STATE OF NEW YORK

PUBLIC SERVICE COMMISSION

Proceeding on Motion of the Commission to Investigate the Outage of the Rochester Gas and Electric Corporation's Ginna Nuclear Plant	Case 28166

DIRECT TESTIMONY OF
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Submitted by,

New York State Consumer
Protection Board

Dated: January 7, 1983
Albany, New York

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Q. State your name, business address and present position.

A. My name is David A. Schlissel, my business address is 99 Washington Avenue, Albany, New York. I am a private attorney employed as a consultant on special projects by the New York State Consumer Protection Board.

Q. State your education and work experience for the record.

A. I graduated from the Massachusetts Institute of Technology in 1968, with a Bachelor of Science Degree in Astronautical Engineering. In 1969, I received a Masters of Science Degree in Aeronautics and Astronautics, with a specialty in trajectory analysis, from Stanford University. In 1973 I received a Juris Doctor Degree from Stanford University School of Law. Following graduation in June, 1973, I moved to Atlanta, Georgia to become staff attorney for a ratemaking intervention group. In December, 1975, I relocated to Albany, New York to take a position as a Utility Intervenor Attorney for the New York State Consumer Protection Board. Three and one half years later, in July, 1979, I left the fulltime employment of the Board to become a private consultant to other state agencies and to community and consumer organizations.

Q. Have you participated in any other proceedings before the New York State Public Service Commission?

A. Yes. Since December, 1975 I have represented the State Consumer Protection Board and/or other intervenor groups in over 25 proceedings before the Commission. The Cases of most relevance to this proceeding were Cases 27123 and 27869 both involving the prudence of management actions which caused or extended outages of the Indian Point 2 Nuclear Plant, owned and operated by Consolidated Edison Company of New York, Inc. In addition, I represented intervenors in Cases 27013 and 28059 involving the comparative economics of completion of Nine Mile 2 versus other available alternatives.

Q. What is the purpose of your testimony?

A. The scope of my testimony is twofold. First, I will demonstrate that prior to January, 1982, sufficient information was available to Rochester Gas and Electric Corporation's management concerning foreign object caused damage to steam generators to alert the Company that detailed inspections of the secondary side of the "B" steam generator would be prudent. Second, I will present a calculation of the number of days of output from the Ginna plant which have been lost since April,

1975 due to foreign object initiated tube leaks on the periphery of the "B" steam generator.

Q. Was Ginna the first nuclear plant at which loose parts or foreign objects were found inside a steam generator?

A. No. From a search of industry and Nuclear Regulatory Commission literature, I have been able to identify 11 instances prior to January, 1982, in which loose parts or foreign objects were discovered inside, and removed from, steam generators. These events are listed in Table 1 below:

TABLE 1

Loose part/foreign object discovery	Year	Source
Genkai 1, Japan	1975	Nuclear Safety, Vol. 18, No. 3
Doel 1, Belgium	1977,1978	Nuclear Safety, Vol. 20, No. 5, and Vol. 21, No. 6
Crystal River 3	1978,1979	Licensee Event Reports
Bugey 3, France	1979	Nuclear Safety, Vol. 22, No. 5
Prairie Island 1	1979	RADAR RESPONSE, NUREG-0651
Salem 1	1979	Nuclear Safety, Vol. 22, No. 5
North Anna 1	~~1979,1980~~ 1980, 1981	Licensee Event Reports
Farley Unit 2	1981	NUREG 0886

Except for the incidents at the Crystal River 3 and the North Anna facilities, the foreign objects were discovered on the secondary side of the steam generators.

Q. From what literature did you develop this information?

A. From NUREG-0651 and NUREG-0886 prepared by the Staff of the Nuclear Regulatory Commission, Licensee Event Reports (LER's) filed by reactor operators with the NRC, the RADAR RESPONSE provided to RG&E by Westinghouse on the October, 1979 tube burst at Prairie Island 1, and from an industry periodical entitled Nuclear Safety.

