ORIGINAL

PETITION FOR VARIANCE BEFORE THE HEARING BOARD OF THE SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

RV 12/29/22

PETITIONER: LOS ANGELES DEPARTMENT OF WATER AND POWER

CASE NO: 1263-76

'22 NOV 17 P4:44

FACILITY ID: 800074

FACILITY ADDRESS: 6801 East 2nd Street
[location of equipment/site of violation; specify business/corporate address, if different, under Item 2, below]

City, State, Zip: Long Beach, CA 90803

1. TYPE OF VARIANCE REQUESTED (more than one box may be checked; see Attachment A before selecting)

☐ INTERIM ☐ SHORT ☒ REGULAR ☐ EMERGENCY ☐ *EX PARTE* EMERGENCY

2. CONTACT: Name, title, company (if different than Petitioner), address, and phone number of persons authorized to receive notices regarding this Petition (no more than two authorized persons).

Katherine Rubin	Tina Shim
Director, Environmental Affairs	Deputy City Attorney
111 N. Hope Street, Room 1050	111 N. Hope Street, Room 340
Los Angeles *Zip* 90012	Los Angeles, CA *Zip* 90012
☎ (213) 367-0436 *Ext.*	☎ (213) 367-4500 *Ext.*
Fax (213) 367-4710	*Fax* (213) 367-4588
E-mail katherine.rubin@ladwp.com	*E-mail* tina.shim@ladwp.com

3. RECLAIM Permit ☒ Yes ☐ No   Title V Permit ☒ Yes ☐ No

4. **GOOD CAUSE:** Explain why your petition was not filed in sufficient time to issue the required public notice. (Required only for Emergency and Interim Variances; see Attachment A)

N/A

5. Briefly describe the type of business and processes at your facility.

Persons with disabilities may request this document in an alternative format by contacting the Clerk of the Board at 909-396-2500 or by e-mail at clerkofboard@aqmd.gov.

If you require disability-related accommodations to facilitate participating in the hearing, contact the Clerk of the Board at least five (5) calendar days prior to the hearing.

[ALL DOCUMENTS FILED WITH CLERK'S OFFICE BECOME PUBLIC RECORD]

Los Angeles Department of Water and Power (LADWP)

LADWP is the largest municipal utility in the nation and supplies water and electric services to 3.8 million residents and businesses in the City of Los Angeles. As a vertically integrated power system, LADWP both owns and operates the majority of its generation, transmission, and distribution systems. A five-member Board of Water & Power Commissioners is appointed by the Mayor and establishes policy. Together, LADWP and the City of Los Angeles have been at the forefront of California utilities in adopting aggressive clean energy initiatives. Together, LADWP and the City of Los Angeles have been at the forefront of California utilities in adopting aggressive clean energy initiatives. To that end, LADWP has set goals to meet renewable energy targets, while at the same time maintaining a reliable and cost-effective power supply for customers. The future of LADWP's energy supply has zero coal, expanded renewables, energy efficiency, clean energy projects, and dramatically reduces fossil fuel emissions.

Haynes Generating Station

LADWP's Haynes Generating Station (Haynes) is a natural gas-fired steam electric generating facility located on 122 acres in the City of Long Beach. Haynes currently operates two conventional steam generating units (Unit 1and Unit 2), two combined-cycle units (Unit 9 and Unit 10), and 6 simple cycle units (Units 11-16). Haynes has a generating capacity of 1,867 megawatts, enough to power approximately one million homes.

Unit 15, which is the subject of this Petition, is a 102.7 MW natural gas fired simple cycle combustion turbine equipped with a Selective Catalytic Reduction (SCR) system and a carbon monoxide (CO) oxidation catalyst to control NOx and CO. (See **Exhibit 1**, photo of Unit 15.) Unit 15 was commissioned in 2013 and its emissions are monitored by a Continuous Emissions Monitoring System (CEMS).

6. List the equipment and/or activity(s) that are the subject of this petition (see Attachment A, Example #1). **Attach copies of the Permit(s) to Construct and/or Permit(s) to Operate for the subject equipment. For RECLAIM or Title V facilities, attach *only* the relevant sections of the Facility Permit showing the equipment or process and conditions that are subject to this petition. You must bring the entire Facility Permit to the hearing.**

Equipment/Activity	Application/ Permit No.	RECLAIM Device No.	Date Application/Plan Denied (if relevant)*
Combustion Turbine Unit 15	559604	D183	n/a

*Attach copy of denial letter

7. Briefly describe the activity or equipment, and why it is necessary to the operation of your business. A schematic or diagram may be attached, in addition to the descriptive text.

Unit 15 is listed under Section D of Hayne's Title V Permit to Operate and is a GE Power Systems Model LMS100P simple cycle natural gas turbine. (See **Exhibit 2**, GE Power Systems LMS Brochure.) There are approximately 78 General Electric Model LMS100Ps in service, including in El Paso, Texas. These units recently were able to provide critical support and stability during the historic 2021 Winter Storm Uri in Texas that shut down most of the state. (See https://www.cnn.com/videos/us/2021/02/19/el-paso-texas-winter-weather-gallagher-pkg-tsr-vpx.cnn.)

Haynes' six Model LMS100P units were purchased in 2016 because of their efficiency, flexibility, and faster startup times that meet fluctuating grid conditions and allow LADWP to integrate more renewable energy in its generation mix. Because of its ability to quickly generate power, Unit 15 is usually run as the sun sets to offset the daily tapering off of renewable energy at that time. With Unit 15 currently out of service, its continuing inoperability affects the stability of the entire LADWP power system.

Haynes is one of three major coastal power plants (along with Harbor Generating Station and Scattergood Generating Station) that work together to support 2,839 MW of installed capacity, thus providing approximately 85 percent of the total generating capacity within the Los Angeles and 39% of the total generating plant capacity owned by LADWP.

For all of these reasons, Unit 15 is a vital component in LADWP's portfolio of in-basin generating facilities because it provides a more flexible and economical way to integrate a diversified energy portfolio while ensuring voltage support and grid reliability.

8. Is there a regular maintenance and/or inspection schedule for this equipment? Yes ☒ No ☐

If yes, how often: Annually Date of last maintenance and/or inspection: 01/18/22-02/20/22

Describe the maintenance and/or inspection that was performed.

Unit 15 has scheduled annual maintenance outages. During these scheduled outages, routine repairs and maintenance are performed on Unit 15 equipment, requiring the unit to be offline in order for the work to be done. The last maintenance outage was January 18, 2022 to February 20, 2022.

The following activities are typically performed during the scheduled maintenance outages:

1. Perform offline engine wash.
2. Borescope inspection of Unit, including the Booster, Supercore, Power Turbine, accessory gear box, inlet plenum.
3. Replace oil filters.
4. Inspect pumps, fans, motors, coolers, heaters, piping, and valves of auxiliary systems, include lube oil, hydraulic oil, jacking oil, water injection.
5. Inspect and replace failed instrumentation components, including probes, sensors, indicators, wiring, etc.
6. Inspect and replaced failed electrical components, including wiring, fuses, switches, etc.
7. Inspect, clean, and repair ammonia air dilution heater and vaporization heaters.
8. Inspect SCR and CO catalysts, and make necessary minor repairs.
9. Inspect Intercooler, and replace gasket and hardware if necessary.
10. Inspect air inlet filters, and replace pre-filters.
11. Perform generator inspection, including generator cooler, heater, fan, turning gear, oil system, etc.; and make necessary repairs.

9. List all District rules, and/or permit conditions from which you are seeking variance relief (if requesting variance from Rule 401 or permit condition, see Attachment A). Briefly explain how you are or will be in violation of each rule or condition (see Attachment A, Example #2).

Rule	Explanation
Permit Condition D82.3 "… The CEMS shall be installed. The CEMS shall be operated in accordance with an approved AQMD Rule 218 CEMS plan application…."	The CO Relative Accuracy Test Audit (RATA) is due by the end of the fourth quarter on December 31, 2022. The CO RATA must be performed while the unit is operating. Since Haynes Unit 15 is inoperable and repairs cannot be completed by the due date, Unit 15 will not be in compliance with these Title V permit conditions and SCAQMD Rules beginning January 1, 2023.
Rule 203(b) "The equipment shall not be operated contrary to the conditions specified in the permit to operate."	
Rule 218(d)(2)(A) "A CEMS installed and granted final approval before May 14, 1999 shall be maintained and operated according to the provisions of Rule 218, Sections (b), (e), (f) and (g), and the requirements of Rule 218.1, Sections (c) and (d)."	

Rule 218(b)(4)(C) "RATA and RAA, as applicable, shall be performed at least once every 12 months. The test shall be completed annually no later than the end of the calendar quarter in which the date of the original certification test was performed..."	
Rule 2004(f)(1) " The Facility Permit holder shall, at all times, comply with all rules and permit conditions applicable to the facility, as specified in the Facility Permit."	
Rule 3002(c)(1) "A person shall construct and operate a Title V facility and all equipment located at a Title V facility in compliance with all terms, requirements, and conditions specified in the Title V permit at all times."	

10. Are the equipment or activities subject to this request currently under variance coverage? Yes ☐ No ☒

11. Are any other equipment or activities at this location currently (or within the last six months) under variance coverage? Yes ☐ No ☒

12. Were you issued any Notice(s) of Violation or Notice(s) to Comply concerning this equipment or activity within the past year? Yes ☐ No ☒

13. Have you received any complaints from the public regarding the operation of the subject equipment or activity within the last six months? Yes ☐ No ☒

14. Explain why it is beyond your reasonable control to comply with the rule(s) and/or permit condition(s):

It is beyond the LADWP's reasonable control to perform the CO RATA by December 31, 2022 due to unexpected failure of Unit 15's supercore and ensuing damage to other parts. (See **Exhibit 3**, photo of damaged supercore in Unit 15.) Unit 15 has not been available to run since it first stalled on August 23, 2022, and LADWP has now confirmed with GE Power Systems that comprehensive repairs are required and will not be completed in time to meet the December 31, 2022 testing deadline.

Unit 15's supercore is the main "core" engine of the LMS100 gas turbine and is the most fundamental and necessary part of power generation. The supercore consists of a High Pressure Compressor, the combustor, the High Pressure Turbine, and the Intermediate Pressure Turbine. The supercore's function is to compress inlet air, mix it with fuel gas, combust the air-gas mixture, and finally exhaust the resulting hot gas after combustion. This exhaust hot gas then drives the High Pressure Compressor (HPC), which in turn forces the Low Pressure Compressor (LPC) in front of the supercore, which then powers the Power Turbine that drives the generator to make electricity.

After the August 23, 2022 stall event, LADWP conducted a boroscope inspection of Unit 15 with GE Power Systems representatives. (See **Exhibit 4**, Boroscope Inspection Report.) After careful research and review, LADWP has determined that Unit 15 had a catastrophic event when a stage 2 or stage 3 blade in the high-pressure compressor broke off and caused extensive damage as it disintegrated and traveled downstream into the engine. The damage was so extensive that the engine could not be rotated for a full inspection, because the blades in the supercore were bent into the vanes.

LADWP's determination regarding the catastrophic failure of Unit 15's supercore is supported by the

Boroscope Inspection Report and visual inspections of the machinery, which have demonstrated that damage can be seen in the HPC starting from stages 3 and downstream, along with impact damage to the Intermediate Pressure Turbine and the Power Turbine. The final supporting piece of information is the fact that a v-seal on the LPC was also found to be loose.

General Electric's LMS100 gas turbine was designed with a modular supercore or main engine. This means that the supercore part was designed to be removable and replaceable, because the supercore is where inlet air is at its highest pressure point (~575-580psi) and where combustion occurs, therefore it is where the most stress and damage can happen. This modular design was intended to allow for an extracted supercore to be sent off for maintenance, while a spare supercore could be installed and the unit restored back to service,

Haynes purchased two additional supercores (878-137 and 878-125), when units 11-16 were first purchased in 2016. At this time, both supercores are damaged and awaiting repairs at the GE Power Systems Houston Service Center, the only facility that is capable of repairing the supercore. (See YouTube Video regarding GE Power Systems Houston Service Center at https://www.youtube.com/watch?v=orZz3WCeGok.)

LADWP believes that supercore 878-125 will be the first of the two damaged spare supercores to be returned. Supercore 878-125 has been with Houston Service Center since 2020 for repairs/replacement of cracked nozzles and was previously due to return to Haynes in July or August 2021. However, prior to shipping, GE performed a final inspection and found that one of the bearing housings in the supercore had developed rust, possibly due to the extended period it has been sitting in the shop. Thus, supercore 878-125 is awaiting these new, additional repairs/replacement of this bearing housing and is expected to return to Haynes on February 24, 2023.

The damaged supercore in Unit 15 will not be removed until a working spare is immediately available to replace it, to ensure proper functioning of the machine. Damaged spare supercore 878-137 is expected to be returned in May 2023. Once the damaged supercore in Unit 15 is removed and sent to the Houston Service Center, LADWP anticipates it will be at least a year before it can be repaired. Due to the specialized nature of the repairs needed, LADWP is unable to perform the repairs or commission any other company to perform the repairs. LADWP is required to send the parts to a GE Power Systems facility and has to abide by their repair schedule.

15. When and how did you first become aware that you would not be in compliance with the rule(s) and/or permit condition(s)?

After the catastrophic event on August 23, 2022, LADWP immediately contacted GE Power Systems. After continuous communications over the next weeks, GE Power Systems notified Haynes management that a new supercore was not available, and that the earliest either of LADWP's two damaged spare supercores could be delivered was October 2022. On November 10, 2022, GE Power Systems revised that date to February 24, 2023. (See **Exhibit 5**, Correspondence with GE Power Systems.)

Even after delivery of a repaired supercore, LADWP will require a minimum of six weeks for installation. For these reasons, LADWP determined that Unit 15 could not be reassembled and restarted in time to meet the December 31, 2022 deadline to conduct the CO RATA, as required by the Title V Permit Conditions and Rules listed in Item No. 9.

16. What actions have you taken since that time to achieve compliance?

After Unit 15 stalled, LADWP immediately halted operations and contacted GE Power System to conduct the boroscope inspection. Once GE Power Systems and LADWP determined the nature and extent of the damage, LADWP immediately engaged General Electric to engage in discussions to repair and/or replace the supercore. After numerous conversations and written requests describing the urgency of the situation, GE Power Systems formally responded that an operable supercore could not be delivered to Haynes until the earliest date of February 24, 2023. As a result of the communications from GE Power Systems, Haynes employees contacted the Environmental Affairs Air Quality Group to request support in securing a variance.

With the expected delivery after February 24, 2023, LADWP has planned and scheduled for the repairs and installation to begin immediately upon delivery of the repaired supercore. To that end, LADWP has already taken inventory of necessary tools and parts, and also created a working timeline for the repairs. In addition, Haynes employees have located a private source test contractor who will be able to perform the CO RATA by the end of the second quarter on June 30, 2023.

Below are the remaining tasks (including but not limited to the installation, repairs, engine restart, and CO RATA testing for Unit 15) that are expected to be completed within a minimum of six weeks following the delivery of the repaired supercore:

1. Extract the damaged supercore. 3-5 days.
2. Extract the Power Turbine. 3-5 days.
3. Remove top-case of the Booster (LPC). 2-3 days.
4. Remove v-seal in the LPC. 1 day.
5. Inspect exposed Booster for other damage, including bearings, oil lines, blades, vanes, etc. 3-5 days process.
6. Repair/replace Booster bearings, if damaged. 1-2 weeks.
7. Install replacement Power Turbine. 3-5 days.
8. Install replacement Supercore. 3-5 days.
9. Alignment of the booster - supercore - power turbine train. 1-2 weeks.
10. Reconnect mechanical, electrical, instrumentation in the Unit 15. ~1 week.
11. Reassembly of the Unit 15 package, including package roof, inlet air ducts, various piping, etc. ~1 week.
12. Haynes Unit 15 Restart.
13. CO RATA Test.

Depending on the extent of the damage, the restoration process of a supercore wreckage can add more than a month of delay to the typical timeframe for repairs.

17. What would be the harm to your business during and/or after the period of the variance if the variance were not granted?

Economic losses: <u>$180,000+</u>

Number of employees laid off (if any): <u>None</u>

Provide detailed information regarding economic losses, if any, (anticipated business closure, breach of contracts, hardship on customers, layoffs, and/or similar impacts).

The permanent inability to operate Unit 15 would result in almost incalculable costs to the residents of the City of Los Angeles. The cost of the unit itself and the ensuing stress on LADWP's ability to generate power would result in hardships to all of LADWP's customers because they would shoulder the burden of paying for all of these costs.

Also, LADWP could be subjected to fines and penalties if this variance is not granted. Although Unit 15 is now schedule to be offline for repairs, LADWP is required to operate and maintain the CEMS, pursuant to the AQMD Rules and Title V permit conditions listed in Item No. 9 of this petition. Thus, LADWP could be subject to a Notice of Violation for the entire duration that the CO RATA is not successfully performed. For a potential six-month time period, LADWP could face a penalty of up to $1,000/day or approximately $180,000 for the entire period the tests have not been performed.

18. Can you curtail or terminate operations in lieu of, or in addition to, obtaining a variance? Please explain.

LADWP has already terminated Unit 15's operations since August 23, 2022, and it is not possible to curtail operations because the unit is out of service.

Even with operations temporarily terminated, LADWP will still require a variance. Since the purpose of this petition is to provide relief from the CO RATA testing due date of December 31, 2022, Unit 15 must have the ability to run again before the CO RATA testing can be conducted.

19. Estimate excess emissions, if any, on a daily basis, including, if applicable, excess opacity (the percentage of total opacity above 20% during the variance period). If the variance will result in no excess emissions, skip to No. 20.

Pollutant	(A) Total Estimated Excess Emissions (lbs/day)	(B) Reduction Due to Mitigation (lbs/day)	(C)* Net Emissions After Mitigation (lbs/day)
None	N/A	N/A	N/A

* Column A minus Column B = Column C

Excess Opacity: 0 %

20. Show calculations used to estimate quantities in No. 19, **or** explain why there will be no excess emissions.

There will be no excess emissions because Unit 15 is not operational and is out of service.

21. Explain how you plan to reduce (mitigate) excess emissions during the variance period to the maximum extent feasible, or why reductions are not feasible.

N/A

22. How do you plan to monitor or quantify emission levels from the equipment or activity(s) during the variance period, and to make such records available to the District? **Any proposed monitoring does not relieve RECLAIM facilities from applicable missing data requirements.**

During the variance period, LADWP will continue to monitor and record emissions through CEMS, which will be operational during the repair of Unit 15.

23. How do you intend to achieve compliance with the rule(s) and/or permit condition(s)? Include a detailed description of any equipment to be installed, modifications or process changes to be made, permit conditions to be amended, etc., dates by which the actions will be completed, and an estimate of total costs.

Compliance will be achieved through relief from the administrative requirement to complete the CO RATA source test by December 31, 2022. If the variance is granted, the CO RATA will be scheduled as soon as is practical following the successful return of Unit 15 to normal operation.

24. State the date by which you expect to achieve final compliance: 4/15/2014. The LADWP requests that the variance take effect on April 1, 2014. We request 30 days of variance coverage in order to provide time to perform the follow up repairs and validate the integrity of the repairs prior to returning the unit to normal operation and performing the ammonia source test.

If the regular variance is to extend beyond one year, you **must** include a **Schedule of Increments of Progress**, specifying dates or time increments for steps needed to achieve compliance. See District Rule 102 for definition of Increments of Progress (see Attachment A, Example #3).

List Increments of Progress here:
N/A

25 List the names of any District personnel with whom facility representatives have had contact concerning this variance petition or any related Notice of Violation or Notice to Comply.

Li Chen Ext. 2426

Scott Caso Ext. 2218

The undersigned, under penalty of perjury, states that the above petition, including attachments and the items therein set forth, is true and correct.

Executed on November 17, 2022, at Los Angeles, California

Katherine Rubin Digitally signed by Katherine Rubin Date: 2022.11.17 16:33:57 -08'00'

Signature

Katherine Rubin
Print Name

Director of Environmental Affairs
Title

EXHIBIT 1

PHOTO OF UNIT 15

[YOU MAY ATTACH ADDITIONAL PAGES IF NECESSARY]

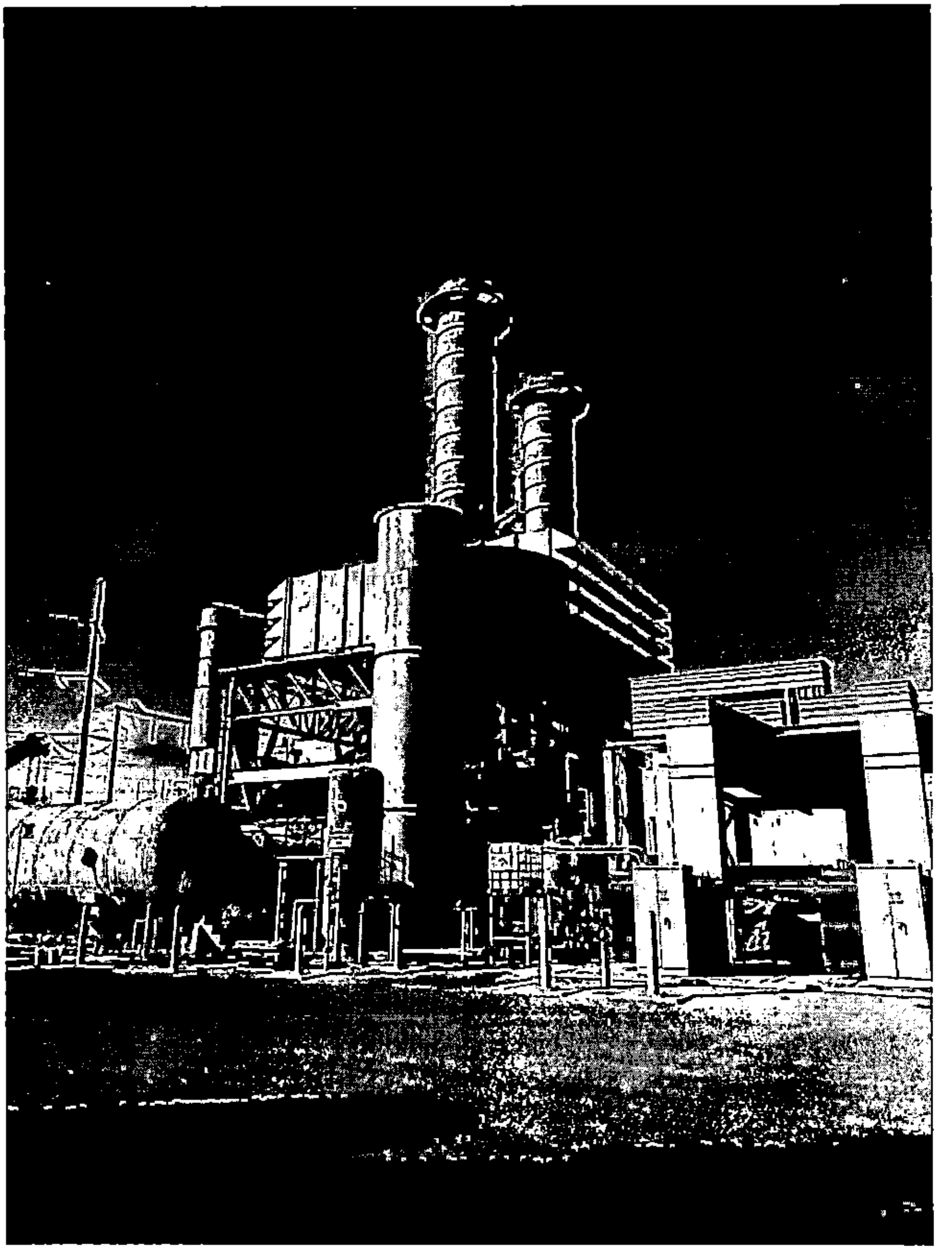
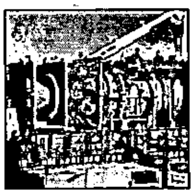


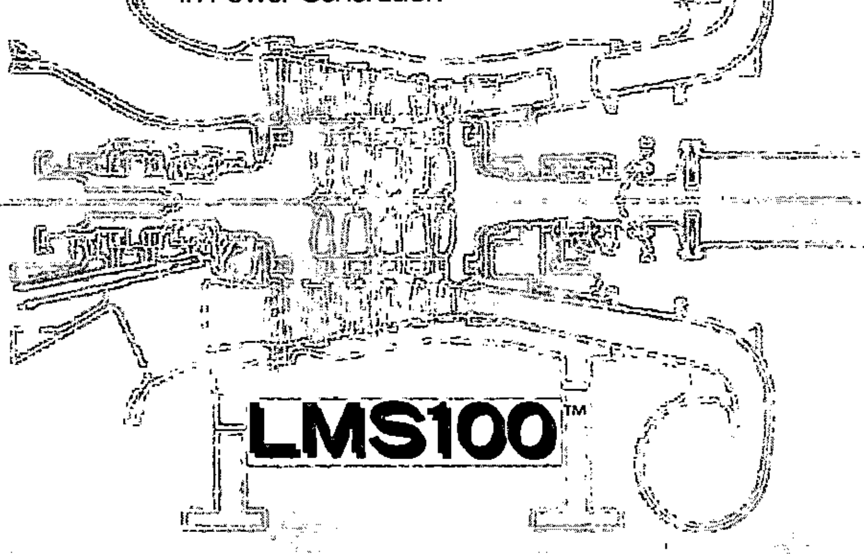
EXHIBIT 2

GE POWER SYSTEMS LMS 100 BROCHURE

The Tradition of Excellence Continues . . .

GE's New Gas Turbine System: Designed to Change the Game in Power Generation





GE Power Systems

GE Power Systems
2707 North Loop West
Houston, TX 77008
Telephone 1-713-803-0900
www.gepower.com

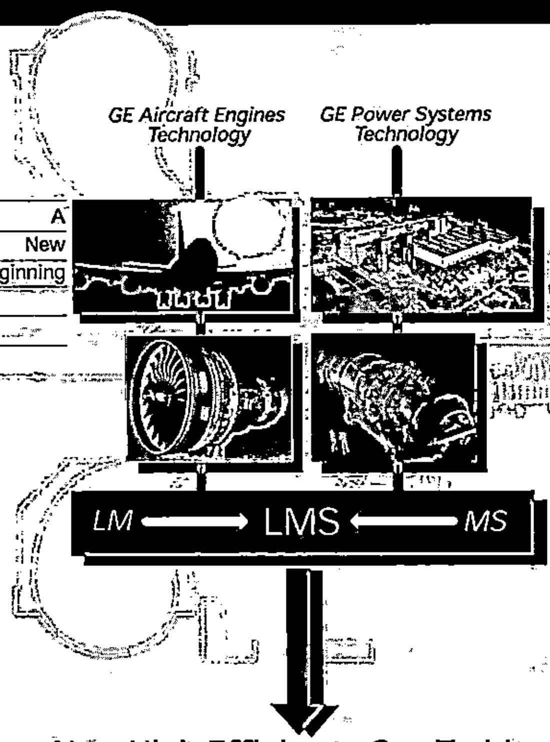
GEA13640 (3M, 11/03)

GE Power Systems

Only GE has the Imagination and Ability to Combine the... **Best of Both Worlds.**

LMS100

A New Beginning



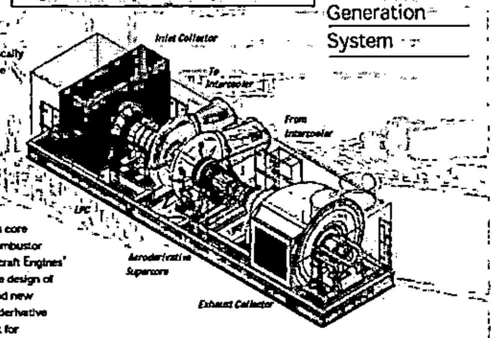
New High Efficiency Gas Turbine
For the Power Generation Industry

The LMS100™ is the first intercooled gas turbine system developed especially for the power generation industry, utilizing the best of two technologies – heavy-duty frame gas turbine and aeroderivative gas turbine technology. The LMS100 will deliver 100MW at 46% thermal efficiency. This efficiency is 10% higher than GE's highest simple cycle efficiency gas turbine available today. It is specifically designed for cyclic applications providing flexible power for peaking, mid-range and baseload.

