February 10, 1998

Mr. Charles H. Cruse
Vice President - Nuclear Energy
Baltimore Gas and Electric Company
Calvert Cliffs Nuclear Power Plant
1650 Calvert Cliffs Parkway
Lusby, MD 20657-4702

SUBJECT: ISSUANCE OF AMENDMENT FOR CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NO. 1 (TAC NO. M98784)

Dear Mr. Cruse:

The Commission has issued the enclosed Amendment No. 225 to Facility Operating License No. DPR-53 for the Calvert Cliffs Nuclear Power Plant, Unit No. 1. This amendment authorizes revision of the Updated Final Safety Analysis Report (UFSAR) in response to your application dated May 16, 1997, as supplemented November 14, 1997.

The amendment involves replacing the service water (SRW) heat exchangers with new plate and frame heat exchangers, having an increased thermal performance capability. The Saltwater and SRW piping configuration will be modified as necessary to allow proper fit-up to the new components. A flow control scheme to throttle saltwater flow to the heat exchangers and the associated bypass lines will be added. Saltwater strainers with an automatic flushing arrangement will be added upstream of each heat exchanger.

However, the licensee is not authorized to operate with one Plate and Frame Heat Exchanger secured, and removing one Containment Air Cooler from service to enable the affected subsystem to remain operable while the one Plate and Frame Heat Exchanger is secured.

A copy of the related Safety Evaluation is enclosed. A Notice of Issuance will be included in the Commission's next regular biweekly Federal Register notice.

Sincerely,
ORIGINAL SIGNED BY:
Alexander W. Dromerick, Senior Project Manager
Project Directorate I-1
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Docket No. 50-317

Enclosures: 1. Amendment No. 225 to DPR-53
2. Safety Evaluation

cc w/encls: See next page

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

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cc w/encls: See next page

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DATED: February 10, 1998

AMENDMENT NO 225 TO FACILITY OPERATING LICENSE NO. DPR-53-CALVERT CLIFFS UNIT 1

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

BALTIMORE GAS AND ELECTRIC COMPANY

DOCKET NO. 50-317

CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NO. 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 225
License No. DPR-53

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Baltimore Gas and Electric Company (the licensee) dated May 16, 1997 as supplemented November 14, 1997, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act) and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended to authorize revision of the Updated Final Safety Analysis Report (UFSAR) as set forth in the application for amendment by the licensee, dated May 16, 1997, as supplemented November 14, 1997. The licensee shall update the UFSAR to reflect the installation of the service water (SRW) heat exchangers with new plate and frame heat

exchangers, including salt water strainers with an automatic flushing arrangement that will be installed upstream of each heat exchanger and the installation of additional control valves.

However, the licensee is not authorized to operate with one Plate and Frame Heat Exchanger secured, and removing one Containment Air Cooler from service to enable the affected subsystem to remain operable while the one Plate and Frame Heat Exchanger is secured.

3. This license amendment is effective as of the date of its issuance to be implemented during the Calvert Cliffs Unit No. 1 spring 1998 refueling outage.

FOR THE NUCLEAR REGULATORY COMMISSION

S. Singh Bajwa, Director
Project Directorate I-1
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO.225TO FACILITY OPERATING LICENSE NO. DPR-53

BALTIMORE GAS AND ELECTRIC COMPANY

CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NO. 1

DOCKET NO. 50-317

1.0 INTRODUCTION

By letter dated May 16, 1997, as supplemented November 14, 1997, Baltimore Gas and Electric Company (BGE), the licensee for the Calvert Cliffs Nuclear Power Plant, requested an amendment to Operating License No. DPR-53 to implement a modification which constitutes an unreviewed safety question as described in Title 10 to the Code of Federal Regulations (CFR) 50.59, "Changes, Tests, and Experiments." The proposed modification involves replacing the Unit 1 service water (SRW) heat exchangers with new plate and frame heat exchangers (PHEs) in order to significantly improve the thermal performance of the SRW System. A flow control scheme would be added to throttle saltwater flow to the SRW heat exchangers and the associated bypass lines. Automatic flushing strainers would be added to the Saltwater System (SW) upstream of each SRW heat exchanger. The saltwater and SRW piping configurations would be modified to accommodate the new components. The licensee found that the flow control valves and the automatic flushing strainers are new active components in the SW that could introduce the potential for malfunctions of a different type than any evaluated previously in the Updated Final Safety Analysis Report (UFSAR). The proposed modification also includes removing one containment air cooler (CAC) from service to allow operating with one of two PHEs on a subsystem. The November 14, 1997, letter provided clarifying information that did not change the initial proposed no significant hazards consideration determination.

