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U.S. NUCLEAR REGULATORY COMMISSION

MEMORANDUM FOR: E. L. Jordan, Deputy Director
Division of Resident and Regional
Reactor Inspection, IE

FROM: T. M. Novak, Assistant Director
for Operating Reactors, DL

SUBJECT: IE DRAFT BULLENTIN ON FLOW BLOCKAGE OF COOLING WATER SYSTEMS BY CLAMS AND SILT

In response to your memorandum dated February 23, 1981 we have invited the principal NRR staff members involved with this matter as it arose on ANO-2 to comment on the proposed bulletin. Their comments are attached.

In summary, while we believe that collection of the large quantities of information required by the currently proposed ACTION STATEMENT would provide more comprehensive knowledge of where the clams and mussels reside we feel that a balancing of the valve of this information against the licensee resource requirements to provide it does not justify issuance of the raft document as a Bulletin. This conclusion takes into account that the most significant safety related aspects of cooling water system performance degradation are addressed by Technical Specification Surveillance Requirements on safety related cooling water systems. We suggest that the draft document is more appropriate for issuance as an IE Information Notice.

Original signed by:
Thomas M. Novak
T. M. Novak, Assistant Director
for Operating Reactors, DL

Attachment: As stated

DISTRIBUTION:
Central File
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TNovak
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JHeltemes
RMartin
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PKreutzer (3)

Muller indicated decision as to IE Bulletin or Notice was a DL decision. TD+R ...

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OFFICE	ORB#3:DL	ORB#3:DL	ORB#3:DL	AD:OR:DL			
SURNAME	PKreutzer	RMartin/pn	RAClark	TMNovak			
DATE	3/ /81	3/04/81	3/4/81	3/9/81			

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

March 10, 1981

MEMORANDUM FOR: E. L. Jordan, Deputy Director
Division of Resident and Regional
Reactor Inspection, IE

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T. M. Novak, Assistant Director
for Operating Reactors, DL

Attachment: As stated

COMMENTS OF: R. Martin, PM for ANO-2
Operating Reactors Branch #3

It is recommended that this information be issued to licensees as an Information Notice since the chief safety concern is already believed to be addressed by the Technical Specification Surveillance Requirements. If, on the other hand, the existing TS's are considered inadequate to address this problem, then it would appear that if issued as a Bulletin, it should concentrate on remedying the TS inadequacies.

I am concerned about the incremental effect that issuance of this draft as a Bulletin, with its presently stated ACTION requirements, will have on the licensees' capability to devote attention to safety issues that may be more significant. When such requirements are imposed by decree on the licensees it reduces both the resources and the flexibility they have available to respond to other issues that, from a technical viewpoint, may be more significant to the safe operation of the plant. A consideration of the costs versus the benefits of sending the draft out as a Bulletin versus sending it as an Information Notice needs to be made.

The sixty day licensee response period is arbitrary. Considering the relative severity of this matter as a safety issue and the TS Surveillance Requirements in effect, 120 days is a more appropriate response time if it is to be sent as a bulletin.

COMMENTS OF: D. Pickett
Operating Reactors Assessment Branch

Doug provided the verbal comment that he had no comments on the detailed format and content of the proposed Bulletin. Doug also commented that he felt that this matter would more appropriately be addressed by issuance of an Information Notice.

COMMENTS OF: M. Masnik
Environmental Engineering Branch

Mikes comments are penciled onto the attached copy of the proposed bulletin.

Bob -
Marginal comments on Draft Bulletin will send formally to Novak today or tomorrow
M. Mamish

SSINS No.: 6835
Accession No.:

IEB 81- (draft)

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
WASHINGTON, D.C. 20555

February 23, 1981

Draft IE Bulletin 81- : FLOW BLOCKAGE OF COOLING WATER TO SAFETY SYSTEM COMPONENTS BY CORBICULA SP. (ASIATIC CLAM) AND MYTILUS SP. (MUSSEL)

Description of Circumstances:

On September 3, 1980, Arkansas Nuclear One (ANO), Unit 2, was shut down after the NRC Resident Inspector discovered that Unit 2 had failed to meet the technical specification requirements for mirimum service water flow rate through the containment cooling units (CCUs). Arkansas Power and Light Company, the Licensee, determined that the inadequate flow was due to extensive plugging of the CCUs by Asiatic clams (Corbicula species, a non-native fresh water bivalve mollusk). After plant shutdown, the licensee disassembled the service water piping at the coolers. Clams were found in the [redacted] diameter supply piping at the inlet to the CCUs and in the cooler inlet water boxes. Some of the clams found were alive, but most of the debris were shells. The size of the clams was approximately [redacted]. The service water, which is taken from the Tarcanelle Reservoir, is filtered before it is pumped through the system. The strainers on the service water pump discharges were examined and found to be intact. Since these strainers have a [redacted] mesh that is much smaller than some of the shells found, it appears that clams had been growing in the system.

