400 Chestnut Street Tower II

May 26, 1981

Mr. James P. O'Reilly, Director
Office of Inspection and Enforcement
U.S. Nuclear Regulatory Commission
Region II - Suite 3100
101 Marietta Street
Atlanta, Georgia 30303

Dear Mr. O'Reilly:

OFFICE OF INSPECTION AND ENFORCEMENT BULLETIN 81-03-RII:JPO 50-259, -260, -296 - BROWNS FERRY NUCLEAR PLANT. 50-327, -328 - SEQUOYAH NUCLEAR PLANT

In response to your letter dated April 10, 1981, Enclosures 1 and 2 are action item responses required of holders of operating licenses (OL) for IE Bulletin 81-03: Flow Blockage of Cooling Water to Safety System Components by Corbicula sp. (Asiatic Clam) and Mytilus sp. (Mussel). Enclosure 1 is a response to items 1 through 5 for the Browns Ferry Nuclear Plant. Enclosure 2 is a response to items 1 through 5 for the Sequoyah Nuclear Plant. Sequoyah's unit 2 is considered licensed for purposes of responding to IE Bulletin 81-03 action items. If you have any questions, please call Ralph Shell at FTS 857-3260.

To the best of my knowledge, I declare the statements contained herein are complete and true.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

L. M. Mills, Manager
Nuclear Regulation and Safety

Enclosures
cc: Mr. Victor Stello, Director (Enclosures)
Office of Inspection and Enforcement
U.S. Nuclear Regulatory Commission
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Enclosure 1

RESPONSE
NRC IE BULLETIN NO. 81-03
RII:JPO
BROWNS FERRY NUCLEAR PLANT

ITEM NO. 1

Determine whether Corbicula sp. or Mytilus sp. is present in the vicinity of the station (local environment) in either the source or receiving water body. If the results of current field monitoring programs provide reasonable evidence that neither of these species is present in the local environment, no further action is necessary except for items 4 and 5 in this section for holders of operating licenses.

RESPONSE

Asiatic clams were first manifested as a nuisance in plant raw water systems in 1974.[1] Even though their presence in the local environment was known, there was no formal monitoring program in effect at that time. An investigation in October 1974 revealed how severe the problem was. An apparent loss of condenser efficiency on units 1 and 2 revealed a heavy infestation of clams on the tubesheets of several waterboxes.[2]

Later, in December 1974, a leaking heat exchanger on 1B recirculation pump MG set drive motor was disassembled and found to be partially plugged with clams.[3] All waterboxes and the intake conduits were drained and several hundred pounds of clams were removed. A program was initiated to clean the waterboxes and intake conduits annually or whenever necessary.[4]

ITEM NO. 2

If it is unknown whether either of these species is present in the local environment or is confirmed that either is present, determine whether fire protection or safety-related systems that directly circulate water from the station source or receiving water body are fouled by clams or mussels or debris consisting of their shells. An acceptable method of confirming the absence of organism or shell debris consists of opening and visually examining a representative sample of components in potentially affected safety systems and a sample of locations in potentially affected

fire protection systems. The sample shall have included a distribution of components with supply and return piping of various diameters which exist in the potentially affected systems. This inspection shall have been conducted since the last clam or mussel spawning season or within the 9-month period preceding the date of this bulletin. If the absence of organisms or shell debris has been confirmed by such an inspection or another method which the licensee shall describe in the response (subject to NRC evaluation and acceptance), no further action is necessary except for items 4 and 5 of actions applicable to holders of an operating license.

RESPONSE

The testing and inspections described below are in compliance with the inspection intervals specified by NRC in the bulletin.

