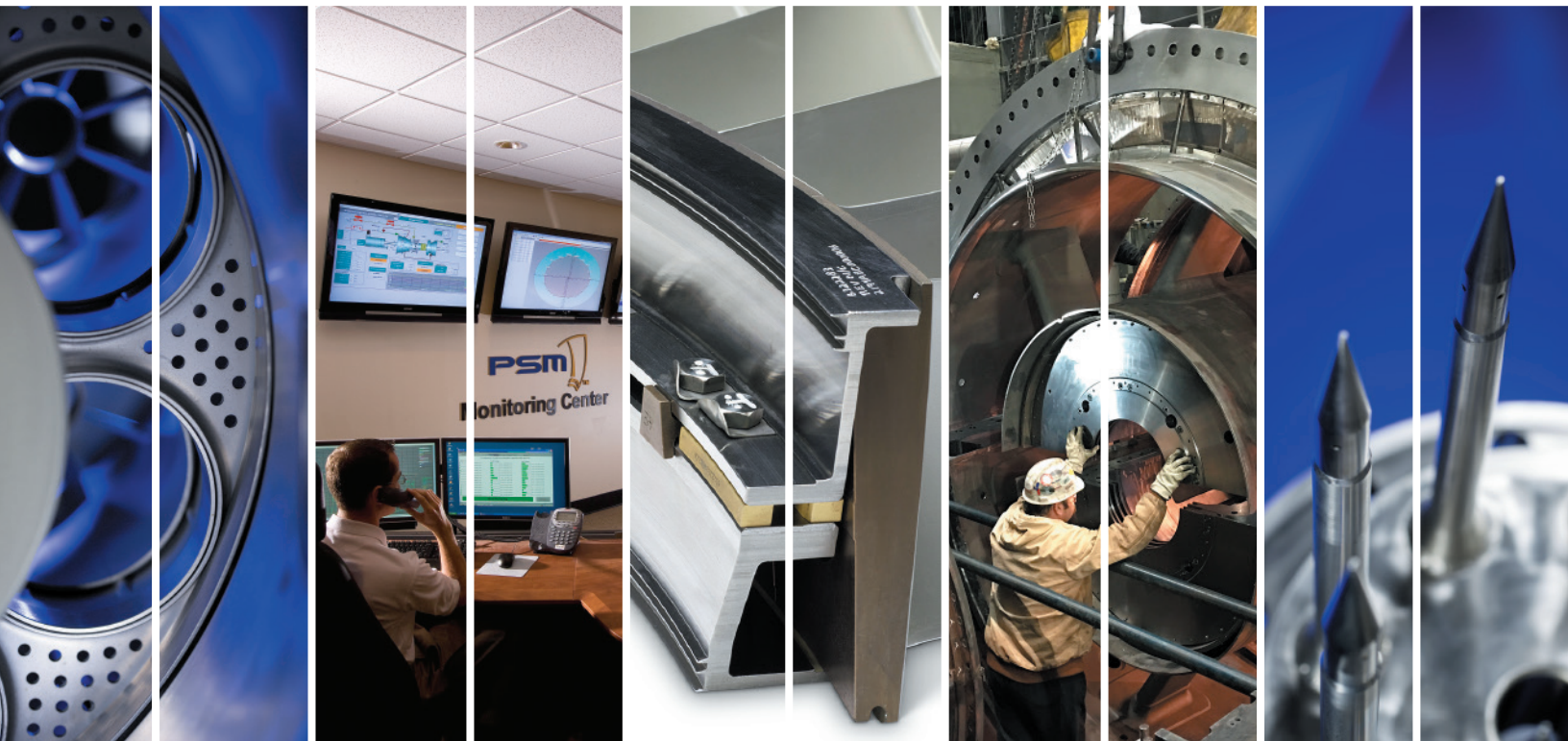


501F Product Portfolio



The Preferred Partner for Service and Innovation

PSM 501F PRODUCTS

- Complete Compressor, Combustor, and Turbine flow path offering
- Sole Source for Aftermarket 501F GT Performance Upgrades
- Full Product Line Capability to Support Long Term Agreements; including Rotor or Exhaust System replacement and Life Time Extension
- Operational Flexibility Solutions for Integration with Renewables

Since 1999, PSM has designed a complete 501F product line that offers robust and proven design improvements and solutions. Our product line has expanded from our flagship combustion offerings to include reliability enhanced, in-kind replacement of turbine, compressor, and rotor hardware, as well as upgrade packages that deliver performance enhancements and extended lifetimes.

