BEFORE THE STATE OF CONNECTICUT
DEPARTMENT OF PUBLIC UTILITY CONTROL

Investigation into the Replacement of the Steam Generators at Millstone Unit 2	)))	DOCKET NO. 92-04-15

TESTIMONY OF
DAVID A. SCHLISSEL
ON BEHALF OF THE
STATE OF CONNECTICUT
OFFICE OF CONSUMER COUNSEL

March 15, 1994

SCHLISSEL ENGINEERING ASSOCIATES
45 HORACE ROAD
BELMONT, MASSACHUSETTS 02178

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is David A. Schlissel. My business address is Schlissel Engineering Associates, 45 Horace Road, Belmont, Massachusetts 02178.

Q. ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS PROCEEDING?

A. I am testifying on behalf of the Office of Consumer Counsel (OCC).

Q. PLEASE SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND RECENT WORK EXPERIENCE.

A. I graduated from the Massachusetts Institute of Technology in 1968 with a Bachelor of Science Degree in Engineering. In 1969, I received a Master of Science Degree in Engineering from Stanford University. In 1973, I received a Law Degree from Stanford University. In addition, I studied nuclear engineering at the Massachusetts Institute of Technology during the years 1983-1986.

In 1983, I formed Schlissel Engineering Associates. Since that time, I have been retained by governmental bodies, publicly-owned utilities, and private organizations in 21 states to prepare expert testimony and analyses on engineering and economic issues related to electric utilities. My recent clients have included the Staff

of the California Public Utilities Commission, the Staff of the Arizona Corporation Commission, the Staff of the Kansas State Corporation Commission, the North Carolina Eastern Municipal Power Agency, municipal utility systems in Massachusetts, the Office of Public Utility Counsel of the State of Texas, and the New York State Consumer Protection Board.

I have testified before state regulatory commissions in Arizona, New Jersey, Connecticut, Kansas, Texas, New Mexico, New York, Vermont, North Carolina, South Carolina, Maine, Illinois, Indiana, Ohio, Massachusetts, and Missouri, and before an Atomic Safety & Licensing Board of the U.S. Nuclear Regulatory Commission.

A copy of my current resume is attached as Exhibit DAS-1.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THIS COMMISSION?

A. Yes. I have testified in Department of Public Utility Control Dockets Nos. 89-08-11, 92-01-05, 92-06-05, and 91-12-07.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS DOCKET?

A. Schlissel Engineering Associates was retained by the Office of Consumer Counsel, in part, to determine the existence, extent and implication of management imprudence with regard to the 1992 replacement of the steam generators of Millstone 2. This testimony

presents the results of my review.

Q. PLEASE DESCRIBE HOW YOU CONDUCTED YOUR EVALUATION OF NORTHEAST UTILITIES' (NU) MANAGEMENT OF THE MILLSTONE 2 STEAM GENERATOR REPLACEMENT ISSUE?

A. I have expended approximately 250 hours of work on the following activities:

* A tour of the Millstone 2 plant on September 10, 1992 along with the DPUC and OCC staff.

* Attendance at two briefings on the steam generator replacement project given by NU personnel.

* A telephone question and answer session with Ray Necci, NU's Project Manager for the Steam Generator Replacement Project.

* Four visits to the bulk document repository at the Company's headquarters in Berlin, CT.

* A review of the limited documentation reviewed by Bevilacqua Consulting Services (BCS) and the BCS report on the steam generator replacement outage.

* The submission of 78 detailed interrogatories to the Company and the review of the more than seven thousand pages of materials which the Company provided in response to those interrogatories. These materials included

  - the outage history and outage closeout report for the steam generator replacement outage

  - outage weekly, monthly, quarterly and some daily progress reports and Fluor Daniel monthly reports

- engineering plans and where available, engineering analyses of the problems experienced during the outage

- correspondence between NU and Flour Daniel

- the documentation prepared during the selection of contractors for the steam generator replacement

- the documentation related to industry experience with steam generator tube degradation and the replacement of the steam generators at other operating nuclear plants

- the materials prepared as part of NU's visits to foreign plants and the Company's monitoring of the steam generators at the Palisades nuclear plant.

* The review of the correspondence between NU and the U.S. Nuclear Regulatory Commission (NRC) concerning (1) the steam generator related degradation experienced by Millstone 2 prior to the 1992 outage and (2) the steam generator replacement project. This correspondence included the NRC's evaluations of NU's management of the planning for the outages and the actual management of outage activities.

* The review of the correspondence between the NRC and the Palisades nuclear power plant which was the first Combustion Engineering designed plant to replace its steam generators.

* The review of INPO's evaluation of the Millstone 2 steam generator replacement outage.

* The steam generator related engineering and economic analyses of prepared by NU between 1982 and 1991.

Q. WHAT PRUDENCE STANDARD HAVE YOU APPLIED IN YOUR REVIEW OF THE REASONABLENESS OF NORTHEAST UTILITIES' MANAGEMENT OF THE MILLSTONE 2 STEAM GENERATOR REPLACEMENT ISSUE?

