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REGION I

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Licensee:	Baltimore Gas and Electric Company Post Office Box 1475 Baltimore, Maryland 21203
Facility:	Calvert Cliffs Nuclear Power Plant, Units 1 and 2
Location:	Lusby, Maryland
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EXECUTIVE SUMMARY

Calvert Cliffs Nuclear Power Plant, Units 1 and 2
Inspection Report Nos. 50-317/96-03 and 50-318/96-03

This integrated inspection report includes aspects of BGE operations, maintenance, engineering, and plant support. The report covers a six week period of resident inspection; in addition, it includes the results of announced inspections by a senior radiation specialist, a security specialist, and an inservice inspection engineer. The report also includes the results of a review of spent fuel pool cooling and refueling activities conducted by the NRR Project Manager.

Plant Operations

- Overall, the inspectors found that BGE had established and implemented good controls for ensuring safety during reduced inventory conditions. These controls included availability of redundant instrumentation and core cooling trains, heightened awareness of operators to the reduced inventory condition, and extensive management involvement in planning and completing the operation.

- A weakness in configuration control was identified during the April 30 reduced inventory condition, when simultaneous work was allowed in the switchyard, the 4 kV switchgear room, and the 13 kV metalclad switchgear room because redundant trains of electric power supply to shutdown safety equipment could simultaneously be affected by adjacent work. Additionally, it was identified that additional controls were needed to ensure proper use of shutdown safety barriers to protect equipment critical to reduced inventory operations. BGE management reviewed reduced inventory operations and established controls designed to heighten worker sensitivity to shutdown safety and protect vital equipment.

Maintenance

- During surveillance testing, a feedwater isolation valve failed to reopen due to the displacement of the motor pinion gear key. BGE promptly verified the operability of the other potentially affected valves. The failure was due to improper staking because of an inadequate maintenance procedure. This was a Non-Cited Violation.

- The steam generator inspection program was comprehensive and the initial scope of inspections was extensive. The inspections were properly implemented by qualified ECT personnel. When indications were identified during the inspections, BGE appropriately expanded the scope of tube inspections to ensure that the indications were bounded within the steam generator inspection scope.

Engineering

- A violation involving the installation of temporary shielding without proper engineering evaluation was closed. BGE's corrective actions were appropriate and promptly implemented.

- A violation involving the failure to implement the proper foreign material exclusion controls to the SBO diesel generator was closed. During subsequent overhauls of both the new diesels due to damage incurred because of lubricating oil incompatibility, the FME controls were excellent and rigorously enforced. Additional site-wide enhancements to improve FME controls appear to have been effective.

- As part of the Unit 1 refueling outage, the plant emergency electrical configuration was upgraded to one safety related emergency diesel generator (EDG) for each 4 kV safety bus and the station blackout diesel (designated OC) was made operational to provide emergency power to the Unit 1 safety busses. The configuration change was accomplished using a detailed plan that coordinated the electrical modifications and testing with other critical plant conditions to maintain a pre-established minimum electrical power supply reliability for both the shutdown and operating units.

- A problem with third harmonic currents that was observed with the new diesels was appropriately evaluated and dispositioned by the BGE design engineering department. The troubleshooting was extensive and appropriately focused on maintaining electrical system reliability and plant safety.

- The spent fuel pool design and refueling practices at the Calvert Cliffs site were reviewed and determined to be consistent with the current licensing basis as documented in it's Updated Final Safety Analysis Report. No discrepancies were identified between the current licensing basis and the facility refueling practices for past or current reloads at either unit.

Plant Support

- BGE implemented, overall, a generally effective applied radiation protection program for the Unit 1 refueling activities. Positive observations included improved outage ALARA planning, an effective internal exposure control program, and an improved radioactive material controls program. Weaknesses noted included failure to use the environmental lower limits of detection (LLD) when analyzing material (e.g., sewage, soil) for radioactivity prior to its removal from the protected area, and weak emergent work planning for change-out of the No. 12 chemical volume and control system (CVCS) letdown filter. Repetitive instances of personnel inattention to high radiation access control requirements were also noted and identified as a violation.

- As a result of effective planning and ALARA considerations, a repair of the refueling upender was completed with a total dose of two person-rem. The inspectors considered the effort by radiation controls and maintenance personnel to be an example of excellent coordination and ALARA performance for a corrective maintenance evolution.

- The actions implemented by BGE to correct the vulnerabilities in the perimeter intrusion detection systems and the weaknesses in the access authorization program were effective and directed toward ensuring the health and safety of the public. However, a weakness was identified in the access authorization program. It involves the reinstatement of unescorted access if an individual has not been under a licensee's or approved contractor/vendor's behavioral observation program for more than 30 days.

- Calvert Cliffs personnel properly implemented the emergency response plan implementation procedures during a contaminated injured man emergency. The inspectors found that the Calvert Cliffs emergency response personnel effectively controlled radioactive materials and provided for monitoring of support personnel during the event.

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Summary of Plant Status

Unit 1 began the period shutdown for refueling outage number 12 and remained shutdown throughout the inspection period. The scheduled outage duration was extended to allow for expanded eddy-current inspection of the steam generator U-tubes.

Unit 2 began the period at full power, reduced power on April 6 and 7 to repair a heater drain tank level indicator, then restored and remained at full power for the rest of the inspection period.

I. Operations

O1 Conduct of Operations [1]

O1.1 General Comments (71707)

Using Inspection Procedure 71707, the inspectors observed plant operation and verified that the facility was operated safely and in accordance with licensee procedures and regulatory requirements. During the inspection period, the inspectors provided onsite coverage and followed unplanned events. Specific events and noteworthy observations are detailed in the sections below.

O1.2 Unit 1 Reduced Inventory Operations

a. Inspection Scope

The inspectors observed the refueling outage activities associated with reduced inventory operations. Unit 1 was placed in reduced inventory on April 13 for one reactor coolant pump seal replacement and nozzle dam installation, and again on April 30 for additional reactor coolant pump seal replacements.

b. Findings and Observations

In preparation for reduced inventory, the inspectors observed that BGE implemented Higher Risk Evolution, Contingency Plan J. The plan, which was prepared jointly by the outage and operations departments, included briefing, training, and communication requirements for involved personnel; a summary of actions to minimize time in the reduced inventory condition; and specified compensatory actions to ensure inventory control.

The reduced inventory operation was conducted by control room operators using Operating Procedure, OP-7, Section 6.3, "Entering Reduced

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[1]Topical headings such as O1, M1, etc., are used in accordance with the NRC standardized reactor inspection report outline found in MC 0610. Individual reports are not expected to address all outline topics.

Inventory Condition." Preparations for the operation included specific training of reactor operators on conduct of reduced inventory controls, a briefing by operations management to involved personnel on the risk of the evolution, and specific performance briefings for all involved personnel on contingency actions. The inspectors verified the availability of the following essential equipment, specified by the BGE procedures:

- -Two offsite power circuits and two emergency diesel generators
- -Two redundant makeup sources for reactor coolant inventory
- -Pressurizer manway removed to provide a hot leg vent path
- -Two independently powered core exit thermocouples
- -Two independent decay heat removal trains
- -Completion of a containment closure verification
- -Placement of "Safe Shutdown Equipment" warning signs to designated equipment

One item not precluded in the BGE procedures, but identified by the inspectors, was the possibility of switchyard work during the reduced inventory condition. The inspectors considered that switchyard work increased the risk of electrical system transients and therefore should be avoided, if possible, during the higher risk, reduced inventory condition. After the inspectors stated the concern, but prior to entry into the reduced inventory condition, the Plant General Manager directed that all switchyard work be suspended. To promulgate this direction, the General Supervisor-Nuclear Plant Operations (GS-NPO) issued an instruction (night order) on April 13, to plant operators to "Ensure Outage Management has established a lockdown of the switchyard and the 500 kV transformer at Waugh Chapel and ensure that no work is in progress in either area."

For both reduced inventory conditions, the inspectors conducted a walkdown of essential equipment. No problems were identified on April 13; however, during this walkdown on April 30, the inspectors identified the following conditions:

-BGE System Operation and Maintenance Department (SOMD) personnel and equipment trucks were inside the 500 kV switchyard. The individuals stated that they had been inside the vehicle barriers to stage equipment for upcoming work.

-Five individuals were working in the 13 kV metal clad switchgear area and "Safe Shutdown Equipment" barriers were moved to the side, out of the access way to the breakers. Following questioning, the inspector concluded that the individuals were not specifically aware that the plant was in a high risk configuration.

-A number of contractor personnel removed scaffolding directly in the vicinity of 4 kV bus number 14 and "Safe Shutdown Equipment" barriers were moved out of the access path to both the 4 kV switchgear room and Bus 14.

The inspectors noted the switchyard and 4 kV bus 14 had been designated by BGE as safe shutdown equipment because power supplies to the shutdown cooling trains were provided through these areas. As a result, the inspectors questioned BGE management on the nature of the work being conducted in these areas during the reduced inventory condition, including the need to conduct the work during reduced inventory, the extent of the precautions taken to ensure electric plant stability, and compliance with Contingency Plan J and the GS-NPO night order. BGE replaced the barriers, stopped work in the 13 kV metalclad switchgear area, and reviewed the inspectors' concerns with the inspectors.