Flexible Power: High Efficiency

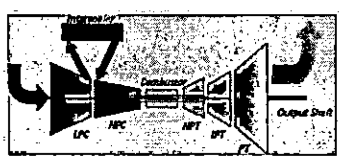
High Part-Power Efficiency, 50% Power	39%
High Simple Cycle Efficiency	46%
High STIG Efficiency	50%
High Combined Cycle Efficiency	54%

GE's New Gas Turbine Power Generation System



Only GE Can Bring You the Best of Both Worlds

The LMS100 features a heavy-duty low pressure compressor derived from GE Power Systems' MS6001FA heavy-duty gas turbine compressor; its core which includes the high pressure compressor, combustor and high pressure turbine is derived from GE Aircraft Engines' CF6-80C2® and CF6-80E1® aircraft engines. The design of the new 2-stage intermediate pressure turbine and new 5-stage power turbine is based on the latest aeroderivative gas turbine technology. The exhaust and aft shaft for hot-end drive are designed using heavy-duty gas turbine practices.



The compressed air from the Low Pressure Compressor (LPC) is cooled in either an air-to-air or air-to-water heat exchanger (Intercooler) and ducted to the High Pressure Compressor (HPC). The cooled flow means less work for the HPC, increased overall efficiency and power output. The cooler LPC exit temperature air, used for turbine cooling, allows higher firing temperatures, resulting in increased power output and overall efficiency.

The Right Solution.

Rugged Design With Proven Components. **LMS100**

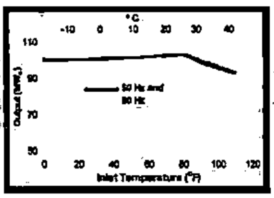
LMS100 Addressing Industry Needs

When asked to describe their requirements for future power generation facilities, customers identified the following items as high on their priority list:

- 100 MW blocks of power
- High efficiency at full and part-power
- Cycling capability
- Fast start
- Peaking capability
- Sustained hot day power
- Fuel flexibility
- Low emissions

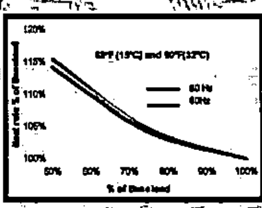
All agreed that a new gas turbine which met these requirements would be an important addition to their generation mix.

- The LMS100 has been designed to specifically address all of these needs, changing the game in the power generating industry.



The LMS100 is the Right Solution:

- Outstanding full- and part-power efficiency
- Low hot-day lapse rate
- High availability — aero modular maintenance
- Low maintenance cost
- Designed for cycling applications
  - *No cost penalty for starts and stops*
  - *Load-following capability*
- 10 Minutes to full power
  - *Improves average efficiency in cycling*
  - *Potential for spinning reserve credits*
  - *Reduced start-up emissions*
- Synchronous condenser capability



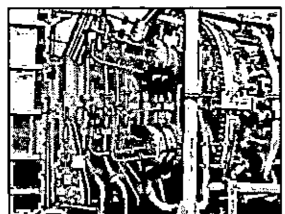
LMS100 Product Features

The LMS100 features an inlet and an LPC comprised of the first six stages of the MS6001FA compressor. These stages are followed by an aerodynamically designed volute which ducts the low pressure compressed air into the intercooler. This LPC provides high airflow capacity for the LMS100 Gas Turbine System.

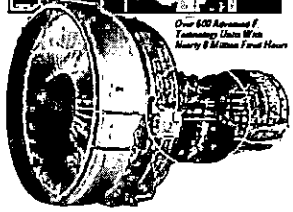
Cooled air from the intercooler is ducted back through another aerodynamically designed volute into the aero supercore. The high efficiency aeroderivative supercore consists of:

- a high pressure compressor (HPC) based on the CF6-80C2 aircraft engine compressor, strengthened for the high (42:1) pressure ratio of the LMS100;
- a combustor which can be either a standard annular combustor (SAC) or an advanced dry low emissions (DLE2) combustor;
- a high pressure turbine (HPT) derived from the CF6-80E1 aircraft engine;
- a 2-stage intermediate pressure turbine (IPT) designed to drive the LPC through a mid-shaft and flexible coupling.

Following the IPT is a 5-stage aerodynamically coupled power turbine (PT) that has been designed specifically for the LMS100. The exhaust frame and aft drive shaft are based on a rugged heavy-duty gas turbine exhaust design.



Over 600 Advanced F Technology Units With Nearly 8 Million Fired Hours



3,788 CF6-80 Engines in Operation With More Than 103 Million Operating Hours

The LPC air is ducted to an air-to-air or air-to-water heat exchanger where it is cooled before being ducted to the HPC. Both designs are industry standard heat exchangers with significant operating hours in multiple industries and are designed to the API 660 and TEMA C standards.

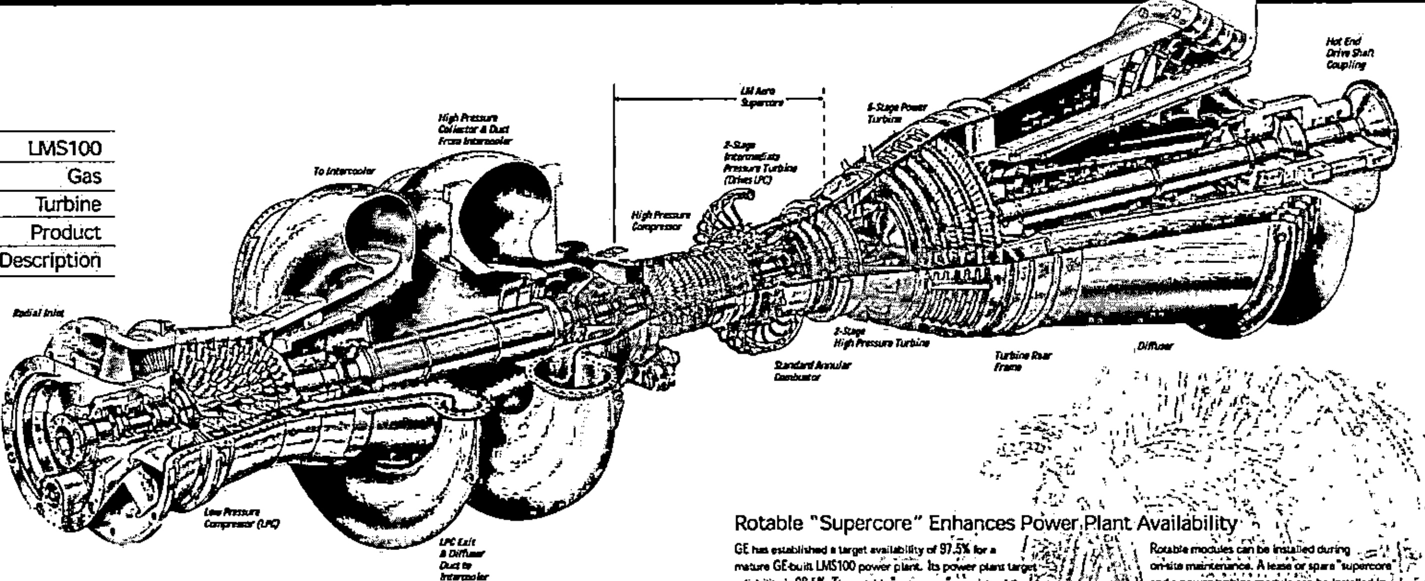
Industrial Example of a Finned Tube Heat Exchanger

Industrial Example of a Tube & Shell Heat Exchanger

Designed for Availability and Maintainability.

LMS100

LMS100
Gas
Turbine
Product
Description



Maintainability Features

- Modular construction permits replacement of the aero components without total disassembly.
- Multiple borescope ports allow on-condition monitoring without turbine disassembly.
- Condition based maintenance and remote diagnostics.
- Split casing construction of the LPC and aeroderivative compressor allows detailed on-site inspection and blade replacement.
- Hot-section field maintenance can be done in several days.
- Accessories are externally mounted for ease of on-site replacement.

Rotable "Supercore" Enhances Power Plant Availability

GE has established a target availability of 97.5% for a mature GE-built LMS100 power plant. Its power plant target reliability is 98.5%. The rotable "supercore" consists of the HPC, Combustor, HPT and IPT modules.

LMS100 Service Intervals

The expected service intervals for the LMS100 based upon normal operation include:

- On-site hot-section replacement....................25,000 fired hours*
- Depot maintenance; overhaul of hot section and inspection of all systems, power turbine overhaul ...50,000 fired hours*
- Next on-site hot section replacement ....75,000 fired hours*
- Depot maintenance....................100,000 fired hours*

Note: These are actual fired hours; no multipliers for cycling are needed.

Rotable modules can be installed during on-site maintenance. A lease or spare "supercore" and a power turbine module can be installed in 24 hours when depot maintenance is required.

Maintenance Services

All warranty and follow-on services for the LMS100 will be provided by GE Power Systems on-site or at its several depot locations around the world. These services can include Contractual Service Agreements, Lease Engines, Spare Parts, Rotable Modules, Training and Training Tools.

Reliability Designed In.

Configured To Meet Your Needs.

LMS100

Package Design

The LMS100 gas turbine package system was designed for reliable operation, easy access for maintenance and quick installation. The auxiliary systems are preassembled on a single skid and factory tested prior to shipment. The auxiliary skid is mounted in front of the turbine base plate utilizing short flexible connectors reducing mechanical interconnects by 25%. The complete gas turbine driver package can be shipped by truck.

LMS100 Plant System Design

While the actual plant layout will be site dependent, it will contain basic elements which include an inlet, an auxiliaries skid containing a water wash system, lube oil system and starter system, a turbine skid, an intercooling system, a generator, silencers, exhaust system and a control system.

Control System

Significant emphasis has been placed on controls design for increased reliability of the entire power plant. The LMS100 control system will have dual channel architecture with a cross-channel data link providing redundancy which will allow multiple failures without engine shutdown. A fiberoptic distributed I/O system located outside the module will be unaffected by electromagnetic or radio frequency interference which will eliminate noisy wiring. Site interconnects are reduced by 90% compared to the typical gas turbine control system.

Fuels

The LMS100 SAC will be equipped with dual fuel capability so that it can burn either natural gas or distillate fuels. The LMS100 DLE will operate on gas fuel.

Emissions Control

The LMS100 gas turbine system has all the advantages of an aeroderivative gas turbine in achieving low emissions. The LMS100 gas turbine with the SAC combustor (using water or steam for NOx control) and the advanced DLE combustor (DLE2) are designed to achieve 25 ppm NOx. This represents a 7 to 18% reduction in mass emissions rate (lbs/kwh) vs. the LM6000. In locations where less than 25 ppm NOx is required a low temperature SCR can be used. The high efficiency of the LMS100 results in exhaust temperatures below 800°F (427°C) which permits the use of low temperature SCRs without tempering air.

Noise Control

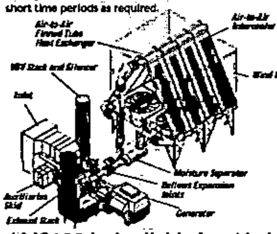
The gas turbine-generator will be rated at 85 dBA average at 3 feet (1 meter). An option for 80 dBA at 3 feet will be available.

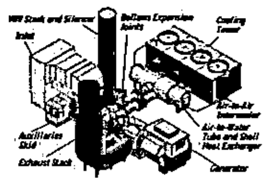
Generator

The generator is dual rated for 50 or 60 Hz applications. Either an air-cooled or TWAC configuration can be provided.

Air-to-Air Intercooler

In locations where water is scarce or very expensive, the basic LMS100 power plant will contain a highly reliable air-to-air intercooler. This unit will be a tube and fin style heat exchanger in an A-frame configuration which is the same as typical steam condensing units in general conformance with API 661 standards. Similar units are in service in the Oil and Gas Industry today. In high ambient temperature climates, an evaporative cooling system can be added for power augmentation. This system would use a small amount of water for short time periods as required.





Air-to-Water Intercooler

In locations where water is readily abundant or less expensive the intercooler can be of the air-to-water type also found in many industrial applications. The intercooler would be a tube and shell type heat exchanger.

Either type of intercooler will be connected through a system of piping and expansion bellows, from the low pressure compressor volute to the intercooler and upon return to the high pressure compressor inlet volute.

LMS100 Plant System Design

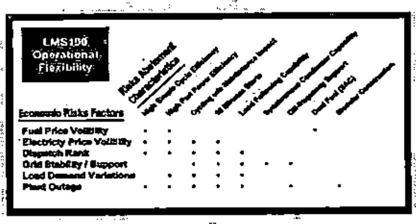
LMS100 is Available in a Variety of Configurations

Four basic LMS100 configurations are available as this product is introduced. When combined with intercooler selection and duty applications, the LMS100 will offer the customer 20 different configuration choices.

LMS100 SYSTEM CONFIGURATIONS

Product Offerings	Fuel	Combustor	Diluent	Power Augmentation	NOx Level
LMS100 SAC, 50/60 Hz	Gas, Liquid or Dual Fuel	Single Annular (SAC)	Water	None	25 ppm
LMS100 SAC Steam, 50/60 Hz	Gas	Single Annular (SAC)	Steam	None	25 ppm
LMS100 SAC STIG, 50/60 Hz	Gas	Single Annular (SAC)	Steam	Steam Injection	25 ppm
LMS100 DLE, 50/60 Hz	Gas	DLE2	None	None	25 ppm

LMS100 Applications For Power Generation



The attributes of the LMS100 make it a versatile power generation system offering customers increased operational flexibility in a wide variety of applications:

■ **Simple Cycle / Peaking & Mid-Range**...high efficiency, low first cost, sustained hot day power, 10-minute starts and no maintenance penalty for cycling, yield the ideal peaking solution. Throw in high part-power efficiency and load following capability to get high dispatch capability for mid-range applications.

■ **STIG** ...steam injection for power augmentation provides significant efficiency and power improvements, as well as flexibility. With variable STIG, an operator can inject all of the steam into the gas turbine or pass the steam to process to take advantage of electricity prices or process steam value.

■ **Combined Cycle** ...the low exhaust temperature leads to lower cost exhaust system materials, smaller steam turbines, condensers and generators, leading to a lower steam plant installed cost.

Another benefit from the lower exhaust temperature is more power from duct firing (up to 30MW).

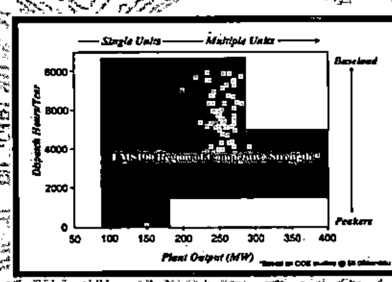
■ **Combined Heat & Power** ...the high power-to-steam ratio allows the LMS100 to meet the steam demand served by 40-50MW gas turbines while delivering more than twice the power. Using both exhaust and air-to-water intercooler energy, an LMS100 plant can reach >85% thermal efficiency.

■ **50Hz and 60Hz Applications** ...the LMS100 can operate at 50Hz and 60Hz operation without a gearbox, reducing system complexity, plot size and cost, while increasing reliability.

■ **Off-Frequency Operation** ...the LMS100 will operate with very little power variation for up to 5% reduction in grid frequency allowing grid support in times of high demand and load fluctuations.

When your power generation need exceeds 100MW, the LMS100 can provide an economic solution in a multi-unit arrangement by providing high efficiency power with unmatched flexibility.

LMS100 Provides Outstanding Customer Value in 80+ MW Applications

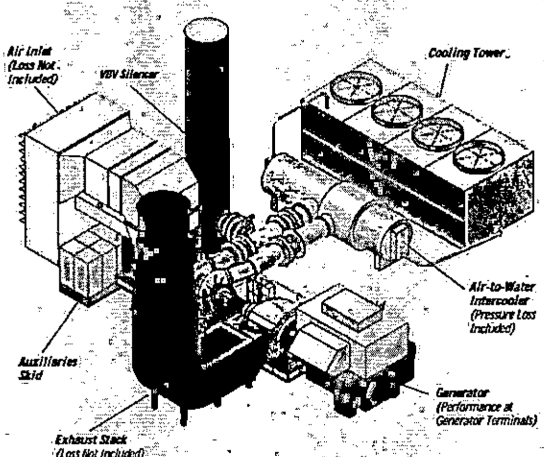


LMS100 ISO Performance Data

Simple Cycle Gas Turbine 60Hz Applications

Model	Output (MWe)	Heat Rate (BTU/KWH)	Efficiency %
DLE	98.7	7509	46
SAC (w/Water)	102.6	7813	44
SAC (w/Steam)	102.1	7167	48
STIG	112.2	6845	50

Conditions:
Performance at the generator terminals
NOx = 25 ppm
59°F, 60% Relative Humidity
Losses: 0"/0" inlet/exhaust
Fuel: Spec. Gas (LHV = 19000 BTU/lb)

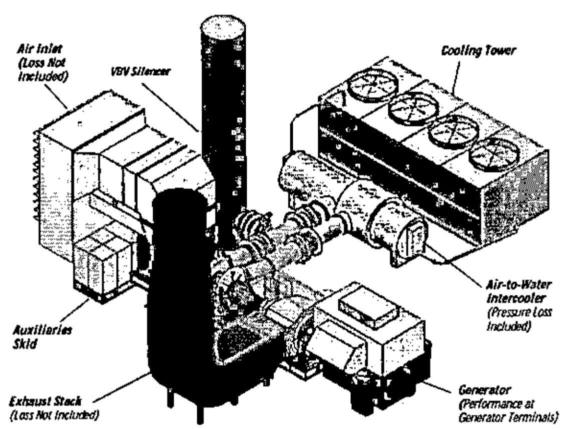


LMS100 ISO Performance Data

Simple Cycle Gas Turbine 50Hz Applications

Model	Output (MWe)	Heat Rate (KJ/KWH)	Efficiency %
DLE	99	7921	45
SAC (w/Water)	102.5	8247	44
SAC (w/Steam)	102.2	7603	47
STIG	110.8	7263	50

Conditions:
Performance at the generator terminals
NOx = 25 ppm
15°C, 60% Relative Humidity
Losses: 0mm/0mm inlet/exhaust
Fuel: Spec Gas (LHV = 44.2MJ/KG)



GEA13640-1 (11/03)

EXHIBIT 3

PHOTO OF DAMAGED SUPERCORE IN UNIT 15

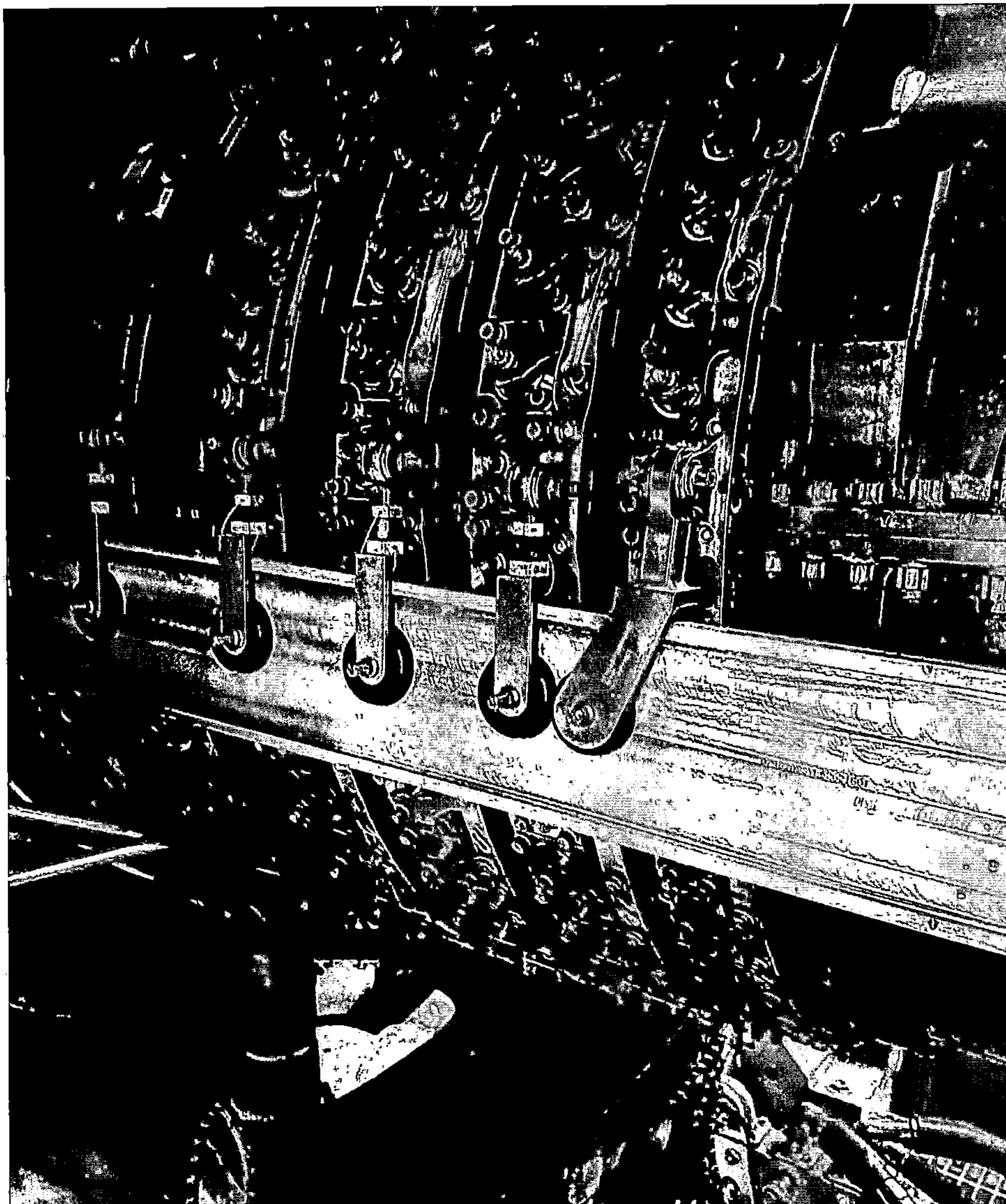


EXHIBIT 4

BOROSCOPE INSPECTION REPORT

[YOU MAY ATTACH ADDITIONAL PAGES IF NECESSARY]

LMS100 PA (SAC)

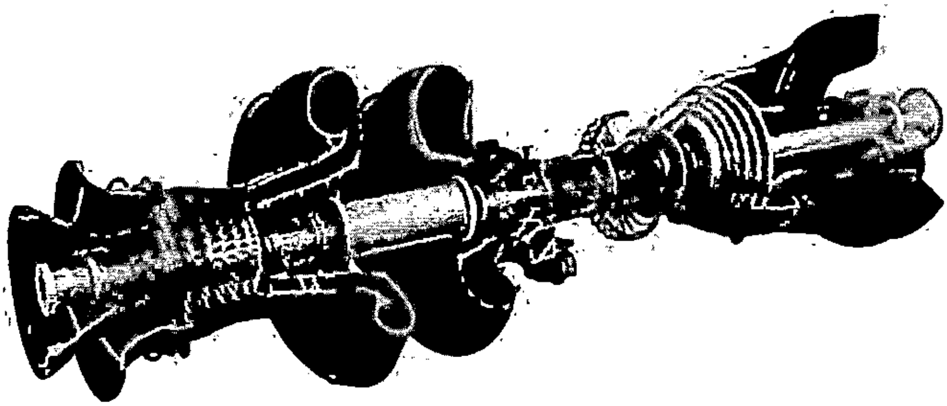
Borescope Inspection Report

Haynes

Site: Haynes
Unit 15
ESN 878-189

Oracle Project Number (OPN) 7309919
PowerMax Number (PMx) I01-083597

Customer Representative: Anh Tuan Le
GE Service Representative: Todd Mckenzie



LMS100 PA (SAC)

Purpose of visit:

The purpose of this visit was to perform a Stall Investigation.

Engine Serial Number 878-189 is **not available** for continued operation and is considered **not serviceable.**

Detail Findings Main Concerns:	Damage to HPC from stage 3 aft. Damage to IPT. Damage to PT.
PAC Number (if available):	
Notifications (CSL/CPM/PM/ENGR/or FieldCore SM/RM):	Frank Gamez, Mike Camp

Follow Up Action Items for Engineering:

Follow Up Action Items CSL/CPM/PM:

Outage Data

Engine Data:

Engine /Package Hours and Fired Starts were obtained from: **Customer's Logbook**

ESN	878189	**Engine Fired Hours**	7803
Model	LMS100 PA (SAC)	**Engine Fired Starts**	1338
Engine Cycles		**Package Hours**	

Maintenance Data:

WP, SB, SL, PB, PL Performed	Manual/Revision Number	Date WP completed	Comments
WP 4014 00 (Booster)	GEK 112166 REV 15	08-27-22	**Serviceable**
WP 4015 00 (Super Core)	GEK 112166 REV 15	08-27-22	**Not Serviceable**

Parts Data:

LMS100 PA (SAC)

Description	Part Removed	SN Removed	Qty	Disposition	PN Installed	SN Installed

DETAILS AND DATA

Work performed:

- **Intercooler - Intercooler appears to be leaking water at end cap gasket.**
- **Booster - Inspected booster. Found V seal aft of stage 5 has started to come out of groove. Is rubbing on casing.**
- **Inlet Gear Box (IGB): Not inspected.**
- **High Pressure Compressor Module (HPC)**
- **HPC Stage 1 Blade: Midspans Not inspected.**
- **HPC Blades/ Vanes: Areas form stage 3 aft has severe damage.**
- **Combustor: No issues noted.**
- **Igniters: No issues noted**
- **Fuel Nozzles: None removed for this inspection.**
- **High Pressure Turbine Module (HPT): Limited inspection due to being unable to turn rotor.**
- **HPT Stage 1 Nozzle**
- **HPT Stage 1 Blade**
- **HPT Stage 1 Shrouds**
- **HPT Stage 2 Nozzle**
- **HPT Stage 2 Blades**
- **HPT Stage 2 Shrouds**
- **HPT Borescope plugs**

- **Intermediate Power Turbine Module (IPT): Impact Damage to IPT**

- **Stage 1 Blades**
- **Stage 1 Nozzles**
- **Stage 1 Shrouds**
- **Stage 2 Blades**
- **Stage 2 Nozzles**
- **Stage 2 Shrouds**
- **IPT Borescope Plugs**

- **Power Turbine Module (PT): Impact damage to PT.**

- **Stage 1 Blades**
- **Stage 1 Nozzles**
- **Stage 2 Blades**
- **Stage 2 Nozzles**
- **Stage 3 Blades**
- **Stage 3 Nozzles**
- **Stage 4 Blades**
- **Stage 5 Blades**
- **PT Borescope Plugs**

CONCLUSIONS

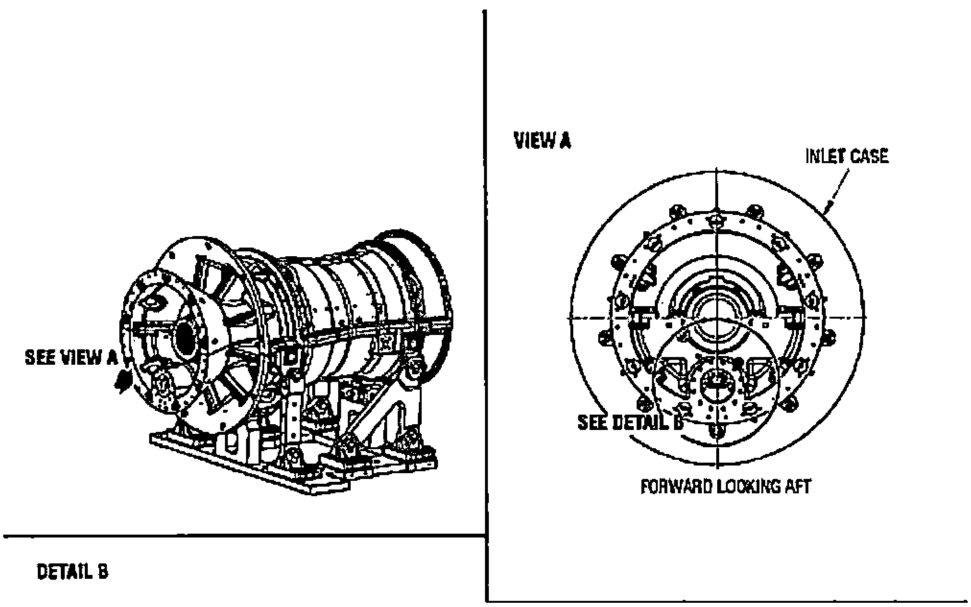
- **HPC, IPT, and PT have impact damage.**

LMS100 PA (SAC)

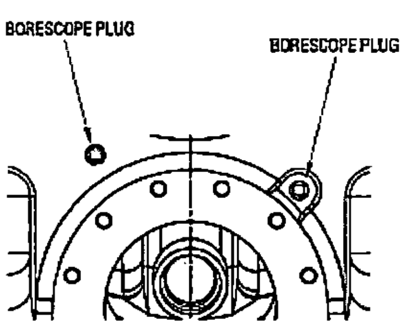
Booster Borescope Inspection:

J1 Hydraulic Hose Inspection: Not Inspected at this visit.

