ENCLOSURE

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

EMERGENCY DIESEL GENERATOR PROJECT - ELECTRICAL ENGINEERING DESIGN REPORT

BALTIMORE GAS AND ELECTRIC COMPANY

CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NOS. 1 AND 2

DOCKET NOS. 50-317 AND 50-318

1.0 INTRODUCTION

By letter dated July 26, 1993, Baltimore Gas and Electric Company (BG&E) submitted Revision 0 of a report entitled "Emergency Diesel Generator Project - Electrical Engineering Design Report" for NRC review and approval. This report is one of a series of design reports that BG&E planned to develop to obtain NRC approval of modifications to the on-site emergency electrical system at the Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 (Calvert Cliffs). These modifications are being implemented in response to 10 CFR 50.63, "Loss of All Alternating Current Power," which is referred to as the station blackout (SBO) rule. The modifications will add one safety-related diesel generator (DG) and one nonsafety-related DG at Calvert Cliffs.

The plant currently has three Class 1E DGs. One DG is dedicated to each unit and one DG swings to the accident unit. After the modifications to the on-site emergency electrical system are complete, Calvert Cliffs will have one DG dedicated to each of the four engineered safety features (ESF) buses. The nonsafety-related DG will be used as an alternate ac source to comply with the SBO rule.

The NRC staff's evaluation of Revision 0 of BG&E's report entitled "Emergency Diesel Generator Project - Electrical Engineering Design Report" is discussed below.

2.0 EVALUATION

The existing electrical on-site system for each unit at Calvert Cliffs consists of six 4.16 kV buses, two of which supply power to the 4.16 kV ESF which are associated with 4.16 kV Emergency Buses 11 and 14 for Unit 1 and Emergency Buses 21 and 24 for Unit 2.

The three existing DGs can be aligned to the four 4.16 kV ESF buses as follows:

* DG 11 can be aligned to Bus 11 (Unit 1) or Bus 21 (Unit 2). It is normally aligned to Emergency Bus 11.

* DG 21 can be aligned to Bus 24 (Unit 2) or Bus 14 (Unit 1). It is normally aligned to Emergency Bus 24.

* DG 12 can be aligned and connected to any one of the 4.16 kV emergency buses. Normally closed disconnect switches align DG 12 to supply power to either Emergency Buses 14 or 21. Although DG 12 is aligned to both buses, the DG output breaker must still be closed to supply power to the ESF bus of the affected unit. This is performed automatically by the control logic for the DG or manually (if required).

The three DGs in the existing standby power system are automatically started by either a 4.16 kV emergency bus undervoltage signal or a safety injection actuation signal (SIAS). For a SIAS, the DG is not connected to a 4.16 kV ESF bus unless an undervoltage condition exists on the ESF bus, as indicated by an undervoltage signal.

The existing electrical system has two independent load groups per unit. After installation of the new safety-related DG, manufactured by Societe Alsacienne de Construction Mecanique de Mulhouse (SACM), each load group will have its own standby electrical power to include a dedicated DG, buses, transformers, loads, and associated ac and dc control power. Each load group is independently capable of safely shutting down its associated unit.

With the addition of the SACM DG, the electrical system will be designated as follows:

* The SACM DG will be designated as DG 1A, and will be connected to 4.16 kV Emergency Bus [illegible]

* DG 11 will be designated as DG 2A, and will be dedicated to 4.16 kV Emergency Bus 21.

* DG 21 will be designated as DG 2B, and will remain connected to 4.16 kV Emergency Bus 24.

* DG 12 will be designated as DG 1B, and will be dedicated to 4.16 kV Emergency Bus 14.

With this configuration, each DG will have adequate capacity to meet the power requirements of its dedicated ESF bus. Each DG will be automatically started by either a 4.16 kV undervoltage signal or a SIAS. For a SIAS, the DG will only be connected to the 4.16 kV emergency bus when a loss of offsite power or a sustained bus undervoltage (degraded voltage condition) is indicated by a two-out-of-four logic signal from either set of four undervoltage relays.