The switchyard work involved taking two equipment trucks into the switchyard to stage equipment for upcoming maintenance on the 500 kV "Black" bus. The involved workers had been briefed on vehicle control during movement in the switchyard and were aware that Unit 1 was in a risk significant configuration that required special precaution to avoid electrical plant transients. The GS-NPO had been contacted concerning the switchyard work and had given permission to the shift operations crew to allow an exception to the night order establishing a lock down on switchyard work. Also, the work group had been briefed by a senior reactor operator in the presence of a BGE system engineer assigned responsibility for oversight of switchyard work.

The work in the metal clad switchgear involved two work groups performing diagnostic checks on a spare 13 kV breaker located in the building. The inspector observed that the work was conducted in the vicinity of the 13 kV supply to the safety related bus 11 transformer and the room, being approximately 8 feet by 24 feet, was congested by personnel. One work group consisted of two individuals who had completed testing of the breaker and were removing equipment as the second (three person) work group performed troubleshooting on the breaker. The two person group was comprised of mobile maintenance electricians and were aware that sensitive equipment was located in the switchgear room. The work package for the group included signed operations permission to conduct the work. On questioning, maintenance management stated that a general briefing had been conducted for the work group, that no energized or safety related equipment was to be worked, and that the workers were knowledgeable that the plant was in a high risk configuration. The second, three person group was performing troubleshooting using an issue report document, consisted of two plant electricians and a vendor, and stated that they had been briefed and received permission to enter the area from operations personnel. None of the individuals questioned were aware that the safe shutdown barriers staged at the entrance to the switchgear building had been moved. The inspectors were informed that the staging of the barriers was not specified in the contingency plan.

In the 4 kV switchgear room, the inspector observed scaffolding removal directly above the vital equipment switchgear that was designated safety bus 14, which provided power to the standby shutdown cooling pump. It was not apparent to the inspector that any special precautions were in place to ensure that the switchgear was not contacted during the

scaffolding removal. On questioning, the work group stated that the scaffolding removal had been ongoing throughout the shift, which would have been concurrent with reduced inventory conditions. On review, plant management stated that the scaffolding removal crew had been briefed prior to work, that a specific pattern of movement had been specified for the scaffolding removal, and that the risk of the evolution could be effectively managed.

Following the discussion with the inspectors, BGE management reviewed the activities that occurred during the April 30 reduced inventory conditions and implemented a number of clarifications and additional controls for shutdown safety. Included in these controls were:

- Operations will identify areas to be barricaded by shutdown safety barriers, will ensure that the barriers are correctly installed, and shall authorize their removal. Periodic walkdowns by operations personnel will be conducted to verify that barriers remain correctly placed.

- Outage management will eliminate activities within the barriers that are not critical, and access into the barriers will not be normally authorized by operations personnel.

- For authorized work behind the barriers, a pre-job brief shall include specific shutdown safety hazards and detailed work restrictions.

- During high risk conditions, such as reduced inventory, an announcement will be made on the plant page stating the high risk condition and the appropriate plant contingency plan in effect.

c. Conclusions

Overall, the inspectors found that BGE had established and implemented good controls for ensuring safety during reduced inventory conditions. These controls included availability of redundant instrumentation and core cooling trains, heightened awareness of operators to the reduced inventory condition, and extensive management involvement in planning and completing the operation.

A weakness in configuration control was identified during the April 30 reduced inventory condition, when simultaneous work was allowed in the switchyard, the 4 kV switchgear room, and the 13 kV metalclad switchgear room because redundant trains of electric power supply to shutdown safety equipment could simultaneously be affected during the work activities. Additionally, it was identified that additional controls were needed to ensure proper use of shutdown safety barriers to protect equipment critical to reduced inventory operations. BGE management reviewed reduced inventory operations and established controls designed to heighten worker sensitivity to shutdown safety and protect vital

equipment. The inspectors considered the BGE controls to be appropriate improvements to shutdown safety during reduced inventory conditions.

II. Maintenance

M1 Conduct of Maintenance

M1.1 Routine Maintenance Observations

Using Inspection Procedures 62703 and 61726, the inspectors observed the conduct of maintenance and surveillance testing on systems and components important to safety. The inspectors also reviewed selected maintenance activities to assure that the work was performed safely and in accordance with proper procedures. The inspectors noted that an appropriate level of supervisory attention was given to the work depending on its priority and difficulty. Maintenance activities reviewed included:

MO1199501783	Perform Power Factor Testing and Dead Breaker Checks
MO2199601114	Replace 22 Salt Water Pump Discharge Check Valve
MO2199601515	High Vibration on 21 ECCS Pump Room Exhaust Fan
MO1199501215	Replace 1PT5313, 5314, 5315, Containment Pressure Transmitters

M1.2 Steam Generator (SG) Inspection Program Review

a. Inspection Scope (73753)

The inspector reviewed the initial scope of eddy current inspections. In addition, the Eddy Current Test (ECT) Personnel Certifications and Calvert Cliffs ECT site-specific training requirements were reviewed.

b. Observations and Findings

The inspector determined that the initial scope of inspections exceeded the Technical Specification requirements. In addition, the initial scope complied with the commitments made by BGE in response to NRC Generic Letter 95-03, "Circumferential Cracking of Steam Generator Tubes." Lastly, BGE added to the initial scope in accordance with recommendations of EPRI document NP-6201, "PWR S/G Examination Guidelines." The initial scope of inspections encompassed degradation mechanisms previously identified at Calvert Cliffs and potential industry identified degradation mechanisms. Also, the probes being utilized were qualified for the scheduled inspection locations.

The inspector determined that the ECT personnel were appropriately certified in accordance with ASNT SNT-TC-1A (1980 edition). The inspector also verified that all Level IIA analysts who performed

analysis had successfully completed the site-specific training as required by Calvert Cliffs procedures.

The inspector ascertained that the site-specific ECT training program provided the analysts with a good introduction to Calvert Cliffs steam generator historical information. Also, it provided training on typical eddy current signals from previously identified indications.

M1.3 Eddy Current Inspection Activities

a. Inspection Scope (73753)

The inspector observed eddy current testing (ECT) personnel perform probe changeouts, equipment calibrations, data acquisition and data analysis resolution. The inspector independently reviewed indication lists from the 1994 and 1996 eddy current inspections. The inspector's goal was to determine whether ECT scope expansions were appropriately performed in 1996.

b. Observations and Findings

Through observation, the inspector determined that the probe changeouts were performed in accordance with procedural requirements and probe serial numbers were verified, in part, to assure that the correct probes were utilized. The equipment calibration and data acquisition activities observed by the inspector met procedural and ASME Code requirements. ECT personnel performing data analysis resolution properly resolved discrepancies in accordance with industry accepted eddy current analysis techniques and procedural requirements.

Through review of indications lists, the inspector determined that a large number of bobbin coil indications were identified in the freespan region both in 1994 and 1996. These indications resided in three categories:

	Identified in 1994?	Identified in in 1996?	Significant (>5%) inc. in size in 1996?
Category 1	Yes	Yes	No
Category 2	Yes	Yes	Yes
Category 3	No	Yes	---

BGE indicated that Category 1 indications were believed to be manufacturing marks (MBM). Tube pulls were performed in 1983 and 1986 to confirm the assumption.

BGE did not know what type of flaw produced the Category 2 and 3 indications. The inspector discussed these indications with several individuals involved in the ECT scope expansion decision process to determine how the indications would be addressed. The inspector did not receive consistent feedback from the various individuals, including the BGE Level III analyst. In addition, the Category 2 and 3 indications were not specifically addressed in the "Calvert Cliffs Steam Generator

Eddy Current Testing Analysis Guidelines," Revision 1, dated March 25, 1996. Therefore, it was not clear how the indications were going to be addressed.

The inspector informed BGE that if these indications were cracks, vice volumetric indications, they could not be sized and dispositioned based solely on bobbin coil data because the bobbin coil probe was not qualified for sizing cracks.

BGE later developed a methodology to address the freespan indications and attached it to the SG Eddy Current Testing Analysis Guidelines as Appendix C. The inspector reviewed Appendix C and concluded that a consistent and technically appropriate method had been developed for addressing freespan indications.

On May 2, 1996, the licensee identified an axial freespan indication located above the ninth tube support plate (TSP). Prior to identifying this indication, the licensee had reported that they had identified freespan indications in both the vertical and horizontal tube runs, however, these indications were all initially identified in either the bobbin coil probe examinations or in the special interest Plus Point examinations of the steam blanket region. The axial freespan indication identified above the ninth TSP was not identified in the bobbin probe inspections. Following the discovery of this indication, BGE expanded their inspections to include additional tubes and a larger extent of examination.

M1.4 Updated Final Safety Analysis Report Review

a. Inspection Scope (73753)

The inspector reviewed selected sections of Chapter 4 of the Updated Final Safety Analysis Report (UFSAR), pertaining to the steam generators, to evaluate the accuracy of the UFSAR regarding existing plant conditions and practices.

b. Observations and Findings

The discovery of a licensee operating their facility in a manner contrary to the UFSAR description highlighted the need to compare plant practices, procedures and/or parameters to the UFSAR descriptions. While reviewing the steam generator inspection activities, the inspector verified that the UFSAR wording was consistent with the observed plant practices, procedures and/or parameters.