Emergency Equipment Cooling Water (EECW) System

Past flow verification tests of the EECW system have frequently indicated inadequate cooling water flow.[5] To date, these flow inadequacies have resulted in five licensee event reports (LER's), and numerous trouble report (TR's).[6] Subsequent investigations have revealed large amounts of clams, mud, and debris plugging tubesheets and restricting flow in piping.[7]

Raw Cooling Water (RCW) System

Similarly, scheduled maintenance activities on other nonsafety-related heat exchangers and coolers supplied by the RCW system have revealed large accumulations of mud and clams.[8]

High Pressure Fire Protection (HPFP) System

Scheduled inspections and flushing of the HPFP system always yield small amounts of mud and clams, but the severe flow restriction and pluggage problems experienced during the initial inspections and flushings are now practically nonexistent.[9]

Residual Heat Removal Service Water (RHRSW) System

The RHRSW system, unlike the EECW system, is a high-volume, high-velocity system that does not operate continuously. These operating conditions are not conducive to clam survival. In addition, water used in the RHRSW system is first strained by rotating screens that effectively remove anything larger than 1/8 of an inch in diameter. Any clams or debris passing through the screens also pass through the RHR heat exchangers.

ITEM NO. 3

If clams, mussels or shells were found in potentially affected systems or their absence was not confirmed by action in item 2 above, measure the flow rates through individual components in potentially affected systems to confirm adequate flow rates i.e., flow blockage or degradation to an unacceptably low flow rate has not occurred. To be acceptable for this determination, these measurements shall have been made within six months of the date of this bulletin using calibrated flow instruments. Differential pressure (DP) measurements between supply and return lines for an individual component and DP or flow measurements for parallel connected individual coolers of components are not acceptable if flow blockage or degradation could cause the observed DP or be masked in parallel flow paths.

Other methods may be used which give conclusive evidence that flow blockage or degradation to unacceptable low flow rates has not occurred. If another method is used, the basis of its acceptance for this determination shall be included in the response to this bulletin.

If the above flow rates cannot be measured or indicate significant flow degradation, potentially affected systems shall be inspected according to item 2 above or by an acceptable alternative method and cleaned as necessary. This action shall be taken within the time period prescribed for submittal of the report to NRC.

RESPONSE

EECW System

Because of the flow restriction problems with the EECW system, the frequency of the flow verification test, Mechanical Results Instruction, MRI-303, has been increased from semiannually to quarterly. All EECW components passed the most recent test performed on February 7, 1981.[10] The next scheduled test was in progress when this response was prepared.

HPFP System

Cleanliness of the HPFP system is assured by the performance of Mechanical Maintenance Instruction, MMI-122, and SI 4.11.A.1.f.a. MMI-122 is performed once per month and effectively flushes all major HPFP loops. Every third month, MMI-122 requires that all in-line strainers be cleaned after the monthly flush. The strainers were last cleaned in March 1981[11] and yielded an insignificant amount of clams and debris.

Surveillance Instruction, SI 4.11.A.1.f.a is performed quarterly and flushes all loops, all deluge systems and all fire hose stations. The spring 1981 performance of SI 4.11.A.1.f.a was completed on April 28, all components yielding clear water with no pluggage or flow restriction. [11]

RHRSW System

Each RHR heat exchanger is cleaned once every two years. There has not been a significant accumulation of clams or debris removed from any RHR heat exchanger. In addition, monthly flow rate testing of RHRSW pumps in accordance with ASME Section XI has indicated no fouling of the RHR heat exchangers.

ITEM NO. 4

Describe methods either in use or planned (including implementation date) for preventing and detecting future flow blockage or degradation due to clams, or mussels, or shell debris. Include the following information in this description:

a. Evaluation of the potential for intrusion of the organism into these systems due to low water level and high velocities in the intake structure expected during worst case conditions.

b. Evaluation of effectiveness of prevention and detection methods used in the past or present or planned for future use.