Following the discovery of Asiatic clams in the containment coolers of Unit 2, the licensee examined other equipment cooled by service water in both Units 1 and 2. Inspection of other heat exchangers in the Unit 2 service water system revealed some fouling or plugging of additional coolers (seal water coolers for both redundant containment spray pumps and one low-pressure safety injection pump) due to a buildup of silt, corrosion products, and debris (mostly clam shell pieces). The high-pressure safety injection (HPSI) pump bearing and seal coolers were found to have substantial plugging in the 1.3cm (½") [redacted] pipe service water supply lines. The plugging resulted from silt and corrosion products.

Clam shells were found in some auxiliary building room coolers and in the auxiliary cooling water system which serves non-safety-related equipment.

Flow rates measured during surveillance testing through the CCUs at ANO-2 had deteriorated over a number of months with the most significant reduction coming from a combined flow rate through the "C" and "D" CCUs of [redacted] in July to [redacted] on August 20, 1980. Flushing after plant shutdown resulted in a further reduction in flow. Proper flow rates were restored only after the clam debris had been removed manually from the CCUs.

The examination of the Unit 1 service water system revealed that the "C" and "D" containment coolers were clogged by clams. Clams were found in the 7.6cm (3 in) ~~3-inch~~ inlet headers and in the inlet water boxes. However, no clams were found in the "A" and "B" coolers. This fouling was not discovered during surveillance testing because there was no flow instrumentation on these coolers. Further investigation revealed that the service water strainer serving the "A" and "B" coolers was intact, whereas the one serving the "C" and "D" coolers was broken. The licensee concluded that the clams found in the "C" and "D" coolers did not grow in the system but were swept in through the broken strainer.

The service water system in Unit 1 was not fouled other than stated above, and the licensee attributed this to the fact that the service water pump suctions are located behind the main condenser circulating pumps in the intake structure. It was thought that silt and clams entering the intake bays would be swept through the condenser by the main circulating pumps and would not accumulate in the back of the intake bays. In contrast, Unit 2 has no main circulating pumps in its intake structure because condenser heat is rejected through a cooling tower via a closed cooling system. As a result of lower flowrates of water through the Unit 2 intake structure, silt and clams could have a tendency to accumulate more rapidly in Unit 2 than in Unit 1. During the September outage, clams and shells were found to have accumulated to depths of 2 ~~to 4 1/2 feet~~ .7 to 1.4m (2 to 4.5 ft) in certain areas of the intake bays.

The Asiatic clam was first found in the United States in 1938 in the Columbia River near Kneppton, Washington. Since then, Corbicula sp. has spread across the country and is now reported in at least 33 states. The Tennessee Valley Authority (TVA) power plants also have experienced fouling caused by these clams. They were first found in the condensers and service water systems at the Shawnee Steam Plant in 1957. Asiatic clams were later found in the Browns Ferry Nuclear Plant in October 1974 only a few months after it went into operation. This initial clam infestation at Browns Ferry was enhanced by the fact that, during the final stages of construction, the cooling water systems were allowed to remain filled with water for long periods of time while the systems were not in use. This condition was conducive to the growth and accumulation of clams. Since that time, the Asiatic clam has spread across the Tennessee Valley region and is found at virtually all the TVA steam-electric and hydroelectric generating stations.

Present control procedures for Asiatic clams vary from station to station and in their degree of effectiveness. The use of shock chlorination during surveillance testing as the only method of controlling biofouling by this organism appears to be ineffective. The level of fouling has been reduced to acceptable levels at TVA stations by using continuous chlorination during peak spawning periods, clam traps, and mechanical cleaning during station outages.