Two sets of dual-level undervoltage relays are provided for each of the 4.16 kV emergency buses. One level of the dual-level undervoltage relays is set for detection of loss of voltage at 59 percent of rated bus voltage with a time delay of 0.5 second. The second level of the dual-level undervoltage relays is set at 90 percent of rated bus voltage with a time delay of 7.5 seconds. Both levels of the dual-level undervoltage relays operate in a two-out-of-four logic to disconnect the offsite power source, load shed the associated 4.16 kV emergency bus, and start the dedicated DG whenever the undervoltage setpoint has been exceeded for the required time delay. An additional 0.5-second delay after the DG has been started and is ready to accept load permits the decay of the residual bus voltage before the DG breaker closes.

A new Class 1E 4.16 kV bus, designated as Unit Bus 17, will be provided and installed in the seismic Category I Diesel Generator Building. Unit Bus 17 may be powered from either its offsite power source or its standby power source (DG). Since these power sources may be operated in parallel during testing, a synchroscope will be provided on the Main Control Board (MCB) Electrical Power System Panels. This synchroscope will allow the operator to verify that the frequency and phase angle of the two source voltages are synchronized within the required limits before closing the breaker to operate the two sources in parallel. The 4.16 kV metal-clad switchgear will use three-pole, electrically operated vacuum circuit breakers of the stored energy type with a five-cycle interrupting time.

Separation in the Diesel Generator Building will be maintained between safety-related and nonsafety-related electrical systems, including associated feeder cables, in accordance with the requirements of IEEE Standard 384-1974, "Criteria for Independence of Class 1E Equipment and Circuits," as endorsed by Revision 2 of Regulatory Guide (RG) 1.75, "Physical Independence of Electric Systems." The following discussion describes how the separation of redundant Class 1E circuits or of Class 1E and non-Class 1E circuits will be maintained for circuits located within the Diesel Generator Building. Separation of redundant equipment and circuits outside the Diesel Generator Building will be addressed by evaluations pursuant to 10 CFR 50.59.

Physical separation in the Diesel Generator Building between redundant Class 1E and non-Class 1E conduits and open trays will generally be in accordance with the figures in IEEE 384-1974 and IEEE 384-1981 that are applicable to enclosed raceway and open cable trays. Separation within the local control panels in the Diesel Generator Building will also be in accordance with the recommendations of RG 1.75 (Revision 2).

There are, however, several additional configurations applicable to conduits that are not addressed by the figures in IEEE 384-1981. After issuing IEEE 384-1981, the IEEE Nuclear Power Engineering Committee Working Group on Independence Criteria published a paper entitled "Cable Separation - What Do Industry Testing Programs Show?" This paper provides additional recommendations that cover these configurations. The recommendations applicable to the Diesel Generator Building for the physical separation between redundant Class 1E conduits and Class 1E open trays are as follows:

* When a Class 1E conduit is horizontal to a redundant Class 1E open tray (i.e., the same elevation), the separation must be greater than 6 inches.

* When a Class 1E conduit is above and parallel to a redundant Class 1E open tray or crosses the open tray at an angle less than 45 degrees, the separation must be greater than 12 inches.

* When a Class 1E conduit is above a redundant Class 1E open tray or crosses the open tray at an angle greater than 45 degrees, the separation must be greater than 3 inches.

* When a Class 1E conduit is below the redundant Class 1E open tray, the separation must be greater than 1 inch.

* Separation between non-Class 1E conduit and Class 1E open tray must be greater than 1 inch.

BG&E is following these recommendations and the staff finds that acceptable.

The DG auxiliaries and Diesel Generator Building auxiliaries will be supplied from the 4.16 kV Unit Bus 17 via a 4.16 kV-480 V unit substation and associated Motor Control Center (MCC). The 480 V unit substation will be a metal-enclosed switchgear consisting of an incoming section, a dry-type transformer, and a low-voltage section that includes a metering and relay cubicle. The 480 V MCC consists of enclosed vertical sections joined together to form a rigid, freestanding assembly. The 480 V unit substation supplies power to two 480 V MCCs for the Diesel Generator Building. One MCC which supplies safety-related loads is Class 1E and the second MCC supplies nonsafety-related auxiliaries. The circuit breaker of the unit substation which supplies the non-Class 1E MCC is designed as a Class 1E isolation device. This arrangement is acceptable as it conforms to RG 1.75 (Revision 2).