RESPONSE

Recently, attention was focused on the intake structure forebay. On December 12, 1980, TVA divers at the request of plant management, inspected the forebay and found a heavy concentration of clams in various stages of maturity. [12] Arrangements have been made to remove the clams from the forebay and the dredging operation is currently in progress. [13, 14]

If the clam population in the forebay were left undisturbed and a high velocity/low water level situation occurred, we would experience severe fouling in the condenser water boxes. The fire pump strainers (if the HPFP pumps were operating), the RCW strainers and the EECW/RHRSW strainers would suffer some mild fouling initially, but because of their continuous backwashing features would soon be clear of debris.

Even though such an occurrence is possible, it appears very remote especially since the clam population in the forebay is being removed. A program of periodic forebay inspections for clam propogation has been established.

The plant's National Pollutant Discharge Elimination System (NPDES) permit allows two (2) 21-day chlorination cycles for clam control per year. The actual dates of the chlorination periods vary but always occur during the late spring and again during late fall. The spring 1981 chlorination cycle is scheduled to begin about June 1. Informal communications with knowledgeable TVA personnel help to optimize the timing of the chlorination so that it coincides with the spawning of the clams in this vicinity.

Due to the uncontrollable "natural" variables that govern the spawning season, and the limited duration and importance of the chlorination cycle, these informal communications will be formalized into SI 4.11.A.1.f.b before June 1.

A recent examination into the flow problems experienced on unit 2 EECW system revealed a biofouling problem.[15] A permanent sodium hypochlorite system is currently under construction and is expected to be completed sometime in 1982. Provisions have been made to chlorinate the EECW system on a temporary basis until the permanent sodium hypochlorite system is completed. Tie-in connections are expected to be installed by May 28, 1981, and the chlorination of the EECW system should begin around June 1, 1981.

As a direct response of I.E. Circular 78-13, the common pit for our 12 RHR service water pumps was inspected by divers. An extensive accumulation of clams and mud was found and removed. A periodic program for inspecting/cleaning this pit was established.

During a subsequent inspection of the pit, only a small accumulation of debris was found. Following the dredging of the intake forebay this spring, the pit will be inspected and cleaned, if necessary, to further minimize clam intrusion problems.

The above programs are in addition to those described in the response to item number 3.

ITEM NO. 5

Describe the actions taken in items 1 through 3 above and include the following information:

a. Applicable portions of the environmental monitoring program including last sample date and results.

b. Components and systems affected.

c. Extent of fouling, if any existed.

d. How and when fouling was discovered.

e. Corrective and preventive actions.

RESPONSE

The information requested by item number 5 is adequately addressed in our response to items 1 through 3 above.

FOOTNOTE REFERENCES

1. Memorandum from B. G. Isom, Supervisor, Limnology Section, EDB, Muscle Shoals; to W. W. Barnes, Chief, Environmental Biology Branch, EDB, Muscle Shoals; titled, "Nuisance Concentration of Asiatic Clams at the Browns Ferry Nuclear Plant," dated October 25, 1974.

2. Ibid.

3. Minutes of Nuclear Safety Review Board Meeting No. 33, held February 19-20, 1975; Attachment 1; titled, "Power Production Experience With Asiatic Clams - Corbicula."

4. Ibid.

5. Browns Ferry Nuclear Plant Mechanical Results Instruction No. 303, "Emergency Equipment Cooling Water System Quarterly Flow Verification; Test Results."

6. Memorandum from J. G. Dewease, Assistant Director of Nuclear Power (Operations), to H. L. Abercrombie, Plant Manager, Browns Ferry Nuclear Plant, dated October 29, 1980, titled, "Browns Ferry Nuclear Plant - Cooling Water Flow Blockage To Components Served By Emergency Equipment Cooling Water (EECW) - Meeting Minutes" (ARMS L22 801015 800).

7. Memorandum from J. G. Dewease, Assistant Director of Nuclear Power (Operations) to H. L. Abercrombie, Plant Manager, Browns Ferry Nuclear Plant dated January 30, 1981, titled, "Inspection of Heat Exchangers and Analysis of Samples Removed From the Emergency Equipment Cooling Water (EECW) System At Browns Ferry Nuclear Plant" (ARMS L26 810119 849).

