POWER AUTHORITY OF THE STATE OF NEW YORK

10 COLUMBUS CIRCLE NEW YORK, N. Y. 10019
(212) 397-6200

March 19, 1980
IPN-80-33

Mr. Darrell G. Eisenhut, Acting Director
Division of Operating Reactors
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Indian Point 3 Nuclear Power Plant
Docket No. 50-286
Turbine Rotor Keyway Cracking Information

Dear Sir:

This letter transmits the Westinghouse application for withholding proprietary information from public disclosure and accompanying affidavit in accordance with our March 19, 1980 letter (IPN-80-32) on the same subject.

Very truly yours,

Paul J. Early
Assistant Chief Engineer-Projects

8003260 394

AW-80-13

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: Indian Point #3 Docket #50-286
Information in Response to NRC Request for Information of February 25, 1980, Relative to Low Pressure Turbine Disc Integrity.

Reference: Appendix A letter from P. J. Early to Eisenhut, dated 3/19/80

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 B. Williamson

R. Williamson, Manager
Customer Order Engineering
Westinghouse Electric Corporation

Ref: AW-80-13

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 15 day of May 1980

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 P. J. Early to Eisenhut, dated March 19, 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 commercial 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.

ATTACHMENT I

SITE SPECIFIC GENERAL QUESTION RESPONSES

POWER AUTHORITY OF THE STATE OF NEW YORK
INDIAN POINT 3 NUCLEAR POWER PLANT
DOCKET NO. 50-286
MARCH 19, 1980

THIS IS A NON-PROPRIETARY COPY OF ATTACHMENT I.
ALL PROPRIETARY INFORMATION HAS BEEN OMITTED.

SITE SPECIFIC GENERAL QUESTIONS
To be Completed in 20 Days

I. Provide the following information for each LP turbine:

A. Turbine type

ANSWER:

The P.A.S.N.Y. Indian Point #3 unit consists of one tandem compound six flow, four casings, condensing, 1800 RPM turbine utilizing 44 in. last row blades in each low pressure element. The low pressure element is designated as a Building Block 81.

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

ANSWER:

23,272 hours.

C. Number of turbine trips and overspeeds.

ANSWER:

Trips - 94
Overspeeds between 104% and 122% - 10
Overspeeds due to periodic testing (<104%) - 7

D. For each disc:

1. Type of material including material specifications.
2. Tensile properties data.
3. Toughness properties data including Fracture Appearance Transition Temperature and upper energy and temperature.
4. Keyway temperatures.
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.

ANSWER:

The following answers refer to the appropriate sections of the table provided for each disc in Appendix A to this Attachment.

1. Type of material is Ni-Cr-Mo-V alloy steel similar to ASTM A-471. The minimum yield strength specified for each disc is given in Section B.

2. Tensile properties data of tests taken from the disc hub are given in Section B. Data obtained from rim material are presented in Section C.

3. Toughness properties are also presented in Sections B and C. As described above, Section B contains hub properties and Section C contains rim properties. Upper shelf energy is not presented when it is the same as the room temperature energy.

4. The keyway temperature is presented in Section G. This is the calculated temperature two inches from the exhaust face of the disc at the bore during full load operation with all moisture separator reheaters functioning (where applicable).

5. The maximum expected keyway crack size is provided in Section H. This was calculated by multiplying the time the unit was in operation prior to disc bore/keyway inspection (item I.B.) times the crack growth rate (Section G).

6. The critical crack size at 1800 rpm and at design overspeed is presented in Section F. It is calculated using the relationship:

b, c, e

7. The ratio of calculated crack to critical crack size for operation and overspeed conditions is provided in Section I. This was calculated by dividing the maximum expected keyway crack (Section H) by the critical crack size for both operation at 1800 RPM and design overspeed (Section F).

