UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
Gulf States Utilities Company, et al.	)	Docket No. 50-458
	)	
	)	
(River Bend Station)	)	

APPLICANTS' PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW RELATED TO CONTENTION 1 (ASIATIC CLAMS (CORBICULA))

Findings of Fact

1. The Asiatic clam is a type of small shellfish introduced to the northwest corner of the Unites States during the late 19th century, Conner, et al., ff. Tr. ____ at 2, ¶5.

2. Most American experts believe that a single highly-variable species of the Asiatic clam is present in the United States, and that its most appropriate technical name is Corbicula fluminea, Conner, et al., ff. Tr. _____ at 2-3, ¶5.

3. Corbicula is now known to inhabit 35 of the contiguous United States, Conner, et al., ff. Tr. ____ at 3, ¶6.

4. In the early 1960's, the Asiatic clam was noticed in the lower Mississippi River in the State of Louisiana, Conner, et al., ff. Tr. _____ at 3, ¶6.

5. Asiatic clams are robust, thick-shelled bivalve mollusks that are roughly triangular when viewed from the side (i.e., their least outside dimension is only slightly smaller than the greatest). They are quite variable in color; usually they appear coppery, greenish-yellow, or brownish-yellow, and tend to become darker with age. The primary mode of feeding for Corbicula is by filtration, Conner, et al., ff. Tr. _____ at 3-4, ¶8.

6. Because Corbicula are capable of surviving only in low to moderate salinities (up to 22 parts per thousand), the species is generally considered to be freshwater form, Conner, et al., ff. Tr. _____ at 4, ¶9.

7. In freshwater, Asiatic clams are able to adapt to a wide variety of natural and manmade environments, although they seem to be more successful in moving water than in quiet water, Conner, et al., ff. Tr. _____ at 4, ¶9.

8. Corbicula are typically "infaunal" or burrowing in habit. Although reported from many types of substrates, they appear to prefer sands and gravels in streams, Conner, et al., ff. Tr. _____ at 4, ¶10.

9. Physical barriers such as drainage divides, saltwater, and an intolerance of low winter temperatures all limit the natural spread of Corbicula in North America. An absolute lower thermal limit for Corbicula fluminea is 2° C (36° F), Conner, et al., ff. Tr. _____ at 4, ¶11.

10. Most Corbicula grow to about 25-35 mm (1.0-1.3 inches) shell lengths (SL), Conner, et al., ff. Tr. _____ at 4, ¶12.

11. Sexual maturity is achieved at 7.5 mm SL (3/8 inch) in some individuals, although about 10 mm SL (7/16 inch) appears to be the more typical size at initial maturity, Conner, et al., Conner, et al., ff. Tr. _____ at 4, ¶12.

12. Growth of Corbuicula during early life is fairly rapid, and most Corbicula (especially in southern U.S. populations) seem to reach a size at which sexual maturity is anatomically possible during their first calendar year of life, Conner, et al., ff. Tr. _____ at 4-5, ¶12.

13. Occasional individuals may live up to four years, but the normal life span of Asiatic clams in southern rivers is about two years, Conner, et al., ff. Tr. _____ at 5, ¶12.

14. Corbicula fluminea is monoecious (hermaphroditic). Whether or not Corbicula actually engage in self-fertilization (and, if so, to what degree) has been the subject of debate, but the capability to do so has been amply demonstrated, Conner, et al., ff. Tr. _____ at 5, ¶13.

15. Once fertilized, the developing embryos and early larval stages are incubated (brooded) inside special pouches in the adult clam's inner gill, Conner, et al., ff. Tr. _____ at 5, ¶14.

16. Development and growth proceed inside the parent until the young clams are about 0.2 mm SL (0.008 inch) and have acquired their bivalved shell and a muscular organ known as the "foot." Corbicula larvae at this stage are technically known as pediveligers, Conner, et al., 5, ¶14.

17. "Spawning" in Asiatic clams consists of the parent clam exhaling the pediveligers via a breathing tube (siphon), Conner, et al., ff. Tr. _____ at 6, ¶14.

18. By virtue of its foot, a pediveliger is capable of crawling, and presumably burrowing, as are the older individuals. It is unlikely that this larvae is capable of intrinsically-directed locomotion when not in contact with a surface, Conner, et al., ff. Tr. _____ at 6, ¶15.

19. When subjected to turbulence, pediveligers can be carried great distances by currents before settling out on substrates, Conner, et al., ff. Tr. _____ at 5, ¶15.