J1 Hydraulic Hose Inspection
Inspection Area: All comments will be made at picture blocks, and details/data block section of report.
Inspect J1 hoses per WP 4014 00.
Inspect hoses for fraying.
Inspect hoses for chaffing.
Inspect hoses for ruptures and leaks.



DETAIL B

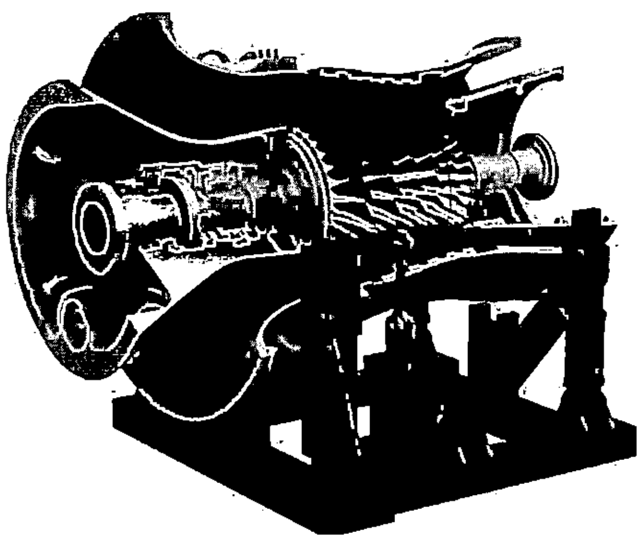


J1 Hydrualic Hose Ports

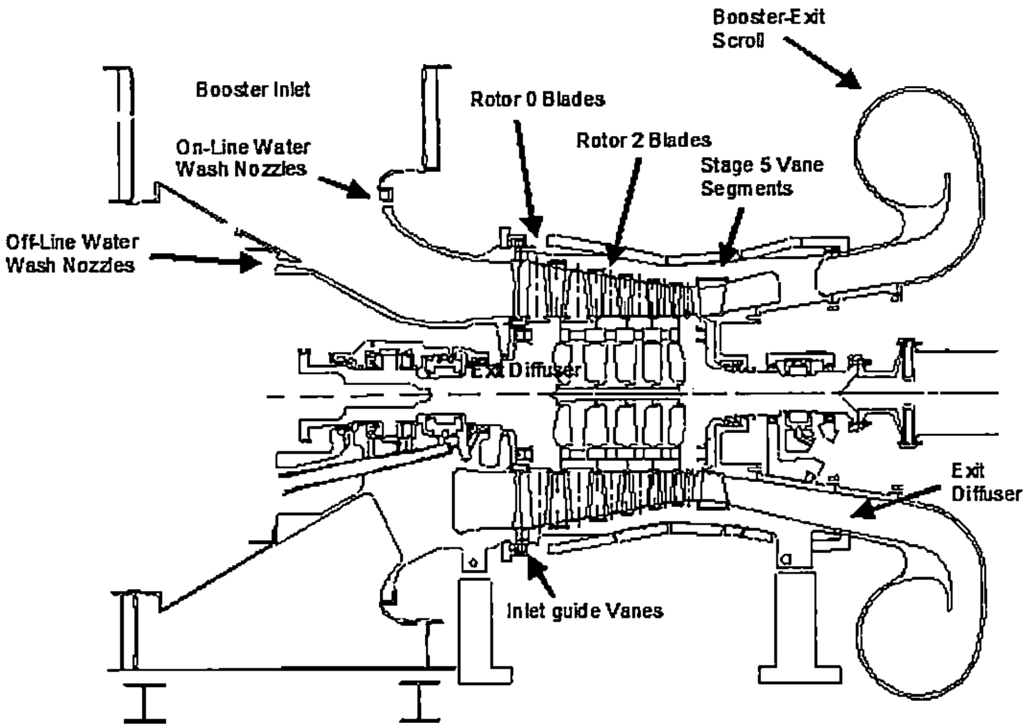
LMS100 PA (SAC)

Booster Borescope Ports :

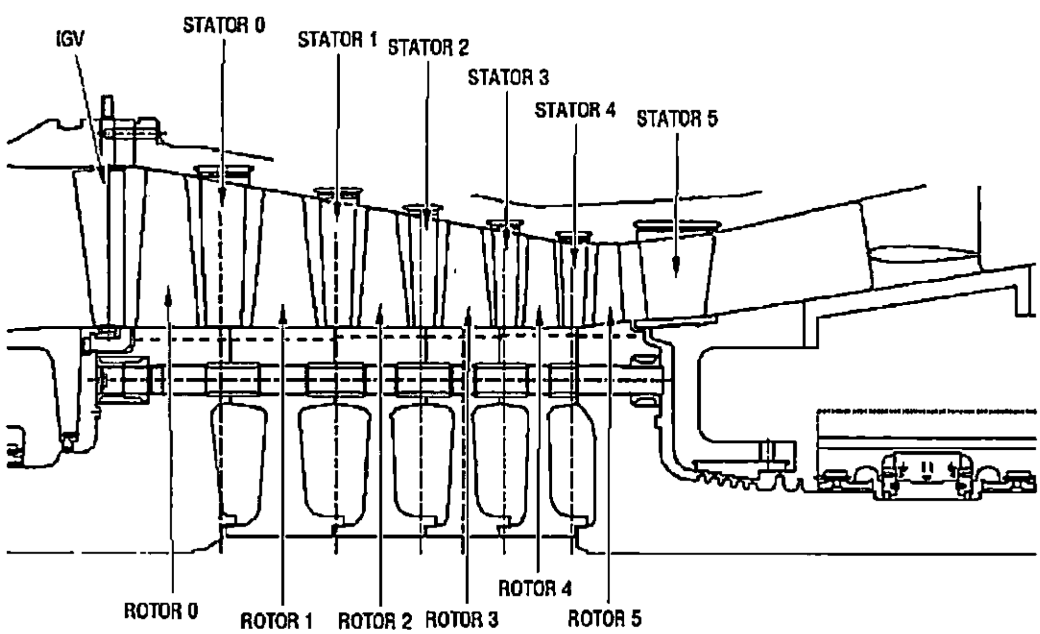
Booster
Inspection Area: All comments will be made at picture blocks, and details/data section of report.
Inspect stages 0 through 5 blades and vanes for cracks, nicks, burrs, tears, curl, missing material, dents, scratches, pits.
VIGV flaps from inlet plenum or BSI ports BS1.
Stage 0 Blades & Stators, BSI port BS2.
Stage 1 Blades & Stators, BSI port BS3.
Stage 2 Blades & Stators, BSI port BS4.
Stage 3 Blades & Stators, port BS5.
Stage 4 Blades & Stators, port BS6.
Stage 5 Blades & Stators, port BS7.
Inspect for airfoils erosion, corrosion, or deposits.
Limited view of all Blades and Vanes.



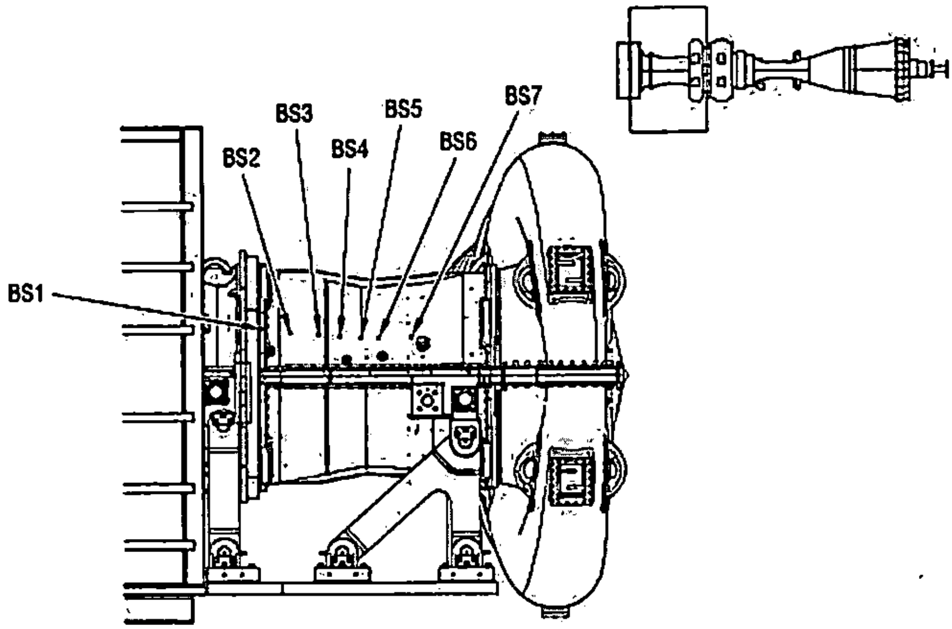
Booster Module



Booster Module

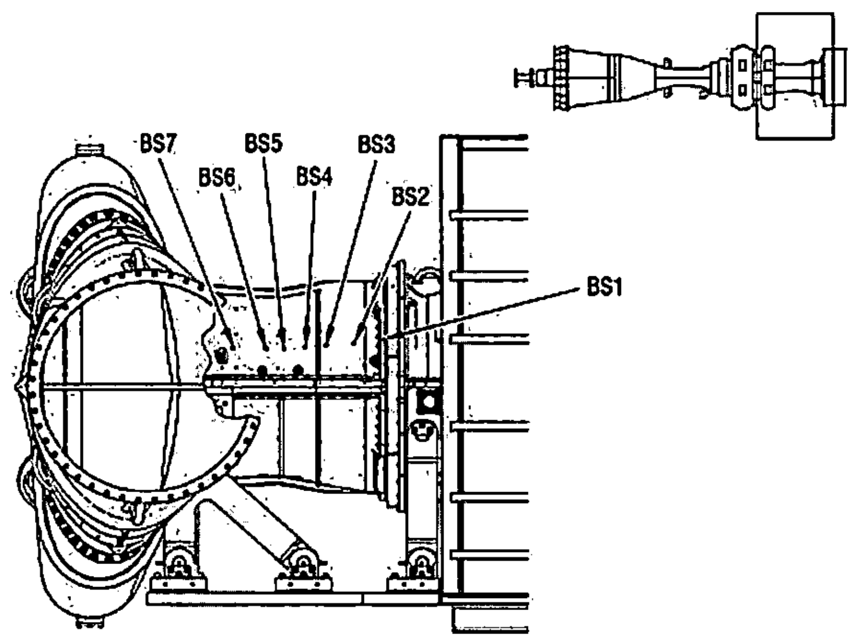


LEFT SIDE



Booster Borescope Ports

RIGHT SIDE



Inspection Details

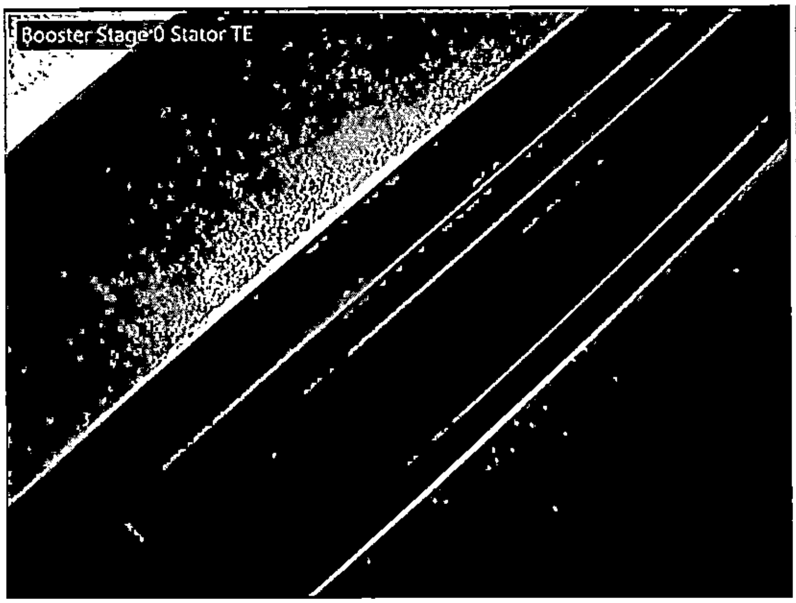
Menu Directed	LMS100PA
Engine Serial Number	878-189
Date	25 08 2022
Time	12:47:29

Inspection Summary

☐ No Images ☐ No Flagged Images ■ Flagged Images

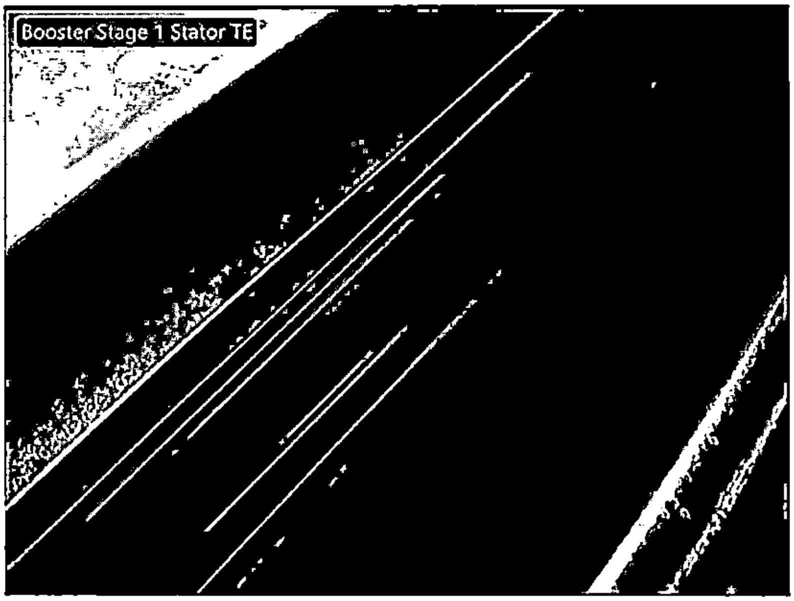
	Inspection Points	Images	Flagged Images
☐ **Engine Data Plate**	0	0	0
☐ **Booster**	27	22	0
☐ **Inlet Gearbox (IGB)**	0	0	0
☐ **HPC**	32	41	0
☐ **Comb**	9	5	0
☐ **Fuel Nozzle**	0	0	0
☐ **HPT**	16	5	0
☐ **IPT**	10	14	0
☐ **Power Turbine**	22	9	0

LMS100 PA (SAC)



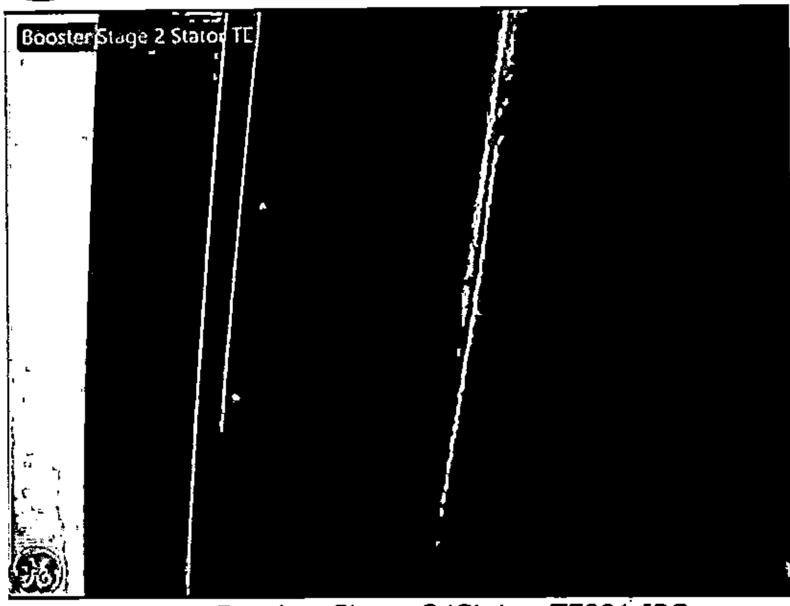
Booster_Stage_0_Stator_TE001.JPG

	Booster
	Stage 0
	Stator
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	



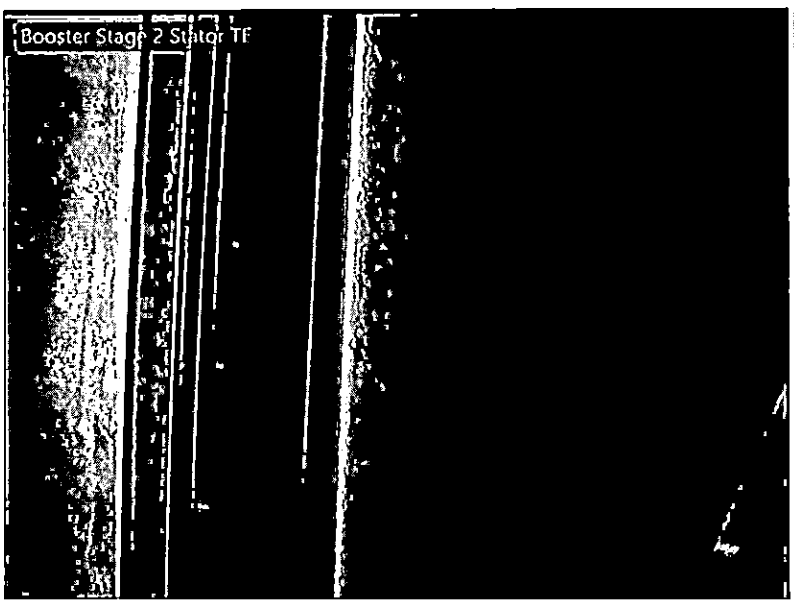
Booster_Stage_1_Stator_TE001.JPG

	Booster
	Stage 1
	Stator
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	



Booster_Stage_2_Stator_TE001.JPG

	Booster
	Stage 2
	Stator
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	

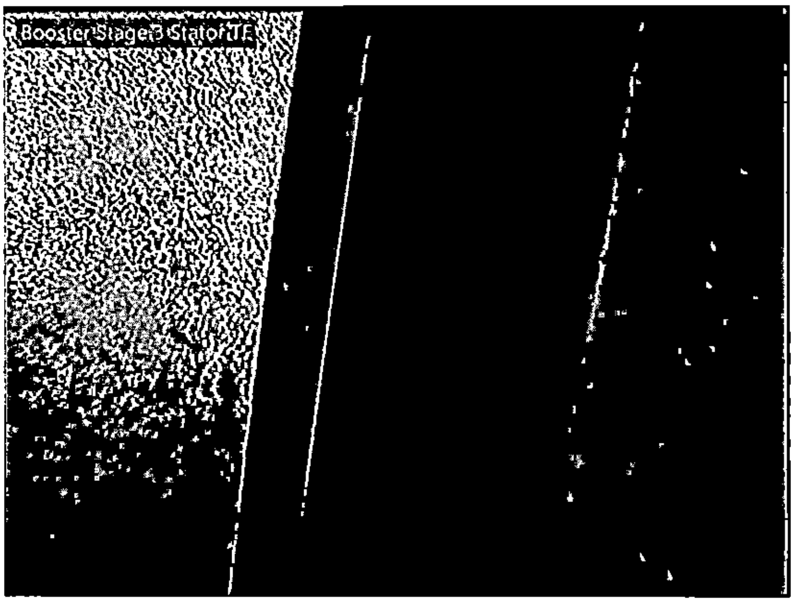


Booster_Stage_2_Stator_TE002.JPG

	Booster
	Stage 2
	Stator
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	

Booster_Stage_3_Stator_TE001.JPG

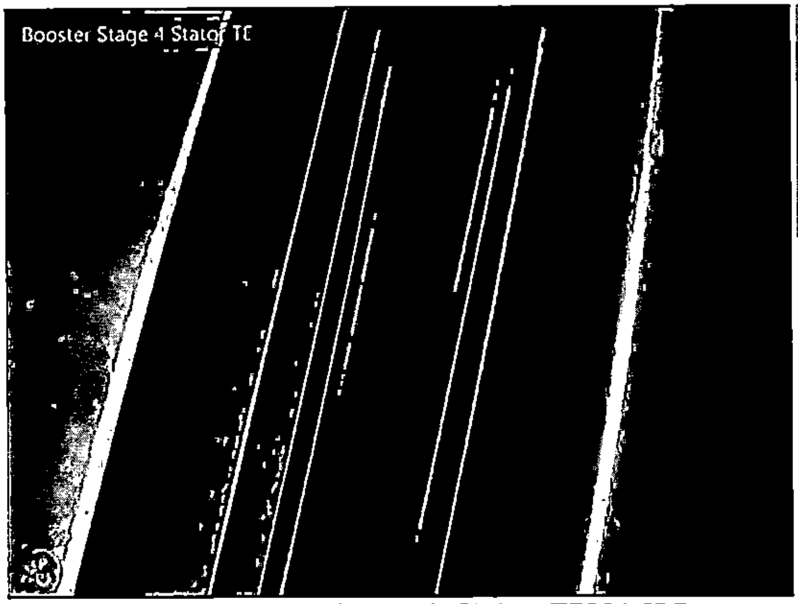
	Booster
	Stage 3
	Stator
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	



Booster_Stage_3_Stator_TE002.JPG

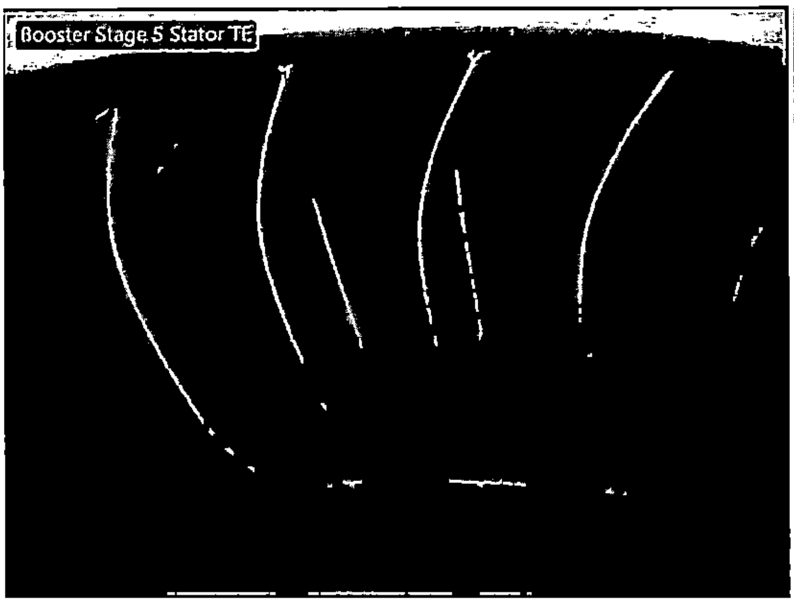
	Booster
	Stage 3
	Stator
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	

LMS100 PA (SAC)