Essential and emergency lighting that requires DG-backed power will be fed from the Class 1E 480 V MCC in the Diesel Generator Building via a 480-208/120 V dry-type transformer and a 208/120 V essential lighting panel. These panels are classified as nonsafety-related. The 480 V feeder breaker (at the MCC) is designed as an isolation device and is acceptable as it conforms to RG 1.75 (Revision 2).

The 208/120 V nonsafety-related auxiliary loads for the Diesel Generator Building are supplied from the nonsafety-related 480 V MCC via a 480-208/120 V dry-type transformer and a 208/120 V distribution panel located in the non-Class 1E MCC.

Motors used in the auxiliary systems for the SACM DG and its Diesel Generator Building are, in general, of the squirrel cage induction type, suitable for across-the-line starting. Safety-related (Class 1E) motors for the SACM DG are capable of starting and accelerating their loads to full speed with 80 percent of the rated motor nameplate voltage. They are also sized to provide full load torque during a momentary voltage dip of 75 percent of rated motor nameplate voltage at the terminals, complying with RG 1.9, "Selection, Design, and Qualification of Diesel-Generator Units Used as Standby (Onsite) Electrical Power Systems at Nuclear Power Plants."

The 125 V dc power for the Diesel Generator Building and the DG auxiliaries will be supplied by a dedicated 125 V dc power system. It will be independent and support only the electrical load group associated with its DG and conforms to the recommendations of Safety Guide 6, "Independence Between Redundant Standby (Onsite) Power Sources and Between their Distribution Systems."

Portions of the 125 V dc power system which support the safety function of the DG to start and supply power to 4.16 kV Emergency Bus 11 are designated as Class 1E. Redundant and diverse Class 1E fuses are used as isolation devices to protect the safety-related 125 V dc distribution panel from faults which could occur in the nonsafety-related 125 V dc distribution panel.

The Diesel Generator Building houses a 125 V dc battery in its own room apart from the battery charger and distribution equipment. The battery room has adequate lighting, ventilation, and space for performing the battery maintenance and has a continuously operating exhaust system to ensure that hydrogen accumulation remains within the limits specified in IEEE 484-1987, "Recommended Practice for Installation Design and Installation of Large Lead Storage Batteries for Generating Stations and Substations."

During normal operation, the battery charger will be energized from the Class 1E 480 V MCC located in the Diesel Generator Building. The battery charger maintains a constant voltage to supply (float) the battery with sufficient current to maintain it fully charged while supplying the dc loads. In the event of the loss of ac power, the 125 V dc battery will supply the required dc loads. When the ac power is restored, the battery charger will be reenergized and will resume normal operation. The battery is designed with adequate capacity to supply safety-related and nonsafety-related dc loads for 4 hours without the battery charger.

The capacity of the battery charger is based on: (a) the largest combined demands of the various steady-state dc loads during normal and post-accident conditions and (b) the charging capacity required to restore the battery from the fully discharged state to the required load capacity within 24 hours as required by RG 1.32, "Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants."

The 125 V dc battery is a 60-cell lead-calcium storage battery designed for full-float operation with a battery charger. The load profile used to determine the battery size is established in accordance with IEEE 485-1983, "Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations." The load profile consists of a combination of transient loads and steady-state loads for the design basis accident scenario, coincident with a simultaneous loss of offsite power and a failure of the battery charger. Transient loads (including DG start, 4.16 kV breaker operation, and flashing of the generator field) are added to the steady-state loads (e.g., indication, protection, alarms, and inverter loads) during the first and last minute of the profile duration. This loading scenario establishes the worst-case dc load for sizing the battery.

The battery is also sized according to the recommendations of IEEE 485-1983, using the temperature correction factor based on the minimum ambient temperature of 50 °F. Aging is compensated for by adding an additional 25-percent capacity when sizing the battery. This allows for battery replacement at 80 percent of rated capacity. Similarly, additional design margin is added as per IEEE 485-1983.

