the licensee either conforms to or is justified in deviating from Regulatory Guide 1.97, with the following exceptions:

1. Redundancy and separation -- Any modifications to bring Category 1 or Type A instrumentation into compliance with Regulatory Guide 1.97 should include the redundancy and separation recommended by the regulatory guide for the modifications. See Section 3.3.28.

2. Interfaces -- The licensee should ensure that qualified isolation devices are used to protect Category 1 and Category 2 instrumentation. See Section 3.3.29.

3. Recording -- The licensee should ensure that recording is provided in accordance with Regulatory Guide 1.97 criteria. See Section 3.3.31.

4. Channel availability -- The licensee should assure their instrumentation is available in accordance with the regulatory guide. See Section 3.3.32.

5. Quality assurance -- The licensee should assure their instrumentation is part of a quality assurance program in accordance with Regulatory Guide 1.97. See Section 3.3.33.

6. Servicing, testing, and calibration -- The licensee should assure their instrumentation is serviced, tested, and calibrated in accordance with Regulatory Guide 1.97 and Regulatory Guide 1.118. See Section 3.3.34.

## 5. REFERENCES


1. Letter, NRC (D. G. Eisenhut) to All Licensees of Operating Reactors, Applicants for Operating Licenses, and Holders of Construction Permits, "Supplement No. 1 to NUREG-0737--Requirements for Emergency Response Capability (Generic Letter No. 82-33)," December 17, 1982.

2. Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident, Regulatory Guide 1.97, Revision 2, NRC, Office of Standards Development, December 1980.

3. Clarification of TMI Action Plan Requirements, Requirements for Emergency Response Capability, NUREG-0737, Supplement No. 1, NRC, Office of Nuclear Reactor Regulation, January 1983.

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7. Letter, Boston Edison Company (R. G. Bird) to NRC, "Response to Request for Additional Information, Emergency Response Capability, Regulatory Guide 1.97, Revision 3, (TAC 51119)," April 11, 1989, BECo 89-053.

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Regulatory and Technical Assistance
EG&G Idaho, Inc.
P.O. Box 1625
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This EG&G Idaho, Inc., report documents the review of the Regulatory Guide 1.97, Revision 2, submittals for the Pilgrim Nuclear Power Station, and identifies areas of nonconformance to the regulatory guide. Exceptions to Regulatory Guide 1.97 are evaluated and those areas where sufficient basis for acceptability is not provided are identified.

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