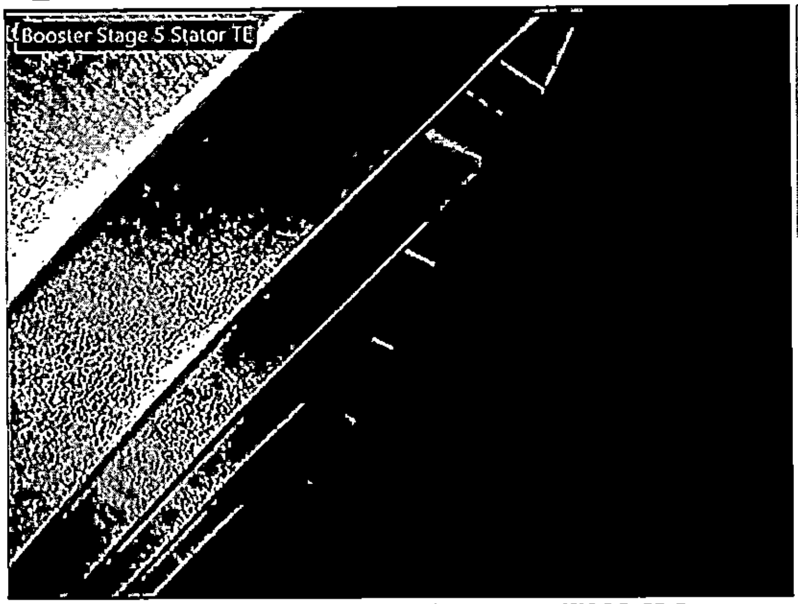
Booster_Stage_4_Stator_TE001.JPG

	Booster
	Stage 4
	Stator
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	



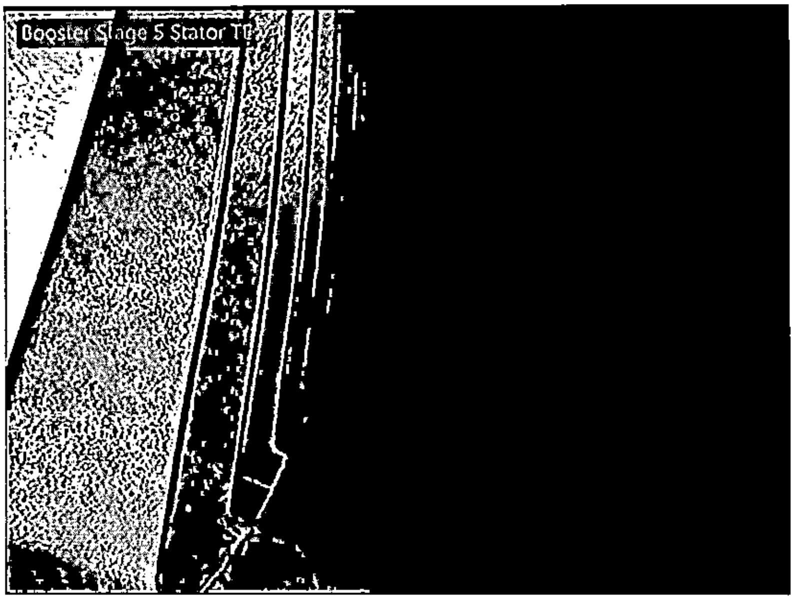
Booster_Stage_5_Stator_TE001.JPG

	Booster
	Stage 5
	Stator
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	



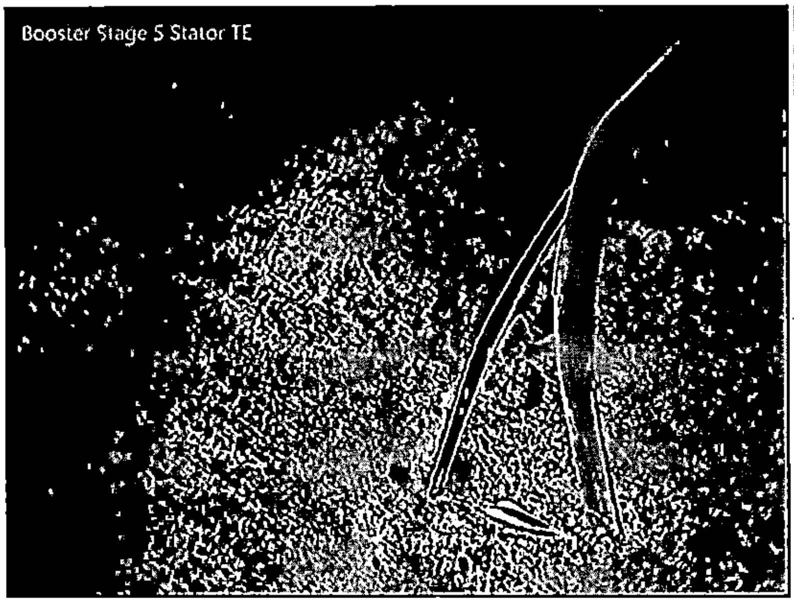
Booster_Stage_5_Stator_TE002.JPG

	Booster
	Stage 5
	Stator
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	



Booster_Stage_5_Stator_TE004.JPG

	Booster
	Stage 5
	Stator
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	

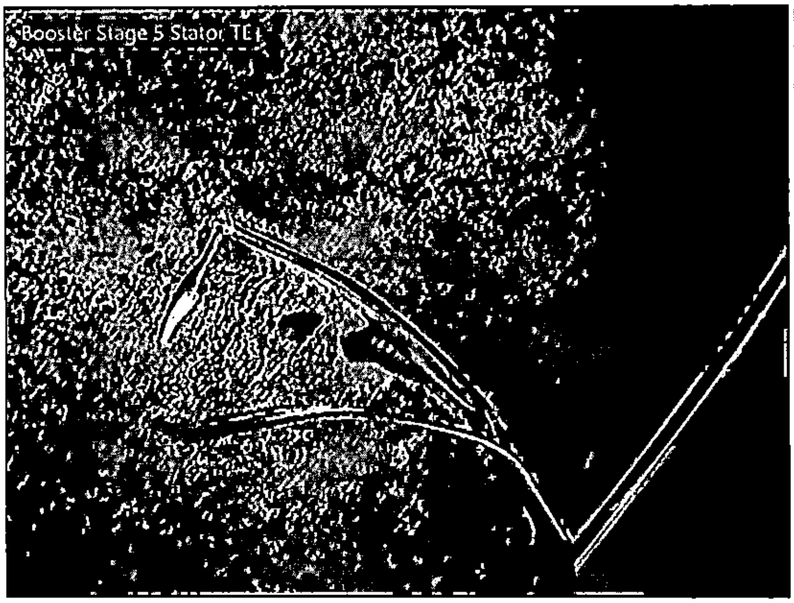


Booster_Stage_5_Stator_TE006.JPG

	Booster
	Stage 5
	Stator
Location	TE
Defect	Protruding V Seal
Comments	

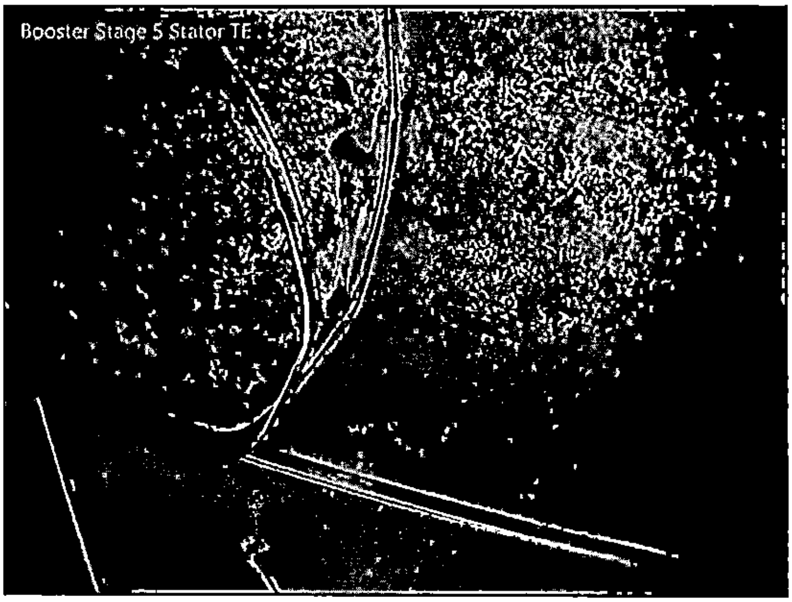
Booster_Stage_5_Stator_TE007.JPG

	Booster
	Stage 5
	Stator
Location	TE
Defect	Protruding V Seal
Comments	



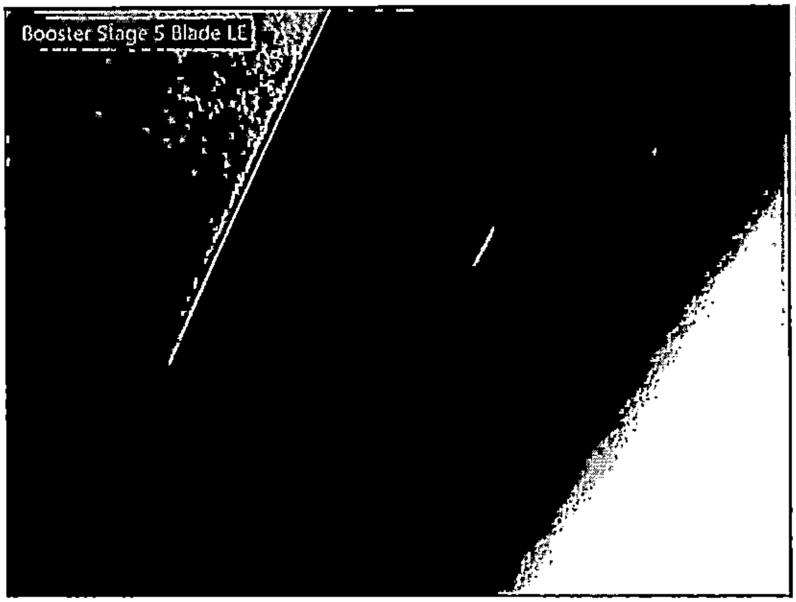
Booster_Stage_5_Stator_TE008.JPG

	Booster
	Stage 5
	Stator
Location	TE
Defect	Protruding V Seal
Comments	



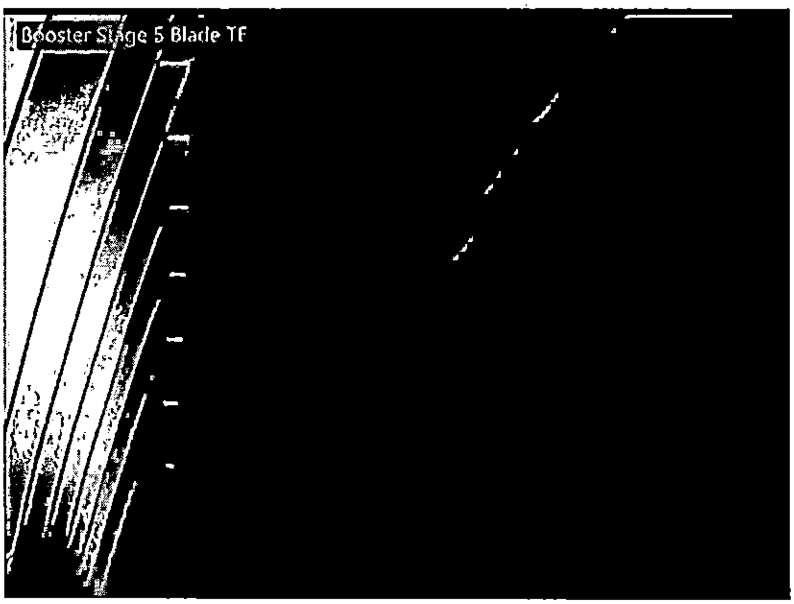
Booster_Stage_5_Stator_TE009.JPG

	Booster
	Stage 5
	Stator
Location	TE
Defect	Protruding V Seal
Comments	



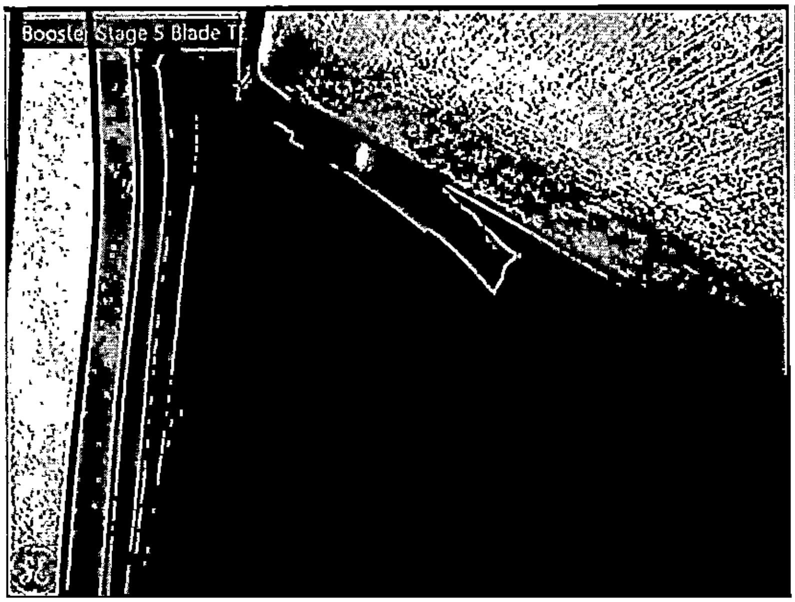
Booster_Stage_5_Blade_LE001.JPG

	Booster
	Stage 5
	Blade
Location	LE
Defect	NO DEFECTS - SERVICEABLE
Comments	



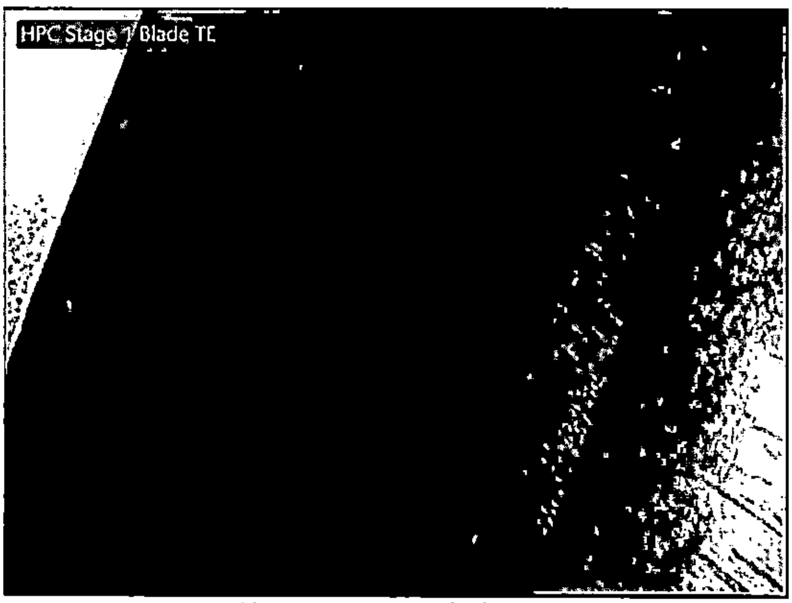
Booster_Stage_5_Blade_TE001.JPG

	Booster
	Stage 5
	Blade
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	



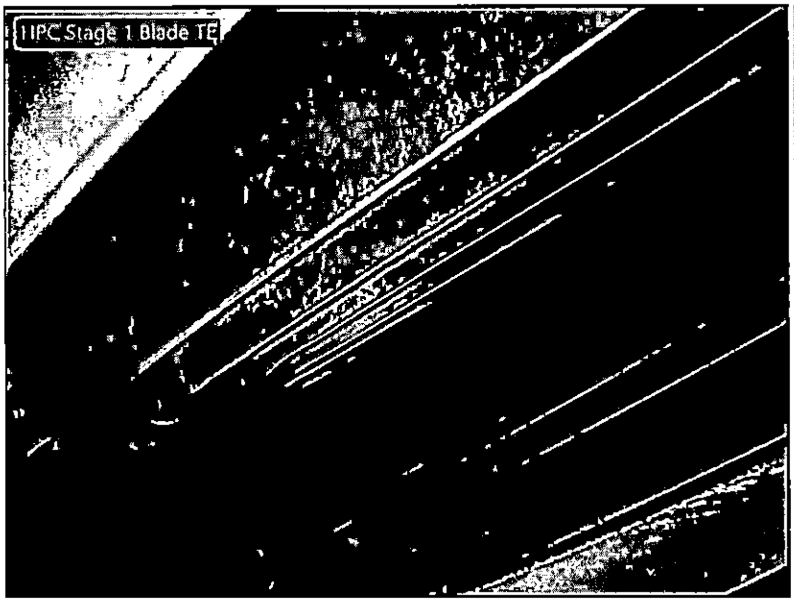
Booster_Stage_5_Blade_TE002.JPG

	Booster
	Stage 5
	Blade
Location	TE
Defect	Protruding V Seal
Comments	



HPC_Stage_1_Blade_TE001.JPG

	HPC
	Stage 1
	Blade
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	

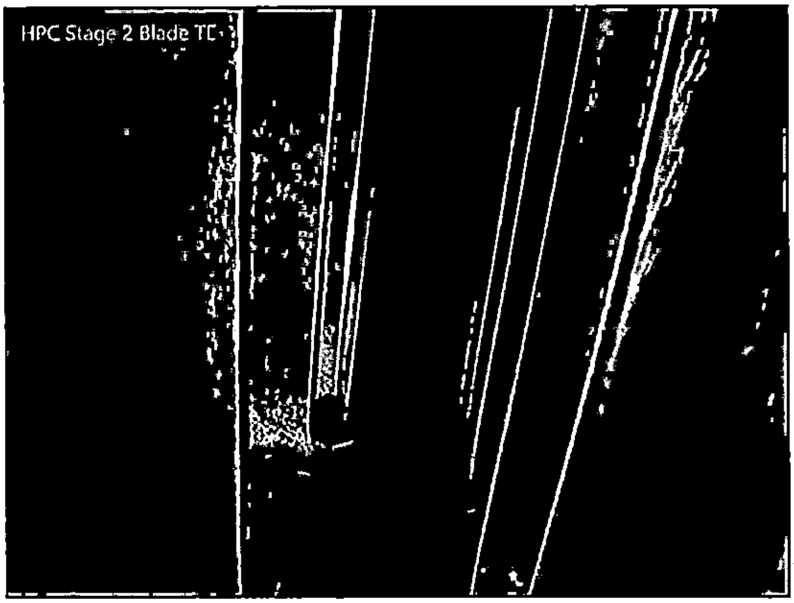


HPC_Stage_1_Blade_TE002.JPG

	HPC
	Stage 1
	Blade
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	

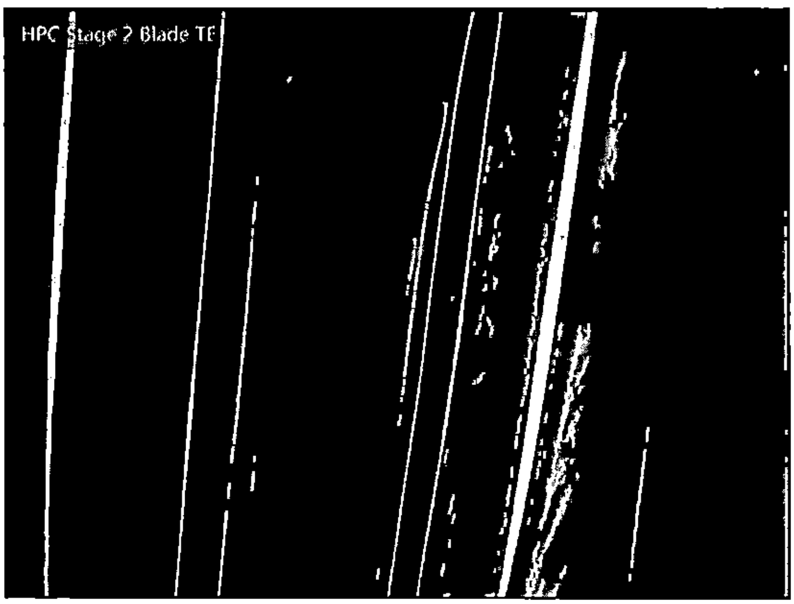
HPC_Stage_1_Blade_TE003.JPG

	HPC
	Stage 1
	Blade
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	



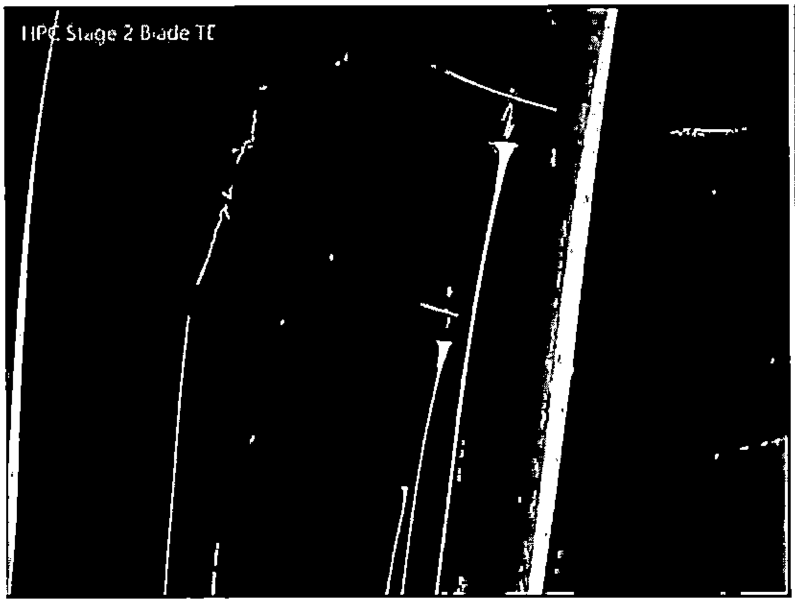
HPC_Stage_2_Blade_TE004.JPG

	HPC
	Stage 2
	Blade
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	



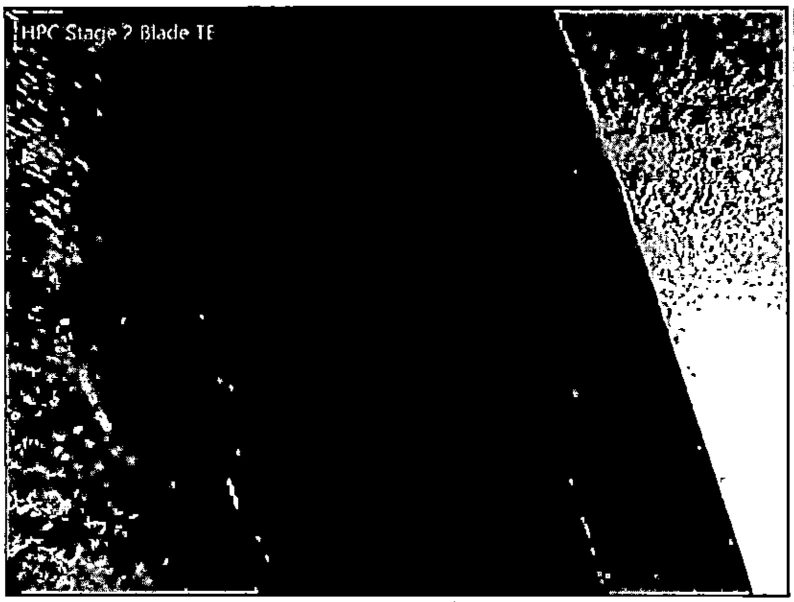
HPC_Stage_2_Blade_TE005.JPG

	HPC
	Stage 2
	Blade
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	



HPC_Stage_2_Blade_TE006.JPG

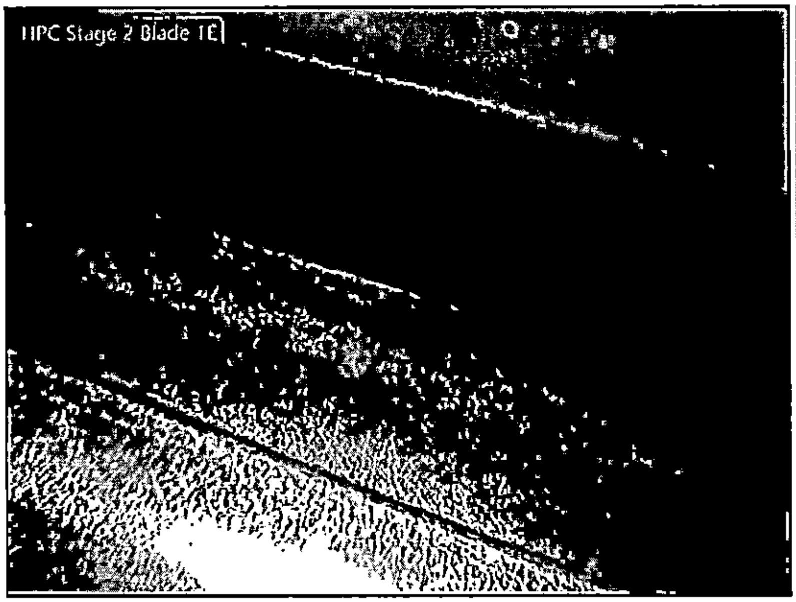
	HPC
	Stage 2
	Blade
Location	TE
Defect	RUB
Comments	



HPC_Stage_2_Blade_TE007.JPG

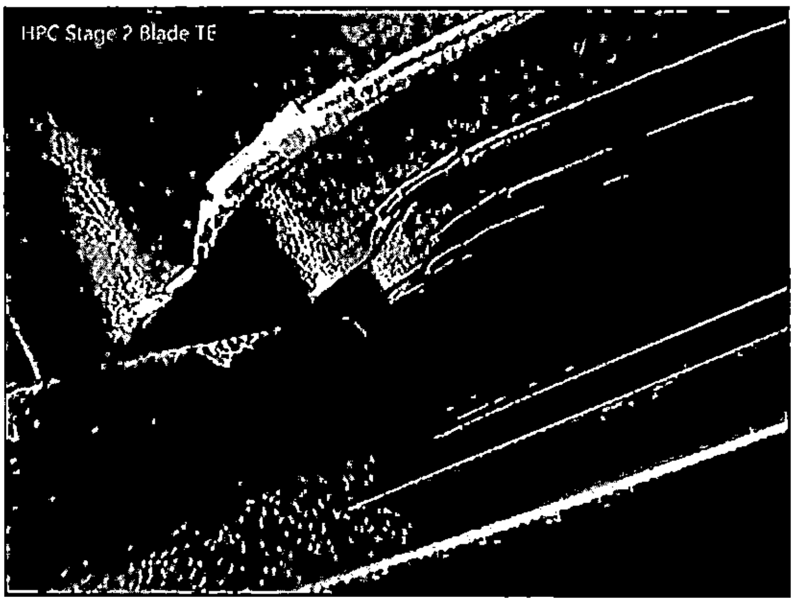
	HPC
	Stage 2
	Blade
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	

LMS100 PA (SAC)



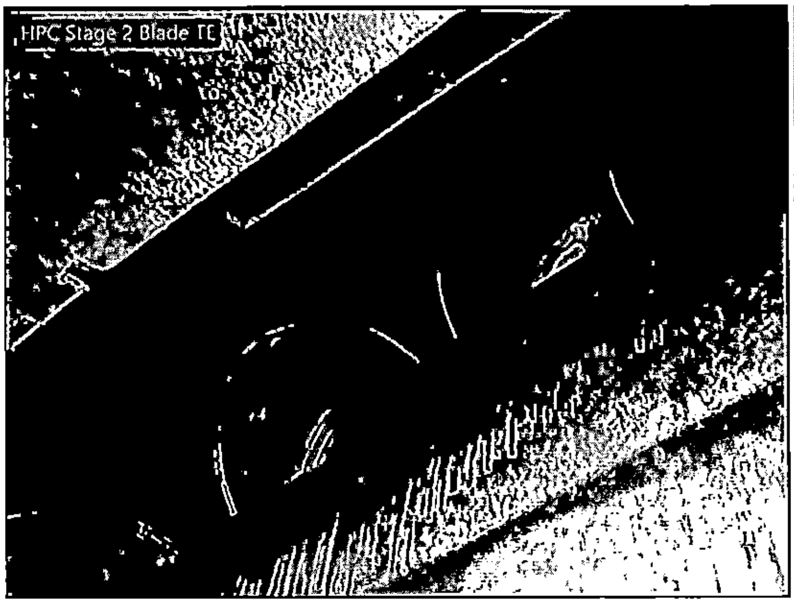
	HPC
	Stage 2
	Blade
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	