8. Inspection of plant boilermakers cooler cleaning logbook and conversations with boilermaker foreman.

9. Inspection of past performances of SI 4.11.A.1.f.; "Flushing of the High Pressure Fire Protection System," period covering 1977 to present and conversations with pipefitter foreman.

10. Mechanical Results Instruction No. 303, "Emergency Equipment Cooling Water System Quarterly Flow Verification," dated February 7, 1981.

11. Mechanical Maintenance Instruction 122, formally Operating Instruction 26 and Surveillance Instruction 4.11.A.1.f.a, dated March and April respectively.

12. Memorandum from H. L. Abercrombie, Plant Manager, Browns Ferry Nuclear Plant, to J. G. Dewease, Assistant Director of Nuclear Power (Operations), titled, "Clam Population in the Forebay - Browns Ferry Nuclear Plant," dated December 15, 1980 (ARMS L52 801215 994).

13. Memorandum from J. G. Dewease, Assistant Director of Nuclear Power (Operations), to H. L. Abercrombie, Plant Manager, Browns Ferry Nuclear Plant, titled, "Clam Population in the Forebay - Browns Ferry Nuclear Plant," dated February 13, 1981 (ARMS L29 810204 965).

14. Special Test No. 199, titled "Dredging of Intake Forebay for Clams - Unit Common," dated May 1, 1981.

15. Memorandum from J. G. Dewease, Assistant Director of Nuclear Power (Operations), to H. L. Abercrombie, Plant Manager, Browns Ferry Nuclear Plant, titled, "Browns Ferry Nuclear Plant" Chlorination Emergency Equipment Cooling Water (EECW) System," dated January 21, 1981 (ARMS L29 810115 925).

Response
NRC IE Bulletin No. 81-03
RII:JPO
Sequoyah Nuclear Plant

Item No. 1

Determine whether Corbicula sp. or Mytilus sp. is present in the vicinity of the station (local environment) in either the source or receiving water body. If the results of current field monitoring programs provide reasonable evidence that neither of these species is present in the local environment, no further action is necessary except for items 4 and 5 in this section for holders of operating licenses.

Response

Corbicula sp. (Asiatic Clams) is present in the vicinity of Sequoyah Nuclear Plant. The Asiatic Clam population density in the Chickamauga Lake (Sequoyah's raw water supply) was determined by a November 1980 survey to be 91.3 clams per square meter. Therefore, Sequoyah has a "moderate" level of Asiatic Clam infestation in the vicinity of the plant ("moderate" being defined as less than 100 clams per square meter of river bottom).

Item No. 2

If it is unknown whether either of these species is present in the local environment or is confirmed that either is present, determine whether fire protection or safety-related systems that directly circulate water from the station source or receiving water body are fouled by clams or mussels or debris consisting of their shells. An acceptable method of confirming the absence of organisms or shell debris consists of opening and visually examining a representative sample of components in potentially affected safety systems and a sample of locations in potentially affected fire protection systems. The sample shall have included a distribution of components with supply and return piping of various diameters which exist in the potentially affected systems. This inspection shall have been conducted since the last clam or mussel spawning season or within the nine month period preceding the date of this bulletin. If the absence of organisms or shell debris has been confirmed by such an inspection or another method which the licensee shall describe in the response (subject to NRC evaluation and acceptance), no further action is necessary except for items 4 and 5 of actions applicable to holders of an operating license.

Response

The fire protection (FP) and essential raw cooling water (ERCW) systems are the only safety-related systems that circulate raw water at Sequoyah. These two systems are not fouled by clams or debris consisting of their shells.