The inspector conducted discussions with plant personnel on Calvert Cliffs steam generator design. During these discussions, BGE informed the inspector that a number of tubes in each steam generator were not explosively expanded (explanded) within the tubesheet, or were only partially explanded within the tubesheet. BGE explained that was an error during the original manufacturing process. The steam generator tubes were hard-rolled into the tubesheet for 1 inch and welded at the

bottom of the tubesheet. Most of the tubes were then explanded the entire length of the tubesheet. Eleven tubes in steam generator No. 11 and 54 tubes in steam generator No. 12 were not adequately explanded. The inspector noted the UFSAR only discussed the weld at the bottom of each tube and not the expansion process. However, the inspector questioned what made it acceptable to operate with the plant in this condition. BGE did not have adequate information to resolve the question and initiated an issue report to address the issue. BGE stated that the issue would be evaluated prior to Unit 1 restart. This item is unresolved **(URI 50-317,318/96-03-01)**. It will remain unresolved pending NRC review of BGE's disposition of the issue.

M1.5 Management Involvement and Vendor Oversight

a. Inspection Scope (73753)

The inspector reviewed BGE management involvement in steam generator issues. In addition, the inspector reviewed BGE's oversight and involvement in ECT vendor activities.

b. Observations and Findings

Management involvement in steam generator issues was evident in various group efforts, such as the SG oversight committee, SG project team and a periodically updated SG management plan. Overall, BGE oversight and involvement in ECT vendor activities was good.

M1.6 Conclusions on Steam Generator Inspection Activities

The inspector found the steam generator inspection program to be comprehensive and the initial scope of inspections to be extensive. The inspections were properly implemented by qualified ECT personnel. When indications were identified during the inspections, BGE appropriately expanded the scope of tube inspections to ensure that the indications were bounded within the steam generator inspection scope.

M1.7 Routine Surveillance Observations

The inspectors witnessed/reviewed selected surveillance tests to determine whether approved procedures were in use, details were adequate, test instrumentation was properly calibrated and used, technical specifications were satisfied, testing was performed by qualified personnel, and test results satisfied acceptance criteria or were properly dispositioned.

The surveillance testing was performed safely and in accordance with proper procedures. The inspectors noted that an appropriate level of supervisory attention was given to the testing depending on its sensitivity and difficulty. Surveillance testing activities that were reviewed are listed below:

STP-O-047A Unit 2 MSIV A Circuit Partial Stroke Test

STP-O-008A 2A EDG and 4KV Bus 21 LOCI Sequencer Test

STP-O-073B Service Water Pump Performance Test - Unit 2

STP-O-005/9 Auxiliary Feedwater Pump Performance Test - Unit 2

ETP 95-019 OC and 1B DG UV and SIAS ESFAS Test

ETP 94-050 1A EDG Phase Test and Parallel

M7 Quality Assurance in Maintenance

M7.1 Motor Operated Valve (MOV) Actuator Key Displacement

On March 31, following the successful timed closure of feedwater header isolation valve 1-FW-4516, the valve failed to stroke open. BGE disassembled the valve actuator and discovered that the motor pinion gear key had been displaced such that the actuator shaft would not rotate. BGE immediately verified that the two identical valves in Unit 2 were operable using radiography. The other Unit 1 valve (1-FW-4517) was visually inspected. All three valve actuator motor pinion gear keys were in place and adequately staked.

BGE engineering identified 30 safety-related MOVs with Limitorque actuators (sizes SMB-0 and larger) susceptible to key displacement. Two low pressure safety injection (LPSI) loop isolation valves were also radiographed with acceptable results. Several non safety-related MOVs being refurbished during the Unit 1 refueling outage were examined and no deficiencies in key placement or staking were noted. BGE stated that the remaining MOVs would be examined during scheduled maintenance periods.

The inspectors noted that BGE had begun a replacement of MOV actuator shafts and keys in 1992 as a result of BGE's evaluation of industry experiences regarding MOV failures. The new shafts and keys utilized harder materials to address shearing concerns. The MOV actuator vendor issued recommendations to improve actuator reliability, one of which was to bevel the edges of the keys to provide a greater surface area to enhance the staking of the key. This guidance was not incorporated in BGE's procedures for actuator overhaul and maintenance.

The inspectors reviewed BGE's investigation into the cause of the key displacement and noted that the failure was most likely due to a combination of factors:

- the increased hardness of both key and shaft made the staking more difficult;
- the susceptible MOVs were in high vibration environments;
- the susceptible MOVs had high speeds of operation; and
- the vendor's recommendation to bevel the key edges to provide a greater metal contact area was not followed.

As noted above, BGE's corrective actions included radiography of selected safety related MOV actuators to verify adequate key engagement. BGE also reviewed the work histories of the MOVs in question and determined that the key displacement in 1-FW-4516 appeared to be an isolated occurrence caused by improper staking by one individual mechanic. The maintenance procedure did not include staking instructions because BGE considered the capability to be a "skill of the craft." BGE engineers stated that the procedures for actuator overhaul and maintenance would be enhanced by incorporating the vendor's guidance on key staking.

The inspectors noted that the actual safety consequences of the key displacement were minimal. The unit was undergoing a refueling outage when the surveillance was performed and the valve had not received an isolation demand. However, the failure to provide an adequate procedure for the maintenance on the MOV actuator was a violation of NRC requirements. In this instance, the violation is being treated as a Non-Cited Violation, consistent with Section VII.B of the NRC Enforcement Policy, because it was of minor safety consequence, the problem was self disclosing, it was not a recurring issue, it was not willful, and the BGE corrective actions were prompt and adequate.

III. Engineering

E1 Conduct of Engineering

E1.1 Realignment of Emergency Electrical Power Supply

a. Inspection Scope

As part of the Unit 1 refueling outage review, the inspectors observed, in part, the emergency electrical power supply configuration change for Calvert Cliffs. The change included the addition of a new safety related diesel generator, the dedication of a single diesel generator to each 4 kV safety related bus, and the addition of the station blackout diesel generator (designated OC) to provide backup power to the Unit 1. 4 kV busses 11 and 14.

b. Observations and Findings

The acceptance testing program for the new safety related and OC diesel generators was conducted consistent with NRC Regulating Guide 1.9, Revision 3, and included a load-run test that demonstrated operation of the generator at the continuous rating for one hour. On April 11, 1996, during testing of the OC EDG on safety bus 11, the output breaker that connected the safety bus with the offsite power grid, Breaker 152-1101, tripped on ground fault overcurrent. On April 12, during troubleshooting of the trip, the test was repeated and completed satisfactorily. Based on the satisfactory testing and troubleshooting that failed to identify any deficiencies with operation of the OC diesel generator, the generator was declared functional for shutdown modes 5 and 6. Operation was limited to the lower modes based on an engineering

evaluation of operability and pending resolution of the cause of the April 11 trip.

On April 18, while the 1A EDG was tested at full generating capacity, feeder breaker 152-1115 tripped on ground fault overcurrent. On this occasion, instrumentation on the safety bus indicated the existence of the third harmonic reactive electrical current, observed as a 180 hertz signal on the bus at the time of the trip. Because the third harmonic was additive on all three phases, the ground fault overcurrent protection occurred when the third harmonic current exceeded the ground fault protection setpoint of 0.5 amps.

BGE design engineering conducted a review of the testing sequence and verified that the third harmonic signal was the cause of the April 11 and April 18 breaker trips. Because the current was not observed during the April 12 test, and because the third harmonic is both generator and load dependent, further investigation was conducted to identify a load problem that affected the existence of the third harmonic.

A loose neutral ground connection was identified on 21 service transformer. The loose neutral connection explained the intermittent nature of the overcurrent faults, because if the neutral was acting as an open circuit, the third harmonic would not exist. Following repair of the grounding strap, additional testing was conducted and the third harmonic was observed as an increasing current as generator load was increased. To allow for the third harmonic during diesel testing, engineering completed a design review and allowed reset of the ground fault overcurrent settings to 2.5 amps vice the 0.5 amp setting that had existed. Subsequently, both the 1A and OC diesels were tested satisfactorily at full load and made operational. The mode restrictions placed on the OC diesel were removed.

c. Conclusions

As part of the Unit 1 refueling outage, the plant emergency electrical power supply configuration was upgraded to one safety related emergency diesel generator (EDG) for each 4 kV safety bus and the station blackout diesel generator (designated OC) was made operational to provide emergency power to the Unit 1 safety busses. The configuration change was accomplished using a detailed plan that coordinated the electrical modifications and testing with other critical plant conditions to maintain a pre-established minimum electric supply reliability for both the shutdown and operating units.

A problem with third harmonic currents that was observed with the new diesels was appropriately evaluated and dispositioned by the BGE design engineering department. The troubleshooting and evaluations were extensive and appropriately directed to maintaining electrical system reliability and plant safety.

E8 Miscellaneous Engineering Issues

E8.1 (Closed) Violation 50-317 and 318/95-02-01: installation of temporary shielding without the prior performance of an engineering evaluation. This was one example, occurring in February 1995, of problems regarding the installation of unauthorized and unanalyzed changes to plant configuration. BGE's immediate corrective actions included removal of the shielding and counseling of affected personnel. A root cause analysis (RCAR 95-15) was performed to assess the event and provide recommendations to prevent recurrence. Its recommendations included additional training for the radiation technicians on temporary shielding requirements and procedure enhancements. Additionally, BGE's operational events review group (ISEG) conducted an independent review (ISEG Evaluation 9503) of the wider issue of unapproved temporary alterations. This review identified three causes:

- failure to incorporate expectations into work practices,
- insufficient definition and ownership of temporary alteration process interfaces, and
- use of long-term workarounds due to inadequate performance goals.

