Attachment A Contains PROPRIETARY Information
In Accordance With 10 CFR 2.790

Wisconsin Electric POWER COMPANY
231 W. MICHIGAN, P.O. BOX 2046, MILWAUKEE, WI 53201

March 19, 1980

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. D. G. Eisenhut, Acting Director
Division of Operating Reactors

Gentlemen:

DOCKET NO. 50-266
INFORMATION RELATED TO TURBINE DISCS
POINT BEACH NUCLEAR PLANT UNIT 1

In your letter dated February 25, 1980, you requested that we provide responses to a series of site specific and generic questions regarding the safety significance of keyway cracking observed in several low pressure turbine rotor discs, including Point Beach Nuclear Plant Unit 1. This information is provided in the enclosures to this letter. Your letter also referenced an earlier letter, dated December 27, 1979, that had requested other additional information. Our response to that request was provided with our letter dated January 30, 1980.

A portion of the site specific responses provided herewith contains information which is proprietary to the Westinghouse Electric Corporation. This information is contained in Appendix A and contains the responses to site specific question I.D. In conformance with the requirements of 10 CFR Section 2.790, as amended, of the Commission's regulations, we are enclosing herewith an application for withholding this proprietary material from public disclosure and an affidavit in support of that application. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission.

Correspondence with respect to the affidavit or application for withholding should reference AW-80-10 and should be addressed to Mr. R. Williamson, Manager, Customer Order Engineering, Westinghouse Electric Corporation, Steam Turbine Divisions Lester Branch, Box 9175, Philadelphia, PA. 19113.

Very truly yours,

Sol Burstein

Sol Burstein
Executive Vice President

PROP/EXCL TO:
PROP FILES
W ROSS BR
ENG BC (2)

CHANGE: LE
NRC PDR, NP
LPDR, NP
NSIC, NP

P

8003260 372

AW-80-10

March 14, 1980

Darrell G. Eisenhut
Division of Operating Reactors
Office of Nuclear Reactor Regulation
US Nuclear Regulatory Commission
Washington DC 20555

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

Subject: Point Beach #1 Docket #50-266
Information in Response to NRC Request for Information of February 25, 1980, Relative to Low Pressure Turbine Disc Integrity.

Reference: Appendix A letter from Sol Burnstein to Eisenhut, dated 3/17/80

Dear Mr. Eisenhut:

This application for withholding is submitted by Westinghouse Electric Corporation ("Westinghouse") pursuant to the provisions of paragraph (b)(1) of Section 2.790 of the Commission's regulations. Withholding from public disclosure is requested with respect to the subject information which is further identified in the affidavit accompanying this application.

The undersigned has reviewed the information sought to be withheld and is authorized to apply for its withholding on behalf of Westinghouse, STG-TOD.

The affidavit accompanying this application sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of Section 2.790 of the Commission's regulations.

Accordingly, it is respectfully requested that the subject information which is proprietary to Westinghouse and which is further identified in the affidavit be withheld from public disclosure in accordance with 10CFR Section 2.790 of the Commission's regulations.

Correspondence with respect to this application for withholding or the accompanying affidavit should be addressed to the undersigned.

Very truly yours,

Robert G. Williamson

R. Williamson, Manager
Customer Order Engineering
Westinghouse Electric Corporation

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA
COUNTY OF DELAWARE:

Before me, the undersigned authority, personally appeared Robert Williamson, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Corporation ("Westinghouse") and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

Robert B Williamson

Robert Williamson, Manager
Customer Order Engineering

Sworn to and subscribed before me this ...... day of .... 19....

Henry E. Squillace

HENRY E. SQUILLACE
Notary Public, Marple Twp., Delaware Co.
My Commission Expires Oct. 18, 1980

(1) I am Manager, Customer Order Engineering in the Steam Turbine Generator Technical Operations Division of Westinghouse Electric Corporation and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing, and am authorized to apply for its withholding on behalf of the Westinghouse Power Generation Divisions.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.790 of the Commission's regulations and in conjunction with the Westinghouse application for withholding accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse Power Generation Divisions in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.790 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

(g) It is not the property of Westinghouse, but must be treated as proprietary by Westinghouse according to agreements with the owner.