Nuclear Safety is a bi-monthly Technical Progress Review prepared for the U.S. Department of Energy and the U.S. Nuclear Regulatory Commission by the Nuclear Safety Information Center at the Oak Ridge National Laboratory. The purpose of Nuclear Safety is described on the inside cover sheet of the September - October, 1981 issue, as follows:

> Nuclear Safety is a review journal that covers significant developments in the field of nuclear safety.
>
> The scope is limited to topics relevant to the analysis and control of hazards associated with nuclear energy,

> operations involving fissionable materials, and the products of nuclear fission and their effects on the environment.
>
> Primary emphasis is on safety in reactor design, construction, and operation; however, safety considerations in regard to the entire fuel cycle including fuel fabrication, spent-fuel processing, nuclear waste disposal, handling of radioisotopes, and environmental effects of these operations are also treated.

The information on loose parts or foreign objects comes from a series of articles on "Steam Generation Tube Performance: World Experience With Water-Cooled Nuclear Power Reactors." The stated purpose of these articles is to "present information on these tube failures to the nuclear industry." (source Nuclear Safety, Vol. 18(3), p. 356)

I have included copies of the articles presenting the world experience with steam generator tubes for the years 1975, 1977 and 1979 as Exhibit DAS-1 ____.

Q. Do these Nuclear Safety articles indicate the locations where the loose parts or foreign objects caused tube damage?

A. Yes. For example, Vol. 18, No. 3, p. 357, Table 2 indicates that the foreign object found in the Genkai 1

plant's steam generator caused a tube failure at the tube sheet. Similarly, Vol. 22, No. 5, p. 646 reports that a tube leak caused by a foreign object at the Bugey 3 Plant was located approximately 10 cm's above the tube sheet. Most significantly, Vol. 20, No. 5, the September - October, 1979 issue, at page 596 reported that at the Doel 1 plant in Belgium in 1977:

> ...10 steam-generator tubes were plugged. These tubes were damaged by foreign objects in the steam generator; the damage occurred just above the tube sheet on the outer perimeter of the tube bundle.

Q. Wasn't the tube burst caused by the spring found inside the steam generator at Prairie Island 1 also on the periphery and above the tube sheet?

A. Yes. As was discussed during the cross-examine of Company witness Smith (S.M. 794-801) a document entitled a RADAR RESPONSE was provided to RG&E by Westinghouse in December, 1979. At page 11 of the LER attached to that document, Northern States Power Company stated:

> Since the leaking tube (Row 4, Column 1, Inlet side) was located in the outer periphery of the tube bundle and the heat was just above the tube sheet within the flow lane, foreign object damage was suspected. (S.M. 799)

Q. What design was the Doel 1 steam generator?

A. Doel 1 is described as a Westinghouse two-loop reactor in Nuclear Safety, Vol. 22, No. 5, Table 1 (page 31 of 48, Exhibit DAS-1—). ~~IE Information Notice No. 79-27 and the data by the NRC's Office of Inspection and Enforcement and provided to the CPB in response to Interrogatory No. 43~~. Table 4 of NUREG-0886 further identifies the steam generators as being of the Model 44 design. The Ginna plant's steam generators are also Model 44's.

Q. When were the foreign objects at Doel 1 discovered?

A. At some point in 1977.

Q. Prior to the publication of the September/October, 1979 issue of Nuclear Safety, was information regarding the Doel 1 experience provided to RG&E?

A. I don't know. As we have only recently identified this incident, we have not had the opportunity to ask RG&E whether it received any information on the Doel 1 experience from Westinghouse, the Nuclear Regulatory Commission, the Steam Generator Owners Group, or any other source. It is certain, however, that subsequent to the publication of the Nuclear Safety article in September - October, 1979, the information was available to the industry.

Q. Did the series of articles in Nuclear Safety also report how the foreign objects were discovered?

A. Yes. Vol. 18, No. 3, states at page 358 that the foreign object at the Genkai 1 unit in 1975 was detected by a fiber-optics examination of the secondary side. I would also note that the RADAR RESPONSE discussed above reported that fiber-optics were used to discover the spring found in the Prairie Island 1 steam generator in 1979.