The ISEG evaluation recommended a number of corrective actions, the most significant of which included:

- ensuring the temporary alteration process has an identified owner with clearly defined management expectations and accountability,
- establishing periodic supervisory/management work observations and coaching sessions focused on procedural compliance,
- reviews to ensure workarounds and other compensatory actions were identified and plans established for removal,
- enhancements to radiological and maintenance procedures to define the temporary alteration process interfaces, and
- performing an effectiveness review of the corrective actions.

BGE conducted the recommended effectiveness review in November, 1995. The review included a physical walkdown of the facility, using the guidance of Plant Engineering Guide (PEG) 7, Rev.4, "Plant Engineering Section System Walkdowns." BGE engineers did not note any significant discrepancies during their walkdowns or other reviews of corrective action implementation. BGE therefore concluded that their corrective actions had been effective in addressing the issue.

The inspectors reviewed BGE's response to the violation and their corrective actions. The inspectors determined that the corrective actions were appropriate and promptly implemented. This violation is closed.

E8.2 (Closed) Violation 50-317 and 318/95-06-01: failure to implement foreign material exclusion (FME) controls during an overhaul/inspection of the station blackout diesel generator (OC). This event occurred in July 1995, during a scheduled maintenance and inspection of the new non

safety-related (but designated as "augmented quality") emergency diesel generator installed to meet the requirements of the Station Blackout Rule. In this instance, the off-going night shift maintenance personnel failed to properly cover openings in the OC-2 engine, as required by procedure, and this was not noted by supervision. BGE's immediate corrective actions included a visual examination of the affected areas to verify that foreign material had not been introduced, personnel counseling, and reiteration of management's expectations regarding FME. Additional actions would be implemented as part of a site-wide initiative to improve the control of FME.

The inspectors monitored BGE's efforts to effectively implement FME controls during plant walkdowns and discussed aspects of the FME program with engineering and maintenance personnel. A number of enhancements to the FME program were noted:

- Specific training was developed by the FME program coordinator and given to all personnel who could be required to work in or have access to FME controlled areas.

- The Unit 1 and Unit 2 containment buildings were designated as FME controlled areas.

- Maintenance procedures MN-1-100, "Conduct of Maintenance", and MN-1-109, "Foreign Material Exclusion", were revised to clarify and augment FME controls and requirements.

- Incorporation of recommendations resulting from BGE's review of Significant Operating Experience Report (SOER) 95-01.

Specific to the two new emergency diesel generators, the inspectors observed that both units were disassembled and rebuilt in early 1996 because of cylinder wall scuffing caused by lubricating oil incompatibility with low sulphur fuel oil. FME controls were excellent and rigorously enforced. FME control in the containment building during Unit 1's refueling outage which commenced in March 1996, was very good with a high level of supervisory and management involvement. The inspectors attended the specific training for entry into FME areas and concluded that the training was professionally conducted, used appropriate material, and included the physical demonstration by each student of how to properly enter an FME area. This violation is closed.

E8.3 Spent Fuel Pool Cooling and Refueling Activities

a. Inspection Scope

A review of the current licensing basis, design basis and refueling practices was conducted to determine if the spent fuel pool design and refueling practices at Calvert Cliffs were consistent with the current licensing basis as documented in the UFSAR.

b. Observations and Findings

The spent fuel pool (SFP) is located in the auxiliary building with the bottom of the pool at the 31 foot level and the pool is divided into two halves. The total volume for both halves is 5.8×10^4 cubic feet and when filled with spent fuel assemblies will hold more than 3.8×10^5 gallons of water. The SFP is normally operated as a single pool and has the capacity to store 1830 fuel assemblies.

The SFP cooling system is tornado-protected and is located in a Seismic Class I structure. The cooling system is a closed-loop system consisting of two pumps and two heat exchangers. One train of the SFP cooling system receives power from a safety-related power bus in Unit No. 1 and the other train from a safety-related power bus in Unit No. 2. The power sources are stripped during an accident or loss-of-offsite power condition requiring onsite emergency diesel generators, but can be manually reconnected to their respective busses. Each of the SFP pumps has a design flow rate of 1390 gpm and each of the heat exchanger's has a design heat transfer capability of 10.1 x MBtu/hr. Thus, the total heat removal with both SFP pumps and heat exchangers is 20.2 MBtu/hr. The SFP cooling system design is capable of removing the maximum decay heat expected from 1613 fuel assemblies, which does not include a full core off-load, while maintaining a maximum SFP temperature of 127° F. This capability can be supplemented by one of the shutdown cooling pumps (SDC) to remove the maximum expected decay heat from 1830 fuel assemblies, which includes a full core off-load, while maintaining a maximum SFP temperature of 130° F. The addition of a SDC pump for additional heat removal from the SFP is accomplished by the realignment of manual valves. Double valve isolation is provided at the system interface between the SFP cooling system and the SDC system to provide the required isolation when the pressure in the SDC system is greater than the design pressure of the SFP cooling system.

The SFP cooling system also has a bypass filter which removes insoluble particulates and a bypass demineralizer which removes soluble ions. The SFP heat exchangers are cooled by service water which in turn is cooled by saltwater. The Chesapeake Bay is the ultimate heat sink which provides the saltwater cooling. As noted, the SFP can be divided into two halves and the pumps and heat exchangers can be aligned in several different combinations to either half or the entire SFP by manual operation of the associated valves. The design pressure of the SFP cooling system is 150 psi and the design temperature is 150° F, with portions of the system designed to 155° F.

Makeup water to the SFP can be supplied at the rate of at least 150 gpm. The sources of makeup water include the following:

1. Demineralizers (normal source of makeup)
2. Two refueling water storage tanks (Seismic Category I makeup)
3. Four reactor coolant makeup pumps
4. Fire protection system
5. Well water

The maximum decay heat from the 1613 fuel assemblies (no full core off-load) is 19.9 MBtu/hr. The fuel is assumed to have undergone a steady-state burnup at 2700 Mwt for an average of 1470 days, a 6 day decay time prior to fuel movement, and the partial core off-load is completed after 7 days. The SFP cooling system will maintain the temperature at or below 127° F. In the event of a single failure resulting in the loss of one train of cooling, the remaining train can remove the heat load while maintaining a SFP temperature at or below 155° F.

The maximum decay heat load expected from 1830 fuel assemblies, which includes a full core off-load, is 37.6 MBtu/hr using conservative assumptions based on maximum irradiation of the fuel during a 24 month fuel cycle. This bounding case also assumes a 6 day decay time prior to fuel movement when the full core is being off-loaded after 9 days. As noted, the SFP cooling system, supplemented by the SDC system, has the capability to remove 38.6 MBtu/hr while maintaining the SFP temperature at or below 130° F. In the event of the loss of any one of the three trains, the remaining two are capable of maintaining the SFP temperature below or at 155° F.

There have been 22 refueling outages at the Calvert Cliffs facility, 12 for Unit No. 1 and 10 for Unit No. 2. Six of these have been full core off-loads. Five of the six were bounded by the bounding case discussed in the preceeding paragraph. A 50.59 safety evaluation was performed for the one full core off-load not bounded. The SDC system was inoperable due to work being performed during the refueling outage. However, the 50.59 safety evaluation indicated, based on the existing conditions (the actual amount of fuel in the SFP, temperatures, and other variables), indicated that given a single failure and only one train of SFP cooling, the SFP would remain below 155° F.

Several readouts and alarms are provided in the control room located on a common panel including:

1.	Demin makeup water	-	Low Flow (105 gpm) Differential Pressure Hi (15 psid)
2.	SFP filter	-	Differential Pressure Hi (35 psid)
3.	SFP Level	-	Hi Level (67 ft 3.5 in) LO Level (66 ft 6.o in)
4.	SFP Cooling Pumps	-	Lo Pressure (70 psig)
5.	SFP Heat Exchangers	-	Disc Temp Hi (110° F)
6.	SFP Temperature	-	Temp Hi (120° F)

No other implicit or explicit prohibitions exist within the current licensing basis (CLB) against performing a full core off-load for any given refueling outage. A summary of the CLB requirements is included as Attachment 2 to this inspection report.

The CLB for the design and operation of the SFP is the safety evaluation (SE) which supports Amendment Nos. 47 and 30, Unit Nos 1 and 2, respectively. These amendments supported the reracking of the SFP and were transmitted by letter dated September 19, 1980. The SE addressed both a bounding case for a normal (partial) core off-load and a full core off-load. This SE was based on a mixture of 12 and 18 month refueling cycles in effect at that time. The 24 month refueling cycles commenced in mid 1987 with Unit No. 2, Cycle 8. The UFSAR, Rev. 15 reflects the CLB for the SFP which is still consistent with the September 19, 1980 SE performed by the NRC staff. The licensee performed an updated calculation, MS-9202, Rev. 0, dated August 25, 1992, which confirms the 1980 SE bounding cases.

The requirements for all reloads are included in Procedure FH-130 which references all the supporting documents that are used as the basis for the latest revision of FH-130. The procedure requires that a SE or 50.59 be performed for all reloads to assure that they are within the CLB. As previously noted, only 1 of the 6 full core off-loads was not within the bounding case and a 50.59 SE was performed.

The licensee's Significant Event Evaluation (SSE) group assesses all industry information which identifies potential concerns or problems. The SSE performed an initial assessment of NRC Information Notice (IN) 95-54 "DECAY HEAT MANAGEMENT PRACTICES DURING REFUELING OUTAGES," to assure that there were no immediate safety concerns. The initial findings were that the refueling evolutions are being conducted consistent with the CLB as defined by the UFSAR, technical specifications, license conditions, and analysis. The SSE assigned the detailed followup review to the responsible technical staff and the action was entered into the Action Item Tracking System (AIT) as item No. 4B199600004.