Visual Inspections to Detect Asiatic Clam Fouling

a. The tube side of the component cooling water heat exchanger circulates ERCW. The unit one heat exchanger was opened in May 1980 and inspected and the absence of clams and their shells confirmed. The unit two heat exchanger was opened in July 1980 with the same results.

b. The auxiliary ERCW cooling towers were inspected and showed no evidence of clam infestation. These cooling towers stand idle most of the time, thereby increasing the probability of clam infestation within the towers. The absence of clams in these towers strongly indicates the absence of clams throughout this system.

c. Flushouts on the ERCW system were inspected upon receipt of this bulletin and showed no evidence of clams or fouling due to the clams or their shells.

d. Sections of ERCW piping, consisting of various pipe diameters and flow rates, were removed and inspected from February through April 1981. No fouling by clams or their shells was found. (Note: this inspection was originated to respond to NRC's concerns on corrosion of piping passing raw cooling water, but also served to indicate clam problems if they existed).

e. The Sequoyah maintenance history records file was researched for any documentation about evidence of clams in the ERCW and FP systems. No evidence was found that suggests clams have caused any problems or that clams have even been sighted within these systems. Discussions with maintenance personnel (craftsmen and engineers) also indicate that clams have never been sighted within the FP or ERCW systems. The only reference that could be found regarding clams was that a "few" were found once in the condenser tube cleaning system (nonsafety-related).

Flow and Temperature Measurements to Detect Asiatic Clam Fouling

a. Preoperational testing of Sequoyah's entire ERCW system is nearing completion and will verify adequate flow rates to safety-related equipment.

b. Annual tests are performed on the centrifugal charging and safety injection pumps that verify a bearing temperature difference (bearing temperature minus ERCW temperature) of less than 72°F. An increase in this bearing temperature difference is indicative of fouling of the bearing oil cooler. The unit one centrifugal charging pumps bearing temperature differences were determined in February 1981 to be less than 72°F and they did not show an increase from the preceding test in February 1980. The unit one safety injection pumps bearing temperature differences were determined in February 1981 to be less than 72°F.

c. To date, Sequoyah has not had any major temperature problem with equipment served by ERCW. The absence of any such temperature problems suggests proper system operation. The increased temperatures on certain components can be used to indicate potential problems.

Item No. 3

If clams, mussels or shells were found in potentially affected systems or their absence was not confirmed by action in item 2 above, measure the flow rates through individual components in potentially affected systems to confirm adequate flow rates i.e., flow blockage or degradation to an unacceptably low flow rate has not occurred. To be acceptable for this determination, these measurements shall have been made within six months of the date of this bulletin using calibrated flow instruments. Differential pressure (DP) measurements between supply and return lines for an individual component and DP or flow measurements for parallel connected individual coolers or components are not acceptable if flow blockage or degradation could cause the observed DP or be masked in parallel flow paths.

Other methods may be used which give conclusive evidence that flow blockage or degradation to unacceptably low flow rates has not occurred. If another method is used, the basis of its acceptance for this determination shall be included in the response to this bulletin.

If the above flow rates cannot be measured or indicate significant flow degradation, potentially affected systems shall be inspected according to item 2 above or by an acceptable alternative method and cleaned as necessary. This action shall be taken within the time period prescribed for submittal of the report to NRC.

Response

No response required since the absence of clams was confirmed in item 2 above.

Item No. 4

Describe methods either in use or planned (including implementation date) for preventing and detecting future flow blockage or degradation due to clams or mussels or shell debris. Include the following information in this description:

a. Evaluation of the potential for intrusion of the organisms into these systems due to low water level and high velocities in the intake structure expected during worst case conditions.

b. Evaluation of effectiveness of prevention and detection methods used in the past or present or planned for future use.