2.0 BACKGROUND

The SW is an open loop system, which utilizes the Chesapeake Bay as the supply source (ultimate heat sink). It consists of two subsystems that provide SW to cool the SRW heat exchangers, Component Cooling (CC) System heat exchangers, and the Emergency Core Cooling System pump room air coolers. During normal operation, both subsystems are in service with one pump on each subsystem, and a third pump in standby that can supply either subsystem. SW flow through the SRW and CC heat exchangers is throttled to provide sufficient cooling to the heat exchangers, and to maintain total subsystem flow to prevent pump runout. Following a loss-of-coolant accident (LOCA), the SW system has two phases, which include pre- and post-Recirculation Actuation Signal (RAS). Each subsystem can satisfy the design heat removal requirements during both phases of the accident. During pre-RAS, a Safety Injection Actuation Signal (SIAS) automatically reconfigures each SW subsystem to fully open the SRW heat exchanger SW outlet valves. An SIAS will permit the ECCS pump room air coolers to be cooled by SW if the room temperatures exceed the designated limits, and it will automatically isolate the SW flow to the CC heat exchangers. On an RAS, the SW outlet valves on the CC and SRW heat exchangers return to their pre-accident positions, and the ECCS pump room air coolers continue to operate. During post-RAS, an operator has to remotely throttle the SW outlet valves for the CC and SRW heat exchangers to maintain system design temperatures.

The SRW System is a closed loop system, which utilizes plant demineralized water that is treated with a corrosion inhibitor. It consists of two subsystems that remove heat from various turbine plant components, a blowdown recovery heat exchanger, CACs, spent fuel pool cooling heat exchangers, and diesel generator (DG) heat exchangers. During normal operation, both subsystems are in service and fully redundant to assure the safe operation and shutdown of the plant, assuming a single failure. The SRW supply temperature is maintained at ≤ 95 degrees F for normal operation and ≤ 105 degrees F during accident conditions. During a LOCA, each subsystem supplies two CACs to support the cooldown of containment, and the No. 12 SRW Subsystem cools the No. 1B DG to ensure continued reliable operation of the DG as an emergency power supply. The non-safety-related portion of the SRW System supplies components in the turbine building, and the piping is automatically isolated during a LOCA.

In response to Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment," BGE performed baseline thermal performance tests on the SRW heat exchangers in 1993. During those tests, the licensee found that the heat removed by the SRW heat exchangers was less than expected. BGE imposed strict cleaning and bulleting requirements on the heat exchangers to compensate for the reduction in the heat removal capability. Also, flow controllers were installed on the SRW inlet valves for the CACs to throttle SRW flow during a LOCA to reduce the SRW System heat load. Despite the addition of the flow controllers, operation at higher ultimate heat sink temperatures still required frequent heat exchanger cleaning to maintain the necessary heat removal capability.

During the spring 1994 Unit 1 refueling outage, the licensee also found that the existing SRW heat exchangers were susceptible to erosion and/or corrosion under normal operating conditions. There were 140 tubes replaced in the No. 11 SRW heat exchanger during the outage, which were plugged previously due to leakage. The licensee discovered severe tube wall thinning in the first 3 to 4 inches of the inlet end of the tubes, which was apparently caused by erosion and/or corrosion on the tube side. Similar damage was also identified on the No. 21 SRW heat exchanger. The licensee temporarily installed sleeves on the inlet end of the tubes. As a result of the erosion and/or corrosion discovery and the reduction in heat removal capability for the SRW heat exchangers, BGE proposes the modification to replace the SRW heat exchangers with the new plate and frame heat exchangers to alleviate these problems.

3.0 EVALUATION

3.1 Proposed Modification

In BGE's proposed modification, the two existing shell and tube SRW heat exchangers would be replaced with four new PHEs that have an increased thermal performance capability. The PHEs are constructed with titanium plates and Ethylene Propylene Diene Monomer (EPDM) gaskets, which would deter the erosion and/or corrosion problem that has damaged the existing heat exchangers. The remaining components consist of carbon steel, which would not be directly exposed to the SW. Additional titanium plates could be added to further increase the thermal performance of the PHEs. Two PHEs would operate in parallel on each of the two SRW subsystems. Each subsystem would be redundant and capable of removing the accident heat load from two CACs and a DG at SW supply temperatures of ≤ 90 degrees F while maintaining SRW within its design limit. A flow control scheme would be added to throttle saltwater flow to the SRW heat exchangers and the associated bypass lines. The saltwater and SRW piping configurations would be modified to accommodate the new components.