The licensee is upgrading the UFSAR to more accurately reflect the CLB for the Calvert Cliffs facility as part of its annual updates. The licensee indicated that it will provide improvements to further clarify the CLB for the SFP by including more of the details that are in the 1980 SE, the 1992 supporting analysis, and the FH-130 Procedure.

c. Conclusions

The spent fuel pool design and refueling practices at Calvert Cliffs were consistent with the current licensing basis as documented in the UFSAR. No discrepancies were identified between the current licensing basis and the facility refueling practices for past or current reloads at either unit.

IV. Plant Support

R1 Radiological Protection and Chemistry (RP&C) Controls

R1.1 Repair of the Refueling Upender

On April 19, during movement of new fuel into the reactor, welds that hold hydraulic rams to the refueling upender failed and prevented raising the upender in the refueling cavity. A new fuel bundle that was in the upender at the time, was manually returned to the spent fuel pool, and the fuel transfer tube was shut isolating containment. BGE management decided to isolate and drain the containment refuel pool to repair the upender. The draining caused the reactor upper guide structure which was stored in the pool to be uncovered from water which increased general area exposure rates in the containment.

To minimize personnel exposures during the upender repair, the radiation controls department staged lead shields, supported by the polar crane, around the work area. Additionally, the entire containment building was declared a high radiation area and high radiation area controls were implemented. The repair involved welding of four welds and was accomplished with workers in full coveralls, gortex water proof suits, and respirators. Evaluation of the failure determined that one weld failed as a result of cyclic fatigue and the others subsequently failed as result of a low cycle, high stress mechanism.

Following the repair, the refuel pool was reflooded and the upender was returned to service. As a result of effective planning and ALARA considerations, the entire repair evolution was completed with a total dose of two person rem. The inspectors considered the effort by radiation controls and maintenance personnel to be an example of excellent coordination and ALARA performance for a corrective maintenance evolution.

R1.2 Unit 1 Refueling Outage Radiological Controls (Program Changes)

a. Inspection Scope (83750)

The inspector reviewed selected radiological controls program changes implemented by BGE since the previous inspection in this area. Areas reviewed included organization and staffing, facilities and equipment, and procedure changes.

b. Observations and Findings

The inspector noted that BGE implemented a radiological controls organization change on December 5, 1995. The change eliminated the line supervisor positions entitled, "Assistant General Supervisor-Radiation Protection." BGE realigned and reassigned personnel to support the change.

The inspector did not identify any apparent safety concerns associated with these changes. However, the inspector noted that the newly-selected radiation protection supervisor-dosimetry was not yet fully qualified for the position, and that the responsibilities and authorities statement indicated a broad scope of responsibilities. It was not apparent that these responsibilities and authorities were clearly delineated given the in-training status of the individual. BGE subsequently issued a memorandum to the individual clearly indicating the responsibilities and authorities (based on current qualifications). BGE also issued guidance to those individuals who would assume the responsibilities and authorities of the radiation protection supervisor-dosimetry pending full qualification.

c. Conclusion

No program changes were identified that would appear to reduce the effectiveness of the radiological controls program.

R1.3 Unit 1 Refueling Outage Radiological Controls (Planning and Preparation)

a. Inspection Scope (83750)

The inspector reviewed the planning and preparation for the Unit 1 refueling outage. The inspector reviewed records, discussed outage planning with BGE representatives, and observed activities to verify necessary planning and preparations and management support for radiation protection planning. The inspector selectively reviewed work that had the potential for creating radiological hazards [e.g., steam generator work, incore instrument removal, and change out of the Unit 1 No. 12 chemical and volume control (CVCS) filter].

b. Observations and Findings

The inspector's review indicated that BGE provided overall effective planning and preparation for outage radiological controls work activities. Of particular note was the integration of radiation protection staff into the outage planning organization before the outage start and the assignment of a radiation protection coordinator to the Outage Control Center (OCC) for work planning/monitoring purposes during the outage.

BGE increased the health physics staff to support outage work and used BGE radiation protection technicians in lead capacities over contracted technicians. Lessons learned form previous outages were effectively incorporated into outage planning, and mock-up training was provided as appropriate (e.g., steam generator work activities). A comprehensive Unit 2 1995 post-outage report was developed as was a Unit 1 Pre-Outage Planning Status Report. BGE effectively used engineering controls to minimize the need to use respiratory protection equipment.

BGE planned and monitored person-hours for outage planning as compared to work completion as indicated by closure of work orders. The

inspector noted that planned outage person-hours total (as of end of inspection) was at 269,000 person-hours. Of this value, 62,500 person-hours were added after the outage cut-off date (July 1995) and of this added value, 3,900 person-hours involved work in radiological controlled areas. The 3,900 additional person-hours added 15 person-rem to the expected aggregate outage exposure total. Despite the additional hours added after the outage cut-off date, by the start of the Unit 1 outage (late March 1996), essentially all work was planned. A limited amount of work was added after the start of the outage representing approximately 300 millirem total person-rem.

The inspector noted that it was not apparent that BGE's outage cut-off date for work addition and planning was realistic in that a significant amount of work was added and planned after the date.

BGE was closely monitoring the ALARA outage exposure goals (expected Unit 1 outage exposure goal of 185 person-rem). Current exposure, based on work load, was closely tracking expected exposure accumulation rates.

The inspector made several negative observations as follows:

- Although no significant exposure was received, an individual was observed assembling scaffolding, for use in another area, in a 20 mR/hr radiation field in the auxiliary building. Lower dose rate areas were noted where this task could be performed. Also, the scaffolding supply was stored in an elevated radiation dose rate area.

- Although no significant exposure was received by personnel, overall planning for the No. 12 chemical volume and control system (CVCS) letdown filter change was considered weak in that expected filter radiation dose rates were not well estimated, a pipe exhibited 10 R/hr on contact in the room that apparently was unexpected, the work chronology was not well described during a pre-briefing, the actual task to be performed was modified after the pre-brief, and there were no well-defined contingency plans for filter handling if unexpected radiation dose rates were encountered. The filter indicated 70 R/hr when pulled instead of the expected 5 R/hr. As a result, the filter was left hanging in the air (in a shielded position in its cubicle) while reviews were performed.

- BGE was not generally evaluating (from an ALARA cost benefit standpoint) routine work for exposure saving over the life of the facility. However, BGE had taken a number of actions that would reduce occupational radiation exposure over the life of the facility (e.g., reduction of tours in high radiation areas, reduction in station radiation hot spots, and use of early boration to remove crud from the reactor coolant system). BGE provided the inspector information which indicated actions taken to date would save approximately 1200 person-rem over the life of the facility. BGE also was evaluating other actions for exposure reduction over the life of the facility (e.g., new types of scaffolding).

- During tours of the Unit 1 containment work locations, the inspector noted one individual on April 17, 1996, at the 10 foot level steam generator control station, to be apparently controlling and overseeing numerous steam generator work activities. The work load for this individual appeared excessive considering the importance of the activities. BGE initiated an immediate review of the matter.

c. Conclusions

BGE implemented overall effective ALARA planning for the Unit 1 eighth refueling outage. However, opportunities for improvement, as discussed above, were noted.

R1.4 Unit 1 Refueling Outage Radiological Controls (Internal Exposure Controls)

a. Inspection Scope (83750)

The inspector selectively examined the internal exposure control program. The inspector reviewed records, discussed the program with cognizant BGE personnel and observed exposure control practices during tours of the RCA and observed work activities.

b. Observations and Findings

The inspector noted that, as of the end of the inspection, no individual had sustained any significant intake of airborne radioactivity. Also, no significant intake of airborne radioactivity occurred in 1995 which included the Unit 2 refueling outage.

The inspector's review indicated that BGE was selectively whole body counting individuals during the outage who had worked on jobs with a potential for airborne radioactivity. The inspector reviewed selected whole body counts and noted no intakes of radioactive material.

The inspector did note that, although BGE was selecting workers for intake evaluation as part of quality assurance measures, the program was not identified in BGE's procedures. Specifically, the inspector noted that there was no defined routine program for comparing whole-body or organ-burden data obtained from bioassays with radioactive material intake estimates based on air-sampling data. Such analysis would provide indications of the adequacy and implementation of BGE's airborne radioactivity sampling and respiratory protection programs. The inspector's review, however, indicated there were so few positive indications of any intake of radioactive material that routine evaluation did not appear practicable. However, BGE indicated this matter would be reviewed.

The inspector observed work in progress and noted air sampling to be representative of air in zones occupied by workers. Also, DAC-hours were calculated and tracked, as necessary.

c. Conclusions

BGE implemented an effective internal exposure control program.

R1.5 Unit 1 Refueling Outage Radiological Controls (External Exposure Controls)

a. Inspection Scope (83750)

The inspector selectively examined the external exposure control program. The inspector reviewed records, discussed the program with cognizant BGE personnel and observed exposure control practices during tours of the RCA and observation of work activities. The inspector reviewed high radiation area controls and general radiological posting, implementation of the radiation work permit program, and implementation of the dosimetry program. The inspector also reviewed BGE's program to minimize exposure to the embryo/fetus and the exposures of declared pregnant women.

b. Observations and Findings

BGE provided conservative limits and procedurally described controls in the area of control of exposure of the embryo/fetus and declared pregnant women. The inspector also reviewed the radiation exposure records of selected workers observed working in high radiation areas. BGE was determining previous exposure and maintaining a real time exposure data base by use of an electronic dosimetry (ELD)/access control system.