Class 1E electrical equipment in the Diesel Generator Building is qualified in accordance with either IEEE 344-1975, "Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," as endorsed by Revision 1 of RG 1.100, "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants," or with IEEE 344-1987 as endorsed by Revision 2 of RG 1.100. Qualification by experience, addressed in Section 9.0 of IEEE 344-1987, is only employed through the use of analysis or test data from previous qualification programs. The licensee's approach is acceptable.

In its submittal, BG&E confirmed that safety-related structures, systems, and components for the SACM diesel generator, namely the ac and dc systems, are designed to comply with General Design Criteria 17 and 18, Safety Guide 6, draft Revision 3 of RG 1.9, and Revision 2 of RG 1.32. The following provides the analyses of the ac and dc systems:

A. AC Systems

1. The rating of the 4.16 kV switchgear was selected from the preferred ratings of IEEE C37.06, "AC High-Voltage Circuit Breakers Rated on a Symmetrical Circuit Basis - Preferred Ratings and Related Equipment Capabilities," to provide a conservative margin of safety based on the required interrupting capability. The 4.16 kV emergency bus switchgear is rated at 250 MVA. The required rating is based on the ac system short-circuit calculation performed in accordance with IEEE C37.010, "Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis," and IEEE 141, "Recommended Practice for Electric Power Distribution for Industrial Plants." The power system, diesel generator, and connected motors are considered in the model for determining the fault currents. All motors connected to the buses are considered to be operating when the short circuit occurs.

2. The interrupting rating of the 480 V unit substation is determined from the preferred ratings of IEEE C37.16, "Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements and Application Recommendations," to provide a

conservative margin of safety. The required interrupting capacity of the 480 V unit substation is determined from the ac system short circuit calculation.

3. The bus system of the 480 V MCCs has a continuous current rating and short-circuit bracing selected from the National Electric Manufacturers Association standard ratings to withstand short-circuit currents determined from the ac system short circuit calculation.

   Short circuit protection for combination motor starters is provided by magnetic-only molded-case circuit breakers with adjustable instantaneous magnetic-trip elements. The continuous current rating of these adjustable instantaneous magnetic-trip molded-case circuit breakers is based on 125 percent of the full load current.

   Running protection of the motors is provided by the thermal overload relays in the combination motor starters. The heater elements in the overload relays have longtime trip characteristics which approximate the heating curves of the motor's loads. The criteria for selection of the thermal overload relays and heater elements is based on 125 percent cf the full-load current for motors with a service factor of 1.15 and 115 percent of the full-load current for motors with a service factor of 1.0. The thermal overload protection is consistent with Regulatory Position C.2 in Revision 1 of RG 1.106, "Thermal Overload Protection for Electric Motors on Motor-Operated Valves." Thermal overload relays are manually reset at the MCC.

4. Protection of feeder circuits, other than motor feeder circuits, is provided by thermal-magnetic molded-case circuit breakers. The continuous current rating of these thermal-magnetic molded-case circuit breakers is also based on 125 percent of the full-load current.

   Control transformers provided with each combination motor starter are one size larger than normally supplied by the manufacturer to accommodate additional controls and auxiliaries that may be required.

5. All wire and cable installed in scheduled raceway in the Diesel Generator Building are flame retardant. In general, all wire and cable installed in the scheduled raceway in the Diesel Generator Building are also designed and specified as Class 1E regardless of the actual circuit function. Materials that are prone to release corrosive off-gases, specifically polyvinyl chloride, are not used as an insulation or jacket for any type of wire and cable.

B. DC System

The 125 V dc system consists of a 125 V dc battery, a battery charger, a safety-related distribution panel, a nonsafety-related distribution panel, and the associated 125 V dc instrumentation. The 125 V dc power system is designed in accordance with the guidance of IEEE 946-1985, "Recommended Practice for the Design of Safety-Related DC Auxiliary Power Systems for Nuclear Power Generating Stations." The battery room is designed in accordance with the installation design requirements of IEEE 484-1987 and Revision 1 of RG 1.128, "Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants." The battery is separately housed in its own room with adequate lighting, ventilation, and space for performing the battery maintenance. Loads used for sizing the battery are based on the recommendations of IEEE 485-1983.

