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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
THE CLEVELAND ELECTRIC ILLUMINATING COMPANY, ET AL.	)	Docket Nos. 50-440
	)	50-441
(Perry Nuclear Power Plant, Units 1 and 2)	)	

APPLICANTS' ANSWERS TO OHIO CITIZENS FOR RESPONSIBLE ENERGY INTERROGATORIES 9-1 THROUGH 9-25 AND 9-38 THROUGH 9-52 RELATING TO ISSUE NOS. 13 AND 15

Applicants for their answers to Ohio Citizens for Responsible Energy ("OCRE") Interrogatories #9-1 through #9-25 and #9-38 through #9-52 from OCRE's Ninth Set of Interrogatories to Applicants, dated January 31, 1983, state as follows:

All documents supplied to OCRE for inspection will be produced either at Perry Nuclear Power Plant ("PNPP"), for documents in the possession of The Cleveland Electric Illuminating Company ("CEI"), or at the offices of Gilbert

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Associates, Inc. in Reading, Pa., for documents in the possession of Gilbert Associates. Arrangements to examine the documents at PNPP can be made by contacting Mr. Alan Jones of CEI at (216) 259-3737, extension 5276. Arrangements to examine the documents at Gilbert Associates can be made by contacting Mr. M. M. Waselus at (215) 775-2600, extension 2148. Applicants, at Applicants' cost of duplication, will provide copies of any of the produced documents or portions thereof which OCRE requests. Arrangements for obtaining copies can be made with Mr. Jones and Mr. Waselus.

RESPONSES

Issue No. 13

9-1. Identify and produce all documents in the possession of Applicants or any of their agents, including A/E Gilbert Associates and NSSS and turbine supplier General Electric, pertaining to turbine missile hazards, including but not limited to those documents listed as references in GAI Report No. 1848, "An Analysis of Low Trajectory Turbine Missile Hazards, Perry Nuclear Power Plant, Units 1 and 2," October 1976 ("Gilbert Report").

Response:

Documents relating to turbine missile hazards available at PNPP include the following:

1. Gilbert Associates, Inc. Report No. 1848, "An Analysis of Low Trajectory Turbine Missile Hazard to the Perry Nuclear Power Plant, Units 1 & 2" (October 8, 1976) ("Gilbert Report").

2. Gilbert Associates, Inc. Report No. 1848, "An Analysis of Low Trajectory Turbine Missile Hazard to the Perry Nuclear Power Plant, Units 1 & 2," Rev. 1 (September 1982) ("revised Gilbert Report").

3. EPRI Seminar on Turbine Missile Effects in Nuclear Power Plants, Palo Alto, California (October 25-26, 1982).

4. General Electric Large Steam Turbine-Generator Division Nuclear Wheel Seminar, Albany, New York (May 5-6, 1982).

5. General Electric Large Steam Turbine-Generator Division, Nuclear Wheel Seminar II, Chicago (August 23-24, 1982).

6. Regulatory Guide 1.115, "Protection Against Low-Trajectory Turbine Missiles," Rev. 1 (July 1977).

7. GEZ 4982, "General Electric Large Steam Turbine-Generator Quality Assurance Program."

8. D. C. Gonyea, GE Report DF73LS12, "An Analysis of the Energy of Hypothetical Wheel Missiles Escaping From Turbine Casings" (February 1973).

9. "Reactor Walls Withstand Turbine 'Missile' Impact," Mechanical Engineering (June 1980), p. 58.

10. "Turbine Missile Casing Exit Tests," EPRI Journal (September 1978), p. 42.

11. GEK-72281, "Steam Purity - Stress Corrosion Cracking" (August 1979).

Documents relating to turbine missile hazards available at the Gilbert Associates offices include the references listed in the Gilbert Report1/ as well as the additional references listed in the revised Gilbert Report. The following documents are also available at Gilbert Associates:

1. ASCE manual of standard practice for design of nuclear power facilities, ch. 6.

2. A. L. Florence and G. R. Abrahamson, Hard missile impact, Stanford Research Institute, Paulter Laboratory (June 1975).

3. Methods for determining the probability of a turbine missile hitting a particular plant.

4. General Atomic disc catcher design for the gas turbine high temp. gas cooled reactor.

Documents in the possession of the General Electric Turbine Division ("GE") are not "in the possession of Applicants or any of their agents," since GE has no contractual obligation to make such documents available to Applicants.

9-2. Identify all documents Applicants intend to present as evidence or use in cross-examination of Intervenor and/or NRC Staff witnesses on Issue #13. Produce any such documents not identified in the response to the previous interrogatory.

1/ Ref. 4, the GE Memo Report dated December 1, 1973, is no longer available.

Response:

Applicants do not yet know which documents they will present as evidence or use in cross-examination on Issue No. 13.

9-3. Identify all persons Applicants intend to call as witnesses on Issue #13.

(a) For each person so identified, state the person's address, title, employer, and educational and professional qualifications.

(b) State the subject matter, including the substance of facts and opinions, on which each such person is expected to testify. Identify and produce any documents to be relied upon by each such person in his/her testimony.

Response:

Applicants do not yet know which persons they will call as witnesses on Issue No. 13 or the subject matter of testimony on this issue.

9-4. Have Applicants or any of their agents prepared any revisions, addenda, supplements, or updates to the Gilbert Report since October 1976? If so, produce same.

Response:

The Gilbert Report was revised and reissued to CEI as Report No. 1848, Rev. 1 (September 19[illegible]). The revised Gilbert Report is available for examination at PNPP.

9-5. Have there been any changes to any assumptions, data, or dimensions (e.g., design changes or differences between the design and as-built conditions) used in the Gilbert Report? If so, identify each such change and the portion of the Gilbert Report thus affected.

Response:

The revised Gilbert Report includes changes in the penetration formula to be consistent with currently accepted NRC methodology, as provided in NUREG-0800. Cf., e.g., § 3.4.2 of the Gilbert Report and § 3.4.2 of the revised Gilbert Report. In addition, multiple strike probabilities have not been included. See § 3.4.5 of the Gilbert Report. Such probabilities are not required by NUREG-0800.