The inspector noted that workers were provided briefings as required by applicable radiation work permits and 10 CFR 19.12. Workers were observed to be generally wearing dosimetry as prescribed. However, some workers were wearing the electronic dosimeter away from the thermoluminiscent dosimeter (TLD) which could result in a mismatch between TLD and ELD dose values. This observation was brought to BGE's attention by the inspector and also observed by radiation protection supervisors during accompaniment of the inspector. Each identified worker was informed to wear his assigned TLD and electronic dosimeter in close proximity to each other.

The inspector noted during tours of the station, that radiological areas (e.g., high radiation areas, radiation areas) were properly posted and locked (as appropriate). The inspector also noted that BGE was generally properly controlling access of personnel to high radiation areas. However, the inspector did note that BGE had experienced several self-identified instances of improper access to or control of high radiation areas. Three of the instances were identified prior to the outage while a fourth example was identified during the outage. These examples are discussed in Section R.7 of this report.

The inspector's review indicated several areas for enhancement as follows:

- BGE's procedures provided limited guidance regarding surveys of material removed from spent fuel pools or other water-filled pools (e.g., reactor cavity). Specifically, it was not clear what constituted removal and to what extent surveys should be made of material partially removed from water-filled pools. BGE initiated a review of this matter.

- Job control standards and licensee procedures for high radiation area controls (in the area of definition of "continuous high radiation area coverage") would not ensure conformance with Technical Specification requirements for continuous coverage. Specifically, BGE's procedures appeared to permit individuals to remain in high radiation areas without a continuously indicating dose rate meter contrary to certain Technical Specification requirements. Notwithstanding this observation, the inspector did not identify any individual not meeting applicable high radiation area access control requirements. Further, the inspector observed BGE to be providing conservative controls for high radiation area access control purposes.

c. Conclusions

The inspector's infield reviews indicated that BGE implemented a generally effective external exposure control program. However, as discussed above, several examples of BGE-identified high radiation area access control problems are discussed in Section R7.

R1.6 Unit 1 Refueling Outage Radiological Controls (Control of Radioactive Materials and Contamination)

a. Inspection Scope (83750)

The inspector selectively reviewed radioactive material and contamination control practices. The inspector reviewed the adequacy of supply, maintenance, and calibration and performance checks of survey and monitoring instruments; and the use of personal contamination monitors and friskers, including consideration of hot particle contamination. The inspector also reviewed the adequacy of surveys to detect personnel exposure due to skin contamination, particularly for hot particle contamination.

b. Observations and Findings

The inspector's tours of the station, including the Unit 1 containment, indicated that BGE implemented generally effective contamination control work techniques and prompt correction and cleanup of contamination. The inspector noted that a small portion of the station area (excluding containment) within the radiological controlled area was contaminated. Contaminated areas exhibited generally low levels of contamination, including the Unit 1 containment. Steam generator work platforms exhibited generally low levels of contamination through use of effective

contamination control techniques. BGE tracked hot spots and total contaminated areas as a performance indicator. There were few hot spots noted.

A number of contamination control enhancements were implemented at the station including installation of gamma sensitive portal monitors to monitor personnel exiting the radiological control area, and enhancement of documentation of personnel contamination. BGE continued to maintain contamination monitors to monitor personnel entering the station.

The inspector's tours and discussions with BGE's radiation control supervisor indicated no plant areas had become unusable as a result of operational occurrences or spills. The inspector noted station material condition to be good.

During the inspection, BGE informed the inspector that the use of environmental lower limits of detection had not yet been instituted for evaluation of potentially contaminated bulk material removed from the station (e.g., sludge, soil, sewage). Use of the environmental LLD was prescribed for such purposes in NRC Information Notice No. 88-22, "Disposal of Sludge from Onsite Sewage Treatment Facilities at Nuclear Power Stations," dated May 12, 1988. BGE was using a LLD for this purpose of which value was between the conventional effluent LLDs and the environmental LLDs. BGE subsequently issued (April 12, 1996) Chemistry Guideline CG-34, "Analyses to Support Free Release of Material Survey." BGE indicated an action plan would be developed to fully implement evaluations and monitoring, as appropriate, of potentially contaminated bulk material released from the site.

BGE had not detected any hot particles during routine surveillance activities, but continued to maintain the open primary system areas (e.g., steam generator platforms) as hot particle surveillance areas. The inspector observed one individual that did not perform a proper survey (in accordance with procedure RSP 1-105, Section 6.5) for hot particle contamination after the inspector exited a steam generator work platform. The technician directed the inspector to remove applicable protective clothing and step across the step-off pad prior to performing the survey for hot particles on the inspector's person. Applicable procedures required the individual to survey for hot particles before removal of protective clothing and before crossing the step-off pad. This was considered a violation of Technical Specification 6.11 which requires that personnel adhere to radiation protection procedures.

BGE immediately counseled the involved individual and provided training on the matter to applicable personnel. BGE's evaluation concluded that the matter was an isolated instance. The inspector reviewed this matter relative to Section IV of the "General Statement of Policy and Procedure for NRC Enforcement Actions," (Enforcement Policy), NUREG 1600. The inspector concluded that this failure constituted a violation of minor safety consequence and the issue was treated as a non-cited violation (NCV), consistent with Section IV of the enforcement policy.

Although no hot particles were identified by BGE during surveys of steam generator platforms, the inspector questioned the adequacy of the surveys for hot particles for material removed from the steam generators and handled by personnel. Specifically, personnel wiped down material and handled material before surveying it. BGE immediately moved radiation detectors in close proximity of material removed from the steam generators to provide for its survey prior to handling. BGE instructed personnel in the changes.

c. Conclusions

BGE implemented a generally effective contamination control program.

R5 Staff Training and Qualification in Radiation Protection and Chemistry

R5.1 Contractor Radiological Controls Personnel

a. Inspection Scope (83750)

The inspector reviewed the training and qualification records of selected contractor radiological controls personnel. The inspector evaluated the training and qualification of these individuals relative to applicable Technical Specification requirements, procedural requirements and 10 CFR 50.120. The inspector reviewed training records, personnel resumes, and discussed qualification criteria with cognizant BGE personnel.

b. Observations and Findings

BGE implemented a generally well-defined training and qualification program for contracted radiological controls personnel providing responsible radiological oversight during the outage. Job coverage standards were established and implemented to provide guidance for radiological coverage of various work tasks and provided training on new procedures and procedure changes. The inspector's review indicated radiological controls personnel were qualified in accordance with applicable requirements.

BGE's contracted radiation protection personnel (Bartlett Nuclear, Inc.) were required, by the contractor, to sign a form indicating that NRC regulations required notification of the licensee of concerns prior to notifying the NRC. The inspector informed BGE that no such regulatory requirement existed. BGE's contractor immediately corrected the form to indicate that the NRC could be contacted if desired, but expressed the preference that BGE be contacted in order to effect prompt resolution. BGE initiated training of personnel on the new form. The inspector verified that general orientation training, provided to all personnel including contractors during the site access training program, stated clearly that the NRC could be contacted to report violations of radiological requirements or procedures. Phone numbers to contact the NRC were provided during the access training. The inspector's

subsequent discussions with contracted technicians indicated they were previously aware that they could contact the NRC anytime.

c. Conclusions

BGE implemented a generally well-defined program to train and qualify contractor radiological controls personnel providing radiological oversight of outage radiological work activities.

R7 Quality Assurance in Radiological Protection and Chemistry Activities (83750)

R7.1 Radiological Incident Reports

a. Inspection Scope (83750)

The inspector selectively reviewed BGE oversight activities for radiological controls. In particular, the inspector evaluated BGE's evaluations and actions associated with self-identified issues and concerns documented in BGE's incident report program.

b. Observations and Findings

The inspector reviewed three BGE-identified concerns in the area of high radiation area posting or access control. The review was against requirements contained in Technical Specification 6.12, "High Radiation Area," and licensee Procedure RSP 1-104, Revision 9, "Area Posting and Barricading." The events reviewed were as follows:

- On August 21, 1995, at about 8:00 a.m., a radiation protection technician identified that the Unit 1, 27 foot level auxiliary building valve alley door was unsecured. The door controlled access to the valve alley (a transient high radiation area) and was considered a locked high radiation area by BGE.

  BGE's surveys in the area at the time indicated dose rates were not in excess of 1 Rem/hr (maximum 700 mR/hr) and consequently, the area was not required to be locked at that time. However, the failure to verify that the door was properly secured prior to leaving the area (as required by Section 6.8.C. of Procedure 1-104) was an apparent violation of Technical Specification 6.11, which required that personnel adhere to radiation protection procedures.

  Subsequent to the event, BGE took the following corrective actions:

  - The door was secured.
  - A radiation safety event review was conducted which indicated that either an operator or radiation protection technician had not properly secured the door. No unexplained personnel exposures were noted. The event was attributed to failure to verify the door was locked after exiting the area.
  - Site personnel were notified of the event.

- Similar High Radiation Area door closure mechanisms were checked to verify proper operation.
- A quarterly function test of High Radiation Area door locking/closure mechanisms was initiated.
- Shift radiation protection technicians were directed to check all High Radiation doors each shift.