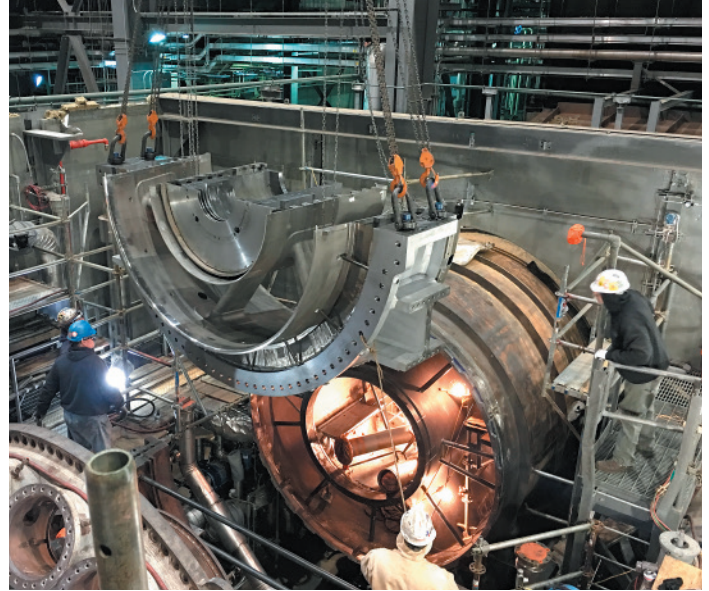
We are the only aftermarket supplier of 501F GT performance upgrades, a capability enabled by our staff of 100+ R&D engineers. We are focused on introducing innovations for the installed F-Class power base, to support the continued viability of these assets. We continue to target the timely introduction of innovative, PSM-designed solutions for emerging 501F fleet issues, through continuous improvement of our current offerings and expansion into new products.

Combining our technical expertise, speed to market, flexible solutions, tools, and multiple OEM cross-platform experience, we've become the industry leading 501F alternative products and services supplier.

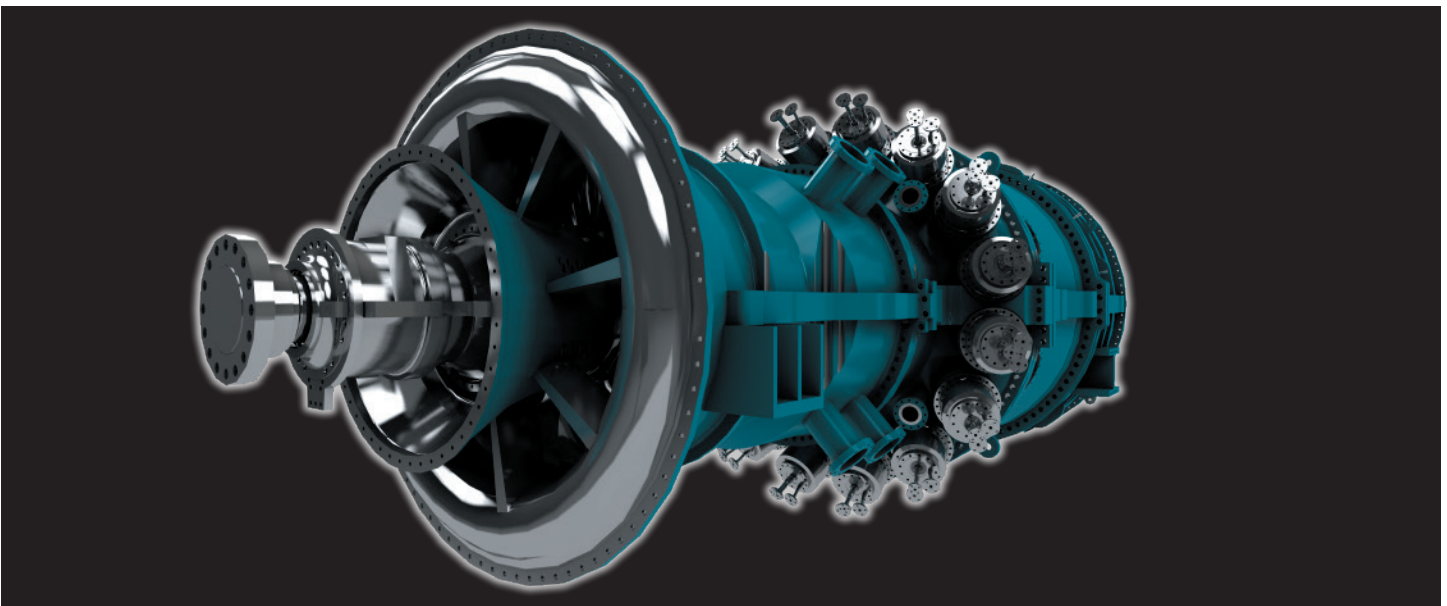
Innovative. Agile. Responsive. Global.