Q. Were fiber-optics used at Ginna before January, 1982?

A. Yes. In response to CPB Interrogatory 13, RG&E stated that it had been using its own fiber-optic equipment on turbines since 1977. It also noted that in 1979 fiber-optic equipment was utilized to locate a dosimeter and a chisel which had been dropped in a Ginna steam generator.

Q. What were the sizes of the chisel and dosumeter found with the fiber-optics equipment?

A. The dosimeter was described by Company witness Smith as being "about the length of a pencil or pen" and about a half-inch in diameter (S.M. 958). The chisel was described as about 6 inches long and a quarter of an

inch in diameter (S.N. 959). Both of these are far smaller than the piece of the downcomer flow resistance plate which initiated the tube burst of January 25, 1982. That piece was 0.5 inches thick by 4.18 inches wide by 6.31 inches long. (Source: NUREG-0916, p. 5-17)

I would also note that the coil spring found at Prairie Island was 8.5 inches long, 1.25 inches in diameter and of 3/32 gauge. (Source: page 12 of the LER attached to the RADAR RESPONSE).

In its response to CPB interrogatory 13, RG&E described the equipment used in its 1982 fiber-optics investigation as follows:

> At the beginning of the outage, RG&E initially utilized a nine foot long, forward looking Olympus fiber optic scope with 6- and 10-mm lenses which had been used for several years in other applications at the plant. To achieve additional length, RG&E purchased a 30-foot long American Optical fiber optic scope which was utilized in conjunction with the Olympus equipment for the steam generator inspection conducted in February 1982.

The Company also indicated that the fiber-optic equipment was fed into the steam generators through the six inch hand holes which are approximately twelve inches above the secondary side of the tube sheet.

Q. Could this equipment have been used before January, 1982 to examine the damaged tubes upon the periphery of the "B" steam generator?

A. Yes. I would note further that the discovery of the foreign objects made on February 10th was achieved through a fiber optic examination of the periphery of the "B" steam generator.

Q. Company witness Smith has testified that RG&E in 1982 was the first utility to use a remote controlled video system to examine inside a steam generator? Do you agree?

A. Basically, yes. However, in 1978, video camera equipment was used to examine the primary side of a steam generator at the Crystal River 3 plant operated by Florida Power & Light. A copy of a License Event Report filed by the utility at the Nuclear Regulatory Commission is attached as Exhibit DAS-2 ____ to my testimony.

I have been informed by several NRC Staff members that inspection of the primary side of the Crystal River 3 steam generator was different and much easier than putting the video system inside Ginna's "B" steam generator. Although that may be true, the incident

does indicate that prior to 1982, at least one utility did attempt to use a video system to examine and identify the source of damage to steam generator tubes.

Q. Are you aware of the equipment used by RG&E subsequent to the tube burst of January 25, 1982, to perform the remotely controlled video inspection?

A. Yes. In response to CPB interrogatory No. 13b, the Company provided a list of the equipment used. A copy of CPB interrogatory 13b and the Company's response is attached as Exhibit DAS-3____.

Q. During the cross-examination of Company witness Smith, Judge Cowan asked whether the technology to perform the remotely controlled video inspections was available prior to 1982. Do you wish to comment?

A. Yes. I believe that the word "technology" was misused during that discussion. Although it may be true that the specific components of the video system, except for the camera, may not have been in existence until developed by RG&E personnel in February, 1982, the fabrication of the components did not require any technological breakthroughs. In other words, the

components that appear to have been used were state of the art technology which was available for at least several years. The fabrication of the system only awaited the commitment of the necessary time and resources.

This analysis is confirmed by the extremely short period of time in which the video system was designed, fabricated, tested and used to "assess the extent of the tube damage and locate the remaining foreign objects." (S.M. 761) As Company witness Smith testified, the decision to design the system was made on February 11th. It was fabricated, tested and used on February 13th.