The proposed modification includes SW strainers that would be installed upstream of each PHE (two strainers per subsystem) to remove debris and minimize macrofouling in the heat exchangers. Each strainer has an automatic flushing function that consists of a flushing valve and a flow diverter, which are regulated by a control assembly. A full port ball valve would be used for the flushing valve to provide for minimal obstruction of debris removal. During normal strainer operation, SW would enter a strainer basket with the flow diverter open and the flushing valve closed. SW would pass through an inlet section and be forced through a screen basket before it passes through an outlet. The strainers would be flushed every 60 minutes initially, then the interval could be adjusted based on operating experience with the strainers. Flushing would occur automatically on high strainer differential pressure (dP). Strainer flushing or regeneration would occur in two stages. First, the flushing valve would open to commence the regeneration cycle, and the total flow through the strainer filter would increase. The increased flow would loosen the debris inside the strainer basket, which would be washed through the flushing valve to the SW discharge header downstream of the heat exchangers. For the second stage, the flow diverter would close while the flushing valve remains open, so the flow would be forced through the basket at the strainer inlet. Most of the flow would exit through the main outlet, but some would be diverted to a debris collection section. Any dislodged remnants would be discharged through the flushing valve. The total flushing cycle would last for approximately 80 seconds. Any large items could be removed through an 8-inch handhole on the cover. The strainers on each subsystem would be interlocked to limit the regeneration cycle to perform on one strainer at a time. A manual SW isolation valve would be provided upstream of each strainer to allow for isolation of any selected strainer and PHE combination.

The proposed modification would replace the two existing SRW heat exchanger SW outlet control valves with six control valves. One control valve would be at the outlet of each of the four PHEs and one control valve would be on each of the two bypass lines. The SW outlet control valves would utilize a flow element, a flow indicating controller (FIC), a valve positioner, solenoid valves, and instrument air valves to modulate the flow at a predetermined flow setting. The bypass line control valves would have similar valve position controls, except the position of these valves would be automatically controlled by a pressure indicating controller (PIC) to maintain SW header pressure in a pre-established band. The positions of these valves would be determined by the associated FIC flow setting or PIC pressure setting. In the existing system, the SRW heat exchanger SW outlet valves go to the fully open position on an SIAS, and return to their pre-accident throttled position on an RAS. Under the proposed modification, these Engineered Safety Features Actuation Signals (ESFASs) would be eliminated since the flow between the minimum and maximum values would be automatically controlled. The staff agrees with the licensee's conclusion, and finds it acceptable to eliminate the ESFAS signals.

Control room annunciation and indication to alert the operators to high PHE outlet temperatures was also included in the proposed modification. A PHE trouble alarm would be generated for high PHE SW dP, high strainer dP, abnormal strainer flushing cycle, low SW flow, or strainer mode control in manual. The high dP alarms would be installed to alert operators to a debris build-up or a failure of the regeneration cycle for the strainers. A local control station would be provided for indication, annunciation, and to override and take local operation of the regeneration controller.

3.2 Potential Component Malfunctions Not Considered in UFSAR

The licensee's proposed modification includes new components that introduce the potential for malfunctions that were not previously considered in the UFSAR. These components include automatic flushing strainers and control valves. Operator actions would not be required to manipulate these components.

3.2.1 Automatic Flushing Strainers

The licensee identified six potential failure modes for the strainers, which are the failure of the pressure boundary, the clogging of the strainer, the flushing valve remaining open, the flushing valve remaining closed, the diverter failing open, and the diverter failing closed. The licensee's justification for these failures are as follows:

a. Pressure Boundary Failure

Since the strainer is designed and manufactured to the same codes and standards as the other system pressure boundary components, the licensee concluded that the probability of a failure of the pressure boundary would be no different from the portions of the system already evaluated in the UFSAR.

b. Clogging of the Strainer

The strainer is designed to flush automatically on a preset timing cycle and on high strainer dP. If the automatic flushing cycle failed, the affected strainer would eventually reach its dP limit and generate a control room alarm. The associated PHE SW outlet control valve would open further to compensate for the clog in the strainer, and the low SW flow alarm setpoint would eventually be reached. This scenario would allow sufficient time for the licensee to investigate and implement corrective actions. A handhole on the strainer cover plate would allow the licensee to inspect the strainer internals and perform a manual cleaning, if necessary. If the clogged strainer adversely affected the subsystem operation, the licensee would deenergize the controls for the failed strainer and initiate manual flushes of the unaffected strainer, or allow the unaffected strainer to resume its automatic flushing sequence.