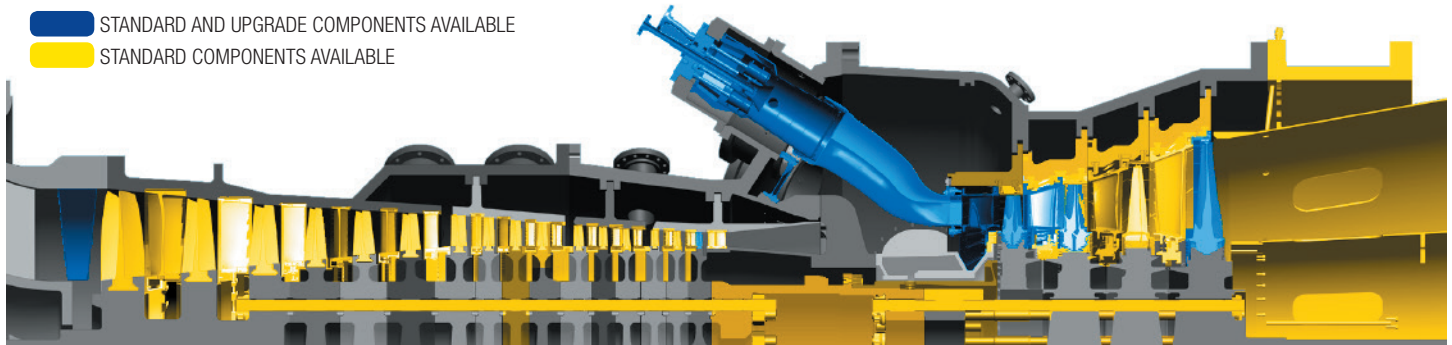
Improved operability and life-cycle maintenance costs
for gas turbine operators with our own technology
service solutions



With the resources and expertise to meet your needs 24/7.



501F PORTFOLIO



Combustor Experience Highlights

- + Drop-In Combustor has successfully eliminated combustor inspections, operating 25K EBH intervals
- + PSM TP experience over 2.2M hours, with 95+ sets sold
- + Pilot Nozzle total life in excess of 60K equivalent baseload hours (EBH). Over 65 sets sold.



SEED ROTOR

Turbine Experience Highlights

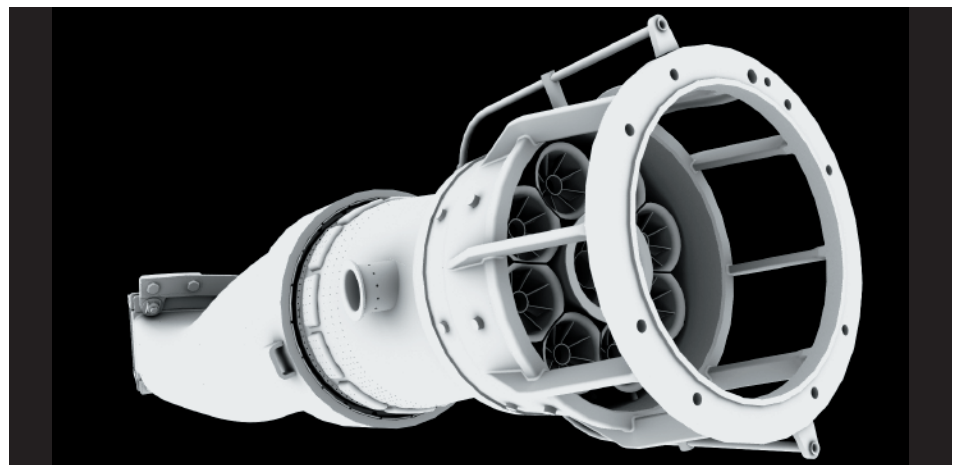
- + Row 1 Blade: 26K EBH interval with 100% repairability. Over 75 sets sold.
- + Redesigned Row 2 Blade for 3-interval life
- + Over 450 total sets of parts sold