9-6. Have Applicants or any of their agents at any time considered any differing designs of the Perry facility with regard to arrangement of turbine-generators and the containment, control complex, and auxiliary building? If so, produce all such designs, and explain why they were not utilized. Were any such designs contemplated specifically to reduce the hazard of turbine missiles?

Response:

Gilbert Associates has five conceptual layout sketches in its files which were completed around 1974 in order to help Applicants evaluate the feasibility of locating four units at PNPP. Two of these sketches depict the present plant orientation while the remaining three sketches are illustrated with radial turbine buildings. In producing these conceptual sketches for a four unit site, the turbine missile hazard was a

consideration. The sketches were not utilized because Applicants decided not to expand PNPP beyond two units. The conceptual layout sketches are available for examination at the Gilbert Associates offices.

9-7. Have Applicants incorporated or considered any structures, equipment, or components (e.g., barriers or shielding of safety-related targets) to lessen the risk of turbine missile damage to the Perry facility? If so, produce any such plans or designs and indicate which have been or will be incorporated into the Perry facility; for those designs not so utilized, explain why.

Response:

PNPP structures which lessen the risk of turbine missile damage are identified in Table 2-2 of the revised Gilbert Report and discussed on p. 6-7 of that report.

9-8. List every reason why Applicants consider the risk of turbine missile damage at the Perry facility acceptable.

(a) What do Applicants consider to be an acceptable risk with regard to turbine missile hazards? Provide the basis, including any experimental data, for this opinion.

(b) For every reason identified above as to why Applicants consider the risk of turbine missile damage acceptable, provide any bases, including any experimental data, supporting this view.

(c) To what extent are these opinions based on engineering judgement [sic]?

Response:

(a) and (b) The revised Gilbert Report, like the original Gilbert Report, is a detailed analysis of the risk of turbine missile damage. The results of the analysis indicate that the risk of component damage is between 10E-7 and 10E-6 per reactor year. This probability is acceptable according to NUREG-0800 because conservative assumptions have been used for turbine failure frequency, and because radioactive releases are conservatively assumed to occur following component damage. The final assessment of the acceptability of the risk is to be made by the NRC, based on a review of Applicants' analysis.

(c) The revised Gilbert Report follows the criteria stated in NUREG-0800, Standard Review Plan 2.2.3.

9-9. (a) Have the turbine-generators, overspeed control systems, and turbine stop and control valves (or any other associated systems or components) been subject to any tests or inspections, either by vendors or Applicants or their agents?

(b) If so, describe any such tests or inspections.

(c) If not, indicate when such tests or inspections will be performed. If no tests or inspections are planned, explain why not.

(d) Have any tests or inspections as described above revealed any flaws, defects, deficiencies, non-conformances, or other anomalies in any system, equipment, or component identified in subpart (a) above? Describe any such anomalies in detail.

(e) For each such flaw, defect, deficiency, nonconformance, or anomaly described above, state when and how the deficiency will be resolved, and describe the technical bases for the resolution chosen.

Response:

(a) Yes.

(b) See GEZ 4982, "General Electric Large Steam Turbine-Generator Quality Assurance Program," which is available for examination at PNPP.

(c) Not applicable.

(d) None of the tests described in GEZ 4982 revealed any flaws, defects, deficiencies, nonconformances or anomalies unacceptable according to GEZ 4982.

(e) Not applicable.

9-10. Have any of the equipment or components listed in Interrogatory 9-9(a) above been previously operated or used (other than in testing) in any other application or facility? If so, provide the complete operational history of any such component and explain why a new unit was not utilized instead.

Response:

All the equipment furnished for PNPP is new.

9-11. Have the turbine-generators of the size and type to be utilized at PNPP been used in any other application (both nuclear and fossil fuel, and test/prototype applications)?

(a) If so, state the name, location, and type of facility where such a turbine-generator is (or was) in use.

(b) Give the complete operational history of each turbine-generator at each application identified above, including date of initial operation, number of turbine-years in operation, and any failures, incidents, or accidents involving the turbine-generators.

(c) Provide a complete description of any turbine failures identified above, including causes identified, corrective actions taken, and the consequences of any turbine failures; i.e., were missiles produced, and, if so, describe the number and size distribution and the degree of damage they caused and range of missile trajectory.

Response:

Turbine-generators of the size and type to be utilized at PNPP have been in service at other nuclear power stations.

(a) The following is a list of other nuclear power stations where a six flow 43" LSB (Last Stage Bucket) nuclear turbine-generator manufactured by General Electric is being operated:

NAME	LOCATION	TYPE OF FACILITY	INITIAL OP2/	TURBINE YEARS
Browns Ferry 1	Alabama	Nuclear	10/73	10
Browns Ferry 2	Alabama	"	8/74	9
Browns Ferry 3	Alabama	"	9/76	7
Peach Bottom 2	Pennsylvania	"	2/74	9
Peach Bottom 3	Pennsylvania	"	8/74	9
Donald C. Cook 1	Michigan	"	2/75	8

(b) Applicants do not know of any General Electric nuclear turbine malfunction which has led to an external missile incident. Applicants do not have any information about the operational histories of the turbine-generators at the facilities identified in (a) above other than the information given there.

2/ Based on US Central Station Nuclear Electric Generating Units: Significant Milestones, U.S. Dept. of Energy (December 1982).

(c) As indicated in response to (b) above, Applicants are aware of no General Electric nuclear turbine which has produced any external missiles.

9-12. Provide an estimate of the cost required to change the orientation and placement of the Perry turbine-generators from the tangential arrangement presently incorporated to a radial arrangement (with respect to the containment and other safety-related targets). Provide the bases for this cost estimate.

Response:

Applicants have undertaken no study to estimate the cost required to change the orientation and placement of the Perry turbine-generators to a radial arrangement. Such a change would clearly be so costly as to be totally impractical.

9-13. Do Applicants in their defense on Issue #13 intend to take credit for:

(a) quality standards used in the manufacture of turbine discs or other components the failure of which could produce turbine missiles;

(b) inservice inspection and maintenance programs for turbine discs and other components the failure of which could produce turbine missiles;

(c) turbine overspeed protection systems?