c. Flushing Valve Remains Open

The flushing valve is designed to fail closed on a loss of power or air. If the flushing valve fails to close, the affected strainer would continue to flush and remain relatively clean. As a result, an abnormal strainer flushing cycle alarm would be generated to prompt the licensee to investigate. Assuming no operator action, an interlock between the two strainers within the subsystem would prevent flushing of the unaffected strainer, which could eventually cause the unaffected strainer to reach its dP limit and alarm setpoint. The associated PHE SW outlet control valve would open further to compensate for the clog in the strainer, and the low SW flow alarm setpoint would eventually be reached. Both PHEs would continue to remove their design basis heat load until the heat exchanger low flow setpoint was reached due to the gradual clogging of the strainer. The PHE may remain functional with reduced flow rate depending upon bay temperature and/or accident conditions. This scenario would be a slow developing process that would provide sufficient time for the licensee to investigate and implement corrective actions as discussed in Section 3.2.1.b.

d. Flushing Valve Remains Closed

The flushing valve is designed to fail closed on a loss of power or air. However, if the flushing valve fails to open during the flushing cycle, then the abnormal strainer flushing cycle would generate a control room alarm. Also, it may eventually cause the affected strainer to reach its dP limit and alarm setpoint. The PHE SW outlet control valve would open further to compensate for the clogging in the strainer, and eventually the low SW flow alarm setpoint and/or strainer dP alarm setpoint would be reached. The flushing circuit on the unaffected strainer would continue to function. Both PHEs would continue to remove their design basis heat load until the heat exchanger low flow setpoint was reached on the affected side as discussed in Section 3.2.1.c.

e. Flow Diverter Fails Open

The diverter valve is designed to fail open on a loss of power or air. If the diverter fails to shut during the flushing cycle, then the abnormal strainer flushing cycle would generate a control room alarm to alert operators to the condition. This failure would lead to less effective flushes that could lead to more automatically-initiated flushes due to a high strainer dP. Eventually this would have the same effect as a flushing valve failing closed, but would be slower in reaching the PHE low flow alarm setpoint.

f. Flow Diverter Fails Closed

The diverter valve is designed to fail open on a loss of power or air. If the diverter fails to fully reopen during the flushing cycle, the abnormal strainer flushing cycle would generate a control room alarm. The number of automatic strainer flushes would increase due to a high dP. Eventually this failure would have the same effect as a flushing valve failing closed. Although, the PHE low flow setpoint may be reached sooner than in other failures due to the reduction in the effective strainer area.

3.2.2 Control Valves

The licensee identified several potential failure modes for the control valves, which include a PHE SW outlet control valve failure and a bypass line control valve failure. If a control valve failure occurred, the valve would go to its fail-safe position. The SW outlet control valves would fail open on a loss of power or instrument air to ensure continued flow to the heat exchanger. The bypass line control valves would fail closed on a loss of power or instrument air to prevent pump runout, and to allow the PHE SW outlet control valves to maintain flow through the PHEs with the FICs.

If a bypass line control valve failed in the closed position prior to an RAS, then the total SW flow would drop below its minimum flow of 10,000 gpm. The impact on the pump would not be immediate, but its reliability would eventually be affected. An operator could increase flow by remotely opening the PHE SW outlet controls valves until an RAS occurs. If a bypass line control valve failure occurred during post-RAS, pump operation would continue with the PHE FICs operating at their normal setpoints and SW header pressure would be within the prescribed limits. The failure to restore minimum pump flow could eventually lead to a failure of the SW pump and subsequent loss of the associated subsystem. However, the other SW subsystem would be unaffected and capable of removing the full design accident heat load.

If either one of the PHE SW outlet control valves failed open, the SW flow to the associated PHE would increase, which would improve the components' heat removal capability. The other PHE on the subsystem would continue to operate, and the SW header pressure could still be automatically adjusted by the bypass line control valves. During post-RAS, an operator would need to reduce flow through the bypass line in order to achieve the minimum required flow to the CC heat exchanger. The remaining SW subsystem would be unaffected by this failure and remain capable of removing the full design accident heat load.