Q. Besides fiber optics and video inspections, were any other methods available to the Company to determine the cause of the peripheral tube damage?

A. Yes. In 1978 the Company, in conjunction with Westinghouse, removed a damaged tube from the periphery of the "B" steam generator. This effort had the potential to alert the Company to the peripheral and mechanical nature of the damage to the pulled tube. However, in extracting the tube, the orientation of the damaged section was lost with the result that the

Company remained unaware that the damage was on the peripheral surface of the tube.

Q. Have you reviewed the RG&E procedure used in the 1978 tube pull?

A. Yes.

Q. Do you believe it adequately protected against a loss of orientation due to rotation?

A. No. A copy of the RG&E Procedure EM-201 for the ""B" STEAM GENERATOR SECONDARY SIDE PERIPHERAL TUBE REMOVAL" is attached to my testimony as Exhibit DAS-4_____. (At S.M. 832 we requested that a copy of the Westinghouse Procedure be provided, RG&E stated it was unable to comply as the procedure was a proprietary document). Steps 3.12.15, 4.5 and 5.4.18 of Procedure EM-201 provide instructions that the tube be marked prior to cutting it into segments so that the tube can be matched together "both axially, and longitudinally." This instruction indicates to me a concern that the orientation of the damage on the tube be known when the entire tube was reassembled a matched together in the Westinghouse laboratory. Unfortunately, in spite of that concern, the instructions in steps 5.4.12 and

5.4.13 direct that once the tube was cut at the U-bend and straightened, it was to be pulled prior to the first marking.

This procedure meant that although the cut pieces of the tube might be reassembled properly after their removal, the Company could not ensure that the initial orientation of the tube had not been lost due to rotation during the pulling in steps 5.4.12 and 5.4.13. In other words, the orientation may have been lost prior to the placement of the first mark in step 5.4.18.

Q. Before completing this section of your testimony, would you care to discuss the comments made by Mr. Harold Denton at a Nuclear Regulatory Commission Session on November 18, 1982?

A. Yes. During cross-examination of Company witness Smith, I read comments attributed to Mr. Denton from the transcript of the November 18th Session. Following the last set of hearings in this proceeding, I contacted Mr. Denton to verify the accuracy of these comments. He informed me that his statement concerned discussions with RG&E held subsequent, not prior, to the tube burst of January 25, 1982. According to Mr.

Denton, the suggestion that perhaps Ginna had a loose parts problem was made on approximately February 10, 1982, before the discovery of the foreign objects in the "B" steam generator.

Q. What is the second area in which you will testify?

A. I will present a calculation of the number of days since April, 1975 that the Ginna plant has not been in service due to tube leaks caused by the foreign objects found in the "B" steam generator in February, 1982.

I note before continuing that this task requires the examination of four separate plant outages or sets of outages:

1. The winter-spring 1982 outage.
2. The fall 1982 steam generator inspection outage.
3. Ginna outages prior to 1982 for which the foreign objects have now been identified as the initiating cause.
4. Ginna plant refueling outages prior to 1982 during which tube leaks on the periphery of the "B" steam generator were repaired.

Q. With regard to the winter-spring 1982 outage, do you accept the allocation of 35 days to the steam generator repairs and 87.5 days to refueling tasks presented by Company witness Noon and accepted by Staff witness Roberts?

A. No. Exhibit 3 only presents information on those days on which refueling related tasks were actually performed. It does not present any evidence on whether refueling tasks were conducted as expeditiously as possible or whether the refueling outage was unnecessarily prolonged by circumstances deriving from the January 25, 1982 tube burst.

In fact, there is a discrepancy between Mr. Noon's allocation of 87.5 days for refueling and the number of days for refueling derived by summing the specific critical path impacts of individual refueling related tasks.

