UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO CONFORMANCE TO REGULATORY GUIDE 1.97

GPU NUCLEAR CORPORATION AND JERSEY POWER & LIGHT COMPANY

OYSTER CREEK NUCLEAR GENERATING STATION

DOCKET NO. 50-219

1.0 INTRODUCTION

GPU Nuclear Corporation (GPUN, the licensee) was requested by Generic Letter 82-33 to provide a report to NRC describing how the post-accident monitoring instrumentation meets the guidelires of Regulatory Guide (R.G.) 1.97 as applied to emergency response facilities. The licensee responded to Item 6.2 of the generic letter on June 13, 1984. Additional information was provided by letters dated May 9, 1986, March 30, 1988, April 13, 1990, and July 23, 1990.

A detailed review and technical evaluation of the licensee's submittals was performed by EG&G Idaho, Inc., under a contract to the NRC, with general supervision by the NRC staff. This work was reported by EG&G in Technical Evaluation Report (TER), "Conformance to Regulatory Guide 1.97: Oyster Creek," dated August 1990 (attached). We have reviewed this report and concur with the conclusion that the licensee either conforms to, or has adequately justified deviations from, the guidance of R.G. 1.97 for each post-accident monitoring variable except for the variables neutron flux, reactor coolant level, reactor coolant system pressure, containment isolation valve position, and primary system safety relief valve position, and the subject of equipment identification.

2.0 EVALUATION CRITERIA

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 R.G. 1.97. At these meetings, it was established that the NRC review would only address exceptions taken to the guidance of R.G. 1.97. Further, where licensees or applicants explicitly state that instrument systems conform to provisions of the regulatory guide, no further staff review would be necessary. Therefore, the review performed and reported by EG&G only addresses exceptions to the guidance of R.G. 1.97. This safety evaluation addresses the licensee's submittals based on the review policy described in the NRC regional meetings and the conclusions of the review as reported by EG&G.

3.0 EVALUATION

We have reviewed the evaluation performed by EG&G contained in the attached TER and concur with its bases and findings. The licensee either conforms to, or

has provided an acceptable justification for deviations from the guidance of R.G. 1.97 for each post-accident monitoring variable except for the variables (a) neutron flux (b) reactor coolant level, (c) reactor coolant system pressure, (d) containment isolation valve position, and (e) primary system safety relief valve position, and the subject of (f) equipment identification.

(a) R.G. 1.97 recommends Category 1 neutron flux monitoring instrumentation to monitor reactivity control. The licensee has provided neutron flux monitoring instrumentation which conforms to the R.G. 1.97 Category 1 criteria except for environmental qualification, seismic qualification, and power source of the intermediate range monitors (IRMs) and source range monitors (SRMs).

The licensee has stated that the redundant instrumentation channels are powered from the same source. With only one power source, a single fault could result in the loss of all redundant neutron flux instrumentation. The use of only one power source is not in conformance with the single failure criteria. Therefore, the licensee's power source is not acceptable. The licensee should provide independent Class 1E power sources for the redundant channels.

The justification provided by the licensee for not fully qualifying the neutron flux monitoring instrumentation is that the variable is only needed for long term use in the event of an anticipated transient without scram (ATWS), which does not result in an environment that is more severe than a normal operating environment. Additionally, the licensee states that with a control rod shutdown, inadvertent reactivity additions are not possible. However, it is the staff's position that neutron flux instrumentation is required for monitoring purposes as related to the mitigation of any inadvertent boron dilution event or any other reactivity addition situation resulting from accidents. The licensee has not shown that the existing instrumentation will be available in a post-accident situation. Therefore, the staff finds the licensee's justification unacceptable.

The staff has been informed that industry has developed wide range neutron flux monitoring systems that satisfy the Category 1 criteria of R.G. 1.97. Therefore, it is the staff's position that the licensee should evaluate the newly developed neutron flux monitoring systems and install neutron flux monitoring instrumentation which complies with the Category 1 criteria, of 10 CFR 50.49, R.G. 1.97, and R.G. 1.100.

It has been concluded by the staff that the existing neutron flux monitoring instrumentation is acceptable for interim operation until implementation of a fully qualified indication system is completed.

(b) R.G. 1.97 recommends Category 1 reactor coolant level instrumentation to monitor the accomplishment of accident mitigation and long term surveillance of the core cooling system. The licensee has provided two channels of reactor coolant level fuel zone instrumentation which are

powered from a single balance of plant power source. The licensee is evaluating the installation of independent power supplies.

The licensee's deviation is unacceptable. The licensee has declared reactor coolant level to be a Type A variable. As a Type A variable, reactor coolant level information is required to permit the operator to take specific manually controlled actions for which no automatic control is provided and that are required to accomplish their safety functions for design basis events. To ensure that reactor coolant level instrumentation is available, redundant Class 1E power sources must be used. Therefore, the licensee should provide redundant Class 1E power sources for the reactor coolant level instrumentation.