8. The crack growth rate is given in Section G. These crack growth rates are the maximum expected rates based upon known cracks to date. Westinghouse has changed the basis for determining these rates to utilize the NRC gray book operating hours. It is believed this agrees with the way the NRC staff determines crack growth rates. Except for four units, the crack growth rate of the number one disc of BB 80 and BB 81 turbines should be assumed to be zero since this disc operates dry under normal conditions. The four exceptions are Haddam Neck, Indian Point 2, Indian Point 3 and Cooper 1.

9. The bore tangential stress at 1800 rpm and at design overspeed are presented in Section E. The values presented include the stresses due to shrink fit and centrifugal force loads only. Additional analyses to include thermal stresses and pressure stresses are being made, but are not presently available.

10. The fracture toughness, K_{IC}, of each disc is calculated from the Charpy v-notch and tensile data. The values, presented in Sections B and C are calculated at the upper shelf temperature or room temperature, whichever gives the lower result.

11. The minimum yield strength specified for each disc is presented in Section 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.

ANSWER:

The P.A.S.N.Y. Indian Pt. #3 Unit had a Westinghouse field inspection team at the job site from 10/26/79 to 11/14/79 to ultrasonic inspect the keyways and disc bores of the L.P. rotors. The rotors inspected were #1 LP-TD44471, #2 LP-TD44472 and #3 LP-TD44473.

The inspection method employed was to ultrasonic inspect all keyways on Disc 1 thru 5 both ends on each rotor. Also, an ultrasonic 360° scan was made on the outlet side of each disc.

The inspection results are as follows:

#1 LP	.378 Deep indication #3 Disc Gov End Keyway 2
	.378 Deep indication #3 Disc Gov End Keyway 3
	.126 Deep indication #2 Disc Gov End Keyway 2
	.126 Deep indication #2 Disc Gen End Keyway 3
#2 LP	.126 Deep indication #2 Disc Gen End Keyway 2
	.308 Deep indication #2 Disc Gen End Keyway 3
#3 LP	.378 Deep indication #3 Disc Gov End Keyway 3

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 second water chemistry in the unit.

ANSWER:

A review has been performed of the steam generator chemistry from the period prior to criticality in the Spring of 1976 through September 1979 at which point the plant was shutdown for its second refueling outage. All operating chemistry data was submitted to Westinghouse for their review and a statistical summary of this data has been completed in conjunction with Westinghouse personnel. Steam generator blowdown is monitored. Main steam from the four (4) steam generators is combined and then fed to the turbines such that the chemistry in each of the three (3) low pressure turbines is the same.

In 1976 blowdown pH was within Westinghouse specifications for 53% of the time based on 224 data points. For the same period of 1976 the steam generator blowdown chlorides were within Westinghouse specifications for 86% of the time based on 132 data points. In 1977 blowdown pH was within specification 92% of the time based on 290 data points and the chloride was within specification 96% of the time based on 225 data points. For 1978 when the Power Authority took over operating responsibility for the plant, blowdown pH was within Westinghouse specification 89% of the time based on 286 data points and the chloride concentration was within Westinghouse specification 92% of the time based on 87 data points. For 1979 blowdown pH was within Westinghouse specification 55% of the time based on 255 data points and the chloride concentration was within Westinghouse specification 84% of the time based on 212 data points.

A calculation has demonstrated that there has been less than 100 ppm days of chlorides present in the steam generator blowdown since plant startup. Tests conducted by Westinghouse in the fall of 1977 and fall of 1978 showed that moisture carryover was within the Westinghouse guarantee of 0.25%.

Although conductivity data was collected on blowdown samples for these periods in all cases these were used only for trending and the results cannot be used for assessment of demonstration of compliance with Westinghouse specifications. In all cases these conductivity samples were drawn in a grab sample manner and standard methods of analysis state that grab samples are not valid for conductivity less than 10 μmho, since the Westinghouse specification is 2 μmho these samples could not be used to demonstrate plant compliance or lack of compliance with Westinghouse specification.