Q. Have you made such a computation?

A. Yes. Relying upon RG&E's responses to CPB Interrogatories 1, 59 and 61, I have computed the number of days reasonably attributable to refueling and other non-steam generator repair related tasks, as follows:

1. RG&E's response to CPB Interrogatory 1, attached as Exhibit DAS-5____, stated that the 61 day planned duration for the refueling outage was based on certain specific time estimates for tasks expected to affect the outage's critical path.

2. RG&E's response to CPB Interrogatory 59, attached as Exhibit DAS-6____, provides figures on the number of days unanticipated problems or work extended the outage's critical path. Accepting each of these adjustments except for the Reactor Coolant Pump Motor repair for the moment, extends the refueling critical path by 7 days, as follows:

Integrated leak test	+102 hours
Steam generator crevice cleaning	+ 16 hours
Steam generator water lancing	+ 10 hours
EW-1444	- 3 hours
Loose parts monitoring system	+ 36 hours
TOTAL	+161 hours (7 days rounded)

3. Exh. 3 indicates that for the period April 1 - April 24, a total of 539 hours were consumed by Reactor Coolant Pump Motor repairs. As can be seen from page 3 of

Exhibit DAS-5____, 15 days had been allocated to this task. Thus, the refueling outage's critical path was extended by 7.5 days over the 61 day planned duration.

4. One of the planned tasks for the winter-spring outage was preventive sleeving of steam generator tubes. This task was not undertaken. According to Company witness Noon the failure to perform this task should have reduced the critical path by some 11 days to 50 days.

Summing these adjustments results in refueling related tasks requiring 64.5 days during the winter-spring 1982 outage.

Q. Please discuss the fall 1982 steam inspection outage.

A. As a precondition for returning the Ginna plant to service, RG&E agreed to conduct an intermediate steam generator inspection outage at no more than 120 effective full power days after return to power (page 5-49 of NUREG-0916, the Ginna Restart Safety Evaluation Report). This outage began on September 25th and lasted until October 21st.

Q. Have you been able to determine the number of days prior to 1982 the Ginna plant was unavailable for commercial service due to foreign object caused peripheral tube leaks in the "B" steam generator?

A. Yes. Table 5.4.1 of NUREG-0916 listed the forced outages initiated by "B" steam generator peripheral tube leaks and the refueling outages during which peripheral tubes with leaks were plugged.

In response to an interrogatory from the Department of Public Service staff, the Company provided information on the durations of the five earlier forced outages caused by the foreign objects. A copy of the Company response is attached as Exhibit DAS-7____. From Exhibit DAS-7____, it can be computed that since 1975, approximately 60 days of output from Ginna have been lost due to peripheral tube leaks. However, on Table 2 of Exhibit DAS-7____, the Company lists the dates during those outages when other maintenance work was performed. When these days are subtracted from the 60 day figure, the total number of days of forced outages attributable to foreign object initiated peripheral tube leaks becomes 52.

Q. Does this represent the entire impact of foreign object initiated tube leaks on Ginna's availability prior to January 25, 1982?

A. As indicated above, tubes on the periphery of the "B" steam generator were plugged during several refueling outages prior to 1982. This plugging may have extended the lengths of those outages.

Q. Why do you say "may have extended the lengths of those outages"?

A. In September, 1982, the Consumer Protection Board served Interrogatory 37 on RG&E seeking detailed information on prior Ginna outages attributable to the foreign objects. Included in the scope of this request was information on the number of days each outage had been extended by the need to identify and plug tubes on the periphery of the "B" steam generator. Unfortunately, the Company to date has not provided this information. A copy of CPB Interrogatory 37 and the Company's response is attached as Exhibit DAS-8____.

It is possible, however, to make a first-cut approximation of the impact of the plugging of the leaking tubes by comparing information provided by the

Company on the planned versus the actual lengths of each refueling outage. Table 2 below presents this information.