(c) R.G. 1.97 recommends Category 1 reactor coolant system pressure instrumentation to monitor the accomplishment of accident mitigation and long term surveillance of reactor coolant system integrity. The licensee has provided instrumentation which meets the Category 1 criteria except for recording. The licensee is evaluating the installation of a recorder.

The licensee has not made a commitment to record reactor coolant system pressure. The Category 1 criteria calls for the recording of at least one redundant channel of each Category 1 variable. If direct and immediate trend or transient information is essential for operator information or action, the recording should be continuously available on redundant dedicated recorders. Otherwise, it may be continuously updated, stored in computer memory, and displayed on demand. Therefore, the licensee's deviation is unacceptable. The licensee should record reactor coolant system pressure.

(d) R.G. 1.97 recommends Category 1 instrumentation to monitor the position of containment (drywell) isolation valves. Most of the licensee's containment isolation valves, while redundant, are powered from a single power source. The position indication for these valves are also powered from the same power source. The loss of this single power source could cause the operator to take an incorrect action or delay action based upon incorrect information. Therefore, the licensee's deviation is unacceptable. The licensee should provide separate Class 1E power sources for the containment isolation valve position instrumentation.

(e) R.G. 1.97 recommends Category 2 primary system safety relief valve position instrumentation to monitor main steam system boundary integrity. The licensee has provided Category 3 instrumentation to monitor the position of these valves. The licensee's justification is that these valves operate automatically and there is no manual means to close these valves.

The licensee's deviation is unacceptable. Even though the operator cannot directly change the position of these valves, he should know the status of these valves. Without such information, he could be delayed in responding to a main steam system boundary integrity failure. This

information should be presented by instrumentation which is powered by a highly reliable power source. Therefore, the licensee should provide Category 2 primary system safety relief valve position instrumentation.

(f) R.G. 1.97 recommends that Types A, B, and C instruments designated as Category 1 and 2 should be specifically identified with a common designation on the control panels so that the operator can easily discern that they are intended for use under accident conditions. The licensee has not provided any control room identification of this instrumentation.

The licensee's justification is that the emergency operating procedures (EOPs) provide symptomatic guidance for the operator for a wide spectrum of events including multiple failures and operator errors and for the operator to utilize whatever instruments are available to determine plant conditions. The licensee has also stated that no distinction between R.G. 1.97 and non-R.G. 1.97 instruments has been made in the EOPs and that doing so could inadvertently mislead the operator into relying (unjustifiably) on an erroneous R.G. 1.97 instrument when not warranted by plant conditions.

The intent of this identification is not for R.G. 1.97 instrumentation to be specifically called out in the EOPs, but rather to identify on the control room panels a minimum set of instruments that are qualified to monitor post-accident situations. This identification does not restrict the operator to using only those instruments identified.

The staff has reviewed the R.G. 1.97 recommendations on the identification of R.G. 1.97 instrumentation and has determined that the Type A and the Category 1 instrumentation need control room identification. Therefore, the licensee should provide identification in the control room of the Type A and the Category 1 R.G. 1.97 instrumentation. The control room identification of the R.G. 1.97 instrumentation should be in accordance with the Detailed Control Room Design Review guidelines.

4.0 CONCLUSION

Based on the staff's review of the enclosed TER and the licensee's submittals, we find that the Oyster Creek Nuclear Generating Station design, is acceptable with respect to conformance to R.G. 1.97, Revision 3, except for the instrumentation associated with the variables a) neutron flux, b) reactor coolant level, (c) reactor coolant system pressure, (d) containment isolation valve position, and (e) primary system safety relief valve position, and the subject of (f) equipment identification.

a) It is the staff's position that information on neutron flux is valuable to the operator in the evaluation of reactivity control. It is also the staff's position that the licensee shall install and have operational neutron flux monitoring instrumentation which fully conforms to the Category 1 criteria, of 10 CFR 50.49, R.G. 1.97, and R.G. 1.100. The

staff finds acceptable the existing neutron flux instrumentation for interim operation until implementation of a fully qualified indicating system is completed.

b) It is the staff's position that information on the reactor coolant level is valuable to the operator in monitoring the accomplishment of accident mitigation and long term surveillance of the core cooling system. It is also the staff's position that the licensee should provide redundant Class 1E power sources for the reactor coolant level instrumentation.

c) It is the staff's position that information on the reactor coolant system pressure is valuable to the operator in monitoring the accomplishment of accident mitigation and long term surveillance of the reactor coolant system integrity. It is also the staff's position that the licensee should provide recording of the reactor coolant system pressure in accordance with R.G. 1.97.

d) It is the staff's position that information on the status of containment isolation valve position is valuable to the operator in evaluation of the accomplishment of isolation of the containment. It is also the staff's position that the licensee should provide separate Class 1E power sources for the containment isolation valve position instrumentation.

e) It is the staff's position that information on the status of the primary system safety relief valve position is valuable to the operator in monitoring the main steam system boundary integrity. It is also the staff's position that the licensee should provide Category 2 primary system safety relief valve position instrumentation.

f) It is the staff's position that, at a minimum, identification of the Type A and the Category 1 R.G. 1.97 instrumentation is necessary to help the operator easily discern that this instrumentation is intended for use under accident conditions. It is also the staff's position that the licensee should provide identification in the control room of the Type A and the Category 1 R.G. 1.97 instrumentation.