The results of a series of tests on mollusks performed at the Savannah River Facility showed that mature Corbicula sp. had as much as a 10 percent survival rate after being exposed to high concentrations of free residual chlorine (10 to 40 ppm) for up to 54 hours. When the clams were allowed to remain buried in a couple inches of mud, their survival rates were as high as 65 percent.

In studies on shelled larvae, approximately 200 microns in size, TVA reported preliminary results indicating that a total chlorine residual of 0.30 to 0.40 ppm for 96 to 108 hours would be required to achieve 100 percent control of the Asiatic clam larvae.

Corbicula sp. has also shown an amazing ability to survive even when removed from the water. Average times to death when left in the air have been reported for low relative humidity as 6.7 days at 30°C (86°F) and 13.9 days at 20°C (68°F) and for high relative humidity as 8.3 days at 30°C and 26.8 days at 20°C.

Corbicula sp. on the other hand, has shown a much greater sensitivity to heat. Tests performed by TVA resulted in 100 percent mortality of clam larvae, very young clams, and 2mm ($\frac{1}{12}$ in) clams when they were exposed to 47°C (117°F) water for 2 minutes. Mature clams, up to 14mm ($\frac{1}{2}$ in), were also tested and all died at 47°C following a 2-minute exposure. A statistical analysis of the 2-minute exposure test data revealed that a temperature of 49°C (120°F) was necessary to reach the 99 percent confidence level of mortality for clams of the size tested.

To date, heat has been shown to be the most effective way of producing 100 percent mortality for the Asiatic clam. At ANO, the service water system was flushed with 77°C (170°F) water obtained from the auxiliary boiler for approximately one half hour; 100 percent mortality was expected.

A similar problem has occurred with mussels (Mytilus sp.). Infestations of mussels have caused flow blockage of cooling water to safety-related equipment at nuclear plants such as Pilgrim and Millstone. Unlike the Asiatic clam, mussels cause biofouling in salt water cooling systems.

ACTIONS TO BE TAKEN BY LICENSEES

Holders of Operating Licenses or Construction Permits:

1. Determine, based on the results of ~~nearfield nonradiological~~ available and confirmed field monitoring programs ~~conducted in support of the construction permit application, as a requirement of the construction permit, for the licensing of the facility, the NPDES permit, or Environmental Technical Specifications~~, whether or not Corbicula sp. (Asiatic clam) or Mytilus sp. (mussel) is present in the vicinity of the station in either the source or receiving water body. A report shall be submitted indicating the presence or absence of ~~these~~ either of these organisms in the vicinity of the station; if present, indicate ~~the~~ which species is present ~~identification~~, the source of this information, the latest sample date of of the monitoring program that was used to make the determination of presence or absence, and a brief description of the monitoring program. If no monitoring ~~programs~~ have been conducted in the vicinity of the station that could reasonably be expected to detect these organisms, this should be so stated.

2. Licensees of operating plants and holders of construction permits for nuclear power plants at which these organisms have been found in the source or receiving waterbody shall include in the aforementioned report the following information regarding the cooling water systems that may be susceptible to the intrusion of such organisms:

   a. A list of any fire protection system or safety-related systems that directly circulate water obtained from the source waterbody that are currently being kept full of water and the interfacing systems and equipment cooled by these same water systems;

   b. A statement as to whether these organisms have ever been found in ~~this piping~~ the above systems. *

   c. A description of any surveillance program in effect or planned that assures ~~the piping~~ these systems are not being fouled by these organisms and the frequency of surveillance; and

   d. A description of any precautions in terms of installed equipment and procedures that have been or will be taken to prevent such a problem.

Licensees of facilities with operating licenses shall provide the requested report within 60 days of the date of this bulletin. Licensees of facilities with construction permits shall provide the report within 120 days.

Provide written reports as required above, signed under oath or affirmation, under the provisions of Section 182a of the Atomic Energy Act of 1954. Reports shall be submitted to the Director of the appropriate Regional Office and a copy forwarded to the Director, Office of Inspection and Enforcement, NRC, Washington, D.C. 20555.

This request for information was approved by GAO under a blanket clearance number B0072 which expires November 30, 1982. Comments on burden and duplication should be directed to U.S. General Accounting Office, Regulatory Reports Review, Room 8106, 441 Eighth Street, N.W., Washington, D.C. 20548

* Add to b. above: If so identify the components or system affected; describe the extent of the fouling, how and when the fouling was discovered, and any corrective actions or preventive measures which were subsequently taken.