- On September 24, 1995, a high radiation area posting and rope barricade was identified to be not in place by a radiation protection technician in the Unit 2, 5 foot level volume control tank (VCT) valve alley. The area was posted as such due to the transient nature of radiation dose rates in the area. At the time the posting and barricade was found down, the area exhibited measured radiation dose rates well below that required to be posted as a high radiation area. The barrier was apparently left down by an individual who entered the area. However, the failure to verify that the access boundary was properly in place prior to leaving the area (as required by Section 6.8.B. of Procedure 1-104) was an apparent violation of Technical Specification 6.11 which requires that personnel adhere to radiation protection procedures.

  Subsequent to the event, BGE took the following corrective actions:

  - The posting and barricade were re-attached. The individual who left the barricade down could not be identified. However, no unexplained personnel exposures were noted.
  - BGE evaluated the event and attributed its cause to inattention to detail and failure to ensure the barricade and posting were re-attached after exiting the area.
  - Station management issued a memorandum to site supervisors which discussed the need to adhere to radiation protection procedures.
  - BGE instituted use of green step-off pads (at entrances to high radiation areas) as an additional alerting mechanism of personnel.

  The above events were also reviewed by the station's operating review committee. In addition, the operations, radiation safety and general employee training programs were revised to include the events in the industry events section.

- On April 12, 1996, a contractor worker entered onto the Unit 1 No. 11 reactor coolant pump stairwell, an area posted as a high radiation area, and did not have the access (rope boundary and posting) second-checked as being in place immediately upon entry as required. Also, the individual did not have the required continuously indicating dose rate meter as required by the applicable special radiation work permit (SWP No. 1407) and the Calvert Cliffs Radiation Safety Manual (Section 6.2.I). The individual was detected by a radiation protection technician monitoring the area with a closed-circuit television camera.

  The area was posted in preparation for work within the steam generators. However, the failure to verify that the access boundary was second-checked prior to entering the area (as required by Section 6.8.B. of Procedure 1-104) was an apparent violation of Technical Specification

6.11 which requires that personnel adhere to radiation protection procedures. BGE attributed the violation, in part, to poor communications. BGE was evaluating the event at the end of the inspection.

Subsequent to the event, BGE took the following corrective actions:

- The high radiation area boundary was verified to be in-place. Maximum radiation levels within the area were about 10 mR/hr.
- The worker was counseled and restricted from entering the radiological controlled area.
- A work stoppage was initiated for all contractor employees of the affected contractor. Remedial instruction was provided for all contractor employees.
- BGE initiated 24 hour manning of the steam generator checkpoint.

The inspector noted that certain aspects of these events were similar in nature to a previously reported occurrence on June 5, 1995, when an operator improperly entered the Unit 2, 5 foot level elevation volume control tank valve alley, a posted high radiation area. The operator did not have the required continuously indicating dose rate meter prior to entering into the area. The entry was identified by an Instrument and Control (I&C) technician and reported to radiation protection personnel. The operator's access to the radiological controlled area was suspended and his personnel monitoring device was removed by radiation protection personnel. Also, BGE informed site personnel of the matter. The NRC previously reviewed the matter (NRC Inspection Report Nos. 50-317/95-05 and 50-318/95-05), considered it to be of minor safety significance and an isolated event, and identified it as a non-cited violation.

The inspector noted that the August 21, 1995, and September 24, 1995, events were similar in nature to the June 5, 1995, event in that each event appeared to involve personnel error or inattention to detail. Further, the April 12, 1996, occurrence was similar to the June 5, 1995, event in that individuals entered areas posted as high radiation areas without all required monitoring equipment.

The inspector reviewed the above apparent violations relative to Sections IV and VII of the "General Statement of Policy and Procedure for NRC Enforcement Actions," (Enforcement Policy), NUREG 1600. The inspector concluded that it was appropriate to cite these latter licensee-identified violations in that: 1) the multiple instances indicate a concern of more than minor safety significance; 2) corrective actions taken for the June 1995 event (e.g., training) could reasonable have prevented the August 21, 1995, and September 24, 1995, events; 3) the corrective actions for the September 24, 1995, event (e.g., green step-off pads) could reasonably have prevented the April 12, 1996, event; and 4) comprehensive corrective actions for the April 12, 1996, event had not yet been developed by the end of the inspection. In addition, the inspector noted that BGE's corrective actions did not

appear to be effective in correcting recurring high radiation area access control deficiencies.

The inspector noted that the non-cited violation identified in Inspection Report 50-317 (318)/95-05 was similar in nature relative to deficiency in adherence to high radiation area access and control requirements and attention to detail. Consequently, the failure to adhere to high radiation area procedure requirements on August 12, 1995, September 24, 1995, and April 12, 1996, as discussed above, was a violation of Technical Specification 6.11.
(VIO 50-317 (318)/96-03-01)

R8 Miscellaneous RP&C Issues

R8.1 (Closed) Unresolved Item 50-317(318)/95-08-02

This item involved apparent failure to follow radiation protection procedures on August 21, 1996, and September 24, 1996, relative to high radiation area access controls. This item is discussed in Section R 7.1 of this report and was cited as a violation. The unresolved item is closed for administrative purposes.

R8.2 Notification of Claim Against Licensee

During the inspection, the inspector was informed that a claim of bodily injury associated with radiation exposure, was brought against BGE by an individual in July 1995. The plaintiff's counsel voluntarily filed for a stipulation for dismissal in April 1996. The inspector questioned BGE's personnel as to whether the NRC was notified of this claim in accordance with 10 CFR 140.6. The inspector noted that 10 CFR 140.6 requires such claims to be formally reported to the NRC as promptly as practicable. The inspector also noted that as of April 19, 1996, no report of this claim had been made to the NRC.

BGE informed the inspector that the concern raised by the individual (a contractor worker formerly employed at the station in 1989 and 1990) involved low level personnel contamination and that no regulatory exposure limits had been approached or exceeded. BGE provided the inspector information indicating that the individual sustained five instances of low-level skin or clothing contamination resulting in accumulated shallow exposure of the skin well within NRC exposure limits. BGE subsequently notified the NRC, in a letter dated May 3, 1996, of the claim in accordance with 10 CFR 140.6a. Further, BGE initiated actions to modify procedures to ensure prompt notification of such claims in the future. BGE also issued an action item to conduct awareness training (by June 28, 1996) on the specific reporting requirements. The inspector noted that, based on discussions with BGE's General Supervisor-Radiation Protection, this was the only such claim filed.

Based on the above, the inspector reviewed this matter relative to Section IV of the "General Statement of Policy and Procedure for NRC

Enforcement Actions," (Enforcement Policy), NUREG 1600. The inspector concluded that this failure constitutes a violation of minor safety consequence and is being treated as a non-cited violation (NCV), consistent with Section IV of the enforcement policy.

S1 Conduct of Security and Safeguards Activities (81070, 81078)

a. Inspection Scope

This inspection was conducted to assess BGE's actions to correct intrusion detection system vulnerabilities identified in Inspection Report No. 50-317 and 318/95-09 in the protected area of the facility and in the independent spent fuel storage installation, and to assess BGE's actions to correct weaknesses in its access authorization program which were identified in Inspection Report No. 50-317 and 318/95-04.

b. Observations and Findings

The licensee was found to be in compliance with NRC requirements and no safety concerns were noted in the areas inspected as described in Section S8 below, six previously identified items, five of which concerned weaknesses in the access authorization program and the other concerning intrusion detection system vulnerabilities in the plant protected area and in the independent spent fuel storage installation were closed based on the inspectors' review of the licensee's corrective actions. However, another weakness was identified in the access authorization program. The procedure addressing the reinstatement of unescorted access if an individual has been away from a licensee, or approved contractor/vendor, behavioral observation program for more than 30 days was not implemented in a timely fashion.

S8 Miscellaneous Security and Safeguards Issue

S8.1 For the violations discussed below, the inspectors determined that the corrective actions described in the licensee's January 30, 1996 and December 28, 1995 letters, in response to the NRC's Notices of Violation, were reasonable and complete. No similar problems were identified.

(Closed) VIO 50-317/95-170-01013 & 50-318/95-170-01013: The licensee failed to provide high assurance that a contractor employee granted unescorted access was trustworthy and reliable.

(Closed) VIO 50-317/95-170-02014 & 50-318/95-170-02014: The licensee failed to conduct an audit of the contractor that performs the background investigation element of the access authorization program.

(Closed) VIO 50-317/95-170-03014 & 50-318/95-170-03014: The licensee failed to provide contractors an opportunity for an objective review of the information on which an access denial or revocation was based.

(Closed) VIO 50-317/95-09-01 & 50-318/95-09-01: The licensee's perimeter intrusion detection systems failed to detect penetration attempts in five of eighteen zones in the plant protected area and nine of nine zones in the independent spent fuel storage installation.

S8.2 (Closed) IFI 50-317/95-04-01 & 50-318/95-04-01: During Inspection No. 95-04, the inspector identified a weakness in the access authorization (AA) program. The potential existed for members of the licensee's AA program staff to be involved in establishing the scope and depth of an approved contractor audit. If that occurred, the audit would not be independent of those individuals responsible for program implementation.

The inspectors determined that the actions implemented by the licensee to resolve the concern appeared to be adequate. Those actions included revisions to administrative procedures QL-3-319, Access Authorization Component Program Audits, and SE-2-300, Access Authorization Manual. The revisions to the procedures, by clearly defining the responsibilities of the audit team members, establish the required functional independence of the audit program. No similar problems were identified.