An appropriate implementation schedule will be developed by the project manager via discussion with the licensee. Once the schedule is established, the licensee is required to inform the Commission, in writing, of any significant changes in the estimated schedule identified in the staff's safety evaluation and when the action has actually been completed.

Principal Contributor: B. Marcus

Date:

Attachment:
TER

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TECHNICAL EVALUATION REPORT

CONFORMANCE TO REGULATORY GUIDE 1.97: OYSTER CREEK

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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 Oyster Creek Nuclear Generating 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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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: OYSTER CREEK

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).

GPU Nuclear, the licensee for the Oyster Creek Nuclear Generating Station, provided a response to Item 6.2 of the generic letter on June 13, 1984 (Reference 4). A submittal dated May 9, 1986 (Reference 5) superseded this early information. A submittal dated March 30, 1988 (Reference 6) gave additional information. Reference 7, dated April 13, 1990, supersedes the previous submittals. Reference 7 addresses Revision 3 of Regulatory Guide 1.97 (Reference 8). The licensee provided additional information on July 23, 1990 (Reference 9).

This report, based on the recommendations of Regulatory Guide 1.97, Revision 3, compares the instrumentation proposed in 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 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

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 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 replaced their early responses to Item 6.2 of NRC Generic Letter 82-33 on April 13, 1990. The licensee describes their post-accident monitoring instrumentation in that submittal as supplemented on July 23, 1990. This evaluation compares the material submitted in References 7 and 9 to the recommendations of Revision 3 of Regulatory Guide 1.97.

3.1 Adherence to Regulatory Guide 1.97

The licensee provided information on the Oyster Creek post-accident monitoring instrumentation. The licensee based their instrumentation evaluation on Regulatory Guide 1.97, Revision 3, criteria. The licensee identifies instrumentation modified to meet the regulatory guide. The licensee provides justification for the continued use of instrumentation where the licensee determined its appropriateness for Oyster Creek. The licensee scheduled modifications under the licensee's living schedule. Therefore, we conclude that the licensee has provided an explicit commitment on conformance to Regulatory Guide 1.97. Exceptions to and deviations from the regulatory guide are 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 has identified the following Type A variables in Reference 5.

1. reactor pressure vessel (RPV) pressure
2. RPV water level
3. torus water temperature
4. torus water level

5. drywell pressure

6. drywell hydrogen concentration

7. drywell oxygen concentration

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 to Regulatory Guide 1.97. The following paragraphs discuss these deviations and exceptions.

3.3.1 Neutron Flux

Regulatory Guide 1.97 recommends Category 1 instrumentation for this variable with a range from 10^{-6} to 100 percent of full power. Category 1 recommendations include independent Class 1E power sources, and environmental and seismic qualification. The source and intermediate range monitors were scheduled for upgrading to Category 2 criteria. Reference 6 recants this commitment. The licensee is still evaluating neutron flux monitoring instrumentation, according to Reference 7. The licensee also notes that the power source for both redundant channels is the same diesel generator backed bus. However, provisions exist to power this bus from the other diesel generator.

The licensee states that the intermediate range monitors will monitor power levels up to 20 percent of full power. Reference 5 states that monitoring beyond 20 percent power is not necessary. This is because the

emergency operating procedures dealing with anticipated transients without scram (ATWS) events require action only if a) the power level exceeds 2 percent, or b) the power level is not known.

The licensee's power source for this instrumentation is not acceptable. A bus fault could result in the loss of all redundant instrumentation, regardless of the provision to transfer the bus to the alternate diesel generator. This is not in conformance with the single failure criteria. The licensee should provide independent Class 1E power sources for the redundant instrument channels.

The licensee proposed, in Reference 6, to base their position on neutron flux monitoring on the BWR Owners Group Regulatory Guide 1.97 subcommittee topical report for neutron flux instrumentatio

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, 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 must, 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. The instrumentation should be fully operable for an extended period, i.e., in the order of sixty days, following an accident.

The licensee based the use of neutron flux instrumentation and the availability of alternate monitoring equipment, such as control rod position indication or boron concentration measurements, on anticipated conditions resulting from standard design basis analysis conditions. These events are normally considered reasonably comprehensive. However, the instrumentation recommendations of Regulatory Guide 1.97 intends to cover a wider range of possibilities, including conditions not necessarily anticipated following standard event analyses defined event paths. The intent of the 10^{-6} percent lower limit of the recommended range was to provide, with maximum forewarning time operator information (via evaluations of deviations from normal post-shutdown flux levels) and warning of possible post-event approaches or a return to a critical state. This might be under circumstances that would involve reactor states and evolving events and conditions not anticipated from analyses following normally considered event scenarios. It would thus be virtually impossible to either predict or demonstrate the implausibility of such event paths and resulting conditions.