TABLE 2

Refueling Outage Durations

	Planned	Actual
1978 outage	38 days	57 days
1979 outage	46 days	52 days
1980 outage	43 days	55 days
1981 outage	52 days	63 days

(Source: Attachment 1 to RG&E's response to CPB Interrogatory 60)

In fairness to the Company, it should be mentioned that some of the days by which the actual exceeded the planned outage durations may be attributable to non-steam generator related problems unanticipated during the planning process. However, without a response to CPB Interrogatory 37, it is impossible to identify or quantify the existence or impact of those other unanticipated problems.

Q. Please summarize your conclusions.

A. Since April, 1975, 137 days of output from the Ginna facility have been lost due to foreign initiated tube leaks on the periphery of the "B" steam generator. 58 days of this total came during the winter-spring 1982 outage, 27 days came during the fall 1982 outage, and 52 days came during forced outages prior to 1982. This total would be higher if the number of days lost during earlier refueling outages were quantified.

Q. Does this complete your testimony?

A. Yes.

Q. Please state your name and business address.

A. My name is David A. Schlissel. My business address is 74 Chester Road, Belmont, Ma. 02178.

Q. Have you testified previously in this proceeding?

A. Yes.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to demonstrate that given the information available to RG&E up to and including the Ginna Station's May 1981 refueling and maintenance outage, the Company should have conducted a visual inspection of the peripheral tube damage in the Station's "B" steam generator. Had this been done, the Company would have detected the nature and extent of the damage in sufficient time to have prevented the January 25, 1982 tube burst. The fact that the Company took no such action and allowed a foreign object to create substantial amounts of internal damage compels a finding of imprudence by the Commission.

Q. Please begin.

A. By May, 1981, when the 80 percent OD indication on tube R43 C53 was discovered, the Company knew certain crucial facts about the peripheral tube degradation in the Ginna Station's "B" Steam Generator:

1) The Company knew that the peripheral degradation was unique in both its location and cause;

2) The Company knew that the degradation progressed rapidly;

3) The Company knew that after January, 1978 many newly degraded tubes were located immediately adjacent to previously plugged tubes and that many also had OD ECT indications.

4) The Company knew that the rapid peripheral tube degradation had resulted in higher rates for its customers during unplanned repair outages.

Furthermore, by May, 1981, the Company had noticed that other Westinghouse plants had experienced similar peripheral tube degradation caused by loose parts or foreign object impacts.

I will address each of these facts in turn.

First, as early as 1976, the Company knew that the tube degradation on the periphery of the "B" steam generator was unique in that it was not caused by the traditional forms of tube degradation, i.e., wastage, stress corrosion cracking (SCC), fretting, denting or intergranular attack (IGA). Each of these forms had a particular location associated with its occurrence. However, none of these locations were on the periphery of

the tube bundle and between the top of the tube sheet and the first tube support plate:

- Wastage had occurred on the tube sheet and Stress Corrosion Cracking had occurred in the crevice region of the tube to tube sheet interface. Both occurred in the interior of the tube bundle, away from the periphery.
- Denting occurred at the interface between the tube and the tube support plate.
- Intergranular attack occurred inside the tube bundle and primarily in the crevice region between the tube and the tube sheet.
- Fretting occurred at the tube support plates and in the region near the antivibration bars.

In fact, when asked in CPB Interrogatory 167 to name the different kinds of tube degradation which were known to occur on the periphery of the tube bundle and between the top of the tube sheet and the first tube support plate, RG&E could only identify "Multiple axial SCC in the same circumference of the tube," a form of degradation it admitted had never "been identified in the Ginna steam generators."

Furthermore, the Company maintained a separate classification for degraded tubes on the periphery and

developed a unique theory, axial/mechanical loading, to explain their existence.

Second, by December, 1979, the Company also knew that the degradation progressed "rather rapidly" in the language of Mr. Denton. When asked in CPB Interrogatory 163 to define the period of time which Mr. Denton considered "rather rapidly" the Company replied:

> The period of time which is considered "rather rapidly" is not precisely quantifiable, but generally can be considered as being less than one year.