The battery charger is sized so that it is able to supply the steady-state dc system loads and recharge the battery from a fully discharged state to the required load capacity in 24 hours. During normal operation, the battery charger is energized from the Class 1E 480 V MCC located in the Diesel Generator Building. The battery charger maintains a constant voltage to supply (float) the battery with sufficient current to keep it fully charged and also supply the steady-state dc load. In the event of the loss of ac power, the 125 V dc battery will continue to supply the required dc loads. When the ac power is restored, the battery charger will be reenergized and will resume normal operation.

The 125 V dc power system is ungrounded. It has a ground detection system to alarm at the MCB when the system becomes inadvertently grounded.

The controls and status indication for the 125 V dc power system are provided locally except for battery current and dc system voltage which are provided on the MCB dc system panel. A system trouble alarm is also provided at the MCB dc system panel.

The following voltage classes of cable are installed in the Diesel Generator Building:

* medium voltage (5 kV) power cable
* low voltage (600 V) power cable
* low voltage (600 V) control cable
* instrumentation and specialty cables
* low voltage (600 V) switchboard wire

The design of the Class 1E cable system for installation in the safety-related raceway system in the Diesel Generator Building uses the guidance of IEEE 690-1984, "Design and Installation of Cable Systems for Class 1E Circuits in Nuclear Power Generating Stations," including its appendices. In lieu of the criteria for percent fill in random fill trays provided in IEEE 690-1984, the following conservative criteria are used for cable derating in the Diesel Generator Building:

* 40-percent fill for random-filled power and control cable tray
* 60-percent fill for random-filled instrument cable tray
* percent fill for conduit is in accordance with National Fire Protection Association (NFPA) Standard 70, "National Electrical Code." Ampacity rating and group derating factors of cables are in accordance with Insulated Cable Engineers Association (ICEA) P-46-426, "Power Cable Ampacities, Volume 1, Copper Conductors and Cumulative Errata Sheets," for cables in conduit, ducts, or maintained-space cable trays. The ampacity rating of cables in randomly filled cable trays is in accordance with ICEA P-54-440, "Ampacities, Cables in Open-Top Cable Trays." The cable short circuit capacity is in accordance with ICEA P-32-382, "Short Circuit Characteristics of Insulated Cable."

The Diesel Generator Building is considered a mild environment, which is defined by 10 CFR 50.49 as "an environment that would at no time be significantly more severe than the environment that would occur during normal plant operation, including anticipated operational occurrences." For the Diesel Generator Building, these operational occurrences include the operation of the DG for periodic testing. This operation for periodic testing produces temperatures in the Diesel Generator Building equivalent to those calculated for postaccident operation of the DG.

To allow the Class 1E cable to be installed anywhere in the plant, cables are qualified to meet the requirements of 10 CFR 50.49. However, synthetic heat-resistant wire which is only used in the Diesel Generator Building is qualified for the Diesel Generator Building environment using the guidance of IEEE 383-1974, "Type Test of Class 1E Electric Cables, Field Splices, and Connections of Nuclear Power Generating Stations," and IEEE 323-1983, "Qualifying Class 1E Equipment for Nuclear Power Generating Stations," for a mild environment. This is acceptable.

For fire protection, automatic preaction suppression systems are provided in the Diesel Generator Room, 1E switchgear room, and non-1E electrical panel room so that a fire initiated by electrical equipment can be contained or extinguished before causing additional damage. The preaction suppression systems for the Diesel Generator Building require both the actuation of a detector and the opening of fusible link sprinkler heads before any water is discharged. The preaction system would spray water on electrical equipment which is in the vicinity of a fire. A fire within the Diesel Generator Building is assumed to disable its DG and render it inoperable. Thus, the electrical switchgear in the Diesel Generator Building would not be required to remain operable. Appendix R to 10 CFR Part 50 also requires physical separation of electrical systems such that:

* One train of systems necessary to achieve and maintain hot shutdown conditions from either the control room or emergency control station(s) is free of fire damage.

* Systems necessary to achieve and maintain cold shutdown from either the control room or emergency control station(s) can be repaired within 72 hours.