We conclude that the licensee's position does not address the conceptual basis that set the recommendations of Regulatory Guide 1.97. The expected flux levels exist for some extended period (in the order of several hours) after rapid shutdown from power operation. These expected flux levels set the required power level that this instrumentation must measure. For the reactivity status to be verifiable, neutron source and intermediate range level detectors must be operational following this rapid shutdown from power operation. The normal non-power flux levels serve as a base for observable deviations of reactivity states in the anomalous and undefined events indicated above.

10 CFR 50.49 requires environmental qualification for Category 1 and Category 2 post-accident monitoring equipment. Therefore, based on the above, we conclude that the Category 1 designation is appropriate. We also conclude that the licensee should environmentally qualify the neutron flux monitoring equipment to comply with 10 CFR 50.49.

Industry has developed and made available at least two different wide range neutron flux monitoring systems that satisfy the Category 1 criteria of Regulatory Guide 1.97. The licensee states, in Reference 7, that they cannot install one of these systems because of physical space limitations inside the biological shield wall at Oyster Creek. The licensee should continue evaluation of these newly developed systems and install neutron flux monitoring instrumentation that fully complies with the Category 1 and range criteria of Regulatory Guide 1.97.

3.3.2 Coolant Level in Reactor

Regulatory Guide 1.97 recommends Category 1 instrumentation for this variable with a range from the bottom of the core support plate to the centerline of the main steamlines. The licensee has two Category 1 fuel zone channels that cover from -144 inches to +180 inches (referenced to the top of active fuel). Additionally, two channels of RPS instrumentation measure from +85 inches to +185 inches above the top of active fuel. The fuel zone channels receive power from divisionally separate 120-Vac RPS power supplies. The licensee will modify this power source to eliminate the momentary power loss when the RPS motor generators lose power. The licensee states that the fuel zone transmitters have loop power supplies that are common to balance of plant instrument loops. The licensee is evaluating the installation of independent loop power supplies. The licensee should include independent loop power suppliers for this instrumentation. The licensee may add strip chart recorders. This is in addition to the computer recording capabilities.

The range limit of -144 inches is 5 inches below the bottom of the fuel. We find this deviation minor and acceptable. The centerline of the 10 inch diameter isolation condenser steamlines is 188 inches above the top of active fuel. The centerline of the main steamlines is 238 inches above the top of active fuel. The range was chosen to prevent water hammer in the isolation condenser steamlines. The licensee states that operating procedures terminate all reactor vessel water injection should the water level reach 190 inches (above the top of active fuel). Because of these

procedures, and training to maintain the water level below the isolation condenser steamlines, we find that this essentially precludes water from entering the main steamlines. Therefore, except the fuel zone loop power supplies, we find the provided instrumentation acceptable.

3.3.3 Reactor Coolant System Pressure

Regulatory Guide 1.97 recommends redundant power supplies and recording for this Category 1 instrumentation. The licensee clarified the power for this instrumentation in Reference 6. 120-Vac vital instrument buses power this instrumentation. In Reference 7, the licensee states plans to modify these power sources to eliminate the momentary power loss when the RPS motor generators lose power. The licensee may add strip chart recorders to cover the entire range. We do not view this as a commitment to follow the regulatory guide recommendations. The licensee should provide recording for this instrumentation.

3.3.4 Drywell Sump Level
Drywell Drains Sump Level

Regulatory Guide 1.97 recommends Category 1 instrumentation for these variables. The sumps at Oyster Creek use level switches to alarm in the control room and to start sump pump out. Timers indicate the duration of the sump pump operation for estimating the amounts of leakage. This instrumentation is Category 3. No safety-related system is either automatically or manually actuated as a result of the sump level. The drywell sump systems automatically isolate at the primary containment penetration should an accident signal occur. Drywell temperature and pressure, and primary containment area radiation instrumentation, can also show leakage from the reactor coolant system.

We conclude that the alternate instrumentation provided by the licensee will provide the appropriate monitoring for the parameters of concern. We base this conclusion 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. The drywell pressure (Category 1) and temperature (Category 2) as well as the area radiation instrumentation located within primary containment are alternative indications to leakage in the drywell.

4. 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 alternate instrumentation acceptable.

3.3.5 Radiation Level in Circulating Primary Coolant

The licensee indicates that radiation level measurements to indicate fuel cladding failure are provided by the following.

1. condenser off-gas radiation instrumentation

2. main steamline radiation instrumentation

3. primary containment radiation instrumentation

4. post-accident sampling system

The NRC reviewed and approved the post-accident sampling system as part of their review of NUREG-0737, Item II.B.3. Additionally, the containment hydrogen concentration instrumentation indicates the extent of any fuel failure.

The licensee indicates that verifying reactor shutdown and maintaining the coolant level are the only mandatory operator actions to prevent the failure of fuel cladding in a post-accident situation. The instrumentation for this variable does not assist in either action.