Under this definition, it indeed can be said that the peripheral tube degradation had progressed rather rapidly for the following five tubes had gone from 20 percent indications to 100 percent indications, i.e., had leaked, in less than 260 days:

* Tube R40 C68 in January, 1976 ----- 225 days
* Tube R12 C91 in May, 1976 ---------- 14 days
* Tube R45 C54 in July, 1977 --------- 41 days
* Tube R44 C54 in January, 1978 ------ 205 days
* Tube R43 C54 in December, 1979 ----- 260 days

(Source RG&E Response to CPB Interrogatory 158)

In addition, tube R43 C53 progressed from less than a 20 percent indication in November, 1980 to an 80 percent indication in May, 1981, a period of 180 days or less.

As I will discuss below, each of these leaking tubes led to an unplanned "forced" outage of the Ginna Station during which replacement power and/or additional fossil fuel costs were incurred by the Company. These higher costs were later passed along to the Company's ratepayers through the fuel adjustment clause.

Third, by January, 1978, the Company knew that newly degraded tubes were situated immediately adjacent to previously plugged tubes. By December, 1979, there also was no doubt that many of the peripheral tubes with new OD indications were also located next to plugged tubes. (See Table 2.3 of Exhibit 91)

It is interesting to note that three of the tubes which went "rather rapidly" from 20 percent indications to 100 percent indications, i.e., became leakers, were also immediately adjacent tubes. Tube R45 C54 had a 100 percent indication in July, 1977. Tube R44 C54 had a 100 percent indication in January, 1978. Tube R43 C54 had a 100 percent indication in December, 1979.

In fact, it is readily apparent from Exhibit 12, a series of tube sheet maps maintained by the Company, that starting in January, 1978, the Company was plugging a significant number of tubes in the Number 4 wedge area of the "B" steam generator.

Fourth, the Company knew that the peripheral tube degradation had already resulted in significantly higher costs for consumers and, subsequently carried the potential for future adverse economic impacts as well. Exhibit ___, DAS-7, demonstrated that between 1975 and 1980 leaking peripheral tubes in the "B" steam generator caused five unplanned maintenance outages, totalling more than 52 days of plant unavailability. (SM 1860)

Thus, Mr. Hutton may be quite correct that the leaking peripheral tubes were not considered a safety related concern. However, they should have concerned the Company for economic reasons. The December 1979 unplanned outage, for example, lasted over seventeen days. At an average daily replacement power cost of approximately $300,000, this outage cost ratepayers an extra $5 million.

Finally, the experiences of other Westinghouse plants with loose part or foreign object caused tube degradation should have given the Company sufficient notice to cause concern that the axial/mechanical loading theory did not adequately explain the phenomena occurring on the periphery of the "B" steam generator. Mr. Hutton has indicated that as part of his work responsibility during 1981, he reviewed the steam generator experience at other Westinghouse plants. From that review he should have learned about the loose parts events at the Prairie Island

and Doel facilities. As the Board discussed at length earlier in this proceeding, the loose parts events at these facilities were sufficiently similar to the peripheral tube degradation being experienced at Ginna to warrant consideration of a loose part or other foreign object as a possible cause of that degradation.

Q. What was the Company's response to the peripheral tube degradation given what it knew about that problem.

A. The Company merely plugged tubes R43 C54 and R43 C57 in December, 1979 and tube R43 C54 in May 1981 and hoped that further problems would not develop.

Q. Are there other actions the Company might have taken?

A. Yes. Had it chosen to act affirmatively to discover and correct the source of the continuing peripheral tube degradation, there were several reasonable, prudent actions the Company could easily have taken.

First, it could have used fiber optics equipment to conduct a visual examination of the damaged tubes. Such equipment had been used at Ginna since 1977. In fact, during the February, 1979 maintenance outage fiber optics were used near the Number 4 wedge area of the "B" steam generator to locate a dosimeter and a chisel which had been dropped during the J-tube modifications.