A. I have employed the standard commonly used in regulatory reviews of the prudence of the management of the design and operation of nuclear power plants. This standard requires that the utility's decisions and actions be evaluated in light of the information which was available to it in the pertinent time frame. Information which is available only through hindsight is given no weight. This standard is based on judgments concerning how reasonable persons, with the skill and knowledge attributed to reasonable utility managers should have been expected to cope with the circumstances and problems confronting Northeast Utilities regarding the Millstone 2 steam generators and the 1992 steam generator replacement outage.

Q. WHAT ARE YOUR CONCLUSIONS?

A. My conclusions are as follows:

1. The forms of steam generator degradation experienced by Millstone 2 during the 1980's were typical of the problems experienced by other nuclear power plants. NU engineers undertook what appear to have been extensive efforts to monitor and arrest the progressive tube degradation.

2. Between 1982 and 1991 NU personnel periodically performed engineering and economic evaluations which compared the costs and benefits of continued repair of the existing steam generators and the installation of replacement steam generators.

3. NU decided in late 1988 to order replacement steam generators from Babcock & Wilcox Canada and to initiate pre-planning for a steam generator replacement at Millstone 2.

4. In late 1989 and early 1990 the Company conducted a detailed process for selecting the main contractor for the engineering and installation of the replacement steam generators. Although concerns over the qualifications of Fluor Daniel were initially expressed by several members of the selection team, the selection process used by the Company was reasonable and the selection of Fluor Daniel as the primary engineering and installation contractor does not appear to have been unreasonable.

5. A. The decision to proceed with the 1992 steam generator replacement was based on a "Millstone Unit No. 2 Steam Generator Scenarios" engineering and economic analysis which was originally prepared in April 1990 and updated in September and December 1990.

B. This study compared replacement of the steam generators in 1992 with a range of scenarios involving continued plugging, preemptive sleeving, and abandonment. The study concluded that replacement was the most economic option.

C. The study's selection of replacement, continued plugging, preemptive sleeving and abandonment scenarios was reasonable given the problems that had been experienced at Millstone 2 and the solutions that had been and were being implemented at other nuclear power plants. However, the 1990 study unreasonably failed to consider adequate sensitivity analyses to reflect reasonable ranges for future Millstone 2 operating performance and operating costs although it did contain several limited sensitivity analyses reflecting a 25% increase in the cost of the steam generator replacement and lower fossil fuel price projections. Instead, the study assumed in the steam generator replacement/continued operation scenarios only a single set of assumptions concerning the plant's likely operating performance and costs over the entire twenty three years of its projected post-replacement operating life.

D. Moreover, the assumptions made in the study concerning the plant's post-steam generator replacement capacity factors and operating costs were overly optimistic, and in at least one case, entirely unsupported. For example, the study assumed that Millstone 2 would achieve a 77 percent average annual capacity factor following the steam generator replacement. This was approximately twelve percentage points higher than the 65 percent capacity factor which the plant achieved during its first 15 years of commercial operation (i.e., December 1975 through 1990).

E. In fact, the operating performance through the end of 1990 of the other five medium or large PWRs which had replaced steam generators demonstrated that only two of the units had actually achieved higher capacity factors after they had installed replacement steam generators. Two other units actually achieved lower capacity factors, while the fifth unit achieved essentially the same capacity factor before and after its steam generators were replaced. This operating performance is shown on Table 1 below:

TABLE 1
PWR CAPACITY FACTORS
BEFORE AND AFTER
STEAM GENERATOR REPLACEMENTS

Unit	Capacity Factor before Replacement	Capacity Factor after Replacement
Surry 1	55	62
Surry 2	62	65
Turkey Point 3	63	59
Turkey Point 4	66	53
H.B. Robinson	62	63

F. Moreover, the same operating performance also demonstrated that each unit achieved higher capacity factors during their first three years of operations with the replacement steam generators than they did in subsequent years.

TABLE 2
PWR CAPACITY FACTORS
FIRST THREE YEARS AFTER
STEAM GENERATOR REPLACEMENTS
COMPARED TO SUBSEQUENT YEARS

Unit	Capacity Factor First Three Years After Replacement	Capacity Factor Years Four and Later After Replacement
Surry 1	66	63
Surry 2	76	60
Turkey Point 3	78	48
Turkey Point 4	61	45
H.B. Robinson	80	59

G. The point of this analysis is not to argue that the replacement steam generators were themselves defective. Indeed, I am not aware of any evidence that the replacement steam generators have caused any significant problems at Surry, Turkey Point or Robinson. What happened at these plants was that other factors, such as managerial or technical problems, or the impact of the aging of plant systems, structures and components, offset and eventually overwhelmed any improvement in performance gained from the steam generator replacements. The net result was a decrease in plant performance over the longer term. In fact, as shown on Table 1 above, the overall capacity factors

achieved by Turkey Point Units 3 and 4 in all years after the installation of replacement steam generators were lower than the capacity factors achieved by the units prior to the replacements. The capacity factors achieved by the Surry and Robinson PWRs have only been between 1 and 7 percentage points higher after the replacement of their steam generators.