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

3.3.6 Containment Effluent Radioactivity
Effluent Radioactivity

Regulatory Guide 1.97 recommends the following instrumentation for these variables. For containment effluent radioactivity, the regulatory guide recommends Category 3 instrumentation with a range of 10^{-6} μCi/cc to 10^{2} μCi/cc. For effluent radioactivity, the regulatory guide recommends Category 2 instrumentation with a range of 10^{-6} μCi/cc to 10^{3} μCi/cc. This instrumentation, because of plant design, is the same for both variables. This instrumentation is in a mild environment and receives Category 2 power.

The licensee states, in Reference 9, that the lower limit of the range of this instrumentation satisfies the recommendation of the regulatory guide. The licensee states, in Reference 6, the upper limit of the range (127 μCi/cc) is acceptable because the worst case calculated radioactivity level monitored is 9.2 μCi/cc. In Reference 9, the licensee states that the NRC previously accepted this range. We find this a good faith attempt to meet NRC requirements (as defined in NUREG-0737, Supplement No. 1, Section 3.7 [Reference 3]) and, therefore, acceptable.

The licensee's instrumentation meets the Category 2 criteria except the signal cables that route through the reactor building. The signal cables connect the local RAGEMS microprocessor to the remote microprocessor near the control room. The licensee states that local manual sampling capability is possible. Thus, if the signal cable should fail, information would still be available to the control room operator by alternate methods.

Because this instrumentation always remains on scale, essentially meets Category 2 criteria, and manual backup sampling is possible, we find the instrumentation acceptable for post-accident monitoring.

3.3.7 Radiation Exposure Rate

Regulatory Guide 1.97 recommends instrumentation for this variable with a range of 10^{-1} R/hr to 10^{4} R/hr. The licensee states that rather than using an arbitrary limit of 10^{4} R/hr, they will, on a case by case basis, address the worst case expected radiation level for a given instrument location. Instruments have ranges of 0.01 mR/hr to 100 mR/hr, and 0.1 mR/hr to 1000 mR/hr, and 10 mR/hr to 10^{6} mR/hr. The licensee states that of the 28 area monitor detectors, analysis shows that 11 of them will remain on scale.

If the signal exceeds the instrument range, alternate instrumentation can detect a further breach of containment or detect and assess significant releases. The licensee also provides portable survey instruments, atmosphere sampling, and effluent monitors. This alternate instrumentation includes long-term surveillance for any releases. Based on this, we find the licensee's instrumentation for this variable acceptable.

3.3.8 Suppression Pool Spray Flow
Drywell Spray Flow

The containment spray system flow instrumentation supplies information for both of these variables. Both the suppression pool and the drywell sprays are portions of the containment spray flow system. Category 2 instrumentation monitors the system flow in the control room. The flow, by design, is proportioned between the two sprays. Position indication of the containment spray bypass valves indicates that the torus spray nozzles spray approximately five percent of the containment spray flow.

Pressure and temperature changes in the drywell and torus determine the effectiveness of the spray. The licensee concludes that the containment spray flow and bypass valve position, supplemented by the torus and drywell

temperature and pressure indications, accurately and reliably measure the effectiveness of the drywell and suppression chamber spray.

We find that this instrumentation will provide appropriate flow indication for these variables.

3.3.9 Torus Water Temperature

The licensee has classified this as a Type A variable; as such, the instrumentation should be Category 1. Reference 5 identified 4 channels of instrumentation. Reference 7 identified a range of 40°F to 240°F.

Reference 6 describes plans to install instrumentation for this variable during refueling outage 12R. The instrumentation will have two divisions with 6 sensors in each division. Each division will have independent Class 1E battery-backed power supplies. The system is to be environmentally and seismically qualified. The plant computer will provide the display and recording capability. Revision 3 of Regulatory Guide 1.97 accepts this recording capability. We find the proposed instrumentation acceptable in meeting the recommendations of Regulatory Guide 1.97.

3.3.10 Standby Liquid Control System Flow

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable. The licensee has elected not to implement this variable as recommended by Regulatory Guide 1.97. The justification given by the licensee is that the standby liquid control system (SLCS) pump discharge pressure provides indication that the SLCS pump, a positive displacement pump, is operating. The pressure indication, as well as pump motor on/off indication, is Category 3. A decreasing level indication in the SLCS storage tank gives indication that flow is occurring. This instrumentation is in a mild environment. In addition, neutron flux and squib valve continuity indicating lights supplement the above SLCS information.

We find the above instrumentation acceptable as an alternative indication of SLCS flow. We base this acceptance on information provided through Reference 6. References 7 and 9 do not provide information on this deviation.

3.3.11 Standby Liquid Control System Storage Tank Level

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable. The licensee uses this instrumentation as a key variable in determining that standby liquid control system (SLCS) flow is occurring.

The licensee states that this Category 3 instrumentation operates in a mild environment. The licensee also states that the design basis for the SLCS recognizes that the system has a safety classification less than the importance of the reactor protection system and the engineered safeguards systems. Based on the use and application of this instrumentation in a mild environment, we find the provided instrumentation acceptable for this variable.