(h) Public disclosure of this information would allow unfair and untruthful judgments on the performance and reliability of Westinghouse equipment components and improper comparison with similar components made by competitors.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information which is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition in those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.790, it is to be received in confidence by the Commission.

(iv) The information is not available in public sources to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in Appendix A to letter from S. Burnstein to Eisenhut, dated March 17, 1980 concerning information in response to NRC request for information of February 25, 1980, relative to low pressure turbine disc integrity.

The information enables Westinghouse to:

(a) Develop test inputs and procedures to satisfactorily verify the design of Westinghouse supplied equipment.

(b) Assist its customers to obtain licenses.

Further, the information has substantial commerc.al value as follows.

(a) Westinghouse can sell the use of this information to customers.

(b) Westinghouse uses the information to verify the design of equipment which is sold to customers.

(c) Westinghouse can sell services based upon the experience gained and the test equipment and methods developed.

Public disclosure of this information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to design, manufacture, verify, and sell electrical equipment for commercial turbine-generators without commensurate expenses. Also, public disclosure of the information would enable others having the same or similar equipment to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the equipment described in part by the information is the result of many years of development by Westinghouse and the expenditure of a considerable sum of money.

This could only be duplicated by a competitor if he were to invest similar sums of money and provided he had the appropriate talent available and could somehow obtain the requisite experience.

Further the deponent sayeth not.

ADDITIONAL INFORMATION RELATED TO TURBINE DISCS
POINT BEACH NUCLEAR PLANT, UNIT 1

RESPONSES TO SITE SPECIFIC QUESTIONS

I. Provide the following information for each LP turbine:

A. Turbine type

RESPONSE:

This unit consists of one Tandem compound four flow, three casing, condensing, 1800 RPM turbine utilizing 40-inch last row blades in each low pressure element. The low pressure element is designated as a Building Block 80 (BB80).

B. Number of hours of operation for each LP turbine at time of last turbine inspection or, if not inspected, postulated to turbine inspection.

RESPONSE:

The Point Beach Nuclear Plant (PBNP) Unit 1 low pressure turbine rotor discs were inspected between October 22 and November 2, 1979. At the time of this inspection, the unit had compiled 63,928 turbine operating hours.

C. Number of turbine trips and overspeeds.

RESPONSE:

A listing of the turbine trips from power and the results of overspeed testing of PBNP Unit 1 are listed in Attachment 1 to this Enclosure.

D. For each disc:

1. type of material including material specifications
2. tensile properties data
3. tougnness properties data including Fracture Appearance Transition Temperature and upper energy and temperature
4. keyway temperature
5. calculated keyway crack size for turbine time specified in "B" above
6. critical crack size
7. ratio of calculated crack to critical crack size
8. crack growth rate
9. calculated bore and keyway stress at operating design overspeed

10. calculated K_{Ic} data
11. minimum yield strength specified for each disc.

RESPONSE:

The information requested for each disc may be found in the tables supplied as Appendix A (Proprietary) and Appendix B.

II. Provide details of the results of any completed inservice inspection of LP turbine rotors including areas examined, since issuance of an operating license. For each indication detected, provide details of the location of the crack, its orientation, and size.

RESPONSE:

The results of the Fall 1979 inservice inspection of the PBNP Unit 1 turbine rotor discs were reported to the NRC in Licensee's letter dated January 30, 1980.

III. Provide the nominal water chemistry conditions for each LP turbine and describe any condenser inleakages or other significant changes in secondary water chemistry to this point in its operating life. Discuss the occurrence of cracks in any given turbine as related to history of secondary water chemistry in the unit.

RESPONSE:

PBNP Unit 1 was placed in commercial service on December 21, 1970, using coordinated phosphate treatment for secondary water chemistry control as specified by the steam generator manufacturer, Westinghouse Electric Corporation. On September 9, 1974, the unit was switched over to an all-volatile chemical control (AVT) as recommended by Westinghouse. The historical secondary chemistry control has been otherwise unexceptional. It is not known at what point in the turbine's operating history the recently discovered cracking occurred. Whether or not water chemistry was or is a factor in the occurrence of the cracks may possibly become apparent as a result of monitoring procedures for currently sound, in-service discs.