The Authority cannot determine when the cracks began or how they propagated and therefore cannot "relate" existing cracks to water chemistry history for our turbine. Future cracks can be "related" to water chemistry because we will be able to pinpoint the occurrence of new cracks.

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.

ANSWER:

The Indian Point Unit #3 L.P. rotors have been inspected as described in the answer to Question II.

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.

ANSWER:

As previously reported in our February 1, 1980 letter (IPN-80-14), the allowable service life of IP-3 L.P. turbine rotor #2 is 29 months and the allowable service life of L.P. rotor #3 is 26 months, based on Westinghouse calculations. Westinghouse states that the rotors are suitable for satisfactory operation until the next inspection, not to exceed 13 months from date of restart. The Authority will perform this reinspection about halfway through the next operating cycle and not more than 13 months after restart of the turbine, using techniques to inspect both sides of the discs.

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.

ANSWER:

A turbine missile analysis and evaluation has been performed for IP-3. The report entitled, "Likelihood and Consequences of Turbine Overspeed at the Indian Point Nuclear Generating Unit No. 3" has been submitted to NRC as Appendix 14A to the FSAR.

In addition the Authority has retained Westinghouse and Gibbs & Hill to perform a new missile analysis and evaluation, based on crack data presented herein.

Appendix A

IP-3 LP ROTOR DISC INFORMATION

THIS IS A NON-PROPRIETARY COPY OF APPENDIX A. ALL PROPRIETARY INFORMATION HAS BEEN OMITTED.

ID # : U0811C2101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 1
5. LOCATION GOV
6. DISC# 1
7. TEST NO. TD44509

B. MATERIAL PROPERTIES (HUB)
1. TYPE (MIN. Y.S. (KSI)) TE
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

[ ]

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

[ ]

D. CHEMISTRY

C [ ] b,c,e MN [ ] b,c,e SI [ ] b,c,e P [ ] b,c,e CR [ ] b,c,e MO [ ] b,c,e V [ ] b,c,e

NI [ ] b,c,e AS [ ] b,c,e SB [ ] b,c,e SN [ ] b,c,e AL [ ] b,c,e CU [ ] b,c,e S [ ] b,c,e

E. BORE STRESS

SPEED (RPM)	STRESS	
1. 1800	(KSI)	[ ] b,c,e
2. 2376 (132%)	(KSI)	

F. CRACK DATA
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

[ ] b,c,e

G. SERVICE DATA
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

[ ] b,c,e

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) [ ] b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) [ ] b,c,e
2. OVERSPEED

ID # : UC81102101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 1
5. LOCATION GOV
6. DISC# 2
7. TEST NO. TD44507

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY
C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e
NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS
SPEED (RPM) STRESS b,c,e
1. 1800 (KSI)
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) [ ] b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) [ ] b,c,e
2. OVERSPEED

ID # : UC811C2101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 1
5. LOCATION GOV
6. DISC# 3
7. TEST NO. TD44550

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

[ ]

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

[ ]

D. CHEMISTRY

C [ ] b,c,e MN [ ] b,c,e SI [ ] b,c,e P [ ] b,c,e CR [ ] b,c,e MO [ ] b,c,e V [ ] b,c,e

NI [ ] b,c,e AS [ ] b,c,e SB [ ] b,c,e SN [ ] b,c,e AL [ ] b,c,e CU [ ] b,c,e S [ ] b,c,e

E. BORE STRESS

SPEED (RPM) STRESS
1. 1800 (KSI)
2. 2376 (132%) (KSI)

[ ] b,c,e

F. CRACK DATA
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

[ ] b,c,e

G. SERVICE DATA
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

[ ] b,c,e

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) [ ] b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM)
2. OVERSPEED

[ ] b,c,e

ID # : UC811F2101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 1
5. LOCATION GOV
6. DISC# 4
7. TEST NO. TD44517

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY
C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e
NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS
SPEED (RPM) STRESS b,c,e
1. 1800 (KSI)
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : DC811F2101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK   81
2. UNIT   INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP#   1
5. LOCATION   GOV
6. DISC#   5
7. TEST NO.   TD44485

B. MATERIAL PROPERTIES (HUB)
1. TYPE   TE
   (MIN. Y.S.   (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL   b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP.
   (DEG.F)
10. U.S. IMPACT ENG.
   (FT.LB.)
11. U.S. KIC
   (KSI.SQRT(IN.))