NEW ROW 1 STATIC SEAL

Additional 501F Hardware

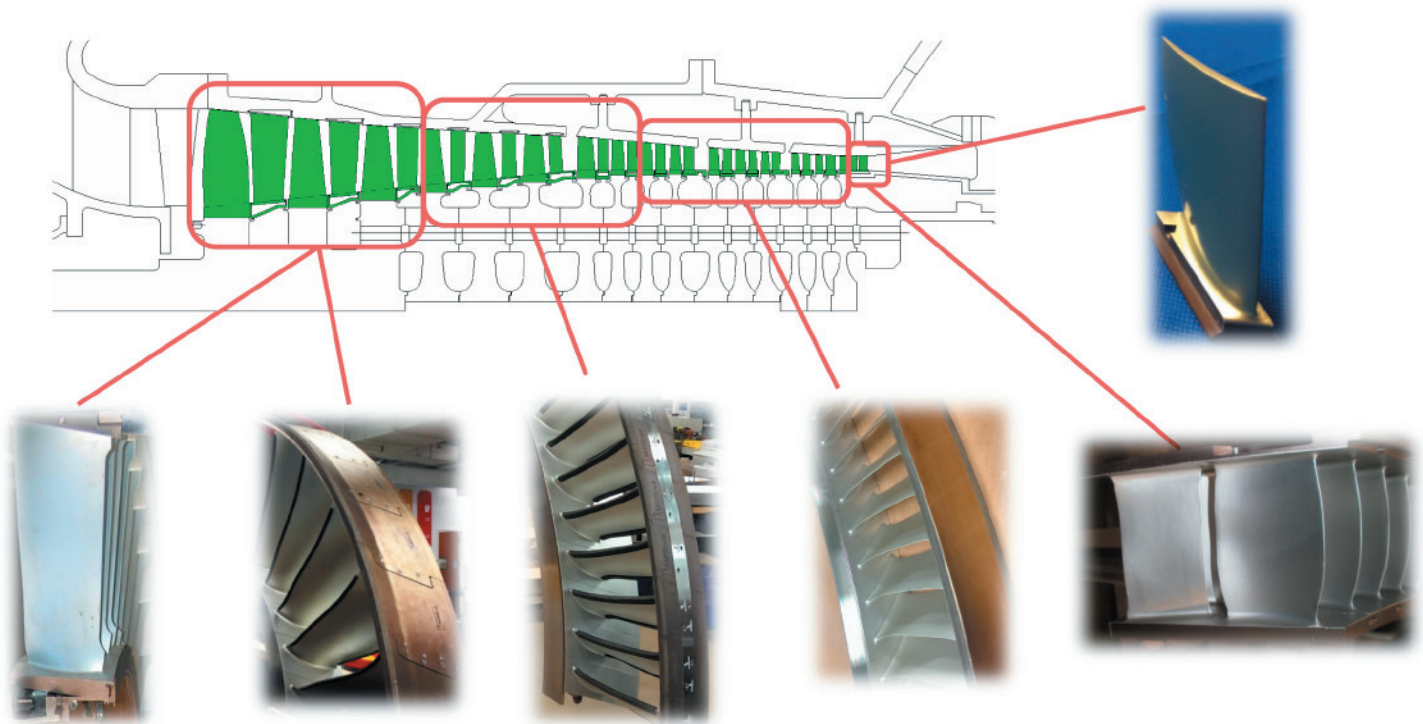
- + Improved rotor solutions
 - Improved compressor bolting to address OEM fleet issue
 - Enhanced turbine bellyband design can be installed at HGP or destack
- + Interstage Seal Assembly components and Static Seals improved from OEM design
- + All consumables included in Outage Kits
- + Advanced early field inspection technology for OEM compressor bolts enables early flaw detection and continuous operation with monitoring
- + Completely redesigned Exhaust Cylinder and Manifold drop-in replacement



25K DROP-IN COMBUSTOR

**Fleet Statistics as of December 2017*

COMPRESSOR RELIABILITY SOLUTIONS



Common OEM fleet diaphragm issues include

- + **Case Wear** driven diaphragm excitation
 - **Original design** with high risk of not reaching HGP interval
 - **Case-modified geometry** showing improved durability but still recorded events or early removal
- + **ID seal box** interaction with the rotor
- + **Failure of anti-rotation** feature on static hardware due to overload