IV. If your plant has not been inspected, describe your proposed schedule and approach to ensure that turbine cracking does not exist in your turbine.

RESPONSE:

The PBNP Unit 1 low pressure turbine rotor discs were inspected during the October-November 1979 refueling outage.

V. If your plant has been inspected and plans to return or has returned to power with cracks, provide your proposed schedule for the next turbine inspection and the basis for this inspection schedule.

RESPONSE:

As discussed in our letter to Mr. Denton dated January 30, 1980, we are planning to reinspect the Unit 1 discs during the Fall 1980 outage to determine whether there has been a change in the condition of the LP turbine rotors. The basis for our continued operation was also discussed in that letter and with the NRC Staff members at a meeting in Bethesda on February 6, 1980.

VI. Indicate whether an analysis and evaluation regarding turbine missiles have been performed for your plant and provided to the staff. If such an analysis and evaluation has been performed and reported, please provide appropriate references to the available documentation. In the event that such studies have not been made, consideration should be given to scheduling such an action.

RESPONSE:

As discussed in Section 14.1.13 of the Point Beach Nuclear Plant Final Facility Description and Safety Analysis Report and Westinghouse Topical Report WCAP-7525-L, dated June 1970, the likelihood and consequences of a turbine overspeed resulting in a turbine missile have been analyzed and evaluated. A reevaluation of the likelihood and consequence of a turbine missile will be performed upon receipt of the revisions to previously reported missile generation probabilities and missile energies presently being developed by Westinghouse. We expect to receive this information from Westinghouse by July 31, 1980, and will submit a report of our turbine missile reevaluation as soon thereafter as practicable.

RESPONSES TO GENERIC QUESTIONS

I. Describe what quality control and inspection procedures are used for the disc bore and keyways.

RESPONSE:

Chemical analyses are made from each heat of steel. During manufacture, mechnical tests are made from the disc bore region. These include tensile and Charpy v-notch impact tests. Each disc bore region is subject to ultrasonic and magnetic particle inspections. On later units, the disc keyways are inspected after machining, using liquid penetrant techniques.

For in-service inspection two ultrasonic techniques, namely the tangential aim and radial aim scans, have been developed to detect and determine the depth of disc keyway and bore cracks. The in-service ultrasonic inspection does not require unshrinking discs from the rotor.

The tangential aim scan is used to locate cracks. The technique requires sound energy to be coupled and directed tangentially towards the keyway from a precalculated position on the hub. This is accomplished by means of a compound angled plexiglass wedge. The wedge is machined to provide a contoured face which makes complete contact with the disc hub, while aiming the sound energy at the disc bore/keyway. Crack indications occurring in the vicinity of the keyway apex and at the bore will reflect the sound energy. The tangential aim scan is performed both in the clockwise and counterclockwise directions to permit locating crack indications with respect to the keyway apex.

A radial aim technique is used to confirm cracks located by the tangential aim scan. The technique is also used to determine the crack depth by comparing the time lapsed in obtaining a ultrasonic reflection from the crack with the time to obtain a reflection from the keyway or bore.

II. Provide details of the Westinghouse repair/replacement procedures for faulty discs.

RESPONSE:

When cracks are found by an inservice inspection, their severity is evaluated by means of an allowable life calculation. The allowable life is relatable to the time required for the crack to grow to critical size for fracture. Based upon the results of this calculation, the following actions may be taken:

A. If the affected disc has a calculated allowable life much greater than zero, a reinspection of the disc is recommended at approximately one-half of the allowable life.

B. If the affected disc has an allowable life less than or close to zero, one or more of the following may be employed:

1. The affected disc is removed by "machining", and is replaced with a collar and pressure drop baffle.

2. Upstream keyways may be drilled oversize to remove cracks after the downstream disc is removed.

3. The affected disc may be replaced. This requires unstacking and restacking several discs on the rotor.

III.A. What immediate and long term actions are being taken by Westinghouse to minimize future stress corrosion problems with turbine discs?

RESPONSE:

Westinghouse has advised the following short range actions are being taken:

A. Those discs which have been observed to be most susceptible to stress corrosion cracking are being redesigned. The new designs will achieve lower bore stresses and utilize lower yield strength material. These changes will increase the margin against stress corrosion cracking.