S8.3 (Closed) IFI 50-317/95-04-02 & 50-318/95-04-02: During Inspection No. 95-04, the inspector noted that the Access Authorization Manual, implemented to satisfy the requirements of Regulatory Guide 5.66 and a commitment in the NRC-approved Physical Security Plan, was not considered by the licensee as an implementing procedure that fell under the review criteria specified in Technical Specification 6.8. Additionally, there were no administrative control criteria in the security program to cover review of security plan implementation procedures.

The inspectors determined, by a review of administrative procedure SE-2-301, Revision 1, dated March 14, 1996, "Control of Security Plans and Procedures," and discussions with security program management, that the actions taken to address the weakness were adequate. No similar problems were identified.

S8.4 (Open) IFI 50-317/96-03-01 & 50-318/96-03-01: During Inspection No. 95-04, the inspector noted a weakness concerning the lack of a control to alert security screening unit personnel when a person has been absent from a behavioral observation program for more than 30 days. During this inspection, the inspectors reviewed the action taken to resolve the concern and noted that procedure SS-11, "30 Day Hold," Revision 3, had been implemented on April 9, 1996. The inspector questioned the timeliness of implementing the procedure and could not evaluate its effectiveness because of the late implementation. This matter will be reviewed during a subsequent inspection.

S8.5 Updated Final Safety Analysis Report (UFSAR) Review

Since the UFSAR does not specifically include security program requirements, the inspectors compared licensee activities to the NRC-approved physical security plan (the Plan) which is the applicable document.

The inspectors reviewed the Plan, Revision 33, dated September 25, 1995, in the area of protected area barriers, Section 4.1 (A), and verified that the Plan was consistent with security program procedures and practices.

P1 Conduct of Emergency Preparedness Activities

P1.1 Personnel Emergency: Contaminated Injured Man

On April 23, 1996, the Calvert Cliffs control room received a report of an injured worker in the Unit 1 containment. The worker had fallen in containment and had sustained suspected leg and hip injuries. Control room personnel implemented Emergency Response Plan Implementation Procedure 3.0, Attachment 11, "Personnel Emergency," and notified emergency response personnel including a radiation safety technician. Due to the nature of the suspected injuries, the individual was transported to Calvert Memorial Hospital in full anti-contamination clothing (Anti-C's) that was being worn at the time of the injury.

Following arrival at the hospital, the anti-Cs were removed and the individual was determined to not be contaminated. The individual was moved to the emergency room for continued treatment. Radiation safety technicians from Calvert Cliffs determined that the anti-Cs were slightly contaminated as was the gurney used to move the individual out of the reactor containment building. BGE and Calvert Memorial Hospital personnel acted appropriately to contain the contamination and prevent its spread. The affected materials were collected and returned to Calvert Cliffs for proper disposal. Verification that decontamination of the facility was complete and that the radiation emergency area at the hospital was restored to the initial state of readiness were also completed.

Following the incident, BGE and Calvert Memorial Hospital personnel conducted a critique of the event to determine adequacy of procedures and effectiveness of the response. Two weaknesses were identified during the critique, one being that not enough detailed information had been collected from hospital personnel during the event to generate full radiation exposure records. The necessary information was subsequently retrieved. Secondly, the emergency response procedure did not provide instructions for documenting the return of the contaminated clothing and gurney to Calvert Cliffs. This documentation issue was being resolved at the time of the inspection. Both issues were considered by the inspectors to be minor and had been entered in the Calvert Cliffs corrective action process.

The inspectors found that the Calvert Cliffs emergency response personnel effectively controlled radioactive materials and provided for monitoring of support personnel during the personnel emergency event. During the event, Calvert Cliffs personnel properly implemented the emergency response plan implementation procedures.

L1 Review of UFSAR Commitments

A recent discovery of a licensee operating its facility in a manner contrary to the UFSAR description highlighted the need for a special focused review that compares plant practices, procedures and/or parameters to the UFSAR description. While performing the inspections discussed in this report, the inspectors reviewed the applicable portions of the UFSAR that related to the areas inspected to verify that the UFSAR wording was consistent with the observed plant practices, procedures and/or parameters. An issue regarding SG U-tubes was noted as described in section M1.4 of this report.

V. Management Meetings

X1 Exit Meeting Summary

During this inspection, periodic meetings were held with station management to discuss inspection observations and findings. On May 10, 1996, an exit meeting was held to summarize the conclusions of the inspection. BGE acknowledged the findings presented.

ATTACHMENT 1

PARTIAL LIST OF PERSONS CONTACTED

BGE

P. Katz, Plant General Manager
K. Cellers, Superintendent, Nuclear Maintenance
K. Neitmann, Superintendent, Nuclear Operations
P. Chabot, Manager, Nuclear Engineering
T. Camilleri, Director, Nuclear Regulatory Matters
B. Watson, General Supervisor, Radiation Safety
C. Earls, General Supervisor, Chemistry
B. Radford, System Engineer, Steam Generator Eddy-Current Testing
L. Gibbs, Director, Nuclear Security
W. Paulhardt, Radiation Safety Supervisor-Dosimetry
G. Phair, Supervisor Radiation Control
M. Rigsby, Supervisor-Radiation Technical Services
T. Sydnor, Outage Manager
R. Wyvill, ALARA Supervisor

NRC

L. Doerflein, Branch Chief, Division of Reactor Projects, Region I
M. Modes, Branch Chief, Division of Reactor Safety, Region I
A. Dromerick, Licensing Project Manager for Calvert Cliffs, NRR

INSPECTION PROCEDURES USED

IP 62703: Maintenance Observation
IP 71707: Plant Operations
IP 93702: Prompt Onsite Response to Events at Operating Power Reactors
IP 61726: Surveillance Observations
IP 37550: Engineering
IP 37551: Onsite Engineering
IP 71750: Plant Support Activities
IP 83750: Occupational Exposure
IP 92700: Onsite Followup of Written Reports of Nonroutine Events at Power Reactor Facilities
IP 92902: Followup - Engineering
IP 81070: Access Control
IP 81078: Detection Aids

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

IFI 50-317, 50-318/96-03-01
VIO 50-317, 50-318/96-03-01
UNR 50-317, 50-318/96-03-01

Closed

UNR 50-317, 50-318/95-08-02
VIO 50-317, 50-318/95-02-01
IFI 50-317, 50-318/95-04-02
VIO 50-317, 50-318/95-06-01
VIO 50-317, 50-318/95-170-01013
VIO 50-317, 50-318/95-170-02014
VIO 50-317, 50-318/95-170-03014
VIO 50-317, 50-318/95-09-01
IFI 50-317, 50-318/95-04-01

LIST OF ACRONYMS USED

ALARA	As Low As Reasonably Achievable
RCA	Radiological Controlled Area
CVCS	Chemical Volume and Control System
LLD	Lower Limits of Detection
CVCS	Chemical and Volume Control System
PDR	Public Document Room
SWP	Special Work Permit
ECT	Eddy Current Testing
FME	Foreign Materials Exclusion
kV	Kilovolts (1000 volts)
SOMD	BGE System Operation and Maintenance Department
GS-NPO	General Supervisor - Nuclear Plant Operations
EPRI	Electric Power Research Institute
S/G	Steam Generator
UFSAR	Updated Safety Analysis Report
TSP	Tube Support Plate
MOV	Motor Operated Valve
LPSI	Low Pressure Safety Injection
EDG	Emergency Diesel Generator
DAC	Derived Air Concentration
RCA	Radiologically Controlled Area
TLD	Thermoluminiscent Dosimeter
VCT	Volume Control Tank
SBO	Station Blackout

ATTACHMENT 2

SUMMARY OF CURRENT LICENSING BASIS REQUIREMENTS (CLB) - SFP DECAY HEAT REMOVAL AND REFUELING PRACTICES

Technical Specification requirements:

3.9.1 - The boron concentration in the reactor coolant system and refueling pool shall be maintained within the Core Operating Limits Report (COLAR) with the reactor vessel head removed.

3.9.2 - Maintain at least two source range monitors in operation while in Mode 6.

3.9.3 - The reactor must be subcritical at least 100 hours before moving irradiated fuel. (This TS is required for the fuel handling accident. The required decay time for movement of fuel from the reactor to the SFP is 6 days, which is not a TS requirement, but is a design and procedural requirement).

3.9.4 - Provides containment penetration controls during refueling.

3.9.5 - Provides communication requirements during refueling.

3.9.6 - Requires that the refueling machine be operable.

3.9.7 - The single failure proof crane must be used to carry loads in excess of 1600 pounds over fuel assemblies in the SFP.

3.9.8 - At least one SDC loop shall be in operation.

3.9.9 - The containment purge valve isolation system shall be operable.

3.9.10 - At least 23 feet of water shall be maintained over the top of the irradiated fuel assemblies seated within the reactor pressure vessel.

3.9.11 - A minimum of 21.5 feet of water shall be maintained over the top of the irradiated fuel assemblies seated in the storage racks.

3.9.12 - The SFP ventilation system shall be operable.

3.9.13 - The containment vent isolation valves shall be closed.

5.3.1 - Maximum of 4.52 weight percent U-235 enrichment and a K_{eff} of ≤ 0.95 as described in Section 9.7.2 of the UFSAR.

5.3.2 - The SFP is designed and shall be maintained to prevent inadvertent draining of the pool below elevation 63 feet.

5.3.3 - The SFP shall be maintained with a designed storage capacity of 1,830 fuel assemblies.