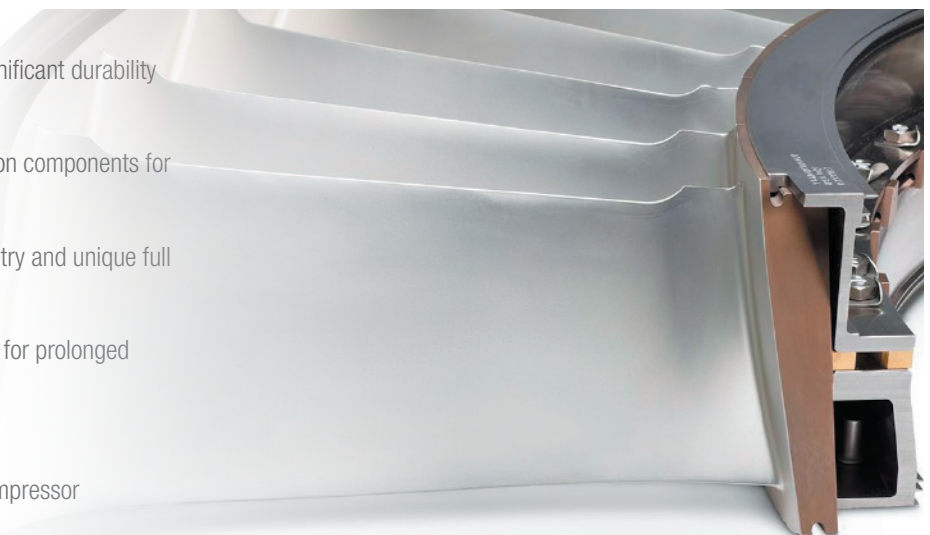
Compressor Diaphragms

Complete offerings for FD2 / FD3 Compressor with significant durability improvements and no case modification

- + S1-8 Completely forged design eliminating welding on components for superior durability
- + S9-16 Individual forged airfoils with patented geometry and unique full penetration laser welding for enhanced durability
- + Advanced wear coating on case interaction surfaces for prolonged case and airfoil life

Compressor Blades

- + Complete OEM equivalent offering for FD2 / FD3 compressor
- + All part manufactured or assessed in compressor cell in Jupiter, FL



HOT SECTION RELIABILITY SOLUTIONS

Designed to Reduce Life Cycle Cost

Maximizing part durability and reliability provides better availability and profitability in the marketplace. Our complete line of SW and MHI 501F compatible parts have been designed to increase the lifetime capability over the OEM hardware. Our hot gas path components utilize advanced materials, coatings, cooling schemes, and design features to maximize durability and reliability. We upgrade OEM components following our proven design approach:

- + Identify the current component issues/failures
- + Use state-of-the-art analytical tools, metallurgical evaluations, and engine test data where possible to determine the root cause of the issues/failures
- + Use the same analytical tools to design and fabricate new hardware with design features to maximize durability and reliability
- + Return that value to owners and operators through reliability and operability enhancements, outage elimination to reduce operating costs, and performance upgrades to improve the bottom line

By co-locating R&D engineering with our repair workshop, our design engineers collect continuous feedback on the performance of PSM and competitor designs and proactively address emerging fleet issues.

Our Hot Gas Path Benefits Include

- + Interchangeability with OEM parts at the component or system level
- + Interval Extension: Minimum 25K EBH or 900 ES repair interval for all parts
- + Life Cycle Costs: 4 Interval component life for all combustion parts; with potential cooling upgrade at repair
- + Operational flexibility: 5-10% turndown improvement
- + Reduced Operational Risk: Design and flow control increases dynamics window for safe operation (improved flashback and NOx margin)



501F DROP-IN COMBUSTION HARDWARE

PSM's Drop-In Combustor includes technology improvements enabling extended turndown and interval extension over competing designs. It is compatible with the OEM's equipment at both the component and system levels. The system includes our Transition Piece and Pilot Nozzle with over 10 years of successful operating experience. The Support Housings and Baskets are more recent additions to the Product Line. The complete system has now demonstrated the capability to eliminate Combustion Inspections, by running uninterrupted through a full Hot Gas Path interval.

Basket

- + Upgraded material, effusion cooled basket wall, and improved screech dampers
- + Improved pilot cone cooling
- + Mechanical attachment decouple from combustion frequency
- + Installed since 2010
- + Compatible with FC / FD1 / FD2 / FD3



Transitions

- + Upgraded material with solid wall construction
- + Modified body shape to improve durability
- + Effusion cooled with full TBC coverage
- + Improved thermally-free mount to stage 1 vane
- + Installed since 2003



Support Housings

- + Known fuel manifold leak risk addressed
- + Reduced rocket tip wear when operated with PSM Baskets
- + Controlled fuel flow variation
- + Gas Only and Dual Fuel systems available
- + Heated and Unheated systems available



Pilot Nozzles

- + Single body torso design to decouple dynamic response
- + Coated heat shield for enhanced durability
- + Dual Fuel designs available
- + Installed since 2003



TURBINE VANES

PSM's product development capabilities are on par with the OEM's, using our own design criteria and industry-proven design analysis toolbox. Our engineering team has the additional benefit of access to the entire global F-class install base to understand which design features work, and which ones don't.