B. Designs that will eliminate spacers and bore keyways are being explored.

The following long range solutions are being examined:

A. Bore Heating - Ways and means to keep the disc keyways dry are being explored.

B. Sealing - Ways of sealing the hub and bore from the steam environment are being studied.

C. Coatings - Another method of sealing is to apply a protective coating. Westinghouse is continuing to experiment with different sealings, but extensive work is still required to develop processes for their application and to demonstrate their benefits.

D. Partial Integral Rotors - Since one piece forgings cannot be procured at this time, Westinghouse is exploring the possibilities of partial integral rotors where the first two or three discs are made a part of the shaft. Only the last few discs will have to be shrunk on.

E. Integral Rotors - A welded rotor design is being evaluated as a means to produce an integral rotor.

III.B. What actions are being recommended to utilities to minimize stress corrosion cracking?

RESPONSE:

Westinghouse has developed recommended limits for steam purity. When these limits are exceeded, corrective actions should be taken.

IV.A. Identify the impurities known to cause cracking in the low pressure turbines, and their sources.

RESPONSE:

The time of occurrence of the cracks, which have been identified in low pressure turbine discs, is not known. Information regarding impurities, and their sources, which may be a contributing factor to disc cracking, is presently being collected; additional information could become available from monitoring of currently sound discs. The main chemical species known to cause or contribute to stress corrosion of steam turbine materials in steam environments are sodium hydroxide, sodium chloride, and sodium sulfate.

IV.B. Discuss the relationship between steam generator chemistry and steam chemistry relative to the introduction of corrosive impurities into the turbine, including phosphate, AVT, and BWR chemistry.

RESPONSE:

Analyses of material within LP disc cracks from PWR units shows the presence of Na, K, Ca, Si, Cl, OH, and C together with Fe, Co, V, Al and Ni ions.

In PWR units with recirculating steam generators, the total carry-over of nonvolatile dissolved solids, such as $NaOH$ and $NaCl$ depends mainly on the mechanical carry-over. However, where ammonia is used for pH control, such as with the all volatile water treatment, carry-over of anions may increase due to a formation of volatile ammonium salts.

In the PWR units with once-through steam generators, the high pressure turbine steam purity is similar to the feedwater purity. Most impurities entering the steam generator are carried directly into the turbine.

The published information on BWR systems indicates the concentration of oxygen in the steam is in the range of 10 to 30 ppm. With respect to other elements, however, it is likely that high steam purity standards will be maintained for control of radio-activity. To achieve this, BWR reactor water is generally double demineralized.

IV.C. Discuss the mechanism of deposition of these impurities that can lead to their concentration in certain areas of keyways and bores.

RESPONSE:

The impurities from steam can get into shrunk-on disc bores and keyways in several possible ways:

1. After deposition in the steam path during operation, corrodents can wash into disc keyways during layup due to moisture condensation.

2. In the wet steam regions, the moisture can dry on hot metal surfaces.

3. As long as the disc retains its shrink fit, Westinghouse is not aware of a mechanism which can concentrate impurities on the bore.

V. What role does the reflux action in the steam separation portion of the steam generator have on scrubbing corrosive impurities from the steam?

RESPONSE:

Two modes of transport of corrosive impurities from the steam generator to the turbine are mechanical entrainment and volatility.

The non-volatile chemical species are transported by mechanical entrainment which is normally expected to be small.

The steam generator scrubbing equipment has minimum effectiveness in preventing the transport of volatile impurities, such as ammonium chloride, to the turbine. The concentration of volatile impurities in turbine steam is determined by their concentration in the steam generator bulk water and their specific volatility coefficient which differs with each species.

VI. To what extent can the buildup of corrosive impurities in the LP turbine be alleviated? What would be the effects of the following action:

A. Pumping moisture separator condensate to condenser?

RESPONSE:

Westinghouse has advised that pumping moisture separator condensate to the condenser would be beneficial in units with condensate polishing. In units without condensate polishing, there will be no effect.

B. Periodically moving (the) point of condensation to prevent localized buildup of corrosive impurities.

RESPONSE:

Westinghouse has advised that conceptually, dilution of these contaminants by increased levels of moisture and their subsequent transport to the condensate system could substantially reduce the buildup of contaminants. However, the effectiveness of this technique and the means for successful control of the local environment of particular turbine parts must be developed and experimentally verified.

