UNITED ST'TES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket Nos. 50-443 OL-01
PUBLIC SERVICE COMPANY OF	)	50-444 OL-01
NEW HAMPSHIRE, *et al.*	)	On-site Emergency Planning
	)	and Safety Issues
(Seabrook Station, Units 1 and 2	)	

AFFIDAVIT OF MICHAEL T. MASNIK

I, Dr. Michael T. Masnik, being first duly sworn, hereby affirm that the responses to the questions set forth herein are correct to the best of my knowledge and belief:

Q1: Dr. Masnik, by whom and in what capacity are you employed?

A1: I am employed as a Technical Assistant to the Director of the Three Mile Island Unit 2 Cleanup Project Directorate, Office of Nuclear Reactor Regulation, USNRC.

Q2: Have you prepared a statement of your professional qualification?

A2: Yes, a statement of my professional qualifications is attached as an exhibit to this affidavit.

Q3: Dr. Masnik, what is the purpose of your affidavit?

A3: My affidavit relates to the question whether NECNP's Contention IV raises issues which must be resolved prior to the reauthorization of low power (5% rated power) operations at the Seabrook facility.

Q4: Dr. Masnik, NECNP Contention IV states:

> The Applicant must establish a surveillance and maintenance program for the prevention of the accumulation of mollusks, other aquatic organisms, and debris in cooling systems in order to satisfy the requirements of GDC 4, 30, 32, 35, 36, 38, and 39, which require the maintenance and inspection of reactor cooling systems. The design, construction, and proposed operation of Seabrook fail to satisfy these requirements.

Please explain the type of measures that would be adequate to prevent the accumulation of mollusks, other aquatic organisms, and debris in cooling systems.

A4: Control of biofouling and debris buildup in the Circulating Water (CW) and Service Water (SW) Systems of a nuclear power plant is accomplished by a coordinated program involving three elements: design, water treatment procedures, and a surveillance program. The first consideration is proper design of the CW and SW systems. A midwater intake to minimize debris, the installation of vertical traveling screens to filter out debris prior to entering plant systems, the use of intermediate heat exchangers to deny access to organisms and debris from downstream plant systems, and the use of screening upstream of individual heat exchangers to prevent clogging are examples of proper design considerations. The use of anti-fouling coatings in areas or under conditions that have high probability for fouling is another example of a design practice that will minimize biofouling and debris buildup.

The second element -- water treatment -- involves treating the water prior to entering the facility to control the extent of biofouling. Typically, this is accomplished by chlorinating the cooling water with a solution of sodium hypochlorite injected into the system as far upstream as possible at a concentration sufficient to destroy organisms downstream of the point of introduction. Historically, at most power plants in the United States, the intermittent introduction of sodium hypochlorite has been sufficient to control attached microorganisms. However, it has been found that for biofouling by macroorganisms, for example, mollusks such as Mytilus sp., intermittent chlorination has little or no effect at the concentrations typically used to control microorganisms. In fact, intermittent chlorination at these levels in some cases has been shown to have a prophylactic effect on the organisms. Continuous chlorination, on the other hand, has proven to be effective against the settlement, attachment and growth of macroorganisms including Mytilus sp. Continuous chlorination is also effective against microorganisms.

Another treatment technique employed in the industry is thermal back-flushing. Thermal backflushing consists of reversing the flow in the cooling system and elevating the temperature of the water. Elevated temperatures will cause virtually 100 percent mortality in all macro and micro fouling organisms. Still another approach to the treatment of biofouling and debris buildup involves physical methods, such as flushing spherical balls made of a slightly abrasive spongy material through the piping. This technique is useful in removing mechanically microorganisms attached to the tubeside of heat exchangers.

The third and final element in controlling biofouling and debris buildup is proper surveillance. An adequate surveillance program ideally is composed of three components: surveillance of system performance, visual inspections, and monitoring. Surveillance of system performance encompasses such tests as measuring backpressure, heat rejection, and periodic pump head testing. Periodic visual inspections should be conducted on such components as the intake structure, travelling screens, intake inlet and outlet water boxes, inlet and outlet water boxes of heat exchangers, and should include the removal of piping spool sections, examination of valves, and inspection of upstream screening devices. Two categories of monitoring should be conducted: physiochemical and biological. Physiochemical monitoring consists the measuring free residual chlorine and temperature throughout the system to determine the adequacy of the treatment program and to identify areas of potential problems. Biological monitoring employs the use of sampling techniques to determine the presence of biofouling organisms in the intake water as well as the presence of mature and immature organisms throughout the CW and SW systems. The use of test coupons that act as an artificial substrate at different locations throughout the CW and SW systems will provide a good indication of the adequacy of the treatment program and can identify areas of possible future flow restrictions.