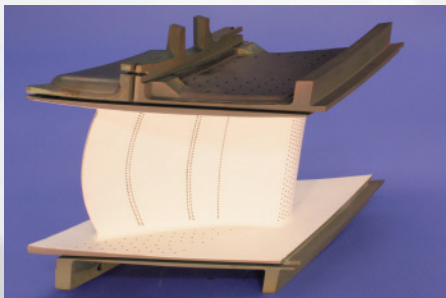
Our Platform Approach to design enables us to leverage our own proprietary technology solutions across multiple OEM gas turbine fleets. So the solutions we bring for 7FA users may also bring value to 501F operators.

Our design objectives always include reliability first. Once demonstrated, we strive to optimize both operability and life cycle costs. That knowledge base is then applied to the development of engine upgrades.

Our continuous improvement efforts draw from: customer feedback, fleet monitoring, rainbow testing, reconditioning analysis, fleet trending including Parts Tracking Database.

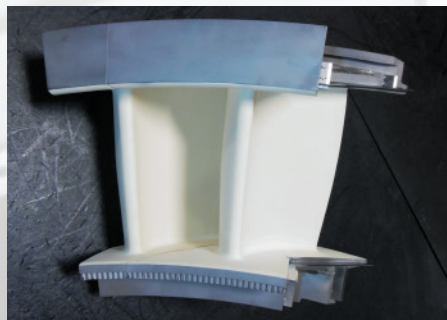
1st Stage Vane

- + Optimized cooling design for improved durability
- + Redesigned to eliminate unscheduled outages caused by ID welded pan failures
- + Simplified vane insert design



2nd Stage Vane

- + Material change for improved creep resistance & repairability / weldability
- + Enhanced platform design to eliminate platform cracking
- + Minimized hot gas ingestion+ Optimized cooling flow for improved platform durability
- + Bolted doublet design for stress reduction



3rd Stage Vane

- + Material change for improved creep resistance & repairability / weldability
- + Enhanced creep properties reduces risk of rotor rub
- + Improved TMF behavior for cyclic environments
- + 50K hours typical without repair



TURBINE BLADES AND RING SEGMENTS

1st Stage Blade

- + Upgraded material compared to OEM designs; improved repairability in high start applications
- + Features an internal cooling scheme with high efficiency and an active platform design
- + Incorporates trailing & leading edge platform undercut design with cast-in tip cap design

2nd Stage Blade

- + Upgraded material compared to OEM designs
- + Blades incorporate optimized trailing edge undercut design with modified tip cap
- + Incorporates high efficiency internal cooling scheme and an under—platform debris pocket

3rd Stage Blade

- + Incorporates modified tip shroud design to reduce weight and address OEM curling
- + Blades feature optimized radial cooling design
- + Includes welded hardface at the shroud Z-notch

4th Stage Blade

- + Incorporates welded hardface at the shroud Z-notch
- + Externally coated with HVOF



1st Stage Ring Segment

- + Improved edge cooling and intersegment purge
- + Ring segments pre-cupped for optimized interaction with the blades

2nd Stage Ring Segment

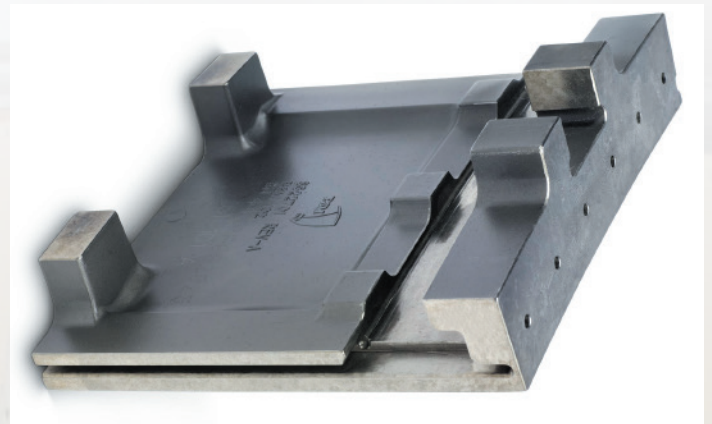
- + Significant Material Upgrade to reduce distortion
- + Optimized intersegment gap
- + Seal retention feature integrated into Ring Segment body