Several of the less volatile active corrodents, such as sodium chloride and sodium sulphate, precipitate as concentrated liquid solutions in a region slightly above the equilibrium saturated vapor line of pure water. This region occurs locally within a given stage during normal operation and migrates toward the turbine exhaust as load reduces. Control of the zone can be affected by changes in load and moisture separator reheater (MSR) outlet temperature.

VII. Describe fabrication and heat treatment sequence for discs, including thermal exposure during shrinking operation.

RESPONSE:

The typical sequence for producing a disc forging includes the following operations, not all of which are necessarily applicable to any given disc.

A. Melting and Casting of Ingot - Most discs manufactured since the early 1960s are made using basic electric furnace steel which is vacuum stream degassed or vacuum-carbon-deoxidized.

B. Forging - The ingot is heated to forging temperature, block forged and cut into two to four pieces from which the individual disc forgings are made.

C. Preliminary Heat Treatment - This step consists of austenitizing and tempering the forging to promote structure uniformity, grain refinment, and good machineability.

C. Preliminary Machining - The forging is machined to the disc contour.

E. Preliminary Ultrasonic Inspection - Typically, the supplier makes a partial ultrasonic inspection of the forging to assure that the quality warrants continued manufacturing effort.

F. Heat Treatment for Properties - The forging is austenitized and tempered at appropriate temperatures to achieve the desired mechanical properties. Cooling from the austenitizing treatment is achieved by water quenching. After tempering, the forging is cooled in the furnace at a controlled rate.

G. Mechanical Properties - Tensile properties are tested to determine if the required strength level has been achieved. Since about 1960, Charpy v-notch impact tests are made on each forging.

H. NDE Inspection - The forgings are rough machined to the Westinghouse drawing requirements and an ultrasonic inspection of the flat surfaces of the hub, web, and rim of the disc is performed.

I. Stress Relief - This treatment is required when a significant amount of metal is machined off of the forging after it has been heat treated for properties. The stress relief treatment is 50-100°F below the tempering temperature. Cooling is accomplished by a controlled furnace cool.

J. Mechanical Properties - When a stress relief is used, the mechanical properties are tested after the stress relief treatment. (Reference Step G)

K. Dimensional Check - The forging is machined to a clean surface, the balance of test prolongations are removed, and the dimensions checked. The forging is then shipped to Westinghouse for final machining and assembly onto the rotor.

L. NDE Inspection - A fluorescent magnetic particle inspection is performed after finish machining. (This inspection was not applied during the early 1970s.)

M. Shrinking Discs on the Rotor Shaft - The assembly operation consists of four parts; namely, preparation of the shaft, preparation of the discs, assembly of the rotor and pinning of the discs to the shaft.

1. Preparation of the Shaft - After final shaft machining and inspections are complete, the shaft is cleaned with degreaser and dry lint-free cloths, and is mounted in a vertical position. The surface of the rotor that will be in contact with the disc is coated with lubricant.

2. Preparation of the Disc - After final machining and inspections are complete, the disc surfaces and blades are cleaned to remove foreign material. Prior to

heating for assembly, the disc bore diameter is measured and compared to that of the drawing to assure a correct shrink fit. The disc is placed on an assembly fixture, leveled and loaded into a furnace which is at 300°F or less.

3. Assembly of the Rotor - The disc is slowly heated to the required shrink temperature between 600 and 750°F. When the shrink temperature is reached, the disc is removed from the furnace and lowered onto the shaft.

4. Axial Aligning and Pinning of Discs - Liners are placed at the exhaust face of each disc to assure the proper axial location. The keyways are then drilled, reamed and honed. Since the early 1970s, a penetrant inspection is performed in the keyway prior to inserting the key.

VIII. Discuss the effect of any local residual stresses on the cracking mechanism.

RESPONSE:

Depending on their nature and magnitude, residual surface stresses can have an effect on crack initiation. Proper control exercised in the selection of machining parameters results in compressive stresses, which are usually beneficial. At an apex of the keyway, the residual stresses may be influenced by local yielding as a result of the stress concentrating action of the keyway.