[ ]

C. MATERIAL PROPERTIES (RIM)   b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP.
   (DEG.F)
8. U.S. IMPACT ENG.
   (FT.LB.)
9. U.S. KIC
   (KSI.SQRT(IN.))

[ ]

D. CHEMISTRY

C [ ] b,c,e   MN [ ] b,c,e   SI [ ] b,c,e   P [ ] b,c,e   CR [ ] b,c,e   MO [ ] b,c,e   V [ ] b,c,e

NI [ ] b,c,e   AS [ ] b,c,e   SB [ ] b,c,e   SN [ ] b,c,e   AL [ ] b,c,e   CU [ ] b,c,e   S [ ] b,c,e

E. BORE STRESS
   SPEED (RPM)   STRESS
1. 1800   (KSI)
2. 2376 (132%)   (KSI)

[ ] b,c,e

F. CRACK DATA
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

[ ] b,c,e

G. SERVICE DATA
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

[ ] b,c,e

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) [ ] b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM)
2. OVERSPEED

[ ] b,c,e

ID # : U08110210l

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 1
5. LOCATION GOV
6. DISC# 6
7. TEST NO. TD44493

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY
C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e
NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS
SPEED (RPM) STRESS
1. 1800 (KSI) b,c,e
2. 2376 (132%) (KSI)

F. CRACK DATA
1. A-CR-OP (1800 RPM) (IN.) b,c,e
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA
1. OPER. TEMP. METAL TEMP. HUB (DEG.F) b,c,e
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) [ ] b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : U0811F2101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 1
5. LOCATION GEN
6. DISC# 1
7. TEST NO. TD44511

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY

C [ ] b,c,e MN [ ] b,c,e SI [ ] b,c,e P [ ] b,c,e CR [ ] b,c,e MO [ ] b,c,e V [ ] b,c,e

NI [ ] b,c,e AS [ ] b,c,e SB [ ] b,c,e SN [ ] b,c,e AL [ ] b,c,e CU [ ] b,c,e S [ ] b,c,e

E. BORE STRESS
SPEED (RPM) STRESS
1. 1800 (KSI) b,c,e
2. 2376 (132%) (KSI)

F. CRACK DATA
1. A-CR-OP (1800 RPM) (IN.) b,c,e
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA
1. OPER. TEMP. METAL TEMP. HUB (DEG.F) b,c,e
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) [ ] b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : U0811F2101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 1
5. LOCATION GEN
6. DISC# 2
7. TEST NO. TD44506

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

[ ]

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

[ ]

D. CHEMISTRY

C [ ] b,c,e MN [ ] b,c,e SI [ ] b,c,e P [ ] b,c,e CR [ ] b,c,e MO [ ] b,c,e V [ ] b,c,e

NI [ ] b,c,e AS [ ] b,c,e SB [ ] b,c,e SN [ ] b,c,e AL [ ] b,c,e CU [ ] b,c,e S [ ] b,c,e

E. BORE STRESS

SPEED (RPM)	STRESS	
1. 1800	(KSI)	[ ] b,c,e
2. 2376 (132%)	(KSI)	

F. CRACK DATA
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

[ ] b,c,e

G. SERVICE DATA
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

[ ] b,c,e

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) [ ] b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) [ ] b,c,e
2. OVERSPEED

ID # : D0811C2101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 1
5. LOCATION GEN
6. DISC# 3
7. TEST NO. TD44548

B. MATERIAL PROPERTIES (HUB)
1. TYPE (MIN. Y.S. (KSI)) TE
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

[ ]