Q5: Dr. Masnik, do Applicants have an adequate program to prevent biofouling at the Seabrook Station?

A5: The Seabrook Station utilizes the three elements described in my previous answer to control biofouling and debris in the CW and SW systems. Applicant has employed a midwater intake structure which, among other things, greatly reduces the intake of debris, and macroorganisms. The intake structure is sheathed in a protective coating of an antifouling agent that will discourage the attachment of organisms. The intake structure has vertical travelling screens to remove debris, a proven technology. The use of intermediate heat exchangers in the SW system to deny organisms access to implant systems, and the use of screening devices upstream of individual room and component heat exchangers to prevent flow blockage have been employed at the Seabrook Station.

The second element of control, treatment of the cooling water, has been comprehensively addressed by Applicants and incorporated into the Seabrook Station design. Continuous chlorination using a solution of sodium hypochlorite at the ocean intake structures with booster chlorination points at a number of locations downstream of the ocean intake structures will assure adequate levels of free residual chlorine to discourage the attachment and growth of fouling organisms. Applicants also have the capability to backflush the system with hot water. Thermal backflushing, under proper conditions, will result in close to 100 percent mortality of all fouling organisms.

The third element in the control of biofouling is a surveillance program. Applicant have in place a program of equipment surveillance, visual inspection, routine maintenance, water chemistry, and biological monitoring using artificial substrates, that is more than adequate to detect the deterioration of system performance due to biofouling or debris buildup. Collectively, these elements of Applicants' program are sufficient to control biofouling of the SW and CW systems and to detect any significant degradation of the systems due to biofouling.

Q6: Does operation of the Seabrook Station at 5 percent rated power present any unique conditions that might result in increased biofouling or debris buildup?

A6: No. Indeed, on the contrary, operation of the Seabrook Station at the 5 percent rated power level would quite likely result in <u>decreased</u> biofouling activity and, depending on the CW and SW flow rates, decreased intake of debris. This is because the rate of biofouling is dependent on a number of factors. Environmental conditions such as salinity, water temperatures, light, availability of food, and frequency and degree of submergence can significantly influence the growth rate of the organisms. Operation at 5 percent of rated power would not have a significant effect on salinity, light, availability of food or frequency and degree of submergence but would influence water temperature in many locations. Since growth rate in this geographic area is highly dependent on temperature, the operation of the facility at 5 percent of rated power would result in much slower growth rates in most of the CW and SW systems than at 100 percent power for any organisms that might attach despite the ambitious program that Applicants are undertaking to discourage attachment.

The amount of debris entering the ocean intake structures is dependent primarily on the availability of debris in the water column at the level of the intake, and the flow regime in the vicinity of the intake. This regime is highly dependent on flow rate. If the flow rate is reduced due to the low power operation, the amount of debris taken into the ocean intake structure would be substantially reduced. Since debris buildup is not considered a problem by the Staff at full power operation, reduced power operation, and possibly a corresponding reduction in cooling water flow, would therefore not present a problem.

Q7: Dr. Masnik, do you have an opinion as to how long it would take to accumulate the amount of mollusks, aquatic organisms, or debris to an extent that could detrimentally affect plant performance?

A7: As mentioned above, the accumulation of biofouling organisms in a system is highly dependent on a number of factors, one of which is temperature. Since temperatures are not expected to be as high throughout most of the CW and SW systems during 5 percent rated power output, the rate of growth of most biofouling organisms would be less than expected at 100 percent power. The principal biofouling organism of concern at the Seabrook Station is the blue mussel Mytilus edulis. M. edulis spawns in the spring when water temperatures are in the range of about 10°C to 20°C. This corresponds to roughly the period May through October in the region where the Seabrook Station is located. The resulting larvae typically remain planktonic for 2 to 3 weeks but can remain plankton as long as several months depending on environmental conditions. The larvae settle out on a suitable substrate, attach and begin growing. Growth rates are highly variable. Under ideal conditions M. edulis may grow more than 60 mm per year. In northern latitudes, blue mussels may grow seasonally with as much as 90% of the growth during the warmer months. A growth rate of 9 mm/month in warm water has been recorded. Nine mm approximates 3/8" which is the minimum size at which some flow blockage by blue mussels could be expected. Therefore, depending on when Applicants begin operation at 5 percent rated power, and assuming that the system did not initially contain any life stages of blue mussel, and assuming a higher (and therefore the more conservative growth rate), and assuming further that there existed no water treatment (i.e., chlorine or backflushing) program, the period of time from beginning of low power operations to the time of earliest flow blockage could range from 1 to 7 months.