3rd Stage Ring Segment

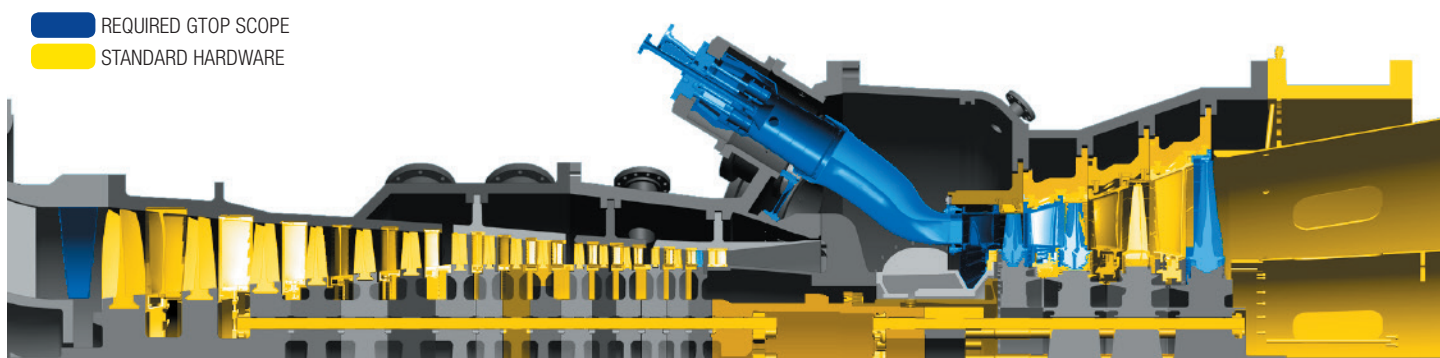
- + Brazed honeycomb material

4th Stage Ring Segment

- + Brazed honeycomb material



GTOP – GAS TURBINE OPTIMIZATION



Providing performance upgrades with improved operability & life-cycle maintenance costs for gas turbine operators

The GTOP package from PSM

- + GT output improvement up to 9% of baseload, efficiency improvement up to 1.6% for 2x1 combined cycle, and interval extension to a combined 32K CI/HGP
- + Incremental upgrade packages allowing tailored solutions to meet your economic goals with compatibility to future improvements
- + Plant Assessment to evaluate the performance impact of the GTOP upgrade on your entire plant
- + No exhaust scope required as part of upgrade package. PSM's 501F Exhaust Cylinder and Manifold solution is available and fully compatible with GTOP.
- + Turn Down capability of PSM combustor demonstrated to be superior to OEM parts. Users can expect a 5-10% improvement in turn down within emissions compliance.
- + Compatibility with OEM hardware on a set-wise basis for non-GTOP components. This enables customers to complete a phased implementation of GTOP upgrade packages and realize the full value of their part purchases.

Design Features of PSM GTOP

Hardware Include

- + Use of PSM's advanced alloys for turbine blades and vanes
- + Material advancement in turbine ring segments
- + New design enhancements to improve durability leveraged from PSM's successful operation in other F-class engines
- + Internal cooling design enhancements
- + Vane durability Improvements
- + Fully compatible with existing cases and rotors

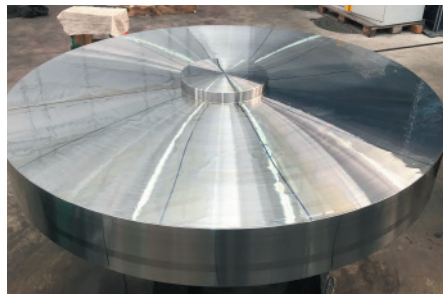
	Interval (KEBH)	GT Power (SC)	Heat Rate (SC)
HGP	25	+4%	-1.5%
	32	Degradation Recovery	
Modified HGP	25	+9%	-3.5%
	32	+5%	-3%

ROTOR MANAGEMENT SOLUTIONS

Capitalizing on our extensive rotor experience, full 3D steady state and transient analysis models, and a portfolio of rotor and blading design upgrades enables PSM to offer customers a proven rotor management alternative.

501F Capabilities

- + Rotor removal, inspection, ship and install capability
- + Shop capability to inspect, assemble, repair, balance
- + Analysis for disk repair approaches and Life Evaluation/Extension
- + Procurement of all required parts, including improved compressor bolting and turbine bellybands
- + In-situ Compressor bolting inspection
- + Patch Ring Repairs
- + Seed rotor to support Rotor Exchange Program
- + Now producing rotor discs. PSM is holding inventory of select rotor components based on fleet need. Compressor and intermediate shaft discs made to date.