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

[ ]

D. CHEMISTRY

C [ ] b,c,e MN [ ] b,c,e SI [ ] b,c,e P [ ] b,c,e CR [ ] b,c,e MO [ ] b,c,e V [ ] b,c,e

NI [ ] b,c,e AS [ ] b,c,e SB [ ] b,c,e SN [ ] b,c,e AL [ ] b,c,e CU [ ] b,c,e S [ ] b,c,e

E. BORE STRESS

SPEED (RPM)	STRESS
1. 1800	(KSI)
2. 2376 (132%)	(KSI)

[ ] b,c,e

F. CRACK DATA
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

[ ] b,c,e

G. SERVICE DATA
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

[ ] b,c,e

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) [ ] b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM)
2. OVERSPEED

[ ] b,c,e

ID # : U0611C2101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 1
5. LOCATION GEN
6. DISC# 4
7. TEST NO. TD44531

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY

C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e

NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS

SPEED (RPM) STRESS b,c,e
1. 1800 (KSI)
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) [ ] b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) [ ] b,c,e
2. OVERSPEED

ID # : UC81102101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 1
5. LOCATION GEN
6. DISC# 5
7. TEST NO. TD44486

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY

C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e

NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS

SPEED (RPM)	STRESS	
1. 1800	(KSI)	b,c,e
2. 2376 (132%)	(KSI)	

F. CRACK DATA
1. A-CR-OP (1800 RPM) (IN.) b,c,e
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA
1. OPER. TEMP. METAL TEMP. HUB (DEG.F) b,c,e
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : D081102101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 1
5. LOCATION GEN
6. DISC# 6
7. TEST NO. TD44499

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY

C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e

NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS
SPEED (RPM) STRESS b,c,e
1. 1800 (KSI)
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : U08110210I

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 2
5. LOCATION GOV
6. DISC# 1
7. TEST NO. TD44512

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY

C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e

NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS
SPEED (RPM) STRESS b,c,e
1. 1800 (KSI)
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : 0081102101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION

1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 2
5. LOCATION GOV
6. DISC# 2
7. TEST NO. TD44503

B. MATERIAL PROPERTIES (HUB)

1. TYPE (MIN. Y.S. (KSI)) TE
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e

1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY

C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e

NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS

SPEED (RPM)	STRESS
1. 1800	(KSI)
2. 2376 (132%)	(KSI)

b,c,e

F. CRACK DATA b,c,e

1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e

1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE

1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK

1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : UC811C2101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK   81
2. UNIT   INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP#   2
5. LOCATION   GOV
6. DISC#   3
7. TEST NO.   TD 44547

B. MATERIAL PROPERTIES (HUB)
1. TYPE   TE
   (MIN. Y.S.   (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL   b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM)   b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY

C [ ] b,c,e   MN [ ] b,c,e   SI [ ] b,c,e   P [ ] b,c,e   CR [ ] b,c,e   MO [ ] b,c,e   V [ ] b,c,e

NI [ ] b,c,e   AS [ ] b,c,e   SB [ ] b,c,e   SN [ ] b,c,e   AL [ ] b,c,e   CU [ ] b,c,e   S [ ] b,c,e

E. BORE STRESS
SPEED (RPM)   STRESS
1. 1800   (KSI)   b,c,e
2. 2376 (132%)   (KSI)

F. CRACK DATA
1. A-CR-OP (1800 RPM) (IN.)   b,c,e
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)   b,c,e
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) [ ] b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) [ ] b,c,e
2. OVERSPEED

ID # : U0811P2101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK   81
2. UNIT   INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP#   2
5. LOCATION   GOV
6. DISC#   4
7. TEST NO.   TD44530

B. MATERIAL PROPERTIES (HUB)
1. TYPE   TE
(MIN. Y.S.   (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL   b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM)   b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY
C b,c,e   MN b,c,e   SI b,c,e   P b,c,e   CR b,c,e   MO b,c,e   V b,c,e
NI b,c,e   AS b,c,e   SB b,c,e   SN b,c,e   AL b,c,e   CU b,c,e   S b,c,e