HPC_Stage_2_Blade_TE008.JPG



	HPC
	Stage 2
	Blade
Location	TE
Defect	TEAR
Comments	

HPC_Stage_2_Blade_TE009.JPG

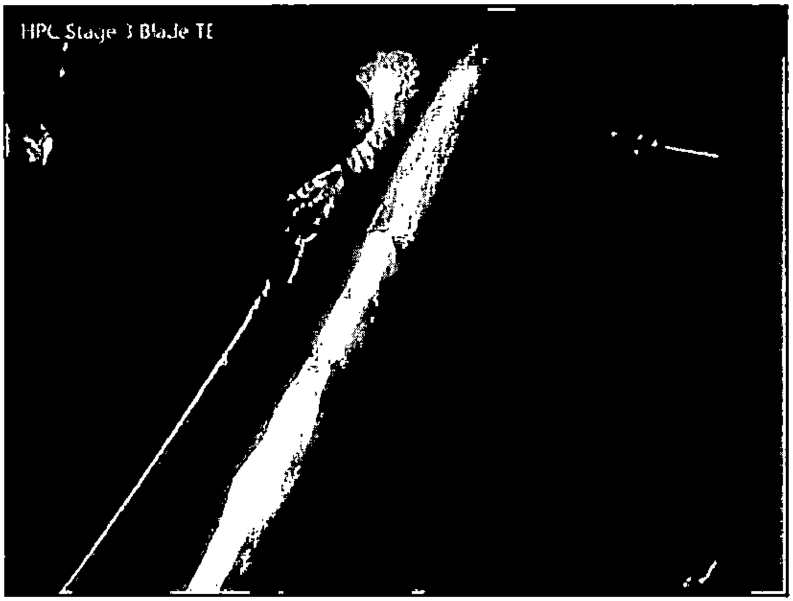


HPC_Stage_2_Blade_TE010.JPG

	HPC
	Stage 2
	Blade
Location	TE
Defect	DENT
Comments	

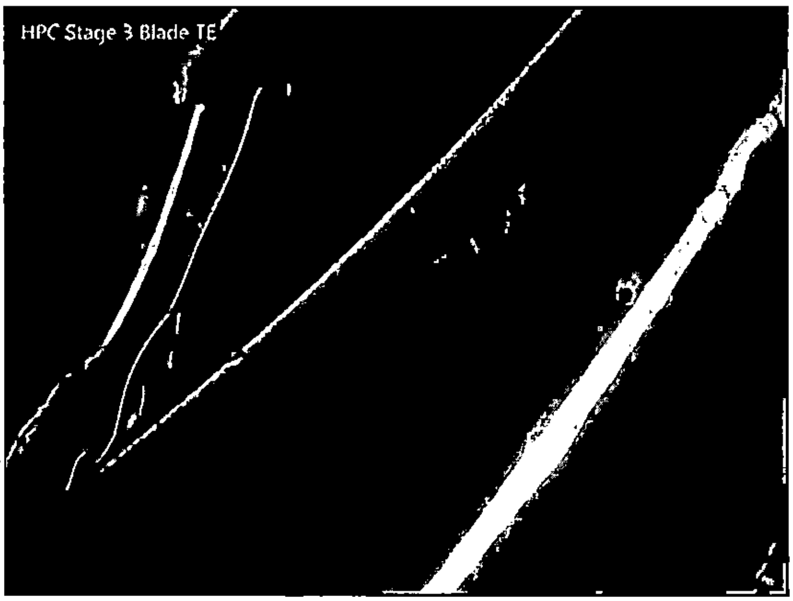
HPC_Stage_3_Blade_LE002.JPG

	HPC
	Stage 3
	Blade
Location	LE
Defect	Missing Material
Comments	



HPC_Stage_3_Blade_TE002.JPG

	HPC
	Stage 3
	Blade
Location	TE
Defect	TEAR
Comments	

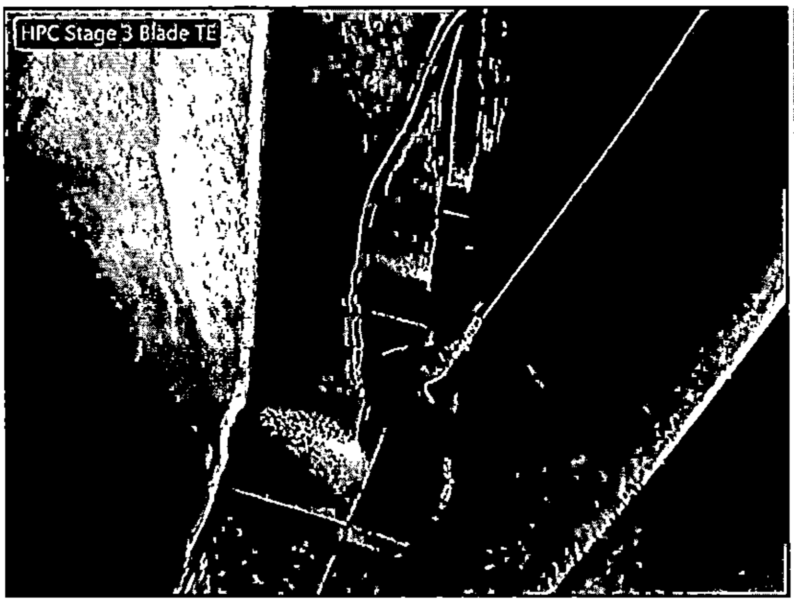


HPC_Stage_3_Blade_TE003.JPG

	HPC
	Stage 3
	Blade
Location	TE
Defect	TEAR
Comments	

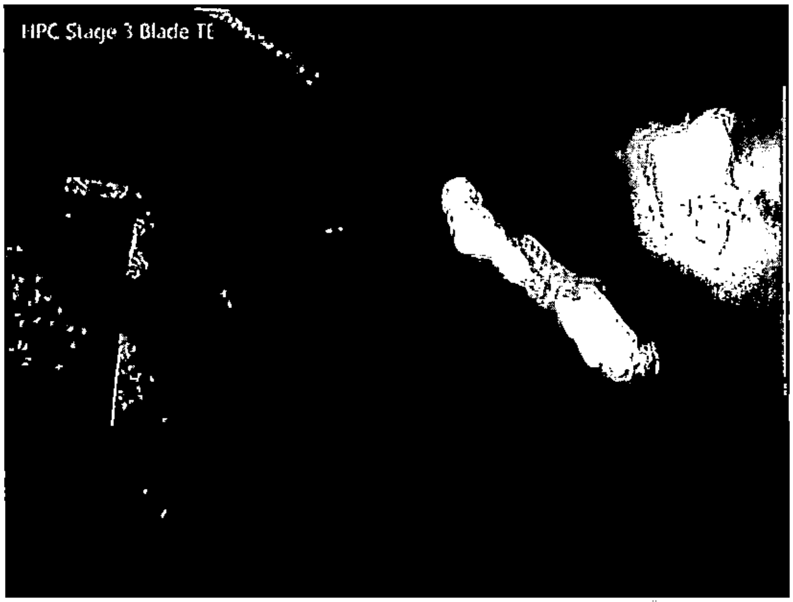
HPC_Stage_3_Blade_TE004.JPG

	HPC
	Stage 3
	Blade
Location	TE
Defect	TEAR
Comments	



HPC_Stage_3_Blade_TE005.JPG

	HPC
	Stage 3
	Blade
Location	TE
Defect	TEAR
Comments	



HPC_Stage_3_Blade_TE006.JPG

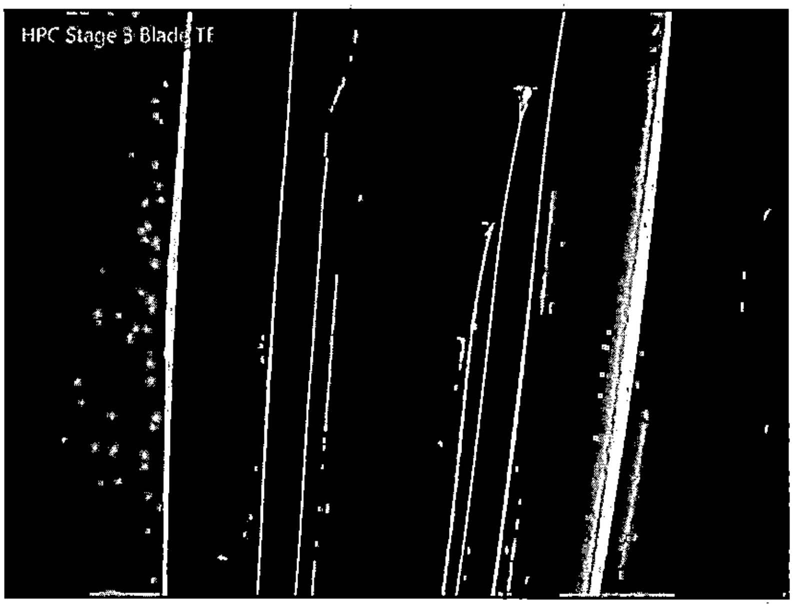
	HPC
	Stage 3
	Blade
Location	TE
Defect	TEAR
Comments	

HPC_Stage_3_Blade_TE007.JPG

	HPC
	Stage 3
	Blade
Location	TE
Defect	TEAR
Comments	

HPC_Stage_3_Blade_TE008.JPG

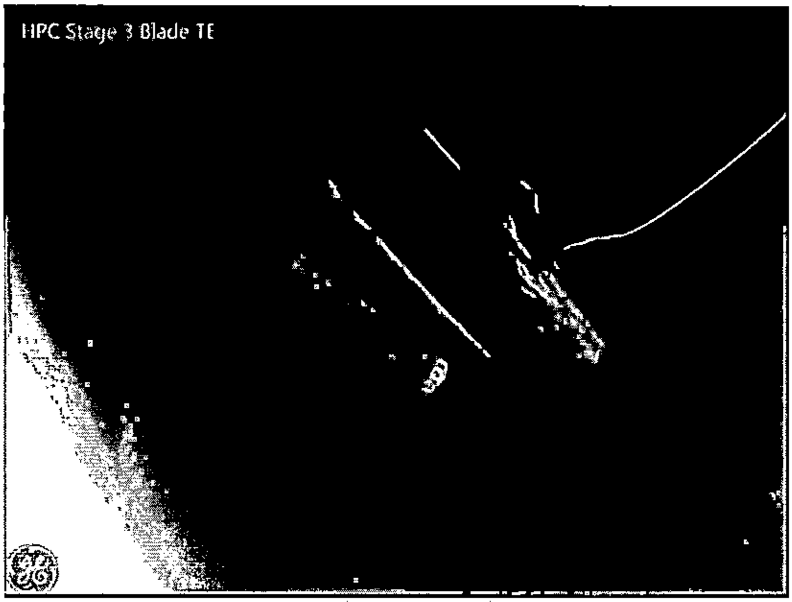
	HPC
	Stage 3
	Blade
Location	TE
Defect	TEAR
Comments	



HPC_Stage_3_Blade_TE009.JPG

	HPC
	Stage 3
	Blade
Location	TE
Defect	NICK
Comments	

LMS100 PA (SAC)



HPC_Stage_3_Blade_TE013.JPG

IPT	HPC
	Stage 3
	Blade
Location	TE
Defect	TEAR
Comments	Missing Vain

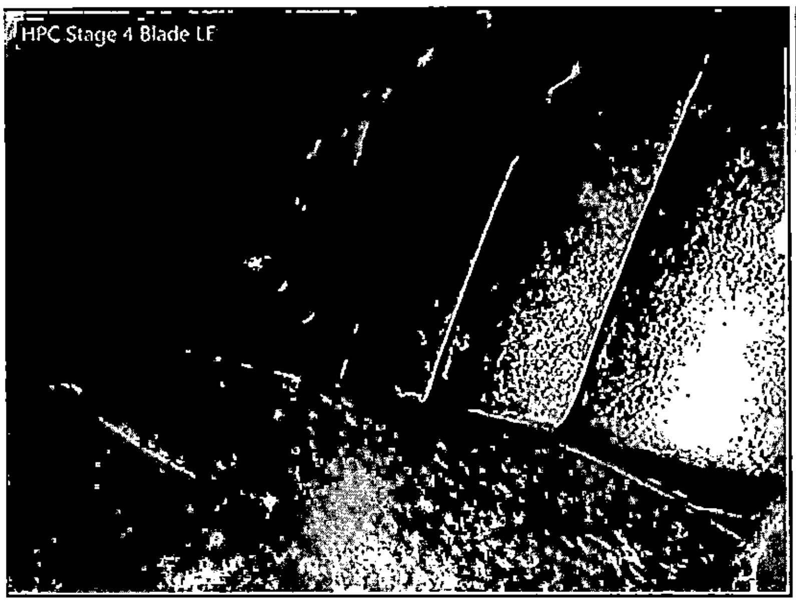
HPC_Stage_3_Blade_TE014.JPG

	HPC
	Stage 3
	Blade
Location	TE
Defect	Missing Material
Comments	

LMS100 PA (SAC)

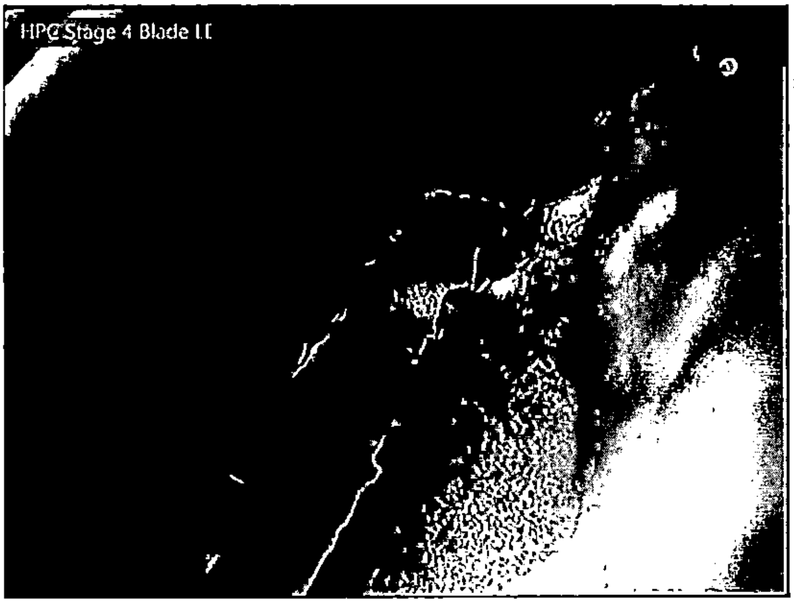
HPC_Stage_3_Blade_TE015.JPG

	HPC
	Stage 3
	Blade
Location	TE
Defect	Missing Material
Comments	



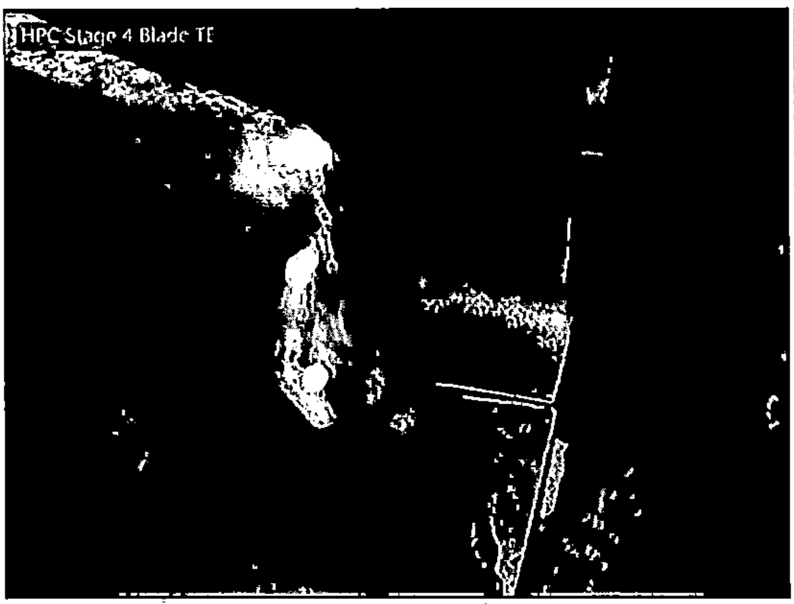
HPC_Stage_4_Blade_LE001.JPG

	HPC
	Stage 4
	Blade
Location	LE
Defect	Missing Material
Comments	



HPC_Stage_4_Blade_LE002.JPG

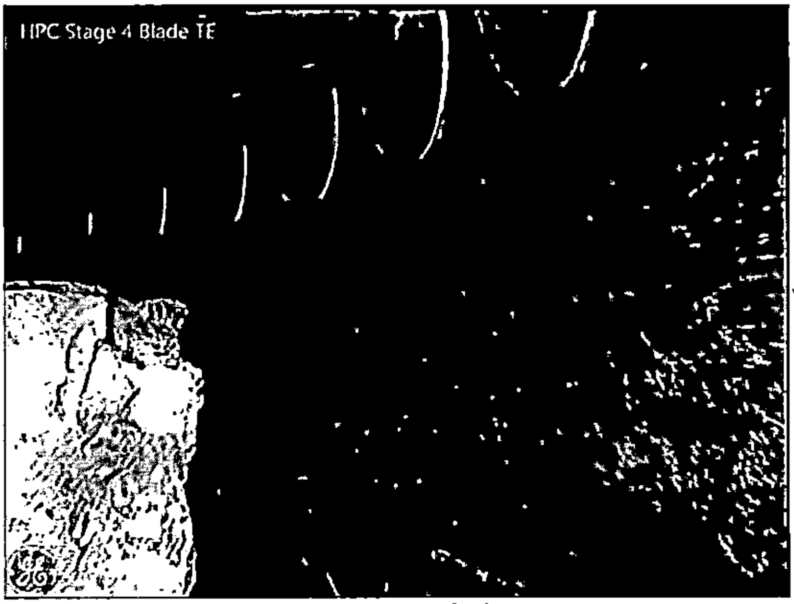
	HPC
	Stage 4
	Blade
Location	LE
Defect	Missing Materail
Comments	



HPC_Stage_4_Blade_TE001.JPG

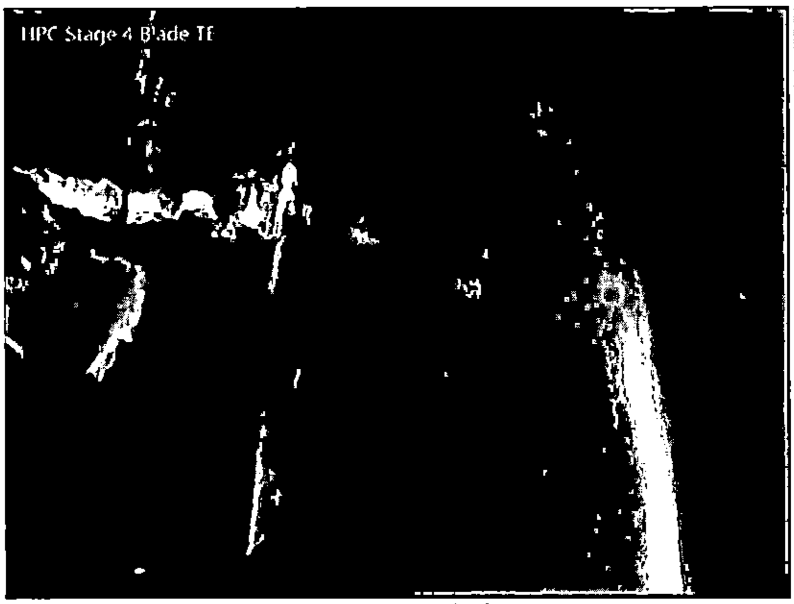
	HPC
	Stage 4
	Blade
Location	TE
Defect	Missing Material
Comments	

LMS100 PA (SAC)



HPC_Stage_4_Blade_TE002.JPG

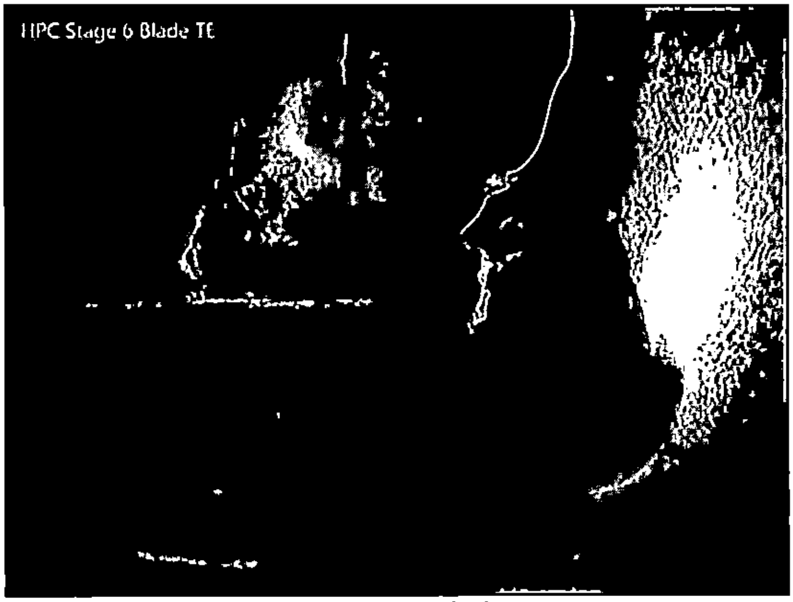
	HPC
	Stage 4
	Blade
Location	TE
Defect	Missing Material
Comments	



HPC_Stage_4_Blade_TE003.JPG

IPT	HPC
	Stage 4
	Blade
Location	TE
Defect	Missing Material
Comments	

LMS100 PA (SAC)



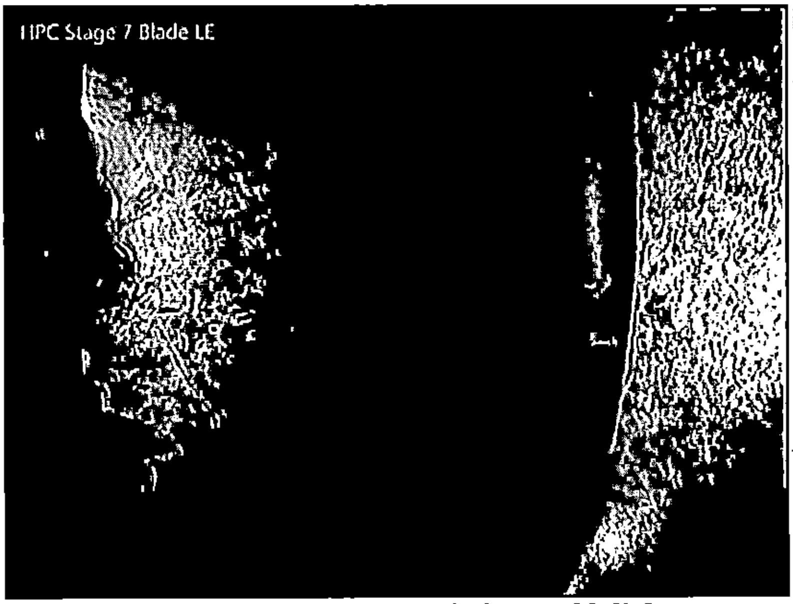
HPC_Stage_6_Blade_TE001.JPG

	HPC
	Stage 6
	Blade
Location	TE
Defect	Missing Material
Comments	

HPC_Stage_7_Blade_LE001.JPG

	HPC
	Stage 7
	Blade
Location	LE
Defect	Missing Material
Comments	

LMS100 PA (SAC)



	HPC
	Stage 7
	Blade
Location	LE
Defect	Missing Material
Comments	

HPC_Stage_7_Blade_LE002.JPG

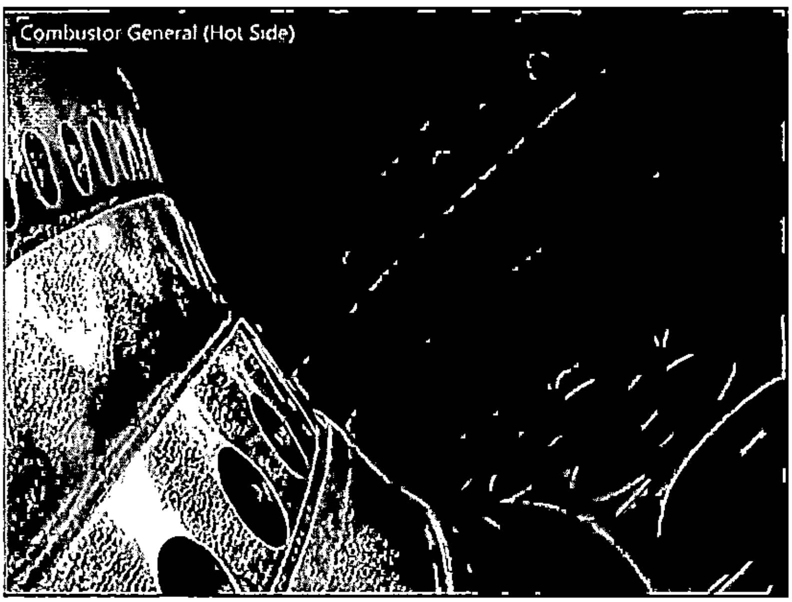
	HPC
	Stage 10
	Blade
Location	LE
Defect	Missing Material
Comments	

HPC_Stage_10_Blade_LE001.JPG

LMS100 PA (SAC)