Response

Methods for Preventing Flow Blockage due to Clams

a. Chlorination is the chief mechanism for preventing the fouling of service water systems at Sequoyah. The fire protection system (FP) is chlorinated each spring and fall for 20 to 27 days coincident with flushing of the system. When the new sodium hypochlorite system is operational (expected this spring), the ERCW system will be continuously chlorinated whenever the river temperature is above 60°F. Chlorination of the ERCW system up until now has been sporadic due to construction interference.

b. The fire protection hose stations and yard fire hydrants have previously been flushed quarterly. Future plans are to flush these headers semiannually coincident with chlorination of the system.

c. The normal variance in water level at Sequoyah does not increase the probability of clam infestation due to lower water levels or higher velocities. The original ERCW pumps took suction from behind the condenser circulation water pumps. The new ERCW pumps are to be fully operational this month and take suction from the bottom of the Tennessee River ahead of the condenser circulating water pumps. We plan to continue the visual inspections in the event that the new ERCW pumps produce an increased level of fouling due to clams.

d. The effectiveness of chlorination to prevent clam infestation has been demonstrated at a number of TVA plants. Continuous chlorination is the best available method of preventing infestation and will continue to be utilized at Sequoyah.

e. Water used in the ERCW system is first strained by rotating screens that effectively remove anything larger than 1/32 of an inch in diameter.

Methods for Detecting Flow Blockage Due to Clams

See the response under item 2. The effectiveness of detecting flow blockage due to clam infestation is greatest when a visual inspection of suspected components is performed. Therefore, visual inspections have been and shall be used whenever system operation will permit.

Item No. 5

Describe the actions taken in items 1 through 3 above and include the following information:

a. Applicable portions of the environmental monitoring program including last sample date and results.

b. Components and systems affected.

c. Extent of fouling if any existed.

d. How and when fouling was discovered.

e. Corrective and preventive actions.

Response

The action taken in items 1 through 3 have been described above and includes the systems and components affected. No fouling was discovered and the preventive actions have been described in item 4. The Sequoyah operational environmental monitoring program does not include sampling or monitoring of flow blockage of cooling water to safety system components by Corbicula sp. (Asiatic Clam) and Mytilus sp. (Mussel).

Conclusion

Presently there is not a clam infestation problem at Sequoyah and the evidence indicates that such a problem will not be evident in the near future.

Prevention of clam fouling in safety-related cooling systems is controlled by semiannual chlorination.

Detection of clam fouling is best determined by visual inspections of various components within the affected systems when opened for other reasons. Flow and temperature monitoring can be used in lieu of visual inspections if system operation will not permit shutdown and disassembly.

Planned Actions

The following items are the actions planned by Sequoyah Nuclear Plant to detect and prevent fouling and infestation of the ERCW and FP systems by clams.

1. Chlorination

   The ERCW system will be continuously chlorinated whenever the ERCW temperature rises above 60°F. In addition, the fire protection system will be chlorinated each fall and spring for about three weeks.

2. ERCW Piping Inspections

   A surveillance instruction will be implemented as part of a corrosion investigation on an annual basis to inspect sections of ERCW piping consisting of various pipe diameters and flow rates. The pipe sections will be visually inspected for evidence of corrosion products, and clam accumulations will also be noted.

3. Fire Protection Hydraulic Performance Tests

At least once every three years, a test will be conducted to verify that the yard and building hydraulic systems can meet design pressure and flow.

4. Fire Protection System Flushes

The fire protection hose stations and yard fire hydrants will be flushed semiannually coincident with the semiannual chlorination of the FP system.

5. Bearing Temperature Measurements

Annual tests will be performed on the centrifugal charging and safety injection pumps to verify a bearing temperature difference of less than 72°F since an increase in this bearing temperature difference is indicative of bearing oil cooler fouling.

6. "C" CCW Heat Exchanger Inspection

The common CCW heat exchanger is scheduled to be opened and inspected for clams in mid 1981.

7. Flow and Temperature Measurements

Although visual inspection is the best method for detecting clam infestation, flow and temperature measurements can be used in lieu of visual inspections when system operation does not permit visual inspection.

8. Visual Inspection of Components

Visual inspection of components as they are opend for other reasons will continue. If clam infestation is noted, consideration of program adjustments will be made.