3.3.12 Cooling Water Temperature to Engineered Safety Features System Components

The licensee has alternate instrumentation for this variable. The licensee states the emergency service water temperature to the containment spray heat exchanger provides this function. The licensee verifies proper operation of the heat exchanger for the containment spray system by observing alternate instrumentation. The alternate instrumentation includes Category 2 containment spray system flow instrumentation, the containment spray heat exchanger inlet and outlet temperature (Category 1 instrumentation for the inlet and Category 2 instrumentation for the outlet), and Category 2 emergency service water flow. The licensee states that the containment spray system is the only system that uses the emergency service water system.

We find this alternate instrumentation acceptable for this variable.

3.3.13 High Radioactivity Liquid Tank Level

Regulatory Guide 1.97 recommends a display of this variable in the main control room. The licensee does not display this variable in the main control room. Instead, indication is in the radwaste control room. The licensee states that the use of telephones or radio links can relay this information to the main control room. This infers that the radwaste control room is habitable and manned following an accident.

Based on the licensee's justification, we find that monitoring this variable in the radwaste control room of the Oyster Creek Station instead of the main control room is acceptable.

3.3.14 Status of Standby Power

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable. The licensee's instrumentation consists of voltmeters and ammeters for the A and B diesel generators and the B and C batteries. The instrumentation has a mild post-accident environment. Cable routed through the turbine building is part of the licensee's cable qualification program.

We conclude that the licensee's instrumentation for the variable 'Status of Standby Power' is acceptable.

3.3.15 Reactor Building Area Radiation

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable with a range of 10^{-1} R/hr to 10^{4} R/hr. The licensee has area radiation monitors with ranges that vary according to location. None of the area radiation monitors meet the recommended range. The licensee reports the use of local radiation exposure rate monitors provides ambiguous indication of containment breach or leakage through primary containment penetrations. 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 using the vent stack noble gas effluent monitors is the proper way to accomplish the detection of releases, release assessment, and the long term surveillance recommended for this variable. The licensee shows that the vent stack noble gas effluent monitors, with dilution, cover the range recommended for this variable. Additionally, should an area radiation monitor go off scale, the licensee prohibits personnel from these areas without appropriate portable radiation monitors.

We find the licensee's use of the area radiation monitors (with ranges that do not comply with the recommended range) in concert with the vent stack noble gas effluent monitors acceptable.

3.3.16 Stack Noble Gas and Vent Flow Rate

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable with ranges of 10^{-6} μCi/cc to 10^{4} μCi/cc (because the vent includes the drywell or standby gas treatment system purge) and zero to 110 percent of design flow. The licensee has described the Radioactive Gas Effluent Monitoring System (RAGEMS) for this variable. The instrumentation has a mild post-accident environment and receives Category 2 power.

The licensee states, in Reference 9, that the lower limit of the range of this instrumentation satisfies the recommendations of the regulatory guide. The licensee states, in Reference 6, the upper limit of the range (127 μCi/cc) is acceptable because the worst case calculated radioactivity level monitored is 9.2 μCi/cc. In Reference 9, the licensee states that the NRC previously accepted this range. We find this a good faith attempt to meet NRC requirements (as defined in NUREG-0737, Supplement No. 1, Section 3.7 [Reference 3]) and, therefore, acceptable.

The licensee's instrumentation meets the Category 2 criteria except the signal cables that route through the reactor building. The signal cables connect the local RAGEMS microprocessor to the remote microprocessor near

the control room. The licensee states that local manual sampling capability is possible. Thus, if the signal cable should fail, information would still be available to the control room operator by alternate methods.

Because this instrumentation will always remain on scale, essentially meets Category 2 criteria, and manual backup sampling is possible, we find the instrumentation acceptable for post-accident monitoring.

3.3.17 Accident Sampling (Reactor Coolant, Containment Air and Sumps)

The licensee can sample and analyze the ranges recommended for this variable for both the reactor coolant and the containment air. The licensee does not sample the containment, auxiliary building, or emergency core coolant system (ECCS) sumps as recommended by Regulatory Guide 1.97. The licensee analyzes samples of the torus water and reactor coolant. The drywell sump systems overflow to the torus.

The licensee deviates from the Regulatory Guide 1.97 post-accident sampling capability criteria. This deviation goes beyond the scope of this review and was reviewed and approved by the NRC as part of the review of NUREG-0737, Item II.B.3.

3.3.18 Drywell (Containment) Isolation Valve Position

Regulatory Guide 1.97 recommends Category 1 position indication for these valves. 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. Table 2 of Regulatory Guide 1.97 specifically excludes position indication of check valves.

In Reference 9, the licensee states there are more than 130 containment isolation valves. The licensee states that except the main steam isolation valves, the isolation condenser isolation valves, and the cleanup system isolation valves, the primary containment isolation valves do not require redundancy and separation. The licensee states that these remaining valves are small and low pressure, and may or may not be a reactor coolant system boundary.