2. NUMBER OF TRIPS AT POWER. UNIT 1

Date	Cause	% or MWe Power Level	Maximum Overspeed If Known
11-5-70	Breaker Problem	40 MWe	
11-5-70	Breaker Problem	35 MWe	
11-6-70	Reactor Trip - LoLo S/G Level	30 MWe	
11-7-70	Turbine Trip Loss of Feed Pump	Low Power	
11-8-70	Manual Trip - Governor Valve Problems	100 MWe	
11-10-70	Turbine Trip - Breaker Lockout	35%	
11-22-70	Testing - Transformer Transfer	40%	
11-22-70	Testing - Load Rejection	50%	
11-29-70	Testing - Turbine Trip	360 MWe	
12-4-70	Turbine Trip - Breaker Lockout Overspeed	422 MWe	
12-5-70	Turbine Trip - Solenoid Failure	50 MWe	
12-6-70	Testing - Open Output Bkr.	70%	2190 RPM
12-8-70	Trip Unit for Overspeed Test	445 MWe	2250 RPM
12-19-70	Reactor Trip - LoLo W/G Level	35%	
1-8-71	W Caused Trip, Working on IEOPS	425 MWe	
1-9-71	Trip Unit for Overspeed Test	351 MWe	2206 RPM
1-27-71	Reactor Trip - Lo Feed Flow	480 MWe	
1-28-71	Turbine Trip - IEOPS Suspected	480 MWe	
1-29-71	Trip Unit for Overspeed Test	351 MWe	2216 RPM
2-3-71	Turbine Trip - IEOPS Suspected	90%	
2-4-71	Turbine Trip - IEOPS Failure	470 MWe	
2-4-71	Turbine Trip - Autostop Oil Low	470 MWe	
2-9-71	Reactor Trip - MESV Closure	400 MWe	
5-1-71	Tripped Output Bkr. - Autostop Oil Low	410 MWe	
5-1-71	Trip Unit for Overspeed Test	404 MWe	2316 RPM

2. (NUMBER OF TRIPS AT POWER - UNIT 1 Continued)

Date	Cause	% or MWe Power Level	Maximum Overspeed If Known
7-2-71	W Worker Caused Trip	480 MWe	
8-29-71	Reactor Trip - Dropped Rods	480 MWe	
12-3-71	Trip Unit for Overspeed Test	410 MWe	2243 RPM
1-3-72	Reactor Trip - Faulty Anal. Testing	480 MWe	
1-13-72	Trip Unit for Overspeed Test	511 MWe	2340 RPM
4-21-72	Reactor Trip - Instrument Power Failure	100%	
9-11-72	Reactor Trip - Hi Pressurized Pressure	100%	
5-18-73	Trip for Test	72%	
7-2-73	Technician Caused Trip	500 MWe	
8-11-73	Reactor Trip - Stop Valve Closure	100%	
1-11-74	Reactor Trip - Instrument Power Failure	100%	
1-18-74	Reactor Trip - Instrument Power Failure	80%	
2-3-74	Manual Trip - Rod Problems	55%	
8-2-74	Trip for Overspeed Test	406 MWe	2150 RPM
9-25-74	Reactor Trip - Faulty Testing	99%	
10-4-74	Trip for Overspeed Test	430 MWe	2193 RPM
2-27-75	Manual Trip - S/G Tube Failure	25%	
4-5-75	Trip for W Test	5%	
11-16-75	Turbine Trip - Instrument Power Failure	100%	
1-10-76	Reactor Trip - Steam Line LoLo Press "B"	470 MWe	
2-21-77	Manual Trip - Rods Dropped	After Runback	
4-5-77	Reactor Trip - Dip in AG Busses	100%	
1-7-78	Turbine Trip - MISSV Closure	100%	
2-9-78	Turbine Trip - Breaker Lockout	100%	
4-2-78	Turbine Trip - MSSV Closure	100%	