20. The drifting of pediveligers, and of juveniles up to 5 mm SL (3/16 inch) given sufficient turbulence, is generally accepted to be the basis for the extensive and rapid downstream dispersal of Corbicula populations in rivers and is also the primary mechanism whereby Asiatic clams gain access to industrial cooling and service water systems, Conner, et al., ff. Tr. _____ at 6, ¶15.

21. The young clams are considered "juveniles" from about 0.5 mm SL (0.02 inch) until attainment of sexual maturity, Conner, et al., ff. Tr. _____ at 6, ¶16.

22. Juvenile Corbicula can produce "byssal threads," or holdfast organs. The byssal thread, muscular foot, and ability to burrow in substrates all enable young Corbicula to rapidly assume a benthonic existence, even in moving water, Conner, et al., ff. Tr. _____ at 6-7, ¶16.

23. Reproduction of Corbicula in the U.S. appears to be closely related to temperature, with spawning essentially limited to those periods when the water is over 16° C (60° F), Conner, et al., ff. Tr. _____ at 7, ¶17.

24. For most Gulf coastal streams, the Asiatic clam has a breeding season of 9-10 months, Conner, et al., ff. Tr. _____ at 7, ¶17.

25. In the lower Mississippi River, however, temperatures ordinarily remain below 16° C from November through March, Conner, et al., ff. Tr. _____ at 7, ¶17.

26. Although some reproduction occurs throughout the period encompassing appropriate temperatures, many U.S. populations of Corbicula exhibit a bimodal pattern of spawning. There are two pronounced peaks of larval release (late spring/early summer and late summer/early autumn), Conner, et al., ff. Tr. _____ at 7, ¶17.

27. During spawning peaks, an individual clam may release several hundred pediveligers per day, Conner, et al., ff. Tr. _____ at 7, ¶17.

28. Corbicula (living and/or dead shells) cause problems by obstructing water flow. Flow is impeded by the clogging of orifices and/or by increased friction on surfaces that would ideally be smooth, Conner, et al., ff. Tr. _____ at 7, ¶18.

29. Attachment of clams to surfaces, or the passive accumulation of living Corbicula and/or their shell debris, can interfere with heat-transfer processes, Conner, et al., ff. Tr. _____ at 7, ¶18.

30. Historical data for Corbicula in the river near the site exist from Louisiana State University (LSU) studies performed for Gulf States Utilities Company (GSU). Twelve years of data exist for substrate-associated juveniles and adults. Eleven years of data exist on drifting juveniles in these same areas, Conner, et al., ff. Tr. _____ at 7-8, ¶19.

31. Benthic (substrate-associated) Asiatic clams have been encountered somewhat less frequently, and in generally lower numbers per unit area, in the late-1970's and early-1980's than duri g the baseline studies of the early- and mid-1970's, Conner, et al., ff. Tr. _____ at 8, ¶19.

32. Sampling of drifting larvae and early juveniles has suggested that, in some years at least, there are two peaks of abundance (early and late summer). This presumably reflects a bimodal spawning pattern such as has been observed in other streams of the southern U.S., Conner, et al., ff. Tr. _____ at 8, ¶19.

33. Adult and larger juvenile clams appear to be more abundant along the west side of the river, Conner, et al., ff. Tr. _____ at 8, ¶19.

34. Based on observations taken since 1980, the substrate in the immediate vicinity of the proposed intake (and of the intake embayment in general) has so far been colonized by extremely low numbers of Corbicula, Conner, et al., ff. Tr. _____ at 8, ¶20.

35. Routine monthly Petersen grab samples have yielded density estimates ranging from 0-5 per square meter with an overall mean of 1 per square meter at this location, Conner, et al., ff. Tr. _____ at 8, ¶20.

36. Two years of samples of microzooplankton exist which include Corbicula larvae. Preliminary indications are that, relative to the river channel, densities of drifting larvae in the intake embayment are quite low, Conner, et al., ff. Tr. _____ at 8, ¶20.

37. Big Cajun, a power plant directly across the river, has had no fouling problems, Conner, et al., ff. Tr. _____ at 9, ¶21.

38. Crown-Zellerbach, a paper mill located on the east shore two miles downstream of the River Bend Station intake, generates its own electricity, Conner, et al., ff. Tr. _____ at 9, ¶22.

39. Crown-Zellerbach circulates more river water through its plant than does River Bend Station, with makeup water suction taken from a position in the river nearer the bottom where Corbicula would be more likely to be found, Conner, et al., ff. Tr. _____ at 9, ¶22.