Biofouling by other organisms, specifically microorganisms, would occur almost immediately with system degradation (i.e., loss of heat transfer capability), again assuming a initially clean system and no water treatment, in a matter of days to weeks.

Debris is accumulated typically at a relatively constant level, with some seasonal variation and punctuated by occasional increases in debris loading due to suspension of debris during storms and other unusual weather activity. Debris at the intake structure located within the site boundary would be pose no safety hazard since such debris will be removed by the vertical travelling screens. This technology has been employed at many intake structures throughout the world and has proven effective in removing debris in areas that have a much higher potential for floating or suspended debris, and intake structures whose design are inferior to Seabrook's. No system degradation at any power level, particularly at 5 percent power, due to debris reasonably can be expected at the Seabrook Station.

Q8: Dr. Masnik, does this complete your affidavit?

A8: Yes it does.

Michael T. Masnik

Michael T. Masnik

Sworn to and subscribed before me
this 12th day of January 1988:

Patricia J. Noonan

My Commission expires: July 1, 1990.

Michael T. Masnik

STATEMENT OF PROFESSIONAL QUALIFICATIONS
NUCLEAR REGULATORY COMMISSION
Washington, D.C.

I am currently employed as Technical Assistant to the Director of the Three Mile Island Cleanup Project Directorate (TMI-2 PD), Office of Nuclear Reactor Regulation, USNRC. As a member of TMI-2 PD I have responsibility for coordinating broad and technically complex projects which have technical aspects encompassing all phases of the Three Mile Island Unit 2 nuclear power plant cleanup operation. As a member of the Office of Nuclear Reactor Regulation, I have responsibility for the review of licensee actions that may affect natural ecological resources, commercial and sport fisheries resources and their impacts to the aquatic environment. Additionally, I review licensee plans and procedures for the control of biofouling of plant systems.

I have participated in the evaluation of aquatic impact for more than ten environmental impact statements and have served on an number of interagency review groups concerned with intake structures, thermal impacts and aquatic monitoring.

I coauthored issued IE Bulletin 81-03 "Flow Blockage of Cooling Water to Safety System Components by Corbicula sp. (Asiatic Clam) and Mytilus sp. (Mussels) issued by the Staff in 1981 and did much of the early compilation of the licensee's responses to the Bulletin. I have investigated flow blockage and biofouling problems at a number of nuclear facilities including Arkansas Nuclear One, Salem 2, Pilgrim 1, Browns Ferry 1, 2, 3, Brunswick 1, 2, and Three Mile Island, 2. These investigations included assessments o the extent of biofouling, the safety significance of such biofouling, and adequacy of the licensees' programs to prevent future problems.

I hold a Bachelor of Science in Conservation from Cornell University (1969), a Master of Science in Zoology from Virginia Polytechnic Institute and State University (1971), and a Doctor of Philosophy in Zoology from Virginia Polytechnic Institute and State University (1975).

While at Virginia Polytechnic Institute and State University, I undertook research in a variety of areas, specializing in zoogeography and distribution of freshwater fishes. Other areas of research which resulted in published papers include thermal studies on fishes, recovery of damaged aquatic eco-systems, and development of sampling methodology for fishes and macroinvertebrates. I have authored or coauthored some 16 publications on the above areas of research. My formal education program has encompassed and emphasized studies in Zoology, Aquatic Ecology, Ichthyology, Evolutionary Biology, and computer techniques for data handling and analysis.

I was a member of the scientific staff of a Duke University Caribbean Cruise involved in oceanographic investigations and have served as a consultant, through Virginia Polytechnic Institute and State University, for American Electric Power Company, Koppers Company, Inc., U.S. Army Corps of Engineers, and Tennessee Valley Authority.