E. BORE STRESS
SPEED (RPM)   STRESS   b,c,e
1. 1800   (KSI)
2. 2376 (132%)   (KSI)

F. CRACK DATA   b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA   b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.)   b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM)   b,c,e
2. OVERSPEED

ID # : U08110210I

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 2
5. LOCATION GOV
6. DISC# 5
7. TEST NO. TD44553

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY

C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e

NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS

SPEED (RPM) STRESS
1. 1800 (KSI) b,c,e
2. 2376 (132%) (KSI)

F. CRACK DATA
1. A-CR-OP (1800 RPM) (IN.) b,c,e
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA
1. OPER. TEMP. METAL TEMP. HUB (DEG.F) b,c,e
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : DO811F2101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 2
5. LOCATION GOV
6. DISC# 6
7. TEST NO. TD39621

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

[ ] b,c,e

C. MATERIAL PROPERTIES (RIM)
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

[ ] b,c,e

D. CHEMISTRY

C [ ] b,c,e MN [ ] b,c,e SI [ ] b,c,e P [ ] b,c,e CR [ ] b,c,e MO [ ] b,c,e V [ ] b,c,e

NI [ ] b,c,e AS [ ] b,c,e SB [ ] b,c,e SN [ ] b,c,e AL [ ] b,c,e CU [ ] b,c,e S [ ] b,c,e

E. BORE STRESS
SPEED (RPM) STRESS
1. 1800 (KSI)
2. 2376 (132%) (KSI)

[ ] b,c,e

F. CRACK DATA
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

[ ] b,c,e

G. SERVICE DATA
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

[ ] b,c,e

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) [ ] b,c,e
2. OVERSPEED

ID # : 0081102101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 2
5. LOCATION GEN
6. DISC# 1
7. TEST NO. TD44510

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY
C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e
NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS
SPEED (RPM) STRESS b,c,e
1. 1800 (KSI)
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : DC8110210I

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 2
5. LOCATION GEN
6. DISC# 2
7. TEST NO. TD44504

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI•SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI•SQRT(IN.))

D. CHEMISTRY
C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e
NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS
SPEED (RPM) STRESS b,c,e
1. 1800 (KSI)
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK b,c,e
1. OPERATION (1800 RPM)
2. OVERSPEED

ID # : U081102101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 2
5. LOCATION GEN
6. DISC# 3
7. TEST NO. TD44545

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY

C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e

NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS

SPEED (RPM) STRESS b,c,e
1. 1800 (KSI)
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : 0081102101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 2
5. LOCATION GEN
6. DISC# 4
7. TEST NO. TD44529

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY
C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e
NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS
SPEED (RPM) STRESS b,c,e
1. 1800 (KSI)
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : U081102101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 2
5. LOCATION GEN
6. DISC# 5
7. TEST NO. TD60930

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY

C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e

NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS

SPEED (RPM) STRESS b,c,e
1. 1800 (KSI)
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA 1 b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : U0811021C1

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 2
5. LOCATION GEN
6. DISC# 6
7. TEST NO. TD39616

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY

C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e

NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS

SPEED (RPM) STRESS b,c,e
1. 1800 (KSI)
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c, e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : D061102101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 3
5. LOCATION GOV
6. DISC# 1
7. TEST NO. TD55615

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY
C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e
NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS
SPEED (RPM) STRESS b,c,e
1. 1800 (KSI)
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : D081102101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 3
5. LOCATION GOV
6. DISC# 2
7. TEST NO. TD44508

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY

C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e

NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS
SPEED (RPM) STRESS b,c,e
1. 1800 (KSI)
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : U08110210I

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION

1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 3
5. LOCATION GOV
6. DISC# 3
7. TEST NO. TD44549