40. In 17 years, Crown-Zellerbach has never observed a single clam in any internal plumbing at their facility, Conner, et al., ff. Tr. _____ at 9, ¶22.

41. If Crown-Zellerbach entrains pediveligers, their clarifiers (very much like those at River Bend Station) and/or continuous low-level chlorination must be entirely effective, Conner, et al., ff. Tr. _____ at 9, ¶22.

42. Considering the River Bend Station intake design and clarification equipment, the only possible means by which Corbicula could enter River Bend Station would be by entrainment of pediveligers, Conner, et al., ff. Tr. _____ at 9-10, ¶23.

43. Adult clams could not pass through the intake screens or clarifiers, Conner, et al., ff. Tr. _____ at 10, ¶23.

44. There are three systems at River Bend Station that could potentially be affected by Asiatic Clams, inasmuch as they use water from the river, the Cooling Tower Makeup Water System, the Circulating Water System, and the Normal Service Water System, Conner, et al., ff. Tr. _____ at 10, ¶24.

45. The Cooling Tower Makeup Water System could potentially act as a physical pathway for Corbicula to the Circulating Water System and to the Normal Service Water System, Conner, et al., ff. Tr. _____ at 10, ¶24.

46. Of the three systems that could potentially be affected by the Asiatic clam, there are safety-related components only within the Normal Service Water System, Conner, et al., ff. Tr. _____ at 10, ¶24.

47. Asiatic clam infestation is a safety concern only in the Normal Service Water System, Conner, et al., ff. Tr. _____ at 10, ¶24.

48. The Normal Service Water System provides cooling water to remove heat from turbine and reactor plant auxiliary systems and components during all modes of normal plant operation, Conner, et al., ff. Tr. _____ at 12, ¶29.

49. During a loss of the Normal Service Water System, the Standby Service Water System goes into operation supplying safety-related components which normally use normal service water, Conner, et al., ff. Tr. _____ at 12, ¶29.

50. The Normal Service Water System consists of three 50% pumps which take suction from the circulating water flume. Design flow for the Normal Service Water System is approximately 51,000 gpm, Conner, et al., ff. Tr. _____ at 12, ¶29.

51. The Normal Service Water pumps discharge into a common header where the system is continuously chlorinated to prevent biofouling, Conner, et al., ff. Tr. _____ at 12, ¶29.

52. Outside of the turbine building, the common header branches into two headers, one to the turbine and radwaste buildings, the other to the auxiliary, diesel generator, control, and reactor buildings. The second branch supplies all safety-related components of the system as well as certain non-safety systems which would be isolated during SSW operation if required, Conner, et al., ff. Tr. _____ at 12, ¶29.

53. Automatic isolation of the Normal Service Water System supply and return headers allows standby service water to supply the auxiliary, control, diesel generator, and reactor buildings, Conner, et al., ff. Tr. _____ at 12, ¶29.

54. The Standby Service Water System consists of the standby service water cooling tower and four 50% capacity pumps, Conner, et al., ff. Tr. _____ at 12-13, ¶30.

55. The Standby Service Water pumps take suction from the standby cooling tower and supply well water from the basin to all safety-related service water components as well as some non-safety related components which are isolated, if required, Conner, et al., ff. Tr. _____ at 13, ¶30.

56. During functional testing of the Standby Service Water System, there may be a potential for water from the Normal Service Water System to enter the Standby Service Water System. Chlorination of the Standby Service Water System would be used to prevent the survival of any Corbicula which may be present, Conner, et al., ff. Tr. _____ at 13, ¶30.

57. The Cooling Tower Makeup Water System is designed to supply approximately 14,000 gpm of clarified water to the circulating water flume, Conner, et al., ff. Tr. _____ at 10, ¶25.

58. Mississippi River water enters the Cooling Tower Makeup Water System through one of two conical-shaped wedgewire screen units which are constructed to screen all material greater than 1.5 X .75 inches, Conner, et al., ff. Tr. _____ at 10, ¶26.

59. One 36 inch diameter intake line for each screen unit conveys water to the makeup pumphouse. In the pumphouse, the intake lines join at a common header to two makeup water pumps, Conner, et al., ff. Tr. _____ at 10, ¶26.

60. A makeup water pump supplies the raw river water to a clarifier which is sized to handle makeup water flow. The clarifier is a Graver solids-contact type treatment unit. Raw water is mixed with a polyelectrolyte and a recirculated floc and enters the clarifier unit, Conner, et al., ff. Tr. _____ at 11, ¶27.