(d) If the answer to any of the above is affirmative, state the exact nature of the defense to be used and provide the applicable quality standards, in-service inspection programs, etc.

Response:

Applicants do not yet know what their defenses will be on Issue No. 13.

9-14. The Gilbert Report only considers the low-pressure stage turbines as missile sources. Why has the high-pressure stage not been considered? Provide all bases for the answer.

Response:

Nuclear turbine high-pressure section rotors operate within heavy, cast-steel shells. There is insufficient energy from an HP rotor missile to penetrate the high pressure shell, and any fragment would be contained. Further, the relatively low stresses in a high-pressure nuclear turbine section make its failure unlikely at any speed.

9-15. Table 2-2 of the Gilbert Report presents "allowable impact momenta on final barriers." Define the term "allowable" as used in that table. I.e., does "allowable" mean the missile does not penetrate the barrier, or that the missile does not cause spallation?

Response:

"Allowable impact momentum" is the maximum impact momentum the barrier will withstand without structural collapse or gross deformation. Missile perforation and spallation are considered independently. If the final barrier fails any of the three tests (perforation, spallation, allowable impact momentum), the target is assumed to be damaged.

9-16. It is stated at p. 9 of the Gilbert Report that GE data on turbine missiles is "reportedly" based on experimental disc-bursting studies performed by the turbine manufacturer. Produce this experimental data and describe the methodology used in the studies.

Response:

The GE methodology used in the missile studies is contained in ref. 2 of the Gilbert Report.3/ The experimental data is contained in ASME 57-A-2495, "Application of the Griffith-Irving Theory of Crack Propagation to the Bursting Behavior of Disks, Including Analytical and Experimental Studies," by D.H. Winne and B.N. Wundt (1957).

9-17. Provide detailed drawings of the turbine low-pressure stages, showing and identifying the turbine discs and "wheel groups" of Table 2-4 of the Gilbert Report.

Response:

A cross section of a low pressure turbine is shown in Attachment 1. The rotor is symmetrical about the vertical centerline. Wheels 1, 2 and 3 make up the first wheel group; and wheels 4, 5 and 6 make up the second group. The seventh wheel by itself is identified as the third group.

3/ D.C. Gonyea, GE Report DF73LS12, "An Analysis of the Energy of Hypothetical Wheel Missiles Escaping From Turbine Casings" (February 1973). This report is available for examination at PNPP.

9-18. It is stated at p. 25 of the Gilbert Report that D fragments are excluded from analysis because they are assumed to be of minimal threat to the plant. Provide the basis of that assumption. What effect would the inclusion of the D fragments in the analysis have on the final probability calculation?

Response:

The "D" fragments are small, secondary missiles from casing perforation, disc rings, etc. These fragments have a low damage potential because of their small size. This fact is illustrated in the P3 single impact damage probabilities, which are all zero for D fragments. Therefore, inclusion of D fragments would have a negligible effect on the multistrike analysis.

9-19. It is stated at p. 25 of the Gilbert Report that all missiles are assumed to be generated with equal independent probabilities in all directions. Provide the basis of this assumption.

Response:

In the plane of rotation of a turbine disk, if a missile is generated, its position when generated is a random event. Hence, if a missile is generated, it will have an equal independent probability of generation in all directions.

9-20. (a) Does the direction of turbine rotation have any bearing on missile trajectory? Explain the bases of the answer.

(b) What is the direction of rotation (e.g., clockwise or counter-clockwise from the perspective of an

observer stationed between the two cooling towers facing plant west) of the Unit 1 turbines? Of Unit 2?

<u>Response</u>:

(a) Yes, hypothetical missiles will exit tangential to the direction of rotation.

(b) Turbine rotation is counterclockwise for both units.

9-21. It is stated at p. 23 of the Gilbert Report that a uniform velocity distribution is assumed for each fragment, reflecting the uncertainty in velocity data in previous turbine failures. Provide the basis for this assumption and demonstrate its conservatism.

<u>Response</u>:

The actual velocity distribution will be a decreasing function [illegible] the maximum value to zero. A uniform velocity distribution is conservative because this assumption will include more high speed missiles in the sample.

9-22. It is stated at p. 32 of the Gilbert Report that in evaluating all targets, triple impact P3 values were assumed to be equal to control room values given in Table 3-5 because of the relatively small effect on P4, with the exception of containment vessel targets. State the basis of this assumption and demonstrate its conservatism.

<u>Response</u>:

On a relative basis, the control room target is one of the most vulnerable structures in the complex, as can be seen from the P3 values. Therefore, the use of this P3 value for less vulnerable structures conservatively overestimates the damage probability.

9-23. Section 10.2.1 of NUREG-0887, the Perry SER, states that the Staff's final acceptance of the inservice inspection plan for disc bores and keyways as recommended by the turbine manufacturer is contingent on a documented commitment by Applicants. When will Applicants submit this documentation? Produce any draft or final inservice inspection plans for disc bores and keyways.

Response:

The inservice inspection plans for disk bores and keyways will be submitted within three years from initiation of power output. See NRC Staff Answers to OCRE Ninth Set of Interrogatories to NRC Staff, dated March 1, 1983, Answer to Interrogatory No. 9-2. No draft plans are available. Inspections will be carried out in accordance with GE TIL 857, "Inservice Inspection of 1500 & 1800 Nuclear Turbine Rotors" (February 18, 1978), which is available for examination at PNPP.

9-24. For what steam environment (temperature, pressure, pH, purity, etc.) is the turbine designed? What assurance is there that the design steam environment will be maintained?

Response:

The turbine is designed for a normal pressure of 965 psia, a normal temperature of 422° F, and 0.6% moisture. The pH of the turbine steam environment is determined by the water quality requirements for the Nuclear Boiler as set forth in the Tech Specs. Manufacturer recommendations for steam purity are outlined in GEK-72281, a copy of which is available for

examination at PNPP. Assurance is provided that the design steam environment will be maintained by continuous monitoring of the turbine for compliance with design conditions.