B. MATERIAL PROPERTIES (HUB)

1. TYPE TE
   (MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e

1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY

C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e

NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS

SPEED (RPM) STRESS b,c,e

1. 1800 (KSI)
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e

1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e

1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE

1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK

1. OPERATION (1800 RPM) b,c,e
2 OVERSPEED

ID # : U081102101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 3
5. LOCATION GOV
6. DISC# 4
7. TEST NO. TD55408

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
   (MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY
C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e
NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS
SPEED (RPM) STRESS
1. 1800 (KSI) b,c,e
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : D081102101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION

1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 3
5. LOCATION GOV
6. DISC# 5
7. TEST NO. TD44557

B. MATERIAL PROPERTIES (HUB)

1. TYPE TE
   (MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

[ ]

C. MATERIAL PROPERTIES (RIM) b,c,e

1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

[ ]

D. CHEMISTRY

C [ ] b,c,e MN [ ] b,c,e SI [ ] b,c,e P [ ] b,c,e CR [ ] b,c,e MO [ ] b,c,e V [ ] b,c,e

NI [ ] b,c,e AS [ ] b,c,e SB [ ] b,c,e SN [ ] b,c,e AL [ ] b,c,e CU [ ] b,c,e S [ ] b,c,e

E. BORE STRESS

SPEED (RPM)	STRESS
1. 1800	(KSI)
2. 2376 (132%)	(KSI)

[ ] b,c,e

F. CRACK DATA

1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

[ ] b,c,e

G. SERVICE DATA

1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

[ ] b,c,e

H. MAXIMUM EXPECTED CRACK SIZE

1. LENGTH (IN.) [ ] b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK

1. OPERATION (1800 RPM) [ ] b,c,e
2. OVERSPEED

ID # : U081102101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 3
5. LOCATION GOV
6. DISC# 6
7. TEST NO. TD39625

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY
C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e
NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS
SPEED (RPM) STRESS
1. 1800 (KSI) b,c,e
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : D081102101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 3
5. LOCATION GEN
6. DISC# 1
7. TEST NO. TD55614

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI*SQRT(IN.))

D. CHEMISTRY

C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e

NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS

SPEED (RPM) STRESS b,c,e
1. 1800 (KSI)
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : D0811G2101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 3
5. LOCATION GEN
6. DISC# 2
7. TEST NO. TD55407

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY

C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e

NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS

SPEED (RPM) STRESS b,c,e
1. 1800 (KSI)
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : U081102101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 3
5. LOCATION GEN
6. DISC# 3
7. TEST NO. TD44546

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI•SQRT(IN.))

D. CHEMISTRY

C	MN	SI	P	CR	MO	V
b,c,e	b,c,e	b,c,e	b,c,e	b,c,e	b,c,e	b,c,e

NI	AS	SB	SN	AL	CU	S
b,c,e	b,c,e	b,c,e	b,c,e	b,c,e	b,c,e	b,c,e

E. BORE STRESS

SPEED (RPM)	STRESS	
1. 1800	(KSI)	b,c,e
2. 2376 (132%)	(KSI)	

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : D081102101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 3
5. LOCATION GEN
6. DISC# 4
7. TEST NO. TD44533

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY

C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e

NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS

SPEED (RPM) STRESS
1. 1800 (KSI) b,c,e
2. 2376 (132%) (KSI)

F. CRACK DATA
1. A-CR-OP (1800 RPM) (IN.) b,c,e
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA
1. OPER. TEMP. METAL TEMP. HUB (DEG.F) b,c,e
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : U0811C2101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 3
5. LOCATION GEN
6. DISC# 5
7. TEST NO. TD44552

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY
C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e
NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS
SPEED (RPM) STRESS b,c,e
1. 1800 (KSI)
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ID # : U0811C2101