3. OVERSPEED TESTING - UNIT 1

Date	Reason/Type	Results
11-8-70	Check Overspeed	
12-6-70	Unit Tripped From 70% for Overspeed Test	2190
12-18-70	Unit Tripped from 445 MWe for Overspeed Test	2259
1-3-71	Tested IEOPS	1840 Reference
		1850 Turbine Shaft
1-3-71	Tested IEOPS	1835 Reference
		1848 Turbine Shaft
1-5-71	Overspeed Tests, All Trips by IEOPS	1858, 1861, 1865
1-8-71	IEOPS	1881
1-8-71	IEOPS	1877
1-9-71	Unit Trip from 351 MWe for Overshoot Test	2206 Overshoot
1-12-71	IEOPS	1843 Reference
		1838 Digital
1-12-71		1844 Reference
		1840 Digital
1-12-71	Mechanical Overspeed	1844, 1843
1-29-71	Unit Tripped from 351 MWe to Check Overspeed	2216 Overshoot
5-1-71	Unit Tripped from 410 MWe to Check Overspeed	2274 Overshoot
5-1-71	Overspeed Tests on IEOPS	1886, 1885, 1886
	Mechanical	1902
12-3-71	Unit Tripped from 410 MWe to Check Overspeed (IEOPS Testing 102.5%)	2243 1.54" Abs
1-15-72	Overspeed Test	1841, 1841
1-19-72	Unit Tripped from 511 MWe to Check Overspeed	2340
3-6-73	Overspeed Test	1835, 1836, 1831

3. (OVERSPEED TESTING - Unit 1 Continued)

Date	Reason/Type	Results
6-8-74	Overspeed Test	1870, 1870, 1872
8-2-74	Unit Tripped from 406 MWe to Check Overspeed	2150 Overshoot
10-4-74	Unit Tripped from 430 MWe to Check Overspeed	2193 Overshoot
1-9-76	Overspeed Test	1874, 1870, 1869
1-25-76	Overspeed Test	1873, 1866, 1867
1-5-77	Overspeed Test	1871, 1871, 1869
10-15-78	Overspeed Test	1864, 1863, 1862
12-1-79	Overspeed Gov. Raised One Flat Prior to Test	1885, 1884, 1883

POINT BEACH NUCLEAR PLANT UNIT 1
ADDITIONAL INFORMATION-TURBINE DISC

	LP-1 GOVERNOR END						LP-GENERATOR END						LP-2 GOVERNOR END						LP-2 GENERATOR END					
DISC NUMBER	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
D.1.-Material Type	Material Type for all Discs is Ni-Cr-Mo-V Alloy Steel Similar to ASTMA-471																							
D.2.-Tensile																								
HUB:																								
Yield Strength-KSI																								
Ultimate Tensile Strength-KSI																								
Elongation - %																								
Reduction Area - %																								
RIM:																								
Yield Strength-KSI																								
Ultimate Tensile Strength-SKI																								
Elongation - %																								
Reduction Area-%																								
D.3. - Toughness																								
HUB:																								
FATT - °F																								
Room Temp. Impact Ft.Lbs.																								
Upper Shelf Impact Ft.Lbs.																								
Upper Shelf Temp. - °F																								
RIM:																								
FATT - °F																								
Room Temp. Impact Ft.Lbs.																								
Upper Shelf Impact Ft.Lbs.																								
Upper Shelf Temp. - °F																								
D.4. Keyway Temp. - °F																								

b,c,e

Appendix B

	LP-1 GOVERNOR END						LP-1 GENERATOR END						LP-2 GOVERNOR END						LP-2 GENERATOR END					
DISC NUMBER	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
D.5. Calculated Crack Size																								b,c,e
At 63,928 Hours a_p - in.																								
D.6. Effective Critical Crack Size																								
1800 RPM - in. Design Overspeed																								
D.7. Ratio D5 to D6																								
a_p/a_{cr}																								
D.8. Crack Growth Rate																								
d_a/d_t - in/hr x 10^{-5}																								
D.9. Calculated Bore & Keyway Stress																								
Bore Stress - KSI @ 1800 RPM @ 132%																								
Keyway Stress	NOTE: Keyway Stress is not used directly in the calculation of effective critical crack size and is not available. The Bore Stress is used together with a Keyway shape factor, Q, to calculate critical crack size.																							
D.10. KIC Calculated - KSI√in																								b,c,e
HUB: RIM:																								
D.11. Min. Yield Strength Specified																								
Y.S. HUB - KSI																								