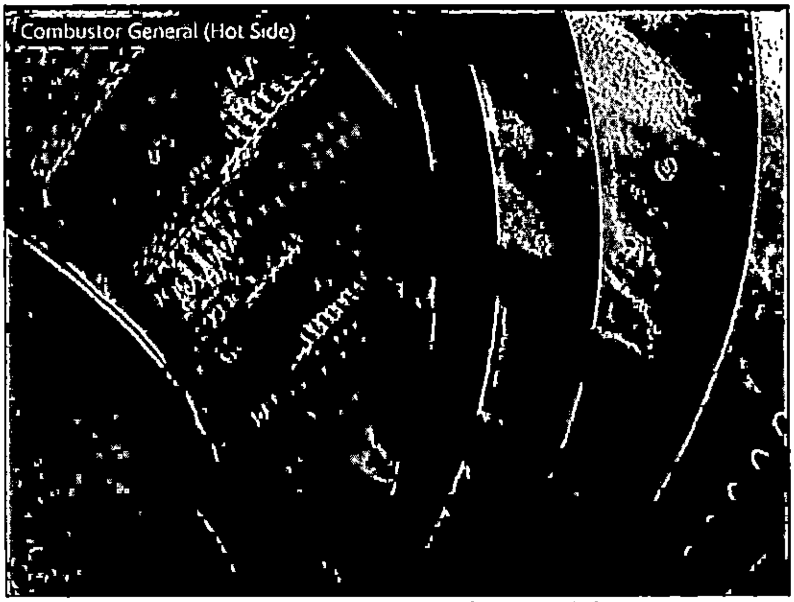
HPC_Stage_10_Blade_LE002.JPG

	HPC
	Stage 10
	Blade
Location	LE
Defect	Missing Material
Comments	



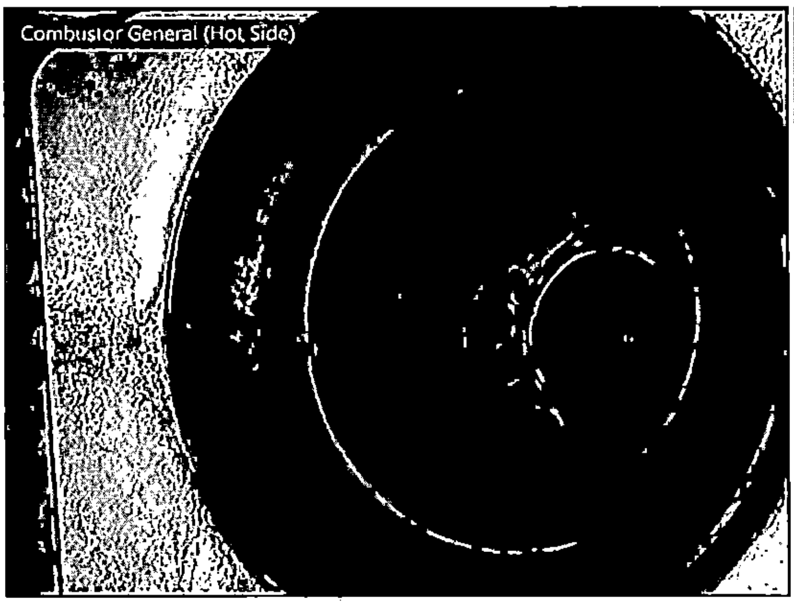
Combustor_General_(Hot_Side)001.JPG

	Comb
	Combustor General (Hot Side)
Defect	NO DEFECTS - SERVICEABLE
Comments	



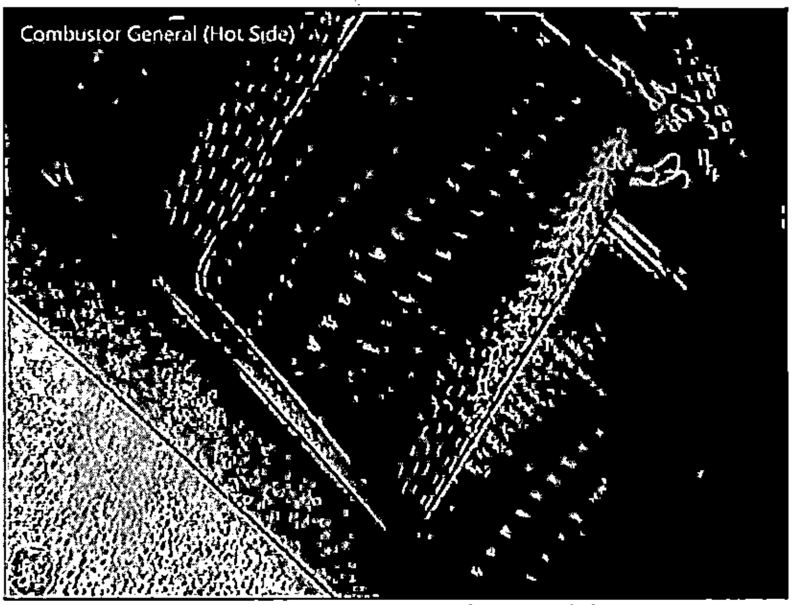
Combustor_General_(Hot_Side)002.JPG

	Comb
	Combustor General (Hot Side)
Defect	NO DEFECTS - SERVICEABLE
Comments	



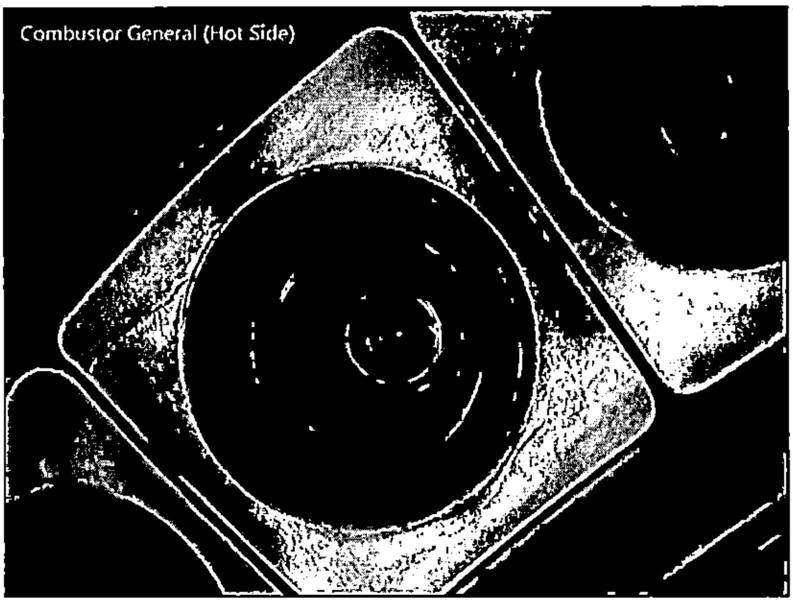
Combustor_General_(Hot_Side)003.JPG

	Comb
	Combustor General (Hot Side)
Defect	NO DEFECTS - SERVICEABLE
Comments	



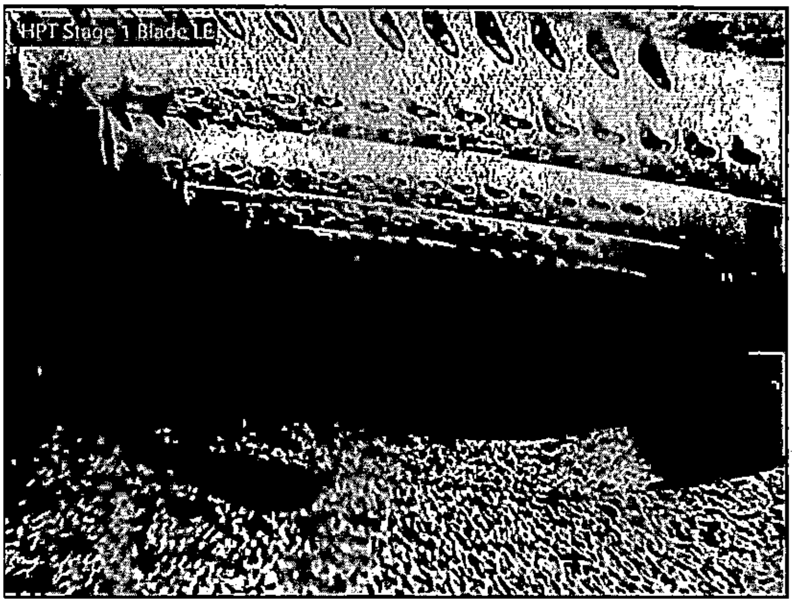
Combustor_General_(Hot_Side)004.JPG

	Comb
	Combustor General (Hot Side)
Defect	NO DEFECTS - SERVICEABLE
Comments	



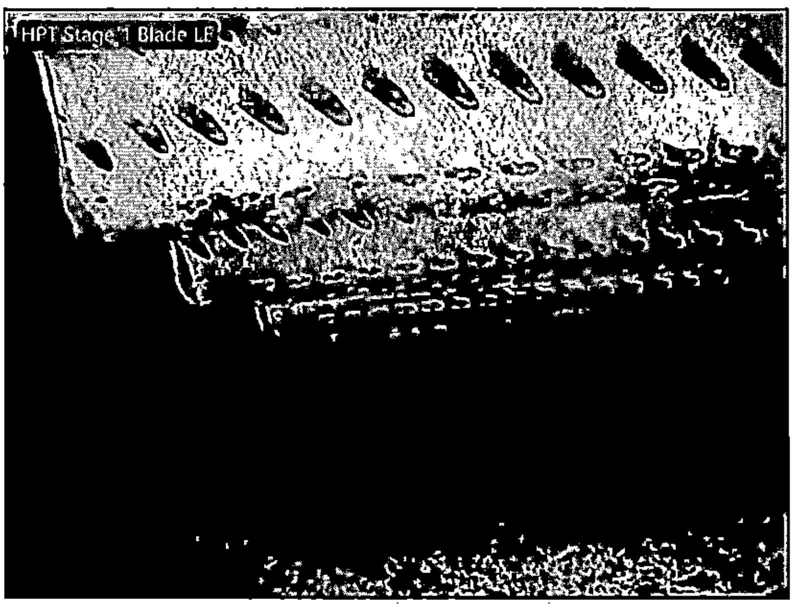
Combustor_General_(Hot_Side)005.JPG

	Comb
	Combustor General (Hot Side)
Defect	NO DEFECTS - SERVICEABLE
Comments	



HPT_Stage_1_Blade_LE001.JPG

	HPT
	Stage 1
	Blade
Location	LE
Defect	NO DEFECTS - SERVICEABLE
Comments	

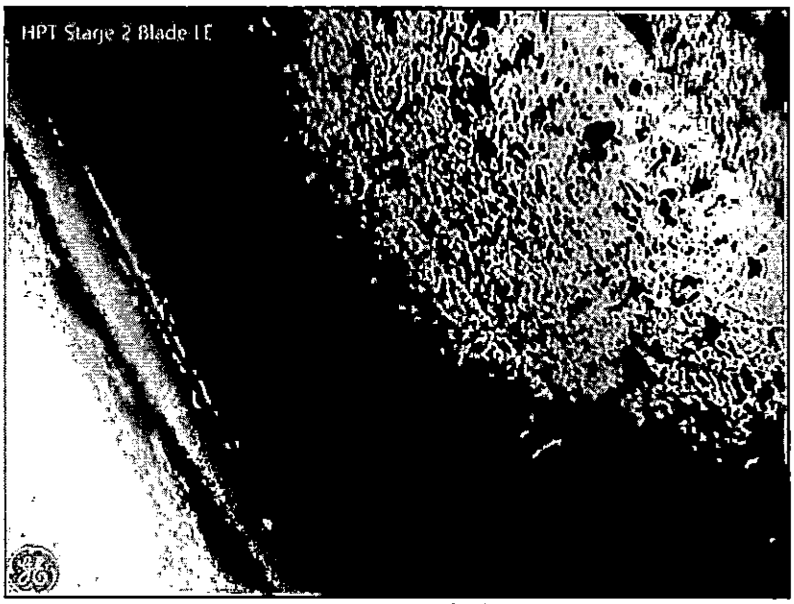


HPT_Stage_1_Blade_LE002.JPG

	HPT
	Stage 1
	Blade
Location	LE
Defect	TBC LOSS
Comments	

HPT_Stage_2_Nozzle_TE001.JPG

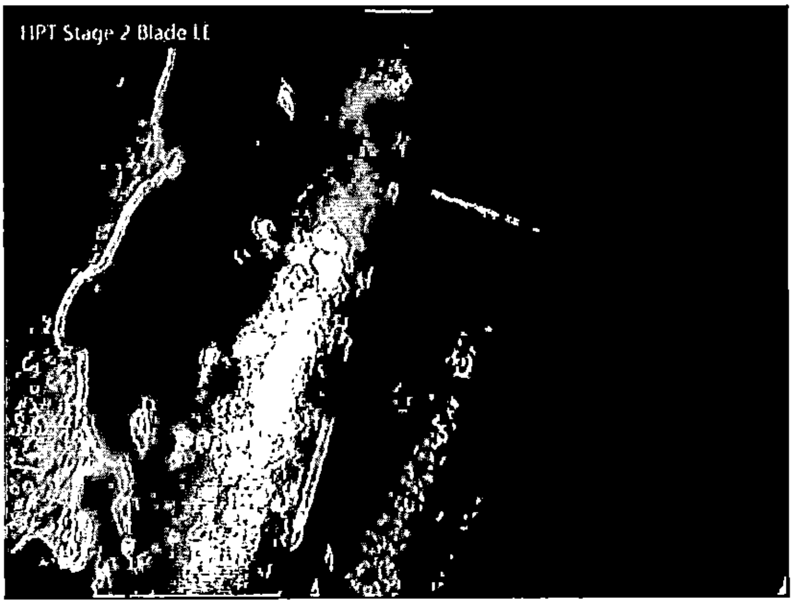
	HPT
	Stage 2
	Nozzle
Location	TE
Defect	TBC LOSS
Comments	



HPT_Stage_2_Blade_LE001.JPG

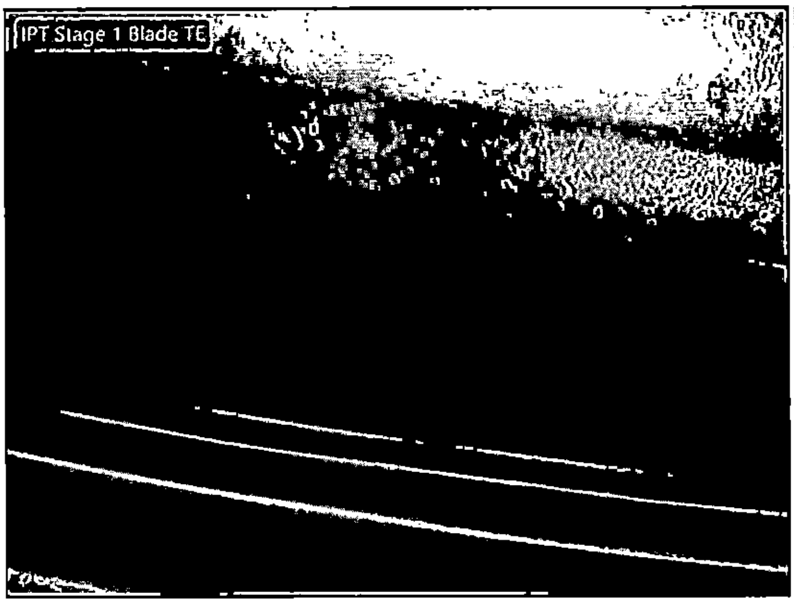
	HPT
	Stage 2
	Blade
Location	LE
Defect	TBC LOSS
Comments	

LMS100 PA (SAC)