The acceptability of the licensee's position indication for the contaminant isolation valves is not evident from the information provided. For example, the licensee lists two shutdown cooling isolation valves and one power supply. This could be acceptable if the design has specific design features that allows powering both containment isolation valves by the same power supply. Similarly, power supply panel CIP-3 is the indication power for all drywell equipment drain tank isolation valves, drywell sump isolation valves, drywell and torus atmosphere control isolation valves, and torus to reactor vacuum relief isolation valves. The operation of some of these isolation valves is the basis for accepting Category 3 instrumentation for the drywell drain sumps level and drywell sump level instrumentation. Thus, the position indication of the values must be reliable. Thus, the impact of using non-Category 1 instrumentation for this variable goes beyond verification of containment isolation. Inaccurate indication of the position of these containment isolation valves could cause the indication of an open line when it is, in fact, closed. As this could delay the operator from taking important procedural steps, the licensee should provide the recommended Category 1 position indication instrumentation for all containment isolation valves.

3.3.19 Reactor Water Level Reference Leg Temperature (Drywell Atmosphere Temperature)

The licensee designated this a Category 2 variable. For drywell atmosphere temperature, the regulatory guide recommends Category 2 instrumentation. Category 2 criteria include a program for servicing, maintaining, and calibrating the instrumentation to maintain the instrument capability. The licensee identified a deviation from the recommendations of the regulatory guide because they cannot calibrate these thermocouples

because of their high radiation location. The licensee states that they check these channels daily, and continuously trend the signals. Thus, undetected thermocouple failure is not likely. The channels normally read nearly the same, and are cross checked. Because the licensee includes observations of these indications in determining the validity of the indication, we find the lack of periodic thermocouple calibration for this variable acceptable.

3.3.20 Main Streamline Isolation Valves' Leakage Control System Pressure

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable. The licensee states that Oyster Creek has no leakage control system for the main steamline isolation valves. Therefore, this variable does not require instrumentation.

3.3.21 Primary System Safety Relief Valve Position

Regulatory Guide 1.97 recommends Category 2 position indication for safety relief valves and automatic depressurization systems. The licensee has 16 code safety valves that have Category 3 position indication. The position indication is an acoustic monitoring system. The licensee states there is no manual means to close these valves.

When a code safety valve operates automatically, the operator should have the indication to show it has operated. Even though the operator cannot directly change the valve position, we find the Category 3 position indication not acceptable. Therefore, the licensee should upgrade this instrumentation to Category 2 criteria.

3.3.22 Reactor Core Isolation Cooling System Flow

Oyster Creek does not have a reactor core isolation cooling system. Therefore, this variable does not require instrumentation.

3.3.23 High Pressure Coolant Injection System Flow

Oyster Creek does not have a high pressure coolant injection system. Therefore, this variable does not require instrumentation.

3.3.24 Low Pressure Coolant Injection System Flow

Oyster Creek does not have a low pressure coolant injection system. Therefore, this variable does not require instrumentation.

3.3.25 Emergency Ventilation Damper Position

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable. The licensee has chosen to monitor the standby gas treatment system operation and secondary containment integrity by observing the reactor building pressure. The licensee states that this Category 2 instrumentation indicates the closure of all isolation dampers and access doors, and operation of the standby gas treatment system when the reactor building pressure is -0.25 inches of water. Based on the licensee's description, we find this alternate instrumentation acceptable.

3.3.26 Redundancy and Separation

The licensee states that Category 1 instrumentation usually uses cables and control panel locations that are part of the original station construction. The design predated Regulatory Guide 1.75 and IEEE Standard 384-1974 and uses conduit to enter the control room. Installations in the control room, especially in the control panels, do not have physical separation that satisfies these more recent criteria. The six inch channel separation is not achievable in these panels. Recently installed instrumentation, installed after the installation of the new cable spread room, maintain separation that meets Regulatory Guide 1.75 and IEEE Standard 384-1974 criteria.

The licensee states that they continuously man the control room. The affected areas have fire detection and fire suppression. Additionally, the licensee has a remote shutdown panel that meets the Appendix R criteria.

The licensee has evaluated the potential of this layout for degrading the instrumentation provided for Regulatory Guide 1.97. The licensee states that the newer instrumentation better meets the separation criteria. The

licensee indicates that a fire is the concern that could cause the loss of redundant channels of instrumentation. The licensee indicates that a fire does not require the use of this instrumentation, nor is the ability to bring the plant to a safe shutdown compromised. The remote shutdown panel is available to shut down the reactor. The licensee indicates compliance with Appendix R to 10 CFR 50.

We find these particular instances of lack of complete separation acceptable. We base this acceptance on the control room panels, cable spreading room, and tray system design predating the separation criteria, the licensee's evaluation of potential hazards as a result of this design, the remote shutdown facility, and fire detection and suppression systems.

3.3.27 Channel Availability

Regulatory Guide 1.97 recommends that the licensee specify minimum channel availability requirements for Category 1 and Category 2 instruments. For Category 1 instruments, the channels should be available before an accident except when under active test, calibration, or maintenance or as allowed by technical specifications. For Category 2 instruments, the channels should be in service as directed by technical specification requirements on the out of service requirements of the system the instrumentation serves, or where specified by other requirements. There is no specific channel availability requirement for Category 3 instrumentation. The licensee takes exception to this requirement.