9-25. Section 10.2 of NUREG-0887, the Perry SER, states that Applicants' inservice inspection program for turbine steam valves requires the exercising of the main steam stop and control, reheat stop, and intercept valves at least once a week.

(a) How many such valves are present on each turbine to be used at PNPP?

(b) Does the exercising of any of these valves affect the power output of the generator? By what amount?

(c) Is it not true that any load reductions necessary for valve exercising will create a disincentive for such inspections? If not, why not?

(d) What assurance is there that the inspection schedule will be adhered to?

Response:

(a) There are four stop valves and four control valves on the high pressure turbine section. There are six reheat stop valves and six intercept valves on the low pressure turbine sections.

(b) The weekly valve exercising will be done at approximately 90-95% power. The exact power rating will be determined during startup testing. The exercising will take, at most, 1/2 hr. to 1 hr.

(c) No, it is not true that the load reduction necessary for valve exercising will create a disincentive for

inspections. The results of a stuck valve could be very costly in terms of unit downtime and repairs. Thus, valve testing is a necessary precaution. Further, valve exercising will be carried out at a time when load demand is relatively low, such as at night.

(d) The exercising requirements will be entered into the Perry Plant Maintenance Information System. Valve exercising will be scheduled along with all the FSAR, technical specification, and ASME code commitments.

Issue No. 15

9-38. Identify and produce all documents in the possession of Applicants or any of their agents pertaining to steam erosion and measures that may be taken to prevent, detect, assess, or mitigate the effects of same.

Response:

Documents relating to steam erosion available at PNPP include the following:

1. Significant Operating Experience Report 82-11, "Erosion of Steam Piping and Resulting Failure" (November 17, 1982).

2. G. Bignold, K. Garbett, R. Garnsey and I. Woolsey, "Tackling Erosion-Corrosion in Nuclear Steam Generating Plants," Nuclear Engineering International (June 1981).

3. IE Information Notice No. 82-22, "Failure in Exhaust Lines" (July 9, 1982).

4. IE Information Notice No. 82-23, "Main Steam Isolation Valve Leakage" (July 16, 1982).

5. EEI Nuclear Power Operations Committee Plant Status Report - Oconee Units 1, 2 and 3 (October 7, 1982), p. 3.

6. David Vitale, "Erosion Tasks of Steam Turbine Blade Material," Power Engineering (January 1982).

7. EPRI NP-2711, Project S145-1, Final Report, Prevention of Wear Problems in PWR Steam Generators - An Annotated Bibliography (October 1982).

8. A. Gany, L. Caveny and J. Johnson, "Water Vapor Contribution to the Erosion of Steel by High Temperature Flows," 103 Journal of Heat Transfer (May 1981).

9. N. Gat and W. Tabakoff, "Effects of Temperature on the Behavior of Metals Under Erosion by Particulate Matter," 8 Journal of Testing and Evaluation (July 1980), p. 177-186.

Documents relating to steam erosion at the Gilbert Associates offices include the following:

1. TVA Mechanical Design Guide DG-M4.1, Corrosion/Erosion Allowance for Determination of Minimum Pipe Wall Thickness in Carbon Steel Piping Systems.

2. Helmut Thielsch, Defects and Failures in Pressure Vessels and Piping (Robert S. Krieger Publishing Company).

9-39. Identify all documents Applicants intend to present as evidence or use in cross-examination of Intervenor and/or NRC Staff witnesses on Issue #15. Produce any such documents not identified in the response to the previous interrogatory.

Response:

Applicants do not yet know which documents they will present as evidence or use in cross-examination on Issue No. 15.

9-40. Identify all persons Applicants intend to call as witnesses on Issue #15.

(a) For each person so identified, state the person's address, title, employer, and educational and professional qualifications.

(b) State the subject matter, including the substance of facts and opinions, on which each such person is expected to testify. Identify and produce any documents to be relied upon by each such person in his/her testimony.

Response:

Applicants do not yet know which persons they will call as witnesses on Issue No. 15 or the subject matter of testimony on this issue.

9-41. List every component, system, item of equipment, etc. at PNPP which is subject to steam flow. For each item identified, give the applicable ASME classification.

Response:

The following systems are subject to single and/or two phase4/ steam flow:

System Designation	System	Process and Instrument Diagram	FSAR
B21	Nuclear Boiler	D-302/352-605/8	Figure 5.1-3, Sheets 1,2,3
C85	Steam Bypass	D-302/352-021	Figure 10.1-1, Sheets 4,8
E51	Reactor Core Isolation Cooling	D-302/352-631/2	§§ 5.4.6, 7.4.1.1
N11	Main Steam	D-302/352-011/14	Figure 10.1-1, Sheets 1,2,3,4,5
N22	Main, Reheat, Extraction and Miscellaneous Drains	D-302/352-121/6	Figure 5.1-3, Sheet 6
N25	High Pressure Heater Drains and Vents	D-302/352-111/5	Figure 10.1-8, Sheets 1,2,3,4, 5,6,7,8
N26	Low Pressure Heater Drains and Vents	D-302/352-113	Figure 10.1-9, Sheets 1,2

4/ Two phase flow represents a mixture of vapor and liquid. See "Section 4 - Thermal Properties of Substances and Thermodynamics," Standard Handbook for Mechanical Engineers, ed. T. Baumeister and L. Marks (New York: McGraw Hill, 1967), 7th ed., p. 4-30 and following.

System Designation	System	Process and Instrument Diagram	FSAR
N36	Extraction Steam	D-302/352-041	Figure 10.1-2, Sheets 1,2

The items of equipment and components of these systems are shown on the Process and Instrument Diagrams ("P&IDs"), which are found in the PNPP FSAR as indicated above. The ASME classifications are also found on the P&IDs.

9-42. For each item identified above, state whether Applicants believe it is vulnerable to damage from steam erosion, and provide the bases for the answer.

Response:

Only the equipment and components which are in direct contact with the process fluid are subject to steam erosion. These items can be identified by examining the P&IDs. See response to Interrogatory #9-41, *supra*.

9-43. For each item identified above, produce Applicants' inservice inspection program.