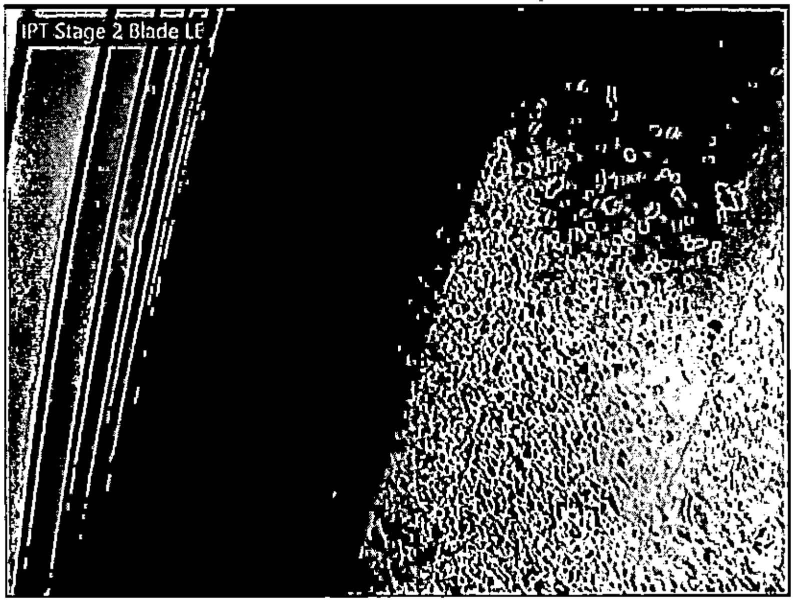
HPT_Stage_2_Blade_LE002.JPG

IPT	HPT
Stage 1	Stage 2
Nozzle	Blade
Location	LE
Defect	TBC LOSS
Comments	



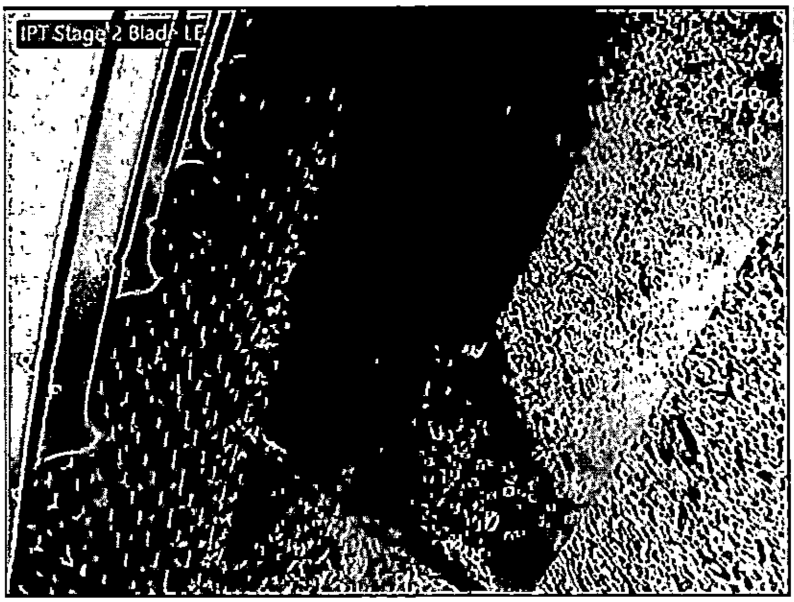
IPT_Stage_1_Blade_TE001.JPG

	IPT
	Stage 1
	Blade
	TE
Comments	



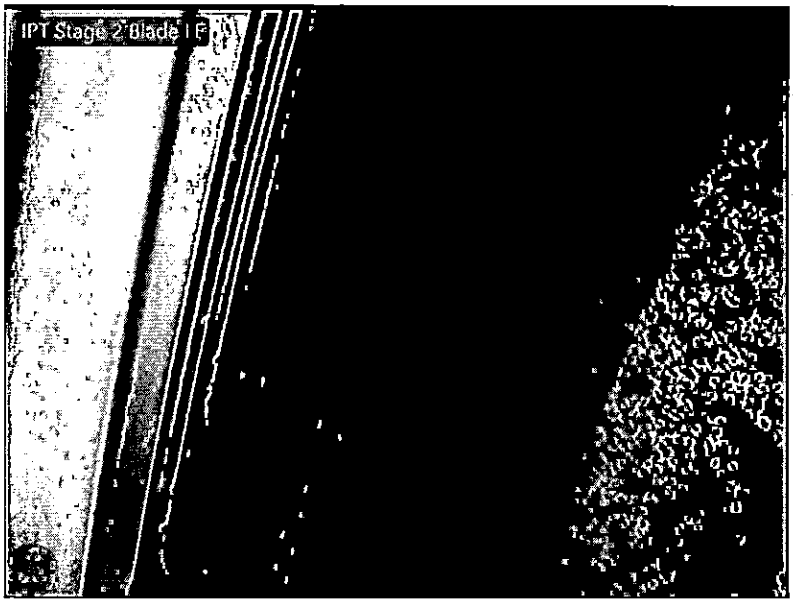
IPT_Stage_2_Blade_LE004.JPG

	IPT
	Stage 2
	Blade
Location	LE
Comments	



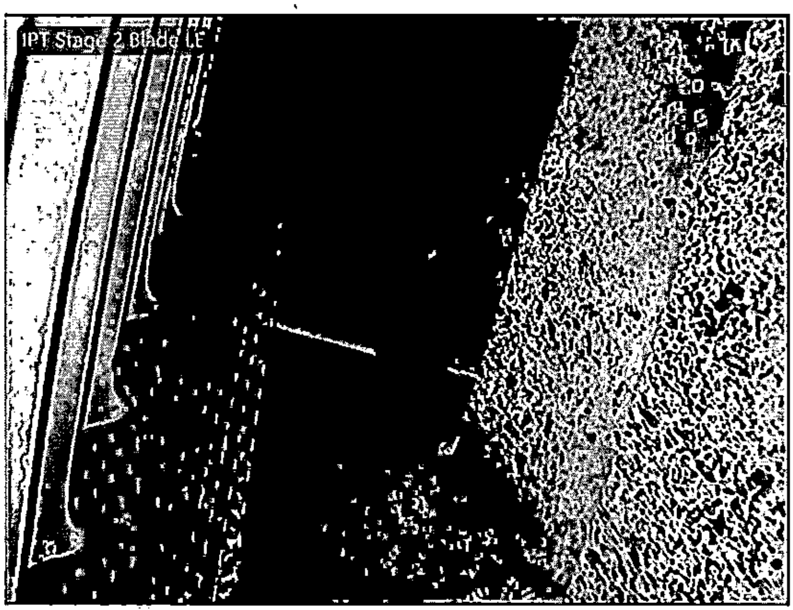
IPT_Stage_2_Blade_LE005.JPG

	IPT
	Stage 2
	Blade
Location	LE
Comments	Missing Material



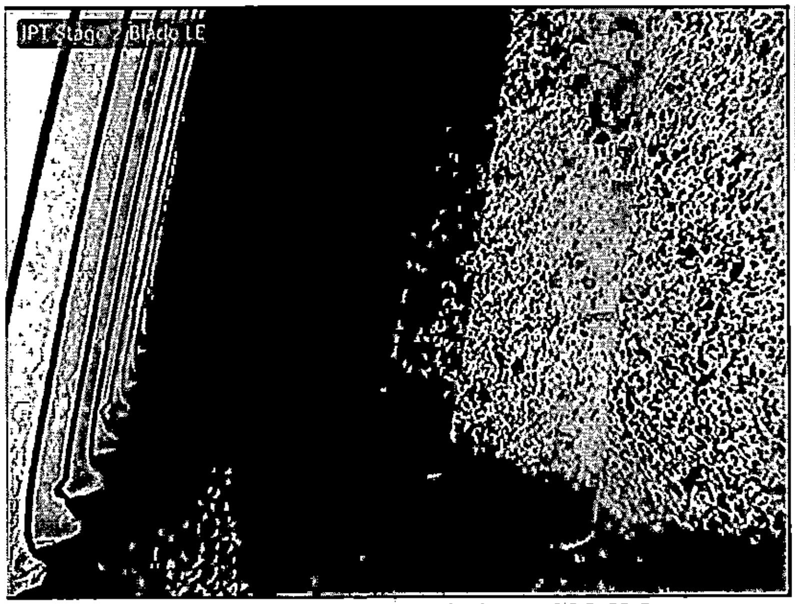
IPT_Stage_2_Blade_LE006.JPG

	IPT
	Stage 2
	Blade
Location	LE
Comments	Missing Material



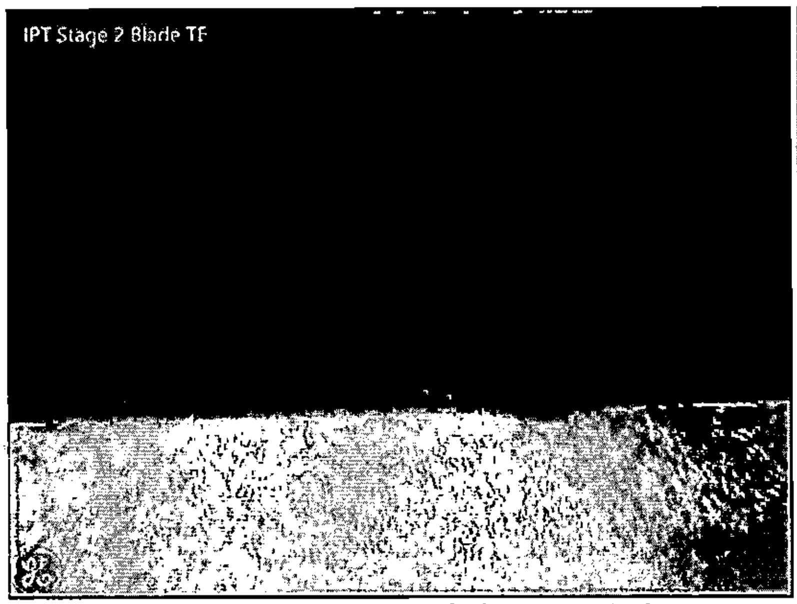
IPT_Stage_2_Blade_LE007.JPG

	IPT
	Stage 2
	Blade
Location	LE
Comments	Missing Material



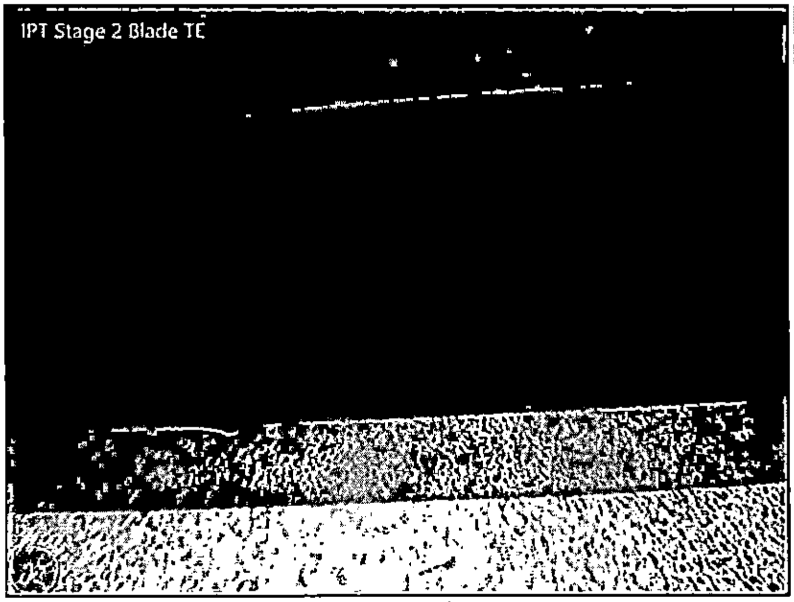
IPT_Stage_2_Blade_LE008.JPG

	IPT
	Stage 2
	Blade
Location	LE
Comments	Missing Material



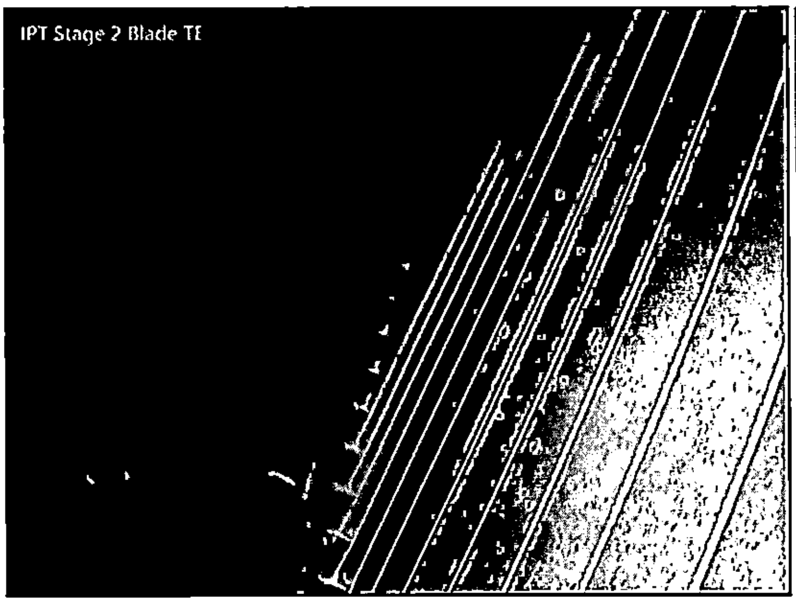
IPT_Stage_2_Blade_TE001.JPG

	IPT
	Stage 2
	Blade
Location	TE
Comments	Dent



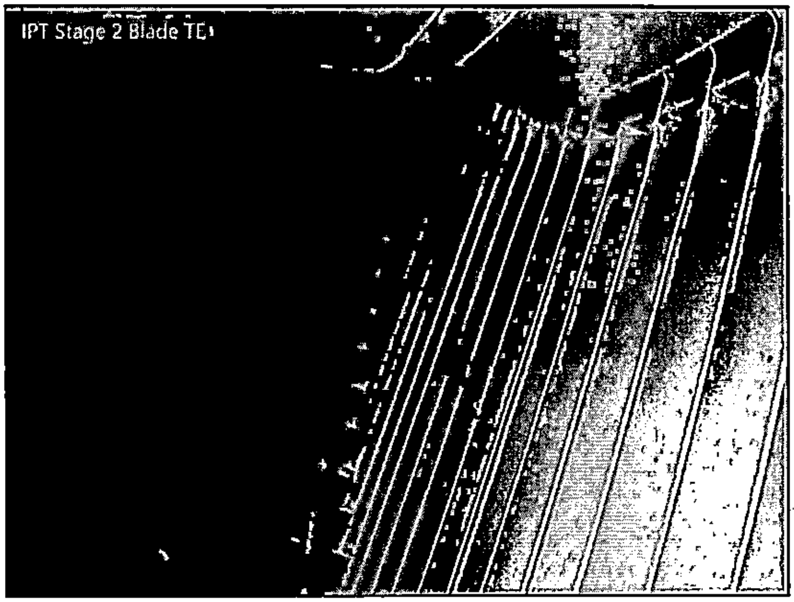
IPT_Stage_2_Blade_TE002.JPG

	IPT
	Stage 2
	Blade
Location	TE
Comments	Dent



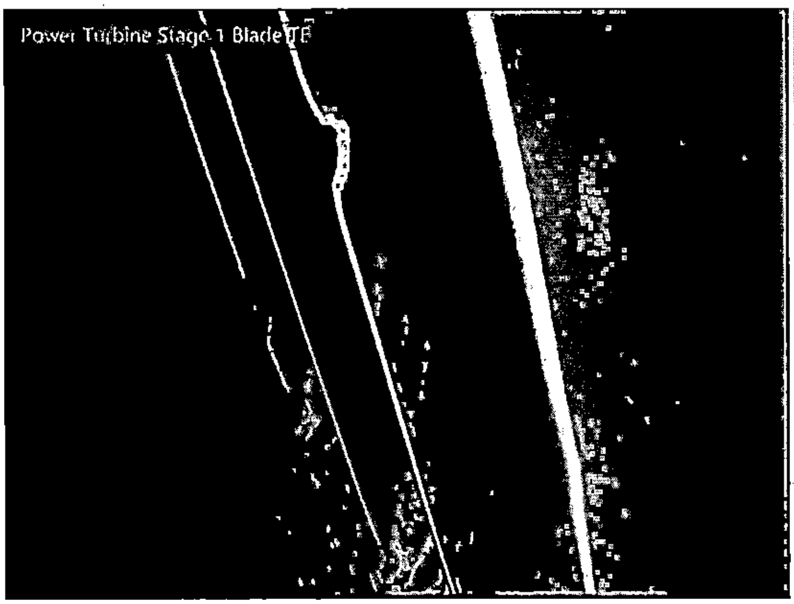
IPT_Stage_2_Blade_TE003.JPG

	IPT
	Stage 2
	Blade
Location	TE
Comments	



IPT_Stage_2_Blade_TE004.JPG

	IPT
	Stage 2
	Blade
Location	TE
Comments	

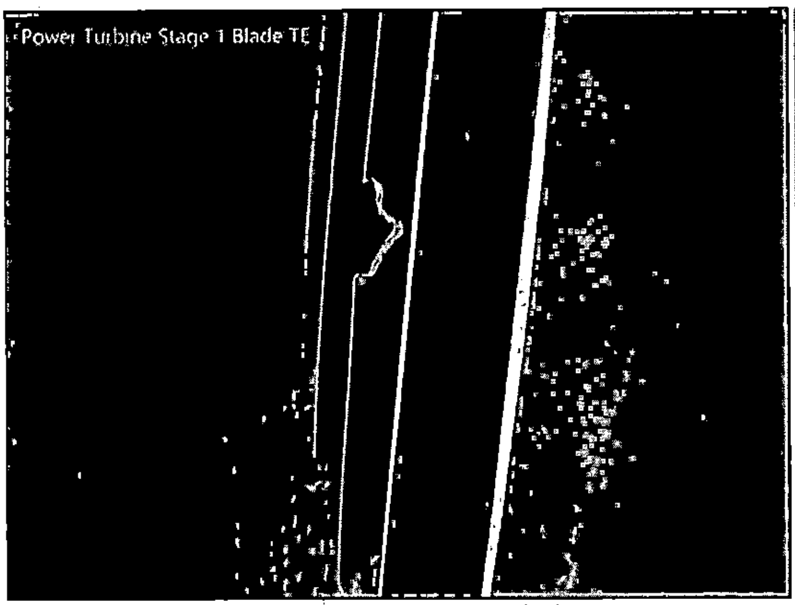


Power_Turbine_Stage_1_Blade_TE001.JPG

	Power Turbine
	Stage 1
	Blade
Location	TE
Defect	Missing Material
Comments	

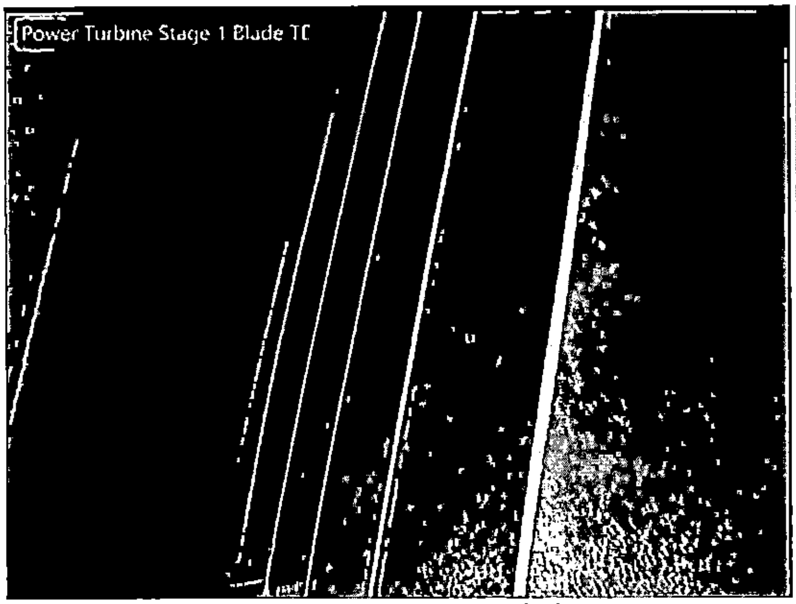
Power_Turbine_Stage_1_Blade_TE002.JPG

	Power Turbine
	Stage 1
Nozzle	Blade
Location	TE
Defect	DENT
Comments	



Power_Turbine_Stage_1_Blade_TE003.JPG

	Power Turbine
	Stage 1
	Blade
Location	TE
Defect	TEAR
Comments	

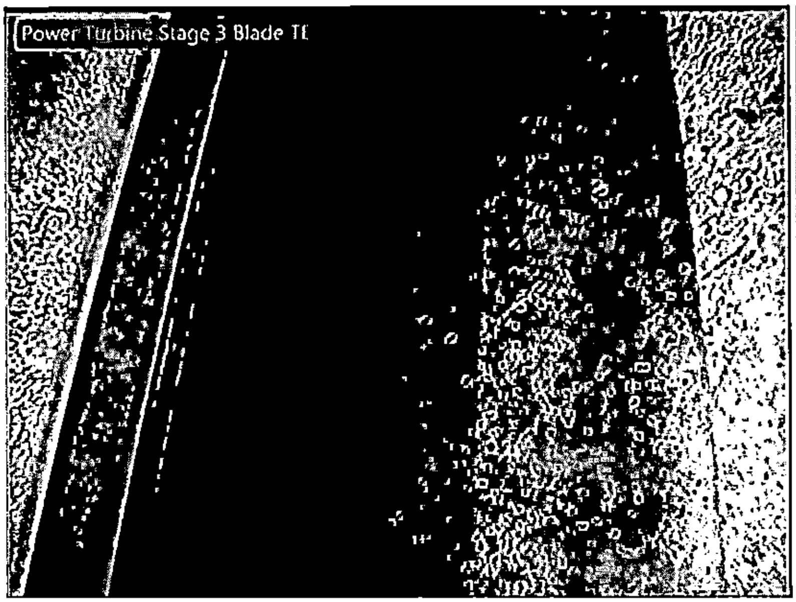


Power_Turbine_Stage_1_Blade_TE004.JPG

	Power Turbine
	Stage 1
	Blade
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	

Power_Turbine_Stage_2_Blade_LE001.JPG

	Power Turbine
	Stage 2
	Blade
Location	LE
Defect	NO DEFECTS - SERVICEABLE
Comments	



Power_Turbine_Stage_3_Blade_TE001.JPG

	Power Turbine
	Stage 3
	Blade
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	

Power_Turbine_Stage_3_Blade_TE002.JPG

	Power Turbine
	Stage 3
	Blade
Location	TE
Defect	NO DEFECTS - SERVICEABLE
Comments	

LMS100 PA (SAC)

Power_Turbine_Stage_3_Blade_TE003.JPG

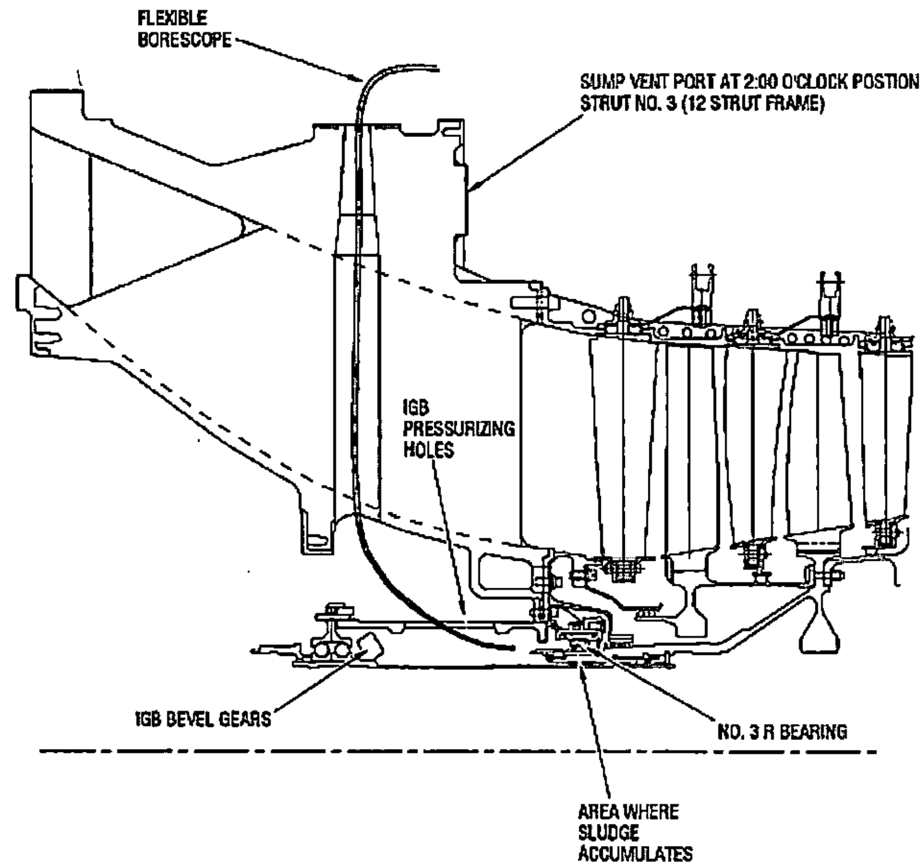
	Power Turbine
	Stage 3
	Blade
Location	TE
Defect	DENT
Comments	


Power_Turbine_Stage_4_Blade_LE001.JPG

	Power Turbine
	Stage 4
	Blade
Location	LE
Defect	DENT
Comments	

Inlet Gearbox Inspection:

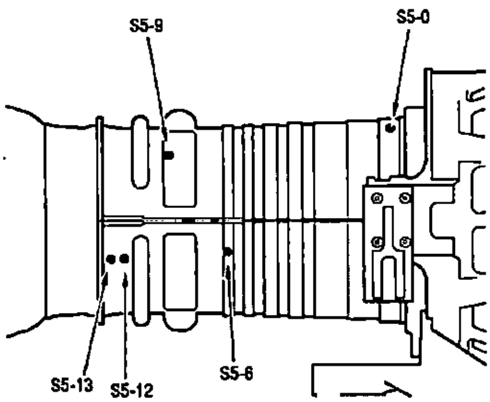
Inlet Gearbox (IGB)
Inspection area: All comments will be made at picture blocks, and detail data section of report.
Insert flexscope into 2:00 Sump Vent port of Front Frame. Carefully enter IGB assembly through the pressurizing holes.
Inspect IGB spline area for evidene of Iron Oxide sludge buildup.
Inspect area of Inlet Gearbox splines for step wear, if light dry sludge deposits found.

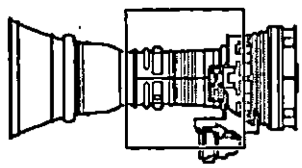


High Pressure Compressor Borescope Ports (HPC):

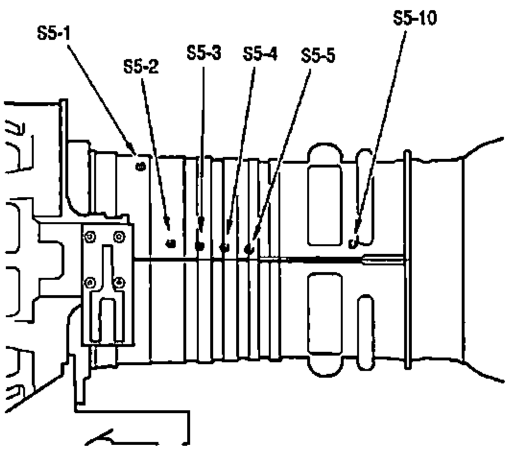
High Pressure Compressor
Inspection Area: All comments will be made at picture blocks, and detail/data section of report.
Remove borescope plugs S5-0 through S5-6, S5-9*, S5-10, S5-12, and S5-13 from HPC Case.
Inspect Stages 1 through 14 Blades for cracks, nicks, tears, burrs, dents, missing material, evidence of tip clang, curl, deposits or deformation. * BSI port are inside manifold cavity.
Inspect Stage 1 Midspan shroud interlock for wear, shingling, gaps, chipped or missing Carboloy pad.
Include measurement of Midspan Caboloy pad

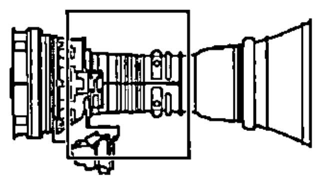
RIGHT SIDE

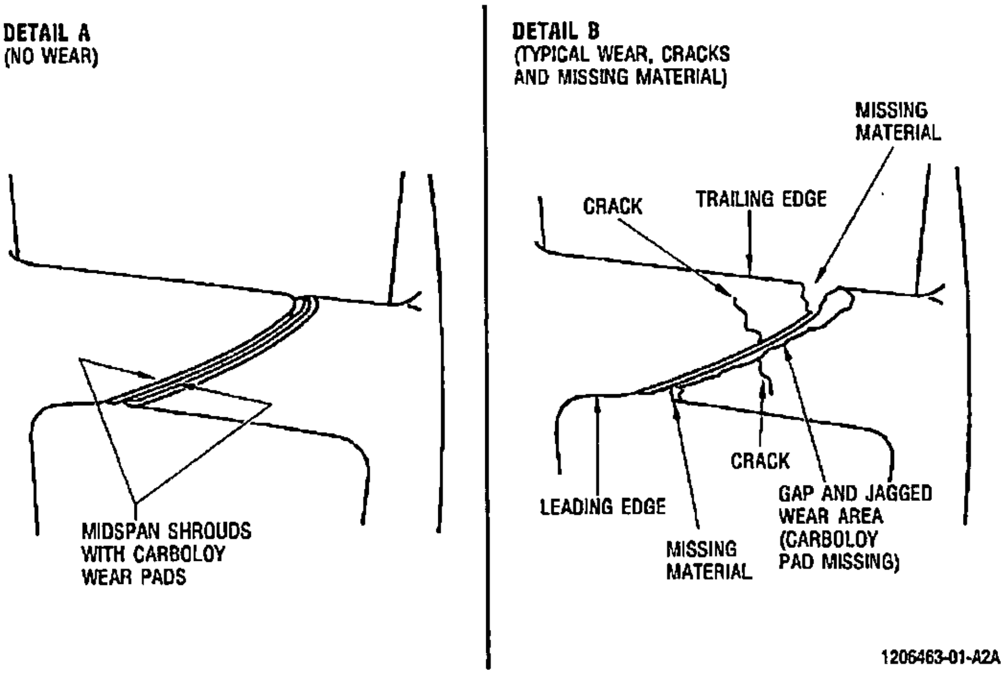




LEFT SIDE



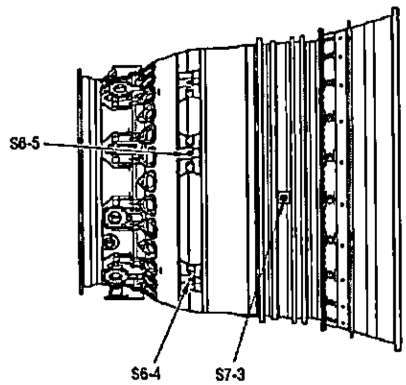


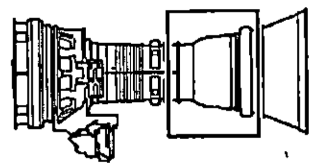


HPC Stage 1 Blade Midspan Carboloy Pad

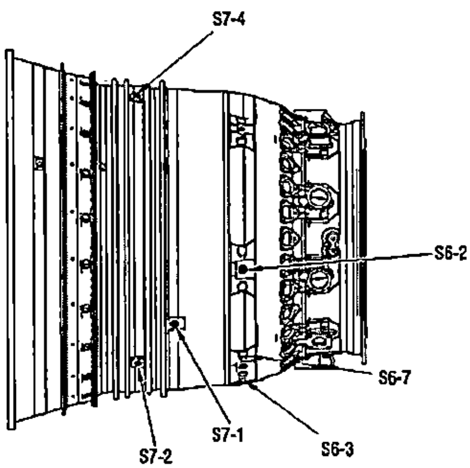
Combustor and Fuel Nozzles:

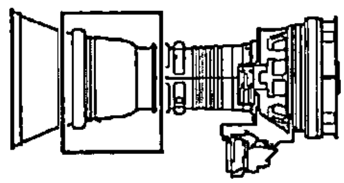
Inspection Area: All comments will be made at picture blocks and Detail Section of report. Inspection Combustor through Ignitors Plug Ports or from removed Fuel Nozzle ports. View area 360°.
Inner and Outer Liners panels for cracks
Dome Assembly – Hot and Cold side
Swirler Assembly – Primary / Secondary
Igniter Plugs – Upper and Lower
Inspect all visible Fuel Nozzle tips for contamination or damage.
Removed (0) Fuel Nozzles and inspect for coating spallation, wear on diameter (area A), wear on conical surface (area B).
Cold side Cowling for cracks.



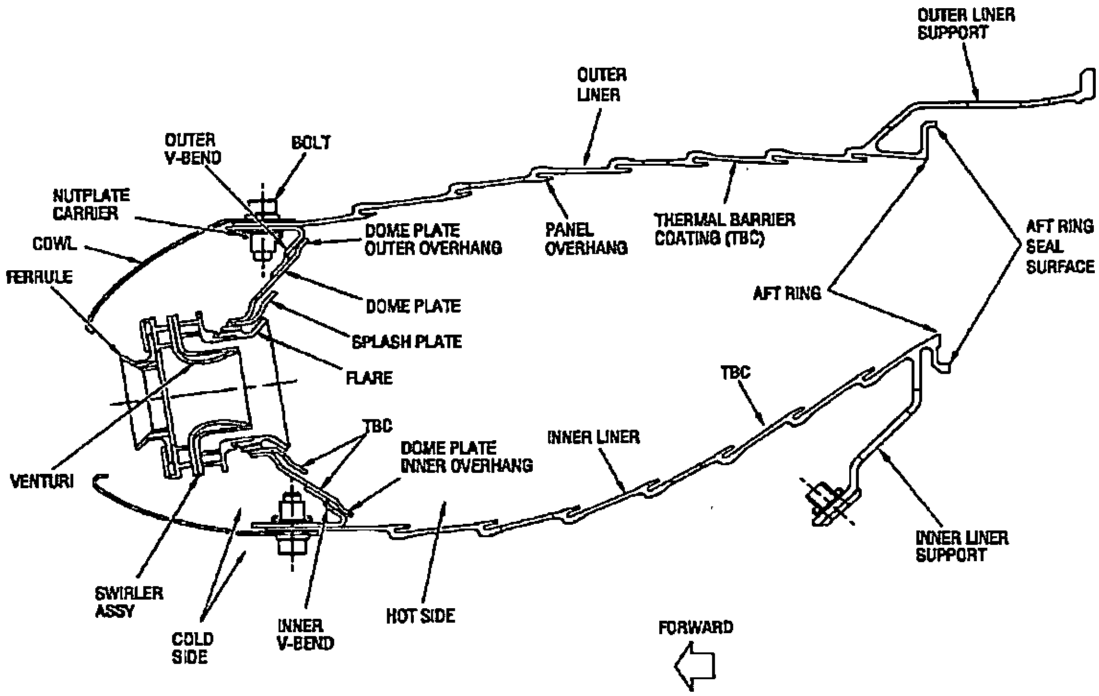


LEFT SIDE





RIGHT SIDE



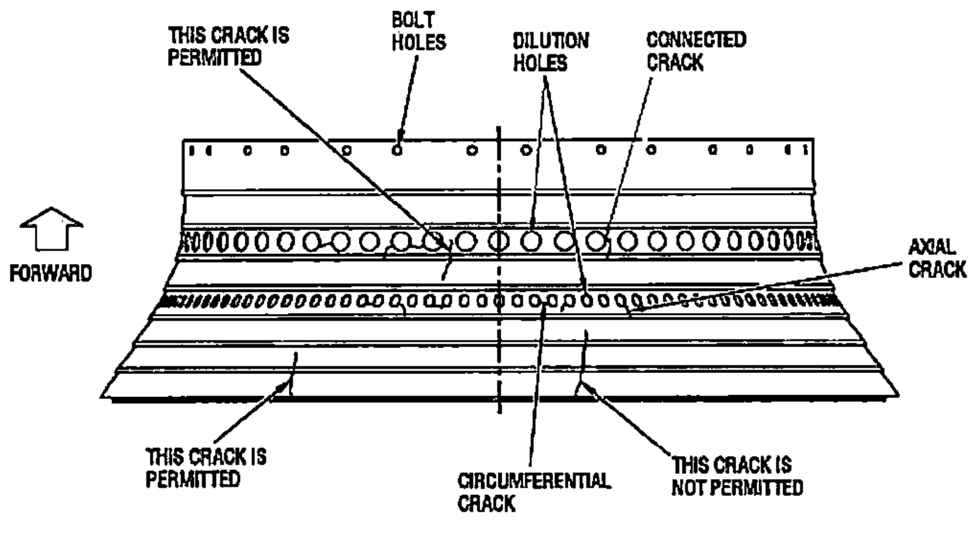
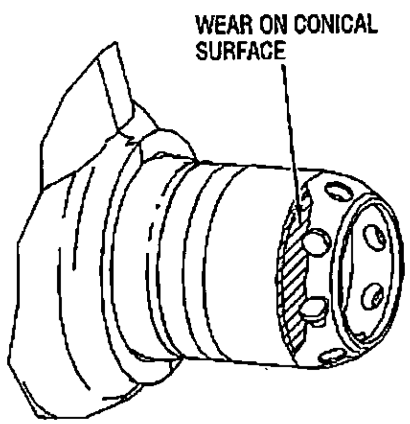
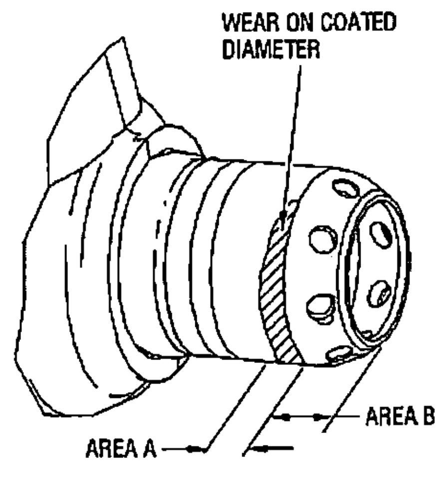


Figure 22. Inner/Outer Liner Cracks (Inner Shown)



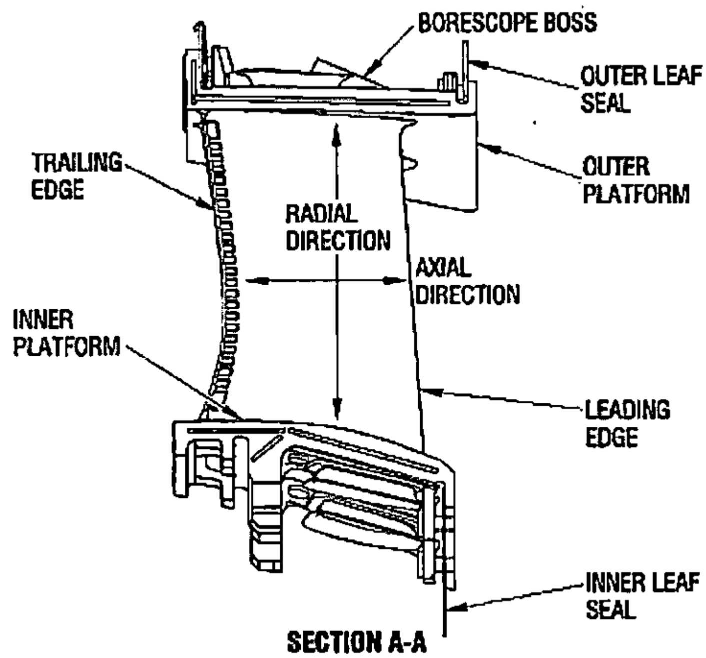


Fuel Nozzles

High Pressure Turbine Module Components:

HPT Stage 1 Nozzle:

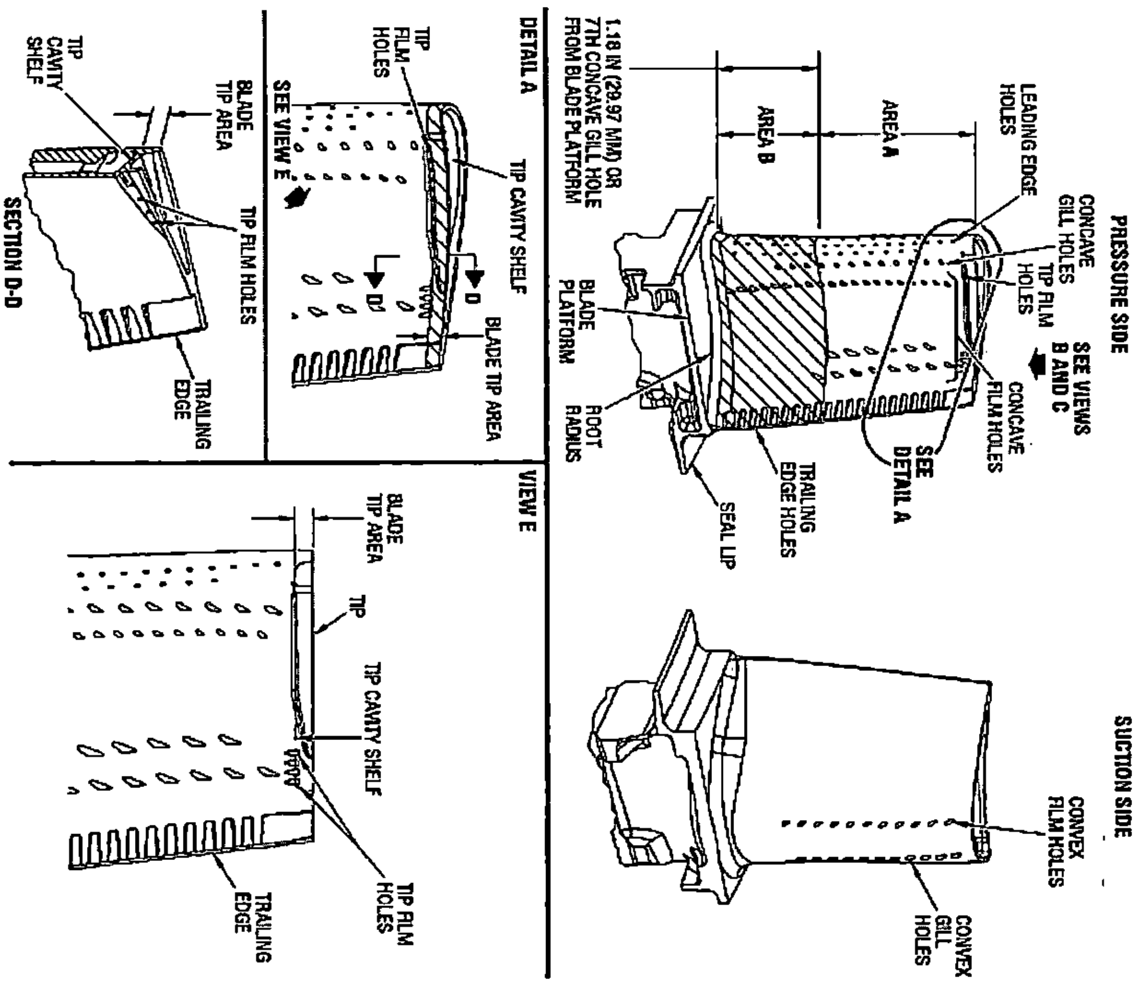
Inspection Area: All comments will be made at picture blocks and Detail Section of report. Inspect this area thru the Compressor Rear Frame utilizing a flexscope 360° for LE and thru HPT Stage 1 TE BSI Port S7-2 for TE Nozzle and HPT Stage 1 Shrouds.
Leading / Trailing edges for burns, cracks, erosion or missing material.
Concave and Convex airfoils for burns, cracks, erosion or missing material.
Inner and Outer platforms for burns, cracks, erosion or missing material.
Thermal Barrier Coating (TBC) loss.