61. The water is retained in the clarifier to permit the chemical and colloidal process to proceed to completion so that by the time the water passes into the outer settling zone, floc particles have formed and separated cleanly. The clear water rises and is uniformly collected over a substantial portion of the surface. Water from the clarifier is supplied to the flume from which the circulating water and service water pumps take suction, Conner, et al., ff. Tr. _____ at 11, ¶27.

62. The design specification for the clarifier is that average suspended solids shall not exceed 10 ppm, Conner, et al., ff. Tr. _____ at 11, ¶27.

63. Any adult clams which reach the clarifier will be trapped within the clarifier along with suspended solids and transferred back to the Mississippi River. The clarifier will also be effective in removing most, if not all, larvae, Conner, et al., ff. Tr. _____ at 11, ¶27.

64. The Circulating Water System dissipates heat from the main condenser and provides the necessary heat sink for the Normal Service Water System, Conner, et al., ff. Tr. _____ at 11, ¶28.

65. The Circulating Water System consists of four multicell cooling towers, four 25% capacity circulating water pumps, and associated piping. Design flow for the Circulating Water System is approximately 510,000 gpm, Conner, et al., ff. Tr. _____ at 11, ¶28.

66. The water chemistry for the Circulating Water System is controlled in order to minimize biofouling by the injection of sodium hypochlorite solution periodically into the discharge of the circulating water pumps downstream of the blowdown header to the Mississippi River, Conner, et al., ff. Tr. _____ at 11, ¶28.

67. Blowdown from the Circulating Water System is approximately 2,200 gpm, Conner, et al., ff. Tr. _____ at 12, ¶28.

68. GSU's program of detection includes sampling for Corbicula in the intake embayment and in the river near the site, Conner, et al., ff. Tr. _____ at 13, ¶31.

69. Sampling for larger juveniles and adults will be continued monthly in the intake embayment, Conner, et al., ff. Tr. _____ at 13, ¶31.

70. Sampling for planktonic early life stages using plankton nets will be conducted semimonthly (April through October) or monthly (November through March) in the river channel near the embayment, Conner, et al., ff. Tr. _____ at 13, ¶31.

71. Sampling for planktonic early life stages will also be conducted semimonthly (April through October) or monthly (November through March) in the clarifier influent line to determine the quantities entrained in the makeup water, Conner, et al., ff. Tr. _____ at 13, ¶32.

72. Most of the sampling effort will be devoted to weekly (April through October) or monthly (November through March) samples of the clarifier discharge using plankton nets, Conner, et al., ff. Tr. _____ at 13-14, ¶32.

73. Sampling for larger juveniles and adults will be conducted monthly in various exposed portions of the Circulating Water System such as the cooling tower basins, Conner, et al., ff. Tr. _____ at 14, ¶33.

74. The sampling programs will begin upon start-up of the cooling tower makeup water system (initial introduction of river water into the plant is estimated to be in February 1985) and will continue through two complete clam reproductive seasons beyond commercial operation. At the end of this period there will be data reflecting: 1) ambient densities of larvae in the river; 2) numbers of larvae entrained by the plant intake water; and 3) numbers of larvae introduced into the plant service and circulating water systems (i.e., clarifier performance), Conner, et al., ff. Tr. _____ at 14, ¶34.

75. If, from clarifier discharge and cooling tower basin sampling, service water component performance trending, and maintenance inspections, minimal or no Corbicula infestation of the plant is indicated, an appropriate reduction in intensity of the detection program will be made, Conner, et al., ff. Tr. _____ at 14, ¶35.

76. Even under a reduced program, monitoring of clam populations in the river, and semimonthly or monthly sampling of the clarifier discharge will be maintained, Conner, et al., ff. Tr. _____ at 14, ¶36.

77. If the sampling program indicates that clams have been introduced into the Service and Circulating Service Water Systems, emphasis in monitoring will immediately shift to address: (a) the adequacy of the chlorination program and modifications to it, as appropriate; (b) the ecology of the clams in the plant (i.e., spatio-temporal distribution, growth, and reproduction); and (c) the relationship(s) between the numbers of clams observed and biofouling problems, Conner, et al., ff. Tr. _____ at 14-15, ¶37.

78. In addition to monitoring and sampling for Corbicula, GSU will utilize instrumentation to detect the deterioration of flow (possible blockage by clams) across heat exchangers in the Normal Service Water System, Conner, et al., ff. Tr. _____ at 15, ¶38.