H. Consequently, the installation of replacement steam generators can be expected to offset further declines in a nuclear power plant's operating performance but cannot, by itself, be expected to improve Millstone 2's capacity factor to 77 percent over the long term.

I. The assumption that Millstone 2 would achieve a 77 percent average annual capacity factor after its steam generators were replaced biased the 1990 economic analyses in favor of replacement and continued operation. Instead of making this overly optimistic and, essentially unsupported, assumption, the Company should have performed a series of sensitivity analyses for a range of capacity factors from approximately 55 percent (10 percentage points below the unit's lifetime capacity factor) through 75 percent.

J. The Company's assumptions for future Millstone O&M expenditures in the replacement scenarios were also overly optimistic in that they essentially assumed that there would only be minimal growth in O&M expenditures until the mid-to-late 1990's. This assumption of flat nominal (and decreasing real) growth in O&M expenditures conflicted with actual industry experience. This assumption also biased the study in favor of the replacement/continued operation scenarios and against the abandonment in 1990 or 1992 scenarios. As with future capacity factors, the Company should have performed several sensitivity analyses to reflect the possibility that O&M costs at Millstone 2 could experience real growth after the steam generators were replaced.

K. The fossil fuel price projections used in the 1990 study heavily impacted the costs of the abandonment scenarios. Although a sensitivity analysis reflecting lower fossil fuel price projections was performed for a number of the scenarios examined in the 1990 study, such an analysis was not conducted for the comparison between the steam generator replacement scenarios and the abandonment in 1990 or 1992 scenarios.

L. Correcting the 1990 study to reflect a range of possible future Millstone 2 capacity factors and O&M costs would have dramatically decreased the economic advantage of replacement/continued operation over abandonment in 1992, especially if lower fossil fuel price projections had also been assumed in the sensitivity. However, these corrections would not have reversed the study's ultimate conclusion that replacement was the more economic option at the time.

6. The Company performed an Update of the 1990 study in late 1991. This Update also concluded that replacement of the steam generators was a more economic option than abandonment, though it did show a smaller economic advantage from replacement. The 1991 Update did assume that Millstone 2 would achieve a 72 percent average annual capacity factor for Millstone 2, instead of the 77 percent figure assumed in the 1990 study. It also assumed somewhat higher O&M expenditures in the later years of Millstone 2's projected 40 year service life. However, like the 1990 study, the 1991 Update failed to include any sensitivity analyses reflecting a range of possible future capacity factors and/or operating costs. Although the 1991 Update was unreasonable for failing to include such sensitivity analyses, it appears that correcting for these flaws would not have changed the Update's overall conclusion that

replacement of the steam generators was the more economic option for Millstone 2 at that time.

7. The Company's preplanning for the steam generator replacement outage was reasonable. The Company appears to have learned from and incorporated the industry experience of steam generator replacements into the Millstone 2 project. In particular, Company personnel closely monitored the late 1990/early 1991 replacement of the steam generators at the Palisades Nuclear Plant.

8. The delays experienced during the outage appear to have been either (a) the result of problems which were not due to mismanagement or (b) the result of inadequate performance by Fluor Daniel.

9. NU was prudent to have taken complete control of the steam generator project from Fluor Daniel in late July, 1992.

10. The Settlement Agreement between NU and Fluor Daniel appears to have reasonably compensated ratepayers for any increased project or replacement power costs incurred as a result of Fluor's inadequate performance during the early months of the steam generator replacement outage.

11. A. The initial engineering plans for the steam generator replacement included the installation of a restraint

system to anchor the pipe in place and to limit potential displacements once the pipes were cut free from the steam generators. However, this restraint system later was removed except for dead weight supports. According to NU, the decision to remove all but the dead weight restraints was made after the Company reviewed the experience of the Palisades plant where the reactor coolant system piping had not moved significantly after being cut during the replacement of that plant's steam generators. The Company has stated that removing the restraint system from the project scope offered potential reductions in project cost, schedule and man-rem exposure. Moreover, according to the Company, all parties, including NU, Fluor Daniel, and Combustion Engineering agreed to the modification of the engineering plans based on the limited movement of the pipes at the Palisades plant.

B. The decision to remove the restrain system from the engineering plants (except for the dead weight supports) appears to have been reasonable given the experience from the Palisades plant.

12. My review of the replacement of the steam generators at Millstone 2 has revealed no evidence of mismanagement or imprudence other than the failure to conduct sensitivity

analyses in the 1990 study and 1991 update to reflect less optimistic future Millstone 2 capacity factors and operating costs and lower fossil fuel price projections.

Q. DOES THIS COMPLETE YOUR TESTIMONY?

A. Yes.