HPT Stage 1 Nozzle

HPT Stage 1 Blade:

Inspection Area: All comments will be made at picture blocks and Detail Section of report. Inspect this area thru HPT BSI Port S7-1 for leading edge, and S7-2 for trailing edge.
Leading edge concave and convex area for impacts, cracks, dents, holes, or missing material.
Leading edge for clogged cooling holes air passages.
Leading edge for erosion and coating penetration (blue or green areas) and TBC loss.
Trailing edge for impacts, cracks, dents, erosion or missing material.
Blade tips for cracks, dents, erosion, missing material, or TBC loss.
Blade platforms for oxidation/corrosion of parent metal.
HPT S1 shroud for cracks, erosion/oxidation or rubs.
HPT 7-1 Borescope Plug inspection.

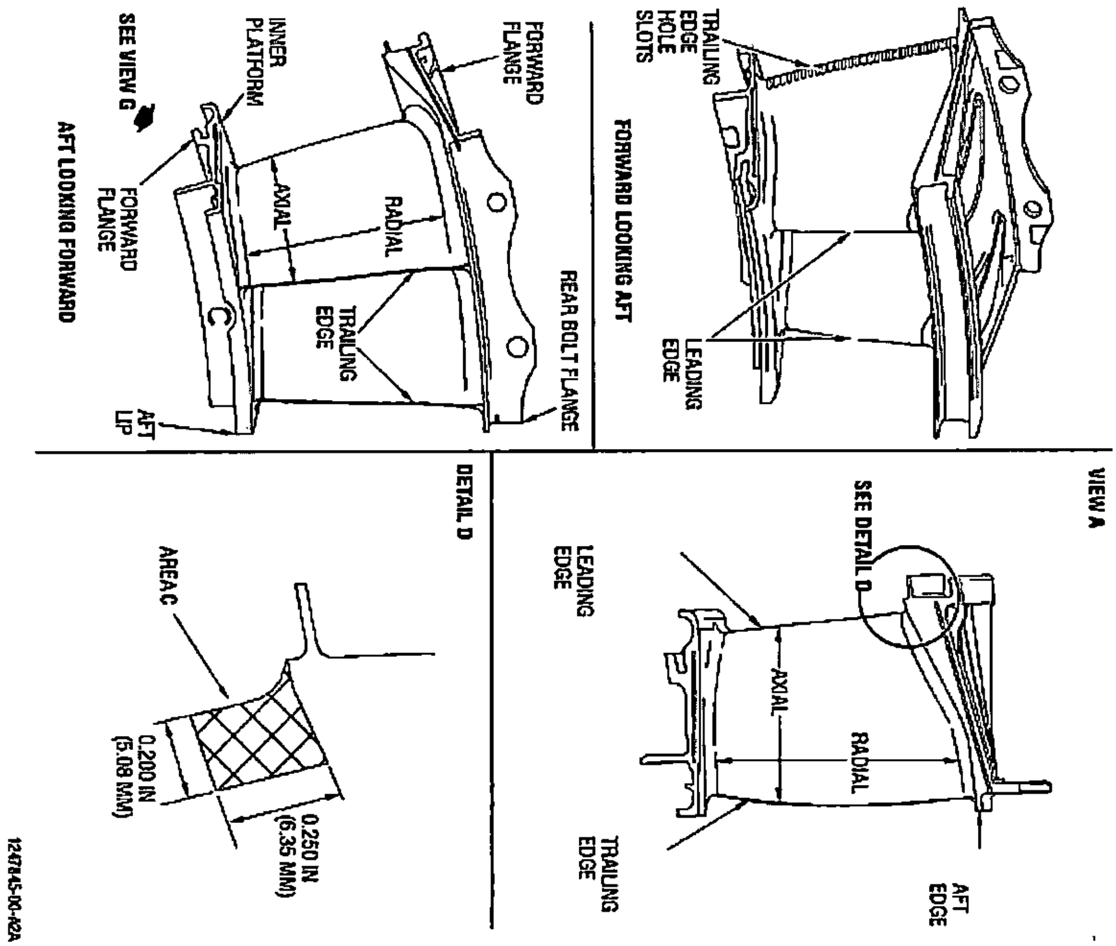


HPT Stage 1 Blade

HPT Stage 2 Nozzle:

Inspection Area: All comments will be made at picture blocks and Detail Section of report. Inspect this area thru HPT BSI Port S7-2 for leading edge/trailing edge, and IPT S4-1 for Stage 2 Shrouds
Leading / Trailing edges for burns, cracks, erosion or missing material.

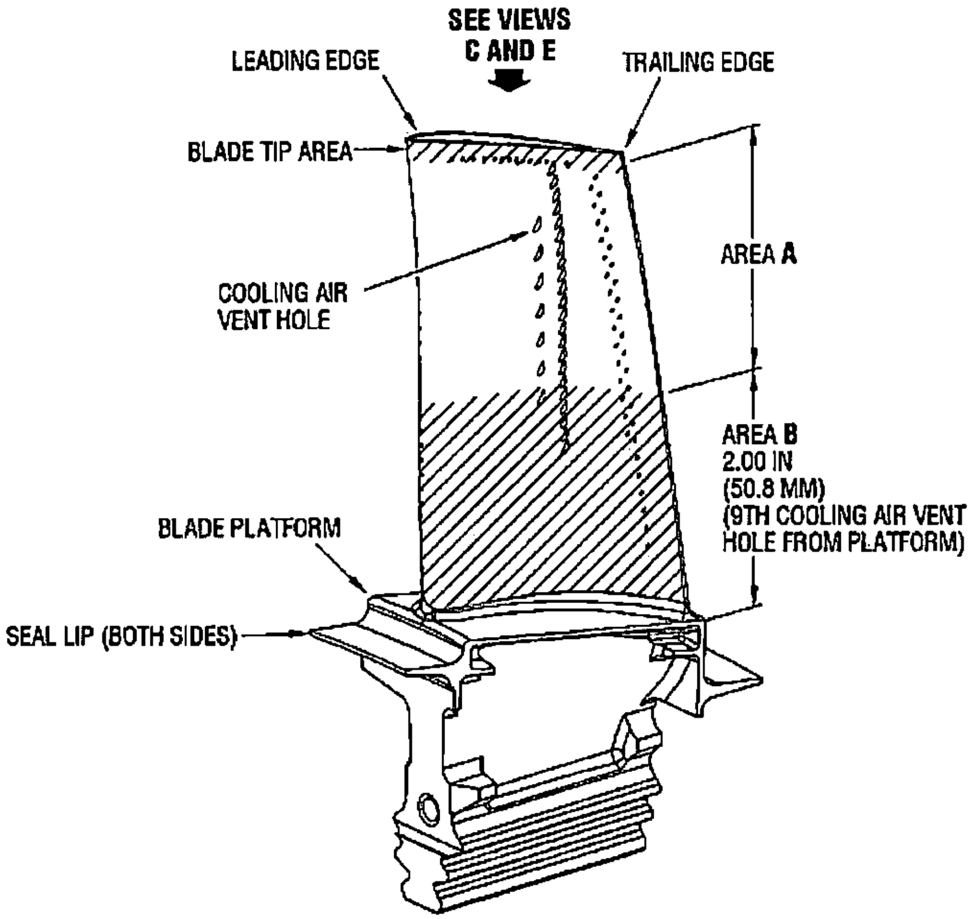
Concave and Convex airfoils for burns, cracks, erosion or missing material.
Inner and Outer platforms for burns, cracks, erosion or missing material.
Thermal Barrier Coating (TBC) loss.



HPT Stage 2 Nozzle

HPT Stage 2 Blade:

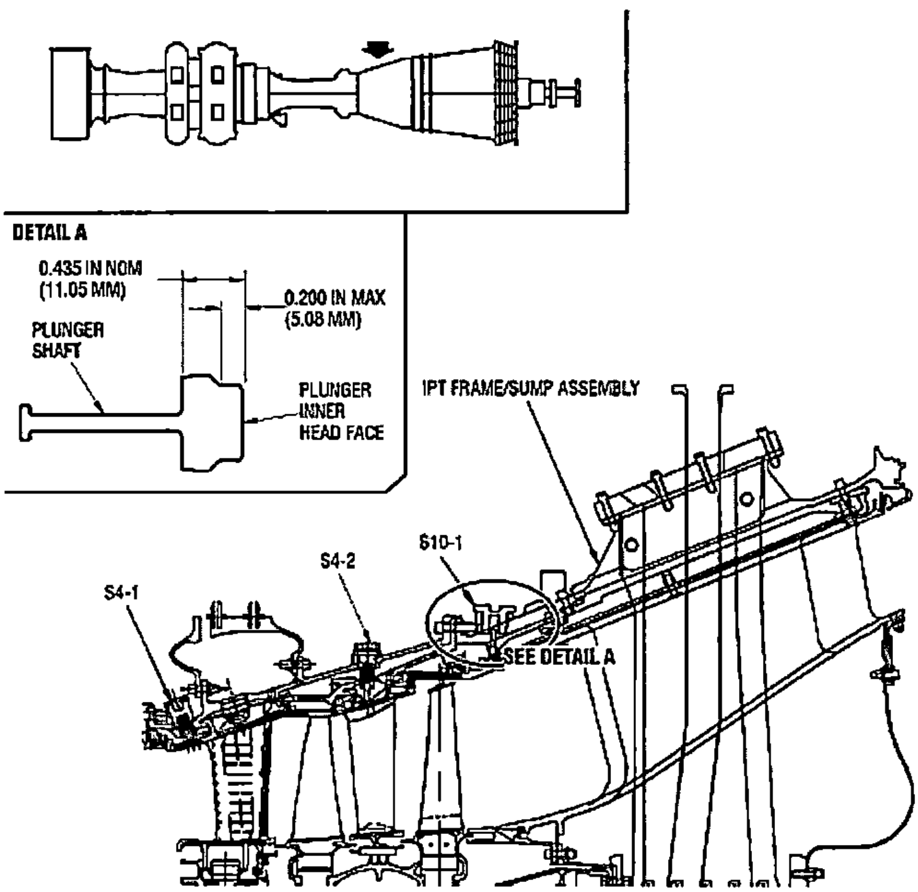
Inspection Area: All comments will be made at picture blocks and Detail Section of report. Inspect this area thru HPT BSI Port S7-2 for leading edge, and IPT S4-1 for trailing edge.
Leading edge concave and convex area for impacts, cracks, dents, holes, or missing material.
Leading edge for clogged cooling holes air passages.
Leading edge for erosion and coating penetration (blue or green areas) and TBC loss.
Trailing edge for impacts, cracks, dents, erosion or missing material.
Blade tips for cracks, dents, erosion, missing material, or TBC loss.
Blade platforms for oxidation/corrosion of parent metal.
HPT Stage 2 shroud for cracks, erosion/oxidation or rubs.
HPT 7-2 Borescope Plug Inspection.



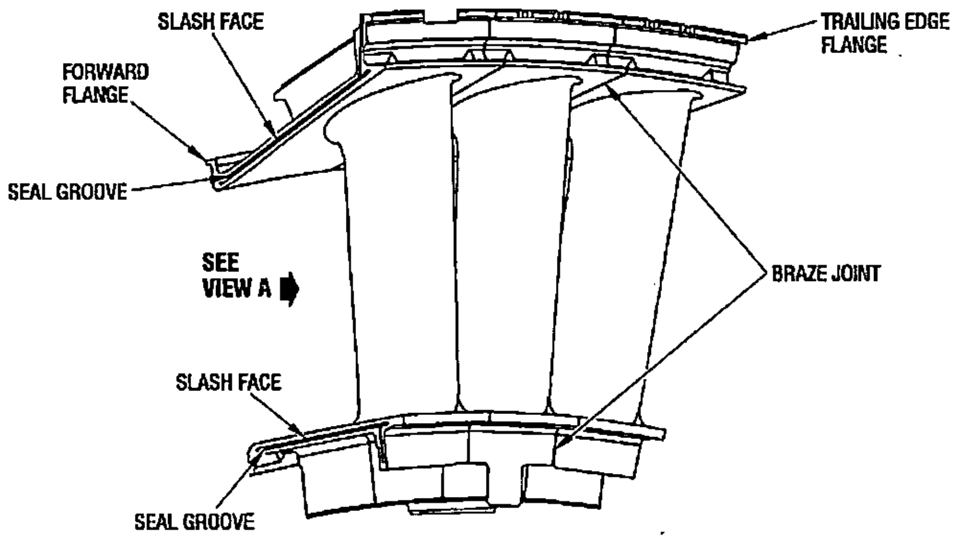
HPT Stage 2 Blade

Intermediate Pressure Turbine Module: (IPT)

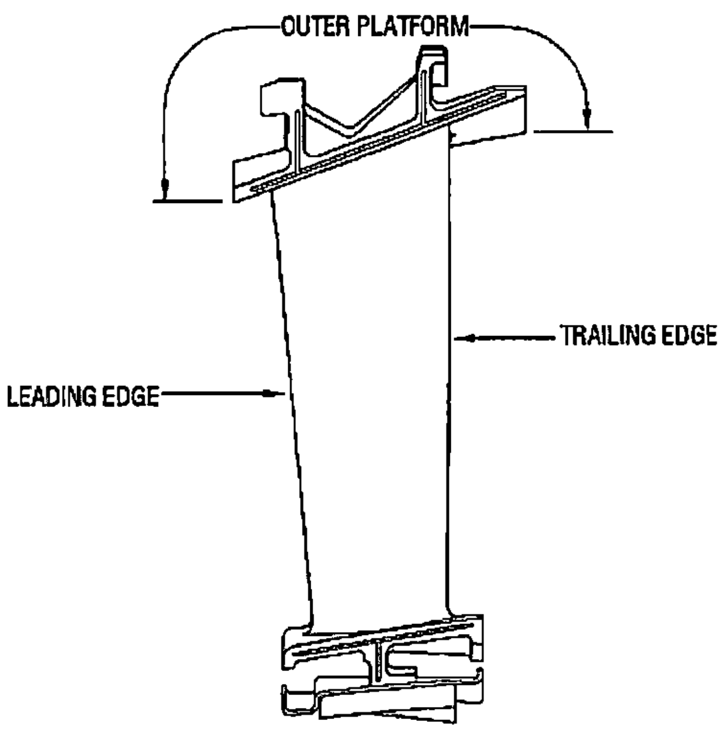
Intermediate Pressure Turbine (IPT)
Inspection Area: All comments will be made at picture blocks and details and data section of report.
Inspect Stages 1 and 2 blades and vanes for cracks, nicks, burrs, tears, curl, missing material, dents, scratches, pits. Stage 1 IPT Nozzle, BSI ports S4-1. Stage 1 IPTR Blades (Qty 118) & Vanes, BSI ports S4-1 & S4-2. Stage 2 IPTR Blades (Qty 124) & Vanes, BSI ports S4-1 and S10-1.
Inspect Stage 2 Blade interlocks for wear and shingling.
Inspect for erosion, corrosion or deposits.
Inspect D Sump Strut Tube for evidence of cracking.


DETAIL A
0.435 IN NOM
(11.05 MM)
0.200 IN MAX
(5.08 MM)
PLUNGER
SHAFT
PLUNGER
INNER
HEAD FACE
IPT FRAME/SUMP ASSEMBLY
S10-1
S4-2
S4-1
SEE DETAIL A

IPT Module



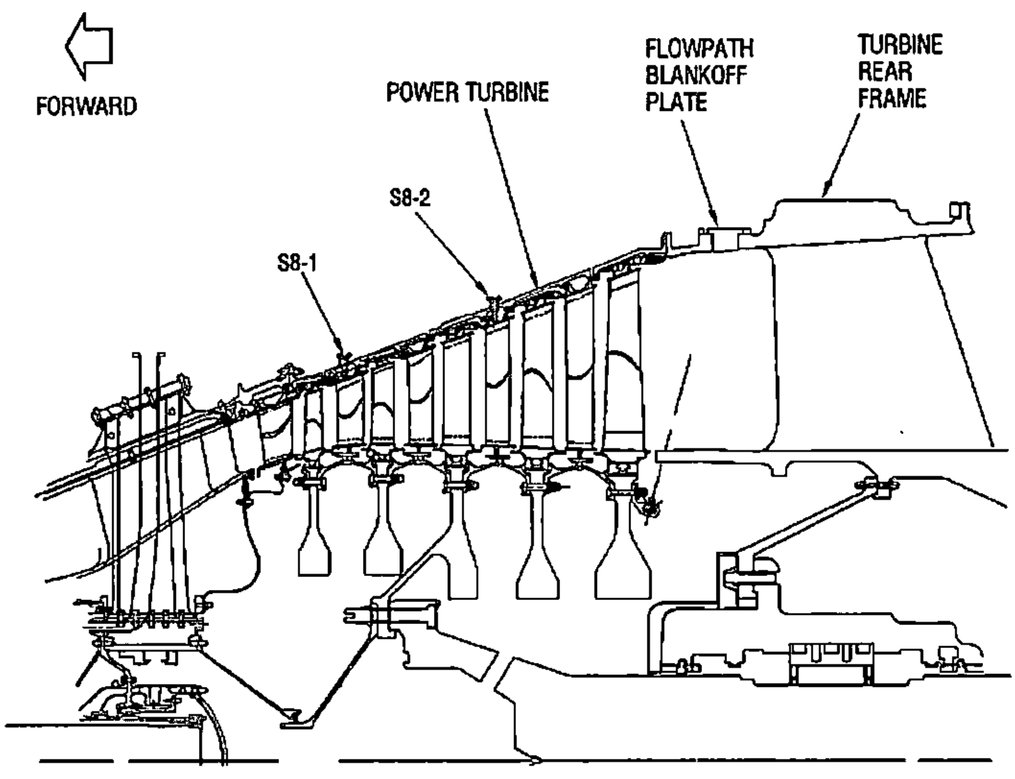
IPT Stage 1 Nozzle



IPT Stage 2 Nozzle

Power Turbine Module: (PT)

Power Turbine (PT)
Inspection Area: All comments will be made at picture blocks, and details / data section of report.
Inspect Stages 1 through 5 blades and vanes for cracks, nicks, burrs, tears, curl, missing material, dents, scratches, pits. Stage 1 PT Nozzle, BSI ports S8-1 & T48 probe. Stage 1 PTR Blades (Qty 118) & Vanes, BSI port S8-1. Stage 2 PTR Blades (Qty 124) & Vanes, BSI port S8-1. Stage 3 PTR Blades (Qty 88) & Vanes, BSI port S8-2. Stage 4 PTR Blades (Qty 80) & Vanes, BSI port S8-2
Stage 5 PTR Blades (Qty 74) & Vanes, BSI port at Turbine Rear Frame 2:00 position
Inspect blade shroud interlocks for wear and shingling.
Inspect for erosion, corrosion or deposits.
S8-1 and S8-2 Borescope Plugs Inspection
Limited view on PT Nozzles.



PT Module

EXHIBIT 5

CORRESPONDENCE WITH GE POWER SYSTEMS

From:	Guthrie, Ian
To:	Villarin, Andrea
Cc:	Lontok, Leizl; Shim, Tina; Le, Anh-Tuan; Ackermann, Jeffrey; Borman, Juliana
Subject:	Fwd: [EXTERNAL] RE: LADWP Haynes Generating Station Unit 15 Forced Outage and Status of Spare Supercore 125
Date:	Wednesday, November 16, 2022 9:59:12 AM

Please see response from GE regarding the status of our spare supercore for the LMS-100 aeroderivative gas turbines.

From: "Gamez, Frank (GE Gas Power)" <frank.gamez@ge.com>
Subject: [EXTERNAL] RE: LADWP Haynes Generating Station Unit 15 Forced Outage and Status of Spare Supercore 125
Date: 16 November 2022 09:56
To: "Guthrie, Ian" <Ian.Guthrie@ladwp.com>
Cc: "Patel, Sagar (GE Gas Power)" <sagar.B.patel@ge.com>, "Grahn, Rob J (GE Gas Power)" <robJ.grahn@ge.com>, "Treinen, Donald J" <Donald.Treinen@ladwp.com>, "Gray, Michael" <Michael.Gray@ladwp.com>, "Madden, Wayne" <Wayne.Madden@ladwp.com>, "Ackermann, Jeffrey" <Jeffrey.Ackermann@ladwp.com>, "Jepsen, Adam" <Adam.Jepsen@ladwp.com>, "Le, Anh-Tuan" <Anh-Tuan.Le@ladwp.com>, "Martin, Gabriel" <Gabriel.Martin@ladwp.com>, "Morales, Kristian" <Kristian.Morales@ladwp.com>

Ian,

As you are aware, in anticipation of returning the equipment back to LADWP for use as spare, during the final reassembly of Supercore 878-125, corrosion was observed on the #4 bearing housing area of the turbine rotor. Although it was our hope that the corrosion observed on the components would be inconsequential, however the engineering disposition determined that the equipment could not be returned to service for normal operation given the findings. LADWP issued GE Task Assignment 47677B-046 on October 4, 2022, in accordance with General Electric Proposal 1623961R1 (dated September 19, 2022) to cover the inspection process necessary to evaluate the extent of the corrosion internal to supercore 125 and secure a slot within the Houston Service Center, General Electric's specialty repair facility for the LMS-100 model combustion turbine. Supercore 125 was shipped to the Houston Service Center on October 6, 2022 and inducted into the repair process on October 27, 2022.

The standard base repair cycle for the General Electric LMS-100 model combustion turbine supercore is 120 days. The standard base repair cycle can vary depending on the specific findings upon the complete disassembly of all the components within the supercore. The repair cycle can be adversely affected by lead times for replacement parts / specialty repair services and has been affected by the global supply chain disruptions since the pandemic.

We at GE understand the challenge associated with your regulatory deadlines and the GE team has worked aggressively to accommodate the unanticipated inspection and repair of supercore 125 into the Houston Service Center repair sequence. We have expedited the process to disassemble the equipment and are on schedule to meet a completion date of February 24, 2023, barring any unforeseen disruptions to the repair process or availability of consumable materials. We will keep you informed of schedule developments or where there might be an opportunity to move from the repair phase to the reassembly phase sooner than the currently projected repair cycle.

Please see the below detailed bullet points with additional information:

- **878-125 Supercore Facts**
  - History
    - 878-125 IPT completed overhaul and shipped to GE Bakersfield in July 2022, it was installed onto the 878-125 core and awaited shipment to LADWP Haynes.
    - Before shipping to LADWP Haynes, GE Engineering requested to inspect the engine for potential corrosion due to the core sitting at GE Bakersfield from July 2020 through July 2022. On August 30th, 2022, said inspection came back positive for corrosion on the 4B bearing housing – if there is corrosion on the housing, then there is a high probability there is present corrosion/damage to the bearings.
  - Houston Service Center Findings
    - 878-125 supercore shipped to Houston from GE Bakersfield October 6th to stage for Oct. 27th induction
    - Induction of 878-125 to the Houston Service Center occurred on October 27th, 2022
    - While in the Houston Service Center, it was found that we need to replace the 3, 4, and 5 bearings along with requested bulletins.
      - *Parts are available*
    - 878-125 has *not* completed the gate 1 process (disassembly/discovery process) as of November 16th, 2022, therefore, there could be additional potential findings.
  - Latest update:
    - 878-125 Shipment from Houston Service Center to LADWP Haynes *February 23rd, 2023 (based on current findings)*
    - GE to work with LADWP on shipment date after all incoming findings are *complete*.

Feel free to call me if any questions. Thank you,

Frank Gamez
Sr. Services Leader, Aero
GE Gas Power

M: 281.620.2296 | E: Frank.Gamez@ge.com

From: Guthrie, Ian <Ian.Guthrie@ladwp.com>
Sent: Thursday, November 10, 2022 2:19 PM
To: Gamez, Frank (GE Gas Power) <frank.gamez@ge.com>
Cc: Patel, Sagar (GE Gas Power) <sagar.B.patel@ge.com>; Grahn, Rob J (GE Gas Power) <robJ.grahn@ge.com>; Treinen, Donald J <Donald.Treinen@ladwp.com>; Gray, Michael <Michael.Gray@ladwp.com>; Madden, Wayne <Wayne.Madden@ladwp.com>; Ackermann, Jeffrey <Jeffrey.Ackermann@ladwp.com>; Jepsen, Adam <Adam.Jepsen@ladwp.com>; Le, Anh-Tuan <Anh-Tuan.Le@ladwp.com>; Martin, Gabriel <Gabriel.Martin@ladwp.com>; Morales, Kristian <Kristian.Morales@ladwp.com>
Subject: EXT: LADWP Haynes Generating Station Unit 15 Forced Outage and Status of Spare Supercore 125
Importance: High

Frank, as you recall, Haynes Generating Station Unit 15 recently experienced a stall event that occurred on August 23, 2022. Subsequent to the stall event, it was observed that the Unit 15 combustion turbine high-pressure compressor section of the supercore was damaged significantly and beyond repair after a turbine compressor blade liberated damaging the adjacent stationary and rotating components throughout the entire combustion turbine. After determining that these Unit 15 components were damaged beyond repair, we prepared to replace them with our spare supercore (number 125). Supercore 125 had been in the General Electric repair facility for an extended duration and we were expecting it to return to Haynes for use a spare at the time of the stall event. Unfortunately, on August 31, 2022 it was determined that corrosion observed at the bearing #4 area of supercore 125 would prevent use of supercore 125 as a viable spare component without further inspection and repair.

The supercore 125 was shipped to the General Electric Houston Service Center in early October 2022 with an agreed upon "induction" date of October 27, 2022 to commence the detailed disassembly, inspection, and repair process of the corroded bearing (if any). Haynes Unit 15 is required to complete a carbon monoxide (CO) relative accuracy test audit (RATA) in accordance with local air quality regulations by December 31, 2022 and I am concerned that due to the unanticipated findings on the engine 125 supercore we will not be able to meet the CO RATA regulatory deadline. Please provide an update regarding General Electric's support of the Department's need to address the Unit 15 forced outage and return the generating unit to service as soon as possible (specifically whether the spare engine 125 supercore will be repaired in time to meet the December 31, 2022 regulatory deadline).

I look forward to your response regarding this matter.

Regards,
Ian Guthrie