The licensee concluded that the failure of any control valve into a position other than its fail safe position is highly unlikely, and would require operator error or equipment malfunction, along with instrument air forcing the valve operator to hold the control valve out of position. This type of failure would not affect the other SW subsystem, which would remain capable of removing the full design accident heat load. The staff finds that no single active failure at any time, and no single passive failure after recirculation from the containment sump would prevent the safety feature systems from fulfilling their design function. Therefore, the staff finds the failure modes analysis performed by the licensee to be acceptable.

3.3 System Operation After Modification

In a letter to support the proposed modification dated November 14, 1997, the licensee stated that the PHEs are designed for a lower minimum required SW subsystem flow of approximately 8,000 gpm for each PHE rather than the minimum shell and tube heat exchanger flow of approximately 16,830 gpm. The reduced flow was based on vendor recommendations to improve the performance of the heat exchangers and to reduce the pressure drop across the PHEs to provide a closer match to the existing SW pump operating characteristics. Even with the reduced minimum flow, the total SW flow would be maintained near its existing value by use of the SW bypass line. In the existing SW System, total SW flow ranges between 15,000 and 20,000 gpm during normal operations. The total system flow for the proposed modification is between 14,000 and 18,000 gpm. The licensee evaluated the change in total system flow, and concluded that all components would receive their minimum required flow and pump performance would not be adversely affected. The minimum flow requirement would maintain sufficient turbulence in the PHE flow passages to minimize microfouling on the PHE plates. The staff agrees with the licensee's conclusion, and finds the change in total system flow to be within the design limits, and is acceptable.

The operation of the SW pumps, the ECCS pump room air coolers, and the CC heat exchangers would be the same as the existing system. Either SRW subsystem could be secured for maintenance by cross-connecting the SRW system to the remaining pair of PHEs. In the event of a break in the common SW piping downstream of the SRW heat exchangers, the same alternate flow path that currently exists would be available to prevent a common mode failure.

On a LOCA (pre-RAS), the proposed modification would eliminate the ESFAS signals associated with any SW equipment in the SRW pump room, which includes the SIAS and RAS to the PHE SW outlet control valves. SW flow to the CC heat exchangers would continue to be isolated upon receipt of an SIAS. The FICs would continue to maintain the preset flow to the PHEs if the PHE SW outlet valves were in automatic. The strainers would continue to automatically flush. The PIC would adjust the bypass valve positions to maintain the SW header pressure within the established limits. No immediate actions would be required during this phase of the accident.

On an RAS, the CC heat exchanger outlet valves would return to their pre-RAS positions, and the CC heat exchanger outlet valves would be manually throttled to maintain CC outlet temperature. The automatic flow controller in the proposed modification would replace the actions required by an operator to manually throttle the SW outlet valves in the existing system. However, if the PHE SW outlet control valves were placed in their fully open position, an operator would be required to return them to automatic after an RAS.

The licensee concluded that the design, procurement, installation, and testing of the equipment associated with the proposed modification are consistent with the applicable codes and standards governing the original systems, structures, and components, and that the SRW System would remain redundant, and separated without any new common-mode failures. Therefore, the staff finds the proposed modification to be acceptable.

However, the licensee also proposed to operate with one of the two PHEs isolated on a subsystem, while continuing to operate with the CC heat exchanger, and the ECCS pump room air coolers on the affected SW Subsystem. A single PHE cannot remove the entire LOCA heat load while maintaining SRW temperature within its design limit. As a result, the licensee proposed to remove one CAC from service, so the single PHE could handle the remaining accident heat load on the subsystem, which would allow the DG, the remaining CAC, the CC heat exchanger, and the ECCS pump room air coolers on the affected subsystem to remain operable when the one PHE is isolated. The staff reviewed the significance of removing a CAC from service in order to facilitate operating with one of the PHEs isolated on a subsystem, and found that it was unacceptable.

The staff reviewed the licensee's submittal, and agrees that the implementation of the proposed SRW heat exchanger modification would provide a significant improvement in the thermal performance capability of the SRW System. Based on the considerations stated above, the staff concludes that the potential for malfunctions of a different type than any evaluated previously in the UFSAR do not preclude the SRW or SW Systems from being within their design limits. Therefore, the proposed modification is acceptable with the exception of operating with one PHE secured, and removing one CAC from service to enable the affected subsystem to remain operable while the one PHE is secured.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Maryland State official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding (62 FR 33118). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributors: V. Ordaz
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Date: February 10, 1998