Response:

An inservice inspection program to address the effects of steam erosion in extraction steam (N36) piping is under development. See response to Interrogatory #9-44, *infra*. The purposes of the program are to increase plant availability and reliability, and to increase operating personnel safety.

The inservice inspection program for extraction steam piping will be consistent with the following principles. Radiographic or ultrasonic test techniques will be used to determine actual wall thickness of the piping. These numbers will be compared to the minimum wall requirements shown in Attachment 3 to determine if repair or replacement is required. All repairs will be done according to ANSI/ASME B31-1.

9-44. Describe in detail any plans, provisions, designs, criteria, standards, etc. which Applicants may have for preventing steam erosion and the effects thereof.

Response:

Modifications were made in the Extraction Steam System (N36), High Pressure (N25) and Low Pressure (N26) Heater Drains and Vents Systems, and Main, Reheat, Extraction and Miscellaneous Drain System (N22) beginning in 1976. These modifications were made primarily to enhance system operational reliability.

(a) N25/N26 - High Pressure and Low Pressure Heater Drains and Vents. Level will be controlled in the high pressure and low pressure heaters by means of a level control switch which will open a control valve in either a normal or alternate flow path. Downstream of this control valve, severe erosion can occur. This problem has been identified throughout the industry. To minimize the effects of erosion, a criterion

was established that no directional changes in piping would be acceptable between the valve and heater/condenser.

Because of physical limitations, this criterion could not always be followed. Where directional changes occur, 90° elbows were replaced with tee's and target plates with telltales added. See Attachment 2 for details. The stainless steel target plate will act as a wear plate and can be readily removed if necessary. This design has been used very successfully at CEI's fossil fuel plants and has minimized erosion problems in heater drain lines.

(b) N22 - Main, Reheat, Extraction and Miscellaneous Drain System. The erosion problems associated with this system are identical to those discussed in (a) above. That is, erosion may occur downstream of the drain control valve. Because this piping is mostly small bore (two inches or less), Applicants decided not to use the solution described in (a) above. Instead, it was decided to change the material downstream of the control valve to a more erosion-resistant material. The material specified was A335, grade P11 or P12, which contains 1-1 1/4% chromium - 1/2% molybdenum.

(c) N36 - Extraction Steam Piping. As explained in response to Interrogatory #9-48(c), *infra*, erosion can occur in steam piping whenever high steam velocity or low steam quality exists. A review of the extraction steam piping system was undertaken by Applicants in 1977. Potential erosion problems were identified in some of the extraction piping.

The piping for which potential problems were identified was replaced in Unit 2 with a more erosion-resistant material (A335, grade P11 or P12). Since it was not practical at that time to replace the Unit 1 extraction piping, it was decided to design an inservice inspection program to monitor piping elbow wall thickness in Unit 1 in order to enhance system reliability. See response to Interrogatory #9-43, supra.

In addition to the above changes, the seating surfaces of the MSIVs have been covered with more erosion-resistant materials.

9-45. Describe in detail any plans, provisions, programs, etc. which Applicants may have for detecting and assessing steam erosion or the effects thereof.

Response:

Plans for detecting and assessing steam erosion in Unit 1 extraction steam piping are described in response to Interrogatory #9-43, supra. Plans for "Type C" leak testing of the MSIVs are described in response to Interrogatory #9-46, infra. In addit- , Applicants will have an inservice testing program for all valves as required by ASME Section XI. This program is still being developed.

9-46. Describe in detail any plans, provisions, procedures, etc. which Applicants may have for mitigating steam erosion or the effects thereof. Include any procedures for the repair or replacement of any affected components.

Response:

As stated in response to Interrogatory #9-43, supra, repair or replacement of Unit 1 extraction steam piping will be carried out as necessary to comply with the minimum wall thicknesses set forth in Attachment 3. Note also that the erosion allowances shown in Attachment 3 exceed the corresponding minimum wall thicknesses from 50% to 400%. The inspection program together with the conservatism in the erosion allowances will minimize steam erosion problems in the extraction steam piping.

The PNPP main steam isolation valve ("MSIV") leakage control system also will mitigate the effects of steam erosion. See FSAR § 6.7. This system is used to reduce the amount of radioactive material released to the environment. To accomplish this, MSIV leakage is directed into the shield building annulus, which is serviced by the annulus exhaust gas treatment system. The MSIV leakage control system is designed to process 100 scfh total leakage per main steam line.

Main steam line leakage results from leakage past the MSIVs. Each line consists of an inboard isolation valve (B21F022), an outboard isolation valve (B21F028), and a long term leakage control valve (N11F020).

To control valve leakage and to insure that the total main steam line leakage does not exceed the capacity of the MSIV leakage control system, the inboard MSIV and outboard MSIV will

be "Type C" leak tested according to the requirements of Appendix J to 10 C.F.R., Part 50. Leakage will not exceed 25 scfh per valve. <u>See</u> FSAR Table 6.2-40, n.4. In addition, PNPP's Tech Specs will require that the leakage rate per valve be restored to less than 25 scfh prior to increasing reactor coolant system temperature above 200° F. In the event these valves become a maintenance problem with regard to leakage, appropriate action (repair or replacement) will be taken.

To insure that the system capacity (100 scfh per line) is not exceeded, conservatism has been built into the MSIV leakage rate (25 scfh). Additional reliability is built into design due to the fact that leakage must pass through these isolation valves in series. Further, no credit has been taken in this analysis for the long term leakage control valve.

9-47. What is the vendor/manufacturer of the MSIV's to be used at PNPP?

<u>Response</u>:

Valve	Manufacturer
B21F022A,B,C,D	Atwood and Morill Co.
B21F028A,B,C,D	Atwood and Morill Co.
N11F020A,B,C,D	Borg-Warner

9-48. It is stated in IE Information Notice 82-22 that the Oconee licensee (Duke Power Co.) theorized that reduced power operation and resultant lower quality steam contributed to accelerated steam erosion.

(a) Define the term "steam quality."

(b) Explain how steam quality is related to level of power operation.

(c) Explain how steam quality influences the degree of steam erosion.

(d) In the responses to the above subparts, include the bases of the answers.