79. The listing of the safety-related systems normally served by the Normal Service Water System, identified in Attachment 1, is correct and the instrumentation, parameters and frequency to be used for each is adequate, Conner, et al., ff. Tr. _____ at 15, ¶38.

80. Operators will monitor the permanent instrumentation daily and will record the readings on their Daily Operating Log. If it is determined that a particular reading has exceeded its prescribed limits, that reading will be brought to the attention of the Shift Supervisor, Conner, et al., ff. Tr. _____ at 15, ¶38.

81. The Technical Staff group will review the Daily Operating Logs on a periodic basis and perform trending to detect component fouling on a monthly basis for those components listed in Attachment 1, Conner, et al., ff. Tr. _____ at 15-16, ¶39.

82. Using the trending program, it will be possible to predict when any particular component will exceed its desired performance capabilities, Conner, et al., ff. Tr. _____ at 16, ¶39.

83. Upon receipt of an excessive instrument reading or indication from the trending program of a component's degraded heat exchange capability, the component will be removed from service, opened, and visually inspected for evidence of Corbicula fouling, Conner, et al., ff. Tr. _____ at 16, ¶39.

84. The tubesheets and water box dividers of the safety-related heat exchangers within the service water system are generally not of copper-nickel material composition. The exceptions, the RHR heat exchangers and the emergency diesel generator coolers, do not rely on differential pressure across the inlet and outlet water boxes for determining fouling, Conner, et al., ff. Tr. _____ at 16, ¶40.

85. The trending program utilizes a heat balance calculation to determine heat exchanger efficiency for these components, precluding a false indication of cooling water flow through the heat exchanger tubes upon flow blockage by Corbicula, Conner, et al., ff. Tr. _____ at 16, ¶40.

86. If evidence of fouling is noted, the system will be flushed and the clams and clam debris will be removed prior to putting the component back in service, Conner, et al., ff. Tr. _____ at 17, ¶42.

87. If any component is found to contain adult clams large enough to foul heat exchangers, the performance testing of all other components served by the service water system and listed in Attachment 1 will be conducted within seven days, Conner, et al., ff. Tr. _____ at 17, ¶42.

88. If performance parameters exceed their prescribed limits, the component(s) will be opened for inspection. Additionally, the trending frequency will be increased, Conner, et al., ff. Tr. _____ at 17, ¶42.

89. Most adult clams will be excluded from entrainment in the makeup water by wedge wire screens mounted on each suction pipeline, Conner, et al., ff. Tr. _____ at 17, ¶43.

90. The clarifier for the removal of suspended matter from the makeup water is expected to remove a majority, if not all, of the Corbicula, Conner, et al., ff. Tr. _____ at 17, ¶43.

91. The continuous chlorination at the normal service water pump discharge header will serve as yet another level of prevention of infestation by Corbicula, Conner, et al., ff. Tr. _____ at 17, ¶43.

92. Operating experience will determine the appropriate chlorine feed rates. A total residual chlorine concentration of 0.6 to 0.8 ppm is initially targeted, Conner, et al., ff. Tr. _____ at 17, ¶43.

93. The residual chlorine concentration will be measured by instrumentation at the outlet of the service water system prior to mixing with the condenser circulating water flow to the cooling towers, Conner, et al., ff. Tr. _____ at 17, ¶43.

94. The monthly rotation of normally-operating redundant safety-related components into service will ensure that the contained water will be periodically exchanged with freshly chlorinated water. Operation of intermittent flow systems in this manner will prevent Corbicula from surviving and growing to fouling size, Conner, et al., ff. Tr. _____ at 17-18, ¶44.

95. To avoid fouling problems following initial introduction of river water or following outages, the Normal Service Water System will be operated such that adequate chlorine levels are maintained continuously during these periods, Conner, et al., ff. Tr. _____ at 18, ¶45.

96. The monthly rotation of normally-operating redundant safety-related components into service will further assure that the plant will not be started (or restarted) with existing fouling unknown to the operators, Conner, et al., ff. Tr. _____ at 18, ¶45.

Conclusions of Law

1. These detection and prevention programs and the facility's design provide reasonable assurance that GSU will be effective in controlling biofouling problems by Corbicula.

2. The issuance of an operating license to the Applicants will not be inimical to the common defense and security or to the health and safety of the public.

3. Pursuant to 10 C.F.R. §2.760a and 10 C.F.R. §50.57, the Director of Nuclear Reactor Regulation should be authorized to issue to the Applicants, upon making requisite findings with respect to matters not embraced in the Initial Decision, a license authorizing operation of River Bend Station.