LP TURBINE DISC INFORMATION

A. UNIT IDENTIFICATION
1. BUILDING BLOCK 81
2. UNIT INDIAN PT. #3
3. CUSTOMER: PASNY
4. LP# 3
5. LOCATION GEN
6. DISC# 6
7. TEST NO. TD44502

B. MATERIAL PROPERTIES (HUB)
1. TYPE TE
(MIN. Y.S. (KSI))
2. SUPPLIER: MIDVALE HEPPENSTALL b,c,e
3. Y.S. (KSI)
4. U.T.S. (KSI)
5. ELONGATION
6. R.A.
7. FATT (DEG.F)
8. R.T. IMPACT(FT.LB.)
9. U.S. IMPACT TEMP. (DEG.F)
10. U.S. IMPACT ENG. (FT.LB.)
11. U.S. KIC (KSI.SQRT(IN.))

C. MATERIAL PROPERTIES (RIM) b,c,e
1. Y.S. (KSI)
2. U.T.S. (KSI)
3. ELONGATION
4. R.A.
5. FATT (DEG.F)
6. R.T. IMPACT(FT.LB.)
7. U.S. IMPACT TEMP. (DEG.F)
8. U.S. IMPACT ENG. (FT.LB.)
9. U.S. KIC (KSI.SQRT(IN.))

D. CHEMISTRY

C b,c,e MN b,c,e SI b,c,e P b,c,e CR b,c,e MO b,c,e V b,c,e

NI b,c,e AS b,c,e SB b,c,e SN b,c,e AL b,c,e CU b,c,e S b,c,e

E. BORE STRESS

SPEED (RPM) STRESS b,c,e
1. 1800 (KSI)
2. 2376 (132%) (KSI)

F. CRACK DATA b,c,e
1. A-CR-OP (1800 RPM) (IN.)
2. A-CR-OS (OVERSPEED) (IN.)

G. SERVICE DATA b,c,e
1. OPER. TEMP. METAL TEMP. HUB (DEG.F)
2. ESTIMATED MAX DA/DT (IN/HR)

H. MAXIMUM EXPECTED CRACK SIZE
1. LENGTH (IN.) b,c,e

I. RATIO OF CALCULATED CRACK TO CRITICAL CRACK
1. OPERATION (1800 RPM) b,c,e
2. OVERSPEED

ATTACHMENT II

GENERIC QUESTION RESPONSES

POWER AUTHORITY OF THE STATE OF NEW YORK
INDIAN POINT 3 NUCLEAR POWER PLANT
DOCKET NO. 50-286
MARCH 19, 1980

GENERIC QUESTIONS - TO BE COMPLETED IN 20 DAYS

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

ANSWER:

Chemical analyses are made from each heat of steel. During manufacture mechanical 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 occuring 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 an 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.

ANSWER:

When cracks are found by an in-service 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 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?

ANSWER:

The following short range actions are being taken:

1. 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.

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

The following long range solutions are being examined:

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

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

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

4. Partial Integral Rotors - Since one piece forgings cannot be procured at this time, we are 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.

5. 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?

ANSWER:

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.

ANSWER:

The main chemical species known to cause or contribute to stress corrosion of steam turbine materials in steam environments are:

Sodium hydroxide
Sodium chloride
Sodium sulfate
Oxygen

The sources of these impurities are under study.

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.

ANSWER:

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 non-volatile 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 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 radioactivity. 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.

ANSWER:

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 maintains shrink fit, we are not aware of a mechanism which can concentrate impurities on the bore.

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

ANSWER:

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?

ANSWER:

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.

ANSWER:

Conceptually, dilution of contaminants by increased levels of moisture and their subsequent transport to the condensate system could substantially reduce the buildup of impurities. 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 corrodants, 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.

ANSWER:

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 1960's 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 2 to 4 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 refinement, and good machineability.

D. 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^{o} 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 1970's.)

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. Since the early 1970's, 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.

ANSWER:

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 the apex of the keyway, the residual stresses may be influenced by local yielding as a result of the stress concentrating action of the keyway.