Response:

(a) "Steam quality"5/ is the fraction of the mixture which is vapor, based on mass (or weight).

(b) Steam quality is related to power operation by pressure and temperature. As pressure and/or temperature increase, steam quality increases. As pressure and/or temperature decrease, steam quality decreases.

(c) The degree of steam erosion is inversely proportional to steam quality. Steam erosion occurs when high density water particles traveling along at steam velocity hit an obstacle directly within their flow path.

(d) The answers are based on Applicants' knowledge of thermodynamics, fluid flow, and piping design, as well as experience in the areas of startup, operations and design.

9-49. Do Applicants in their defense on Issue #15 intend to take credit for any other PNPP systems (e.g., MSIV leakage control system)? If so, identify each such system and state how it prevents or mitigates steam erosion or the effects thereof. Include the bases for your answer.

5/ Kenneth Wark, Thermodynamics (New York: McGraw-Hill, 1966), p. 66.

Response:

Applicants do not yet know what their defenses will be on Issue No. 15.

9-50. Do Applicants in their defense on Issue #15 intend to take credit for any inservice inspection programs? If so,

(a) identify each such inservice inspection program;

(b) state when it is to be submitted;

(c) identify any codes, standards, regulatory requirements or guides to which it complies;

(d) produce the inservice inspection program when available.

Response:

Applicants do not yet know what their defenses will be on Issue No. 15.

9-51. For each item identified in the response to Interrogatory 9-41 above, give the pressure and steam flow rate expected in normal operation and the maximum pressure and steam flow rate for which the item is rated.

Response:

Operating and maximum pressure and steam flow rates can be found on the P&IDs referenced in response to Interrogatory #9-41, supra.

9-52. For each interrogatory above, identify the person(s) responsible for the response and provide the professional qualifications for each such person. If any documents

were relied upon in responding which were not previously identified, identify and produce these documents.

Response:

The names and professional qualifications of the persons responsible for the answers to the above interrogatories are attached hereto as Attachments 4 and 5. All documents relied upon have been identified.