Q. Would this fiber optics equipment have discovered the presence of the foreign objects?

A. The presence of the foreign objects was discovered after the January 25, 1982 tube burst using fiber optics. However, even before using the fiber optics equipment to look for loose parts, it could have been used to scan the damaged tubes along the periphery of the "B" steam generator. Given that by December, 1979, plugged tubes near the Number 4 wedge area had already caused subsequent damage to adjacent tubes, it is probable that the fiber optics would have shown broken tubes and other damage. Having seen this damage, the equipment could have been used to scan neighboring tubes, such as tube R42 C55, the tube which ultimately burst on January 25, 1982, or to search for loose parts. Repairs could also have been performed.

Q. Were such examinations conducted by other utilities?

A. Yes. The series of Nuclear Safety articles submitted as Exhibit DAS-1 (62) indicates that by 1977 a number of utilities had used fiber optics to inspect their steam generator tubes. (Exhibit DAS-1 (62), Page 25 of 48)

More specifically, a meeting summary prepared by the Staff of the U.S. Nuclear Regulatory Commission, dated February 2, 1977, indicates that Southern California

Edison Company inspected the tubes of several steam generators using a combined "fiberscope/TV camera. A copy of this meeting summary to attached as Exhibit DAS-9 (____)

Q. What would have been the cost of this "inspection"?

A. RG&E's response to CPB Interrogatory 13a, attached as Exhibit DAS-10 (____) indicates that the fiber optics inspections following the January 25, 1982 consumed 52 hours. Similarly, the Company's response to CPB Interrogatory 11 attached as Exhibit DAS-11 (____), indicates that only one shift was required for both the discovery of the chisel and dosimeter using fiber optics and the removal of these articles from the "B" steam generator.

Q. You mentioned earlier that there were "several" actions the Company might have taken in May, 1981, in addition to plugging tube R43 C53.

A. Yes. In addition to conducting a fiber optics examination of the damaged area, the Company could have:

1. Built and used a remote controlled TV inspection system as it later did following the January 25, 1982 tube burst. As was demonstrated conclusively earlier in this proceeding, the technology needed to conduct

such an inspection was available prior to January, 1982. In fact, similar technology had been used to inspect tubes at the Bugey Plant in France as early as 1979. (Exhibit 107)

2. Determine the width, shape and orientation of the OD indication on tube R43 C53. As the Company stated in its response to CPB Interrogatory 166:

> Actions taken by the Company in 1981 are fully described in its prefiled testimony. Those actions were sufficient to determine the existence of defects in the subject tubes and were totally consistent with NRC and industry standards in 1981. Nevertheless, it is possible to determine additional information, including width, shape, and orientation, using probes equipment with so-called "pancake" coils. Such probes were not used because it is not customary to undertake the expense, delay, and exposure related to their use unless the signal received from the standard bobbin coils is ambiguous; the signals in question were not ambiguous.

Q. Do you wish to offer any comments on the prefiled testimonies of Mr. Hutton and Mr. Denton?

A. Yes. First, the testimonies are confusing as to whether the lengths of the OD indications on tubes R43 C54 and R43 C57 in 1979 and tube R43 C53 in 1981 were determined in 1979 and 1981 respectively. However, it is clear from the Company's responses to CPB Interrogatory 165 that the

lengths of these OD indications were only determined after the January 25, 1982 tube burst:

> As already explained in the prefiled testimony of Clyde J. Denton at CJD-9, the length of the indication on tube R43.C53 was not specifically calculated in 1981. The same was true of the 1979 examinations of tubes R43 C57 and R43 C54.

Second, both men portray the indication on tube R43 C53 as nothing unusual. (CJD-8 and JCH-10) It must be emphasized that the tubes they relied upon for reference were also peripheral tubes. Thus, the indication on tube R43 C53 was not "unusual" only because other peripheral tubes have had similar indications. However, and quite obviously, it was the sum of the peripheral damage that was unusual and inconsistent with the Company's prior experience and that of other utilities. That is the reason that an inspection should have been performed by no later than May of 1981.

Q. Does this complete your testimony?

A. Yes.