As required by Appendix R to 10 CFR Part 50, the Diesel Generator Building provides fire protection separation of cabling and circuits for redundant diesel generators which are used to safely shut down each unit. The SACM DG and the Unit 1 redundant diesel generator are not located within the same fire areas. Such fire protection for electrical equipment is acceptable.

The following electrical auxiliary systems are provided:

* lighting systems (normal, essential, emergency, and security) are in accordance with Illuminating Engineers Society standards.

* communications systems (public address, commercial telephone, and sound powered) are an extension to the existing plant communications.

* lightning protection uses an air terminals network connected to the plant grounding grid. The system is designed in accordance with NFPA 78, "Lightning Protection Code," and the recommendation of Nuclear Energy Liability Property Insurance Association. The installation is in accordance with the Underwriters Laboratory Standard UL 96A, "Installation Requirements for Lightning Protection Systems."

In its submittal, BG&E took several exceptions to RG 1.75 (Revision 2). These exceptions and justifications for them are discussed below:

A. Physical Identification

Regulatory Guide 1.75 (Revision 2) recommends identification methods which are adequate for verifying that the installation conforms to the separation criteria. The regulatory positions of the regulatory guide expand the guidance of IEEE 384-1974 to recommend that cables be marked every 5 feet to identify the channel/separation group. It further states that the method of identification should be simple and should preclude the need to consult any reference material to distinguish between the various channel/separation groups. The preferred method of marking the cables per the RG is color coding.

The method for identification and verification that circuit and raceway installations in the Diesel Generator Building conform to the separation criteria is consistent with the methods identified in the current licensing basis for Calvert Cliffs. This method does not use color coding and does not mark the cables every 5 feet to identify the separation group. It is considered acceptable based on the following:

* Plant personnel are already familiar with the use of the current system of facility codes to verify separation of redundant Class 1E circuits. This will minimize the potential for personnel error in future maintenance activities.

* The cables within the Diesel Generator Building are the same Class 1E channel as the DG or are non-Class 1E. Therefore, physical separation of redundant Class 1E circuits is not a concern.

* Some of the cables are pulled from the Diesel Generator Building into the plant. Color coding these cables in the plant could potentially mislead personnel working with these circuits.

The facility code is the first portion of the scheme cable number that is tagged on each end of the cable. Similarly, the raceway identification tag number also begins with the facility code. Cable and raceway facility codes will always match for a correctly installed circuit.

B. Isolation Devices

The design of isolation devices in the Diesel Generator Building is in accordance with the intent of RG 1.75 (Revision 2), except as noted below:

For the safety-related Class 1E 125 V dc system in the Diesel Generator Building, there are certain nonsafety-related annunciation loads that should be tripped on a SIAS to prevent a common-cause failure from affecting the safety function of redundant systems or components (as recommended by Regulatory Guide 1.75 (Revision 2)). These nonsafety-related annunciator loads have been designed for a dc source to ensure their operation under abnormal conditions. Therefore, tripping these loads on a SIAS would negate the purpose of the dc source for this equipment.

To comply with the intent of RG 1.75, these nonsafety-related 125 V dc loads are separated from the safety-related 125 V dc system using redundant and diverse Class 1E fuses. The fuses are selected, qualified, and coordinated so that the failure of one fuse to trip on fault current will not prevent the operation of the second fuse to disconnect the nonsafety-related load. The battery is sized so that it can supply both safety-related and nonsafety-related loads for the required time period, and failure of a nonsafety-related dc load will not affect the operation of safety-related dc loads.

3. CONCLUSION

On the basis of its review, the staff concludes that the design bases of the modifications to the electrical system (after the addition of one safety-related diesel generator) at Calvert Cliffs and BG&E's commitment to various codes, standards, and regulatory guides are acceptable. The staff acknowledges that these commitments are for design, procurement, fabrication, and construction only, and that operational and surveillance commitments will be made through the license amendment request process.

Principal Contributor:
S. Saba

Date: February 14, 1994

related diesel generator) and the commitments to the various codes, standards, and regulatory guides are acceptable.

We have completed all actions related to TAC Nos. M87130 and M87131.

Sincerely,

Original signed by:

Daniel G. McDonald, Senior Project Manager
Project Directorate I-1
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

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