Respectfully submitted,

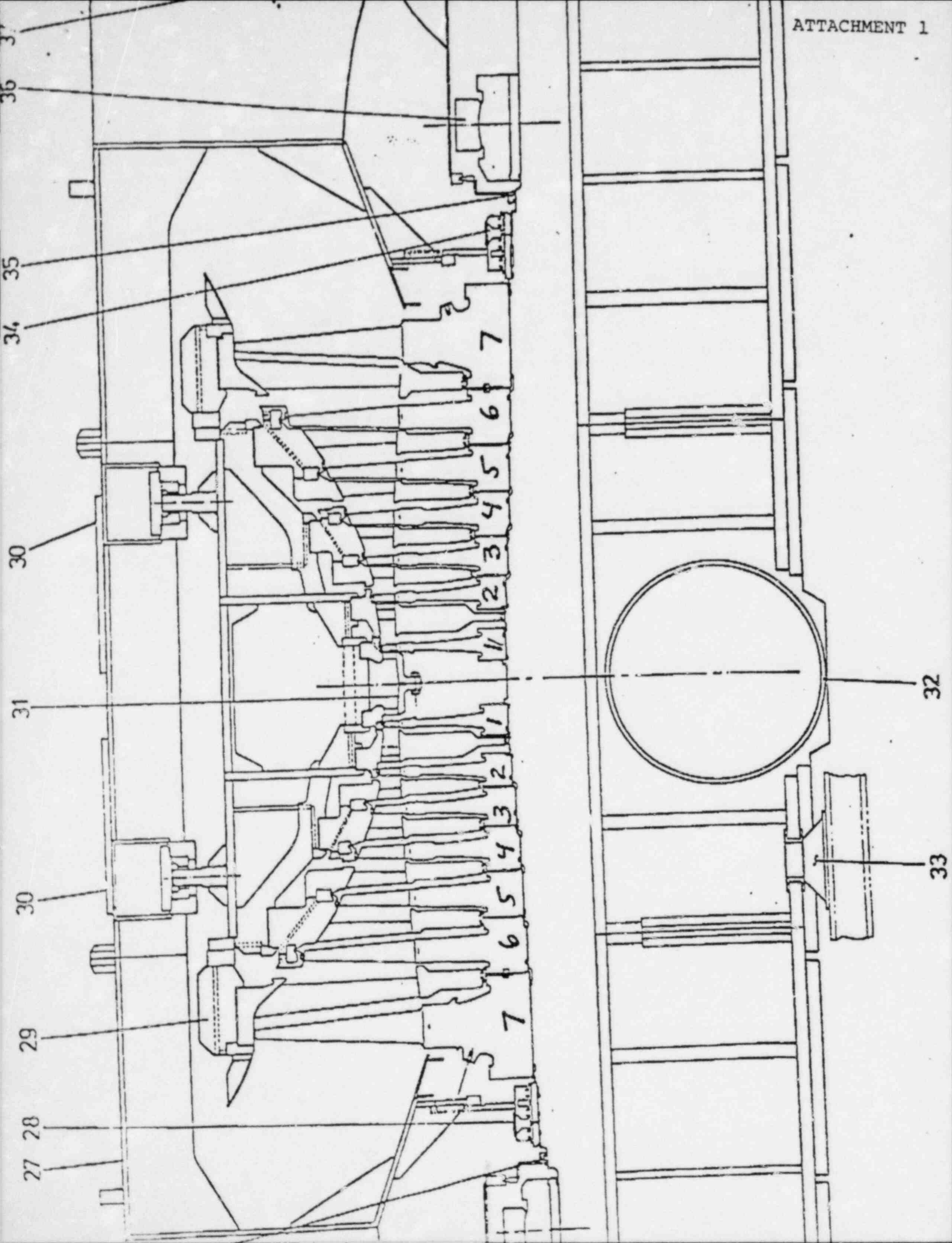
SHAW, PITTMAN, POTTS & TROWBRIDGE

By: Michael A. Swiger
Jay E. Silberg, P.C.
Michael A. Swiger

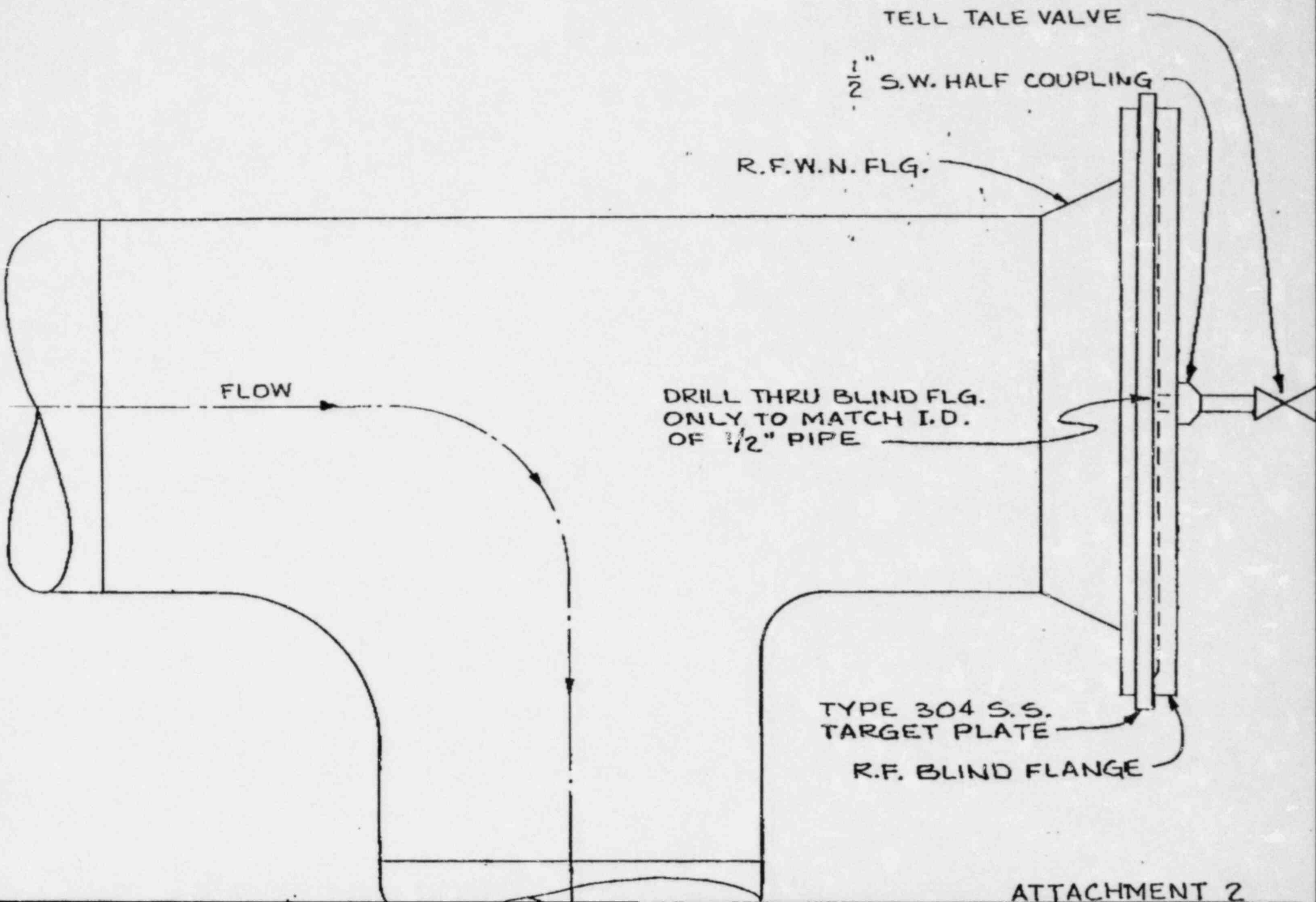
Counsel for Applicants
1800 M Street, N.W.
Washington, D.C. 20036
(202) 822-1000

Dated: March 8, 1983

ATTACHMENT 1



TARGET PLATE WITH TELL TALE VALVE



ATTACHMENT 2

ATTACHMENT 3

System & Diagram	Piping Description	Required Minimum Wall	Actual Wall	Erosion Allowance
N36 - Extraction Steam D-302-041	20" Gl-4 Line from Crossaround to 5th Stage Heater	0.133	0.593	0.460
	24" Ll-4 Extraction Line to 3rd Stage Heater	0.060	0.375	0.315
	36" Ll-4 Extraction Manifold to Heaters 3A and 3B	0.10	0.50	0.40
	14" Gl-4 HP Turbine Extraction	0.285	0.438	0.153
	20" Gl-4 Manifold HP Turbine Extraction 6A and 6B Heaters	0.261	0.593	0.332
	16" Gl-4 Extraction Line to 6th Stage Heater	0.208	0.500	0.292
	18" Gl-4 Manifold to 1st Stage Reheaters	0.366	0.562	0.196
	12" Gl-4 Extraction Line to 1st Stage Reheaters (1A/1B)	0.259	0.406	0.147
	10" Gl-4 Extraction Line to 1st Stage Reheaters (2A/2B)	0.219	0.365	0.146
	14" Ll-4 Common Line from LP Turbine	0.050	0.375	0.325
	24" Ll-4 Manifold Between LP Turbine & DG Heater	0.088	0.375	0.287
	18" Gl-4 Lines from Connection to Crossaround	0.120	0.562	0.442
	26" Gl- ? Common Line from Crossaround	0.164	0.801	0.637

ATTACHMENT 4

EDWARD J. TURK

Civilian Education:	Illinois Institute of Tech, BSEE, 1963 (Electronics) Cleveland State University, MBA, 1975 (Finance) General Electric BWR Plant Design & Fundamentals Course, San Jose, 1975 1981 National Electric Code
Military Education:	U. S. Naval Submarine School, 1963-1964 U. S. Naval Nuclear Power School, 1964-1965 U. S. Naval Nuclear A-1-W Reactor Prototype, 1965 SSBN 640 Inertial Navigator School, 1967

Civilian Experience:

1979-Present	Nuclear Engineering Department - Lead Balance of Plant Engineer administering procurement and installation specifications in support of installation engineering including cash flow and budget allocations. Equipment qualification experience gained by complying with IEEE 323-1974. Special Project - Reactor Vessel Safe-End replacement for Units 1 and 2. Senior Design Development Engineer - Preparing the Design Control Manual Procedures in compliance with ANSI N45.2.11, Quality Assurance Requirements for the Design of Nuclear Power Plants. Interfacing with Nuclear Licensing Section on the turbine missile issue.
1975-1979	Nuclear Test Section - Developed the Test Program Manual, Test Sequence Network and Manning Plans. Lead Balance of Plant Test Engineer - Developed Test Specifications, FSAR Chapter 14 and System Startup Scoping Packages in compliance with Regulatory Guide 1.68, Preoperational Test Program. Prepared Responsibility Guide and Qualification Sheet for Senior Engineer, Nuclear Startup.