Reference 9 addresses Type A variables. With three exceptions, the Type A instrumentation channels are under limiting conditions of operation (LCO).

- Fuel zone wide-range reactor water level.

  This instrumentation has automatic malfunction lights and operator observation to assure system operation. The operator can compare the indicated level to the narrow-range level instruments. The licensee calibrates the instruments on a refueling basis.

- Wide-range reactor pressure

  This instrumentation is compared to other reactor pressure instruments and is logged daily.

- Drywell oxygen concentration

  The licensee tests this instrumentation by procedure monthly along with the hydrogen concentration instrumentation. It is a common monitoring system and thus subjected to the LCOs for the hydrogen monitors.

The licensee is planning to adopt the proposed updated boiling water reactor Standard Technical Specifications. This will contain LCOs on all Category 1 instruments. Category 2 instruments are considered part of the system availability. We consider the licensee's program to assure the availability of the post-accident monitoring instrumentation acceptable.

3.3.28 Equipment Identification

Regulatory Guide 1.97 recommends that each Category 1 and Category 2 readout, indicator, or recorder that serves a Type A, Type B, or Type C function have a common, specifically-identified designator on contr l panels. With the common designator, operators can readily discern the instrument is for use under accident conditions.

The licensee has not complied with this recommendation. The licensee states that the emergency operating procedures (EOPs) are symptomatic. As such, the EOPs do not reference specific instrumentation. The licensee states that relying on potentially erroneous post-accident monitoring instrumentation is not warranted. The licensee also infers that over-reliance on a single set of instruments or Category 1 variables impairs transient recovery.

The whole purpose of Regulatory Guide 1.97 is to provide the control room operators with reliable instruments to work with in a post-accident

situation. By design, the operators can rely on this set of instruments. Where ambiguity between channels exist, the operator can identify the correct instrument with ease. This identification on the control panels does not restrict the operators to using only those instruments so identified. We conclude that the licensee should provide the recommended common instrument identification.

3.3.29 Interfaces

Section 9 of Table 1 of Regulatory Guide 1.97, Revision 3, requires isolation devices between Category 1 and 2 instrumentation and any equipment that does not meet the same design criteria. Separation and redundancy up to and including the isolation device protects Category 1 channels from potential single failures. The licensee states, in Reference 9, that they do not use fuses for isolation devices. However, the licensee did not identify isolation devices. Therefore, an undetected fault could introduce an offset or other anomality to the signal. Therefore, the licensee should provide isolation amplifiers in accordance with Regulatory Guide 1.97.

4. CONCLUSIONS

Based on our review, we find that the licensee either conforms to, or has acceptable justification for deviating from Regulatory Guide 1.97, except the following variables.

1. Neutron flux -- The licensee should provide neutron flux monitoring instrumentation that fully meets the Category 1 and range recommendations of Regulatory Guide 1.97. The licensee should provide independent Class 1E power supplies for the redundant channels of instrumentation. See Section 3.3.1.

2. Coolant level in reactor -- The licensee should provide independent loop power supplies for the fuel zone transmitters. See Section 3.3.2.

3. Reactor coolant system pressure -- The licensee should provide recording for this variable. See Section 3.3.3.

4. Drywell (containment) isolation valve position -- The licensee should provide Category 1 position indication for all containment isolation valves. See Section 3.3.18.

5. Primary system safety relief valve position -- The licensee should upgrade the indication for the code safety valves to Category 2 criteria. See Section 3.3.21.

6. Equipment identification -- The licensee should provide a common instrument identification for Category 1 and 2 variables. See Section 3.3.28.

7. Interfaces -- The licensee should provide isolation amplifiers in accordance with Regulatory Guide 1.97. See Section 3.3.29.

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.

4. Letter, GPU Nuclear Corporation (P. B. Fiedler) to NRC (D. G. Eisenhut), "Supplement 1 to NUREG-0737 Regulatory Guide 1.97 Response," June 13, 1984.

5. Letter, GPU Nuclear Corporation (P. B. Fiedler) to NRC (J. A. Zwolinski), "Supplement 1 to NUREG-0737 Regulatory Guide 1.97 Response," May 9, 1986.

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7. Letter, GPU Nuclear Corporation (E. E. Fitzpatrick) to NRC, "Topical Report 028, Rev. 1, OC Response to U.S. NRC Regulatory Guide 1.97," April 13, 1990.

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9. Letter, GPU Nuclear Corporation (E.E. Fitzpatrick) to NRC, "Oyster Creek Nuclear Generating Station Response to NRC Questions Regarding Regulatory Guide 1.97," July 23, 1990, C370-90-753.

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11. ABSTRACT (200 words or less)

This EG&G Idaho, Inc., report documents the review of the Regulatory Guide 1.97, Revision 3, submittals for the Oyster Creek Nuclear Generating 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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