1974-1975	Perry Plant Department - Taught BWR Plant Design & Fundamentals Course to Nuclear Engineering Department, 1975-1977.
	Duane Arnold Nuclear Plant - Outage Training - 10 weeks.
	Hatch Nuclear Plant - Operation Observation - 1 week.
Military Experience:	Submarine Qualified. Main Propulsion Assistant, USS George Bancroft (SSBN 643). Auxiliary Division Officer, USS George Bancroft (SSBN 643). Navigator/Operations Officer, USS George Bancroft (SSBN 643). Engineering Officer of the Watch, S-5-W, Reactor Plant.
Licenses:	Professional Engineer, Ohio, E-42506 Third Class Stationary Engineer, Ohio
Other:	American Nuclear Society, Local and National Past Local Program Chairman, 1978-1979 Executive Committee Member, 1977-1980

ATTACHMENT 5

RICHARD A. PENDER

Education:	Ohio State University - B.S. Mechanical Engineering - December, 1969. Cleveland State University - M.S. Mechanical Engineering - June, 1981 Registered Professional Engineer in the State of Ohio Member ASME.
Professional Experience:	Employed, Cleveland Electric Illuminating Company since graduation from OSU.
October, 1982 to Present:	Senior Engineer - Nuclear Design & Analysis Section, Nuclear Engineering Department. Presently supervising engineering section which is responsible for technical support of Perry Nuclear Power Plant licensing activities.
January, 1979 to October, 1982:	Engineer - Nuclear Design Section, Nuclear Engineering Department. Supervising engineering section responsible for the design of 2-1250 MW Nuclear Generating Plants, Perry 1 and 2, with a capital expenditure exceeding 2 billion dollars. Section responsibilities included: design, start-up support, construction support and equipment procurement. Promoted to Senior Engineer in October, 1982.
October, 1975 to January, 1979:	Associate Engineer/Engineer - Nuclear Design Section, Nuclear Engineering Department. Responsible for Turbine Cycle - Balance of Plant design for Perry Units. Included specification writing, knowledge of codes and equipment procurement. Promoted to Engineer in October, 1976.
April, 1974 to October, 1975:	Associate Engineer - Mechanical Design Section, Civil and Mechanical Engineering Department. Responsible for Piping design. Supervised drafting personnel.
January, 1970 to April, 1974:	Junior Engineer/Associate Engineer - Production Engineering Unit, Civil and Mechanical Engineering Department. Responsible for the testing of mechanical equipment. Included lead test engineer of ASME Turbine Acceptance Test of 650 MW, Super-critical Unit. Supervised Technicians. Promoted to Associate Engineer in July, 1972.

THE CLEVELAND ELECTRIC ILLUMINATING COMPANY

CLEVELAND, OHIO

Edward J. Turk, being duly sworn according to law, deposes that he is Senior Engineer, Nuclear Engineering, of The Cleveland Electric Illuminating Company, and that the facts set forth in the answers to Interrogatories 9-1 through 9-25 and 9-52 in the foregoing "Applicants' Answers to Ohio Citizens for Responsible Energy Interrogatories 9-1 through 9-25 and 9-38 through 9-52 relating to Issue Nos. 13 and 15," dated March 8, 1983, are true and correct to the best of his knowledge, information and belief.

Edward J. Turk

Sworn to and subscribed

before me this 8th day

of March, 1983

Joanne Kibinskas

JOANNE KIBINSKAS, Notary Public
State of Ohio - Lake County
My comm. exp. Nov. 12, 1983

THE CLEVELAND ELECTRIC ILLUMINATING COMPANY

CLEVELAND, OHIO

Richard A. Pender, being duly sworn according to law, deposes that he is Senior Engineer, Nuclear Engineering, of The Cleveland Electric Illuminating Company, and that the facts set forth in the answers to Interrogatories 9-38 through 9-52 in the foregoing "Applicants' Answers to Ohio Citizens for Responsible Energy Interrogatories 9-1 through 9-25 and 9-38 through 9-52 relating to Issue Nos. 13 and 15," dated March 8, 1983, are true and correct to the best of his knowledge, information and belief.

Richard A. Pender

Sworn to and subscribed before me this 8th day of March, 1983

Joanne Adomaitis

JOANNE ADOMAITIS, Notary Public
State of Ohio - Lake County
My comm. exp. Nov. 12, 1983

March 8, 1983

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
THE CLEVELAND ELECTRIC ILLUMINATING COMPANY, ET AL.	)	Docket Nos. 50-440
	)	50-441
(Perry Nuclear Power Plant, Units 1 and 2)	)	

CERTIFICATE OF SERVICE

This is to certify that copies of the foregoing "Applicants' Answers to Ohio Citizens for Responsible Energy Interrogatories 9-1 through 9-25 and 9-38 through 9-52 Relating to Issue Nos. 13 and 15" were served by deposit in the United States Mail, First Class, postage prepaid, this 8th day of March 1983, to all those on the attached Service List.

Michael A. Swiger

Michael A. Swiger

DATED: March 8, 1983

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
THE CLEVELAND ELECTRIC	)	
ILLUMINATING COMPANY, ET AL.	)	Docket Nos. 50-440
	)	50-441
(Perry Nuclear Power Plant,	)	
Units 1 and 2)	)	

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