Example Design Solutions Available

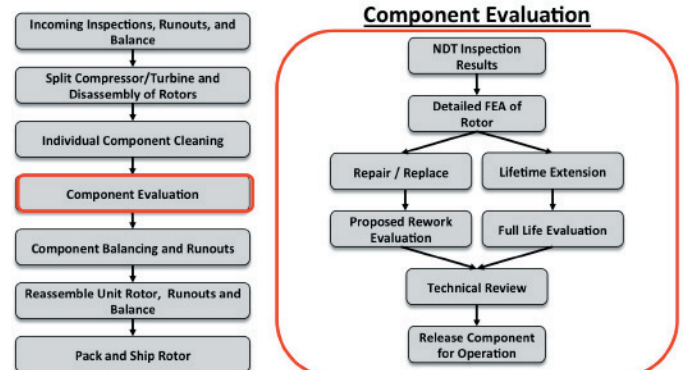
- + Developed in response to rotor failures attributable to a 501F compressor bolting issue, PSM developed an in-situ inspection technique which can detect flaws before they reach critical size. If an indication is found, an inspection program can be implemented to allow continued operation before rotor replacement is required.
- + Custom solutions include field blending of a 501F compressor disk indication, which has operated successfully for over 5 years.
- + Patch Ring Repair – A spigot fit was found to have failed, so that both sides of the spigot fit were found in one disc. Our team was able to design, analyze, review, and fabricate a custom design to re-create the controlled interface between discs.

Rotor Lifetime Extension (LTE)

PSM's Rotor LTE program can extend the useful lifetime of your rotor. With the advancements in computing power, material properties, fracture mechanic methodologies, and inspection techniques, it is now possible to assess the potential to run rotors beyond their original published limits. Rotor LTE is enabled by:

- + Advanced non-destructive inspection techniques, utilized to detect surface and volume flaws
- + Full rotor material characterization, based upon new and aged samples
- + Full 3D Finite Element Analysis (FEA) models for thermal & structural analysis
- + Inspection results and operational history fed back to the FEA Model as part of a unit-specific evaluation

Any problematic flaws identified during inspection are analyzed, and a report detailing the predicted remaining rotor capability is generated, empowering owners to make informed decisions about their rotor assets. Optional rotor modifications can be applied (called LifeMod), that are designed to extend starts-based rotor lifetime in known life limiting locations.



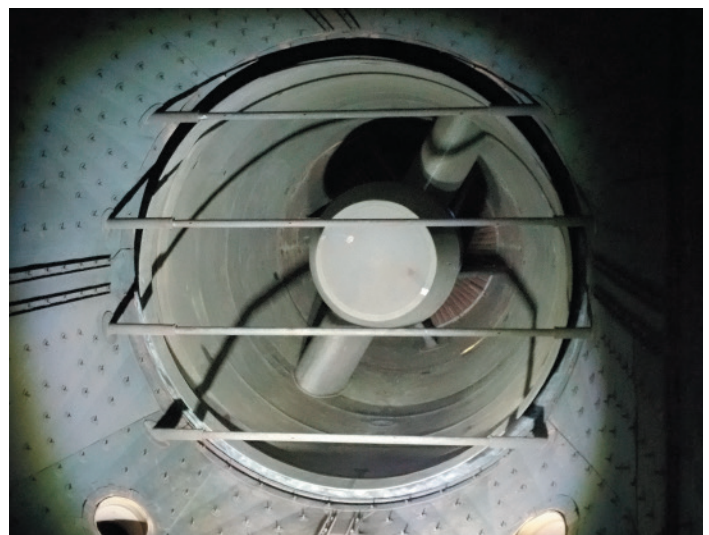
EXHAUST CYLINDER

Exhaust Cylinder

- + Thermally free cylinder design
- + Baffle plates eliminated
- + Lower stress strut shield design
- + Higher strength strut material
- + Mechanically robust liners
- + Liner material changed for increased weldability
- + New exhaust static seal design
- + Utilizes improved aft flange design when installed with OEM manifold

Exhaust Manifold

- + Compatible with PSM exhaust cylinder
- + Flange thermal fight removed
- + Tapered flange design
- + Reduced count low profile ribs
- + Improved manway design
- + Thicker OD liner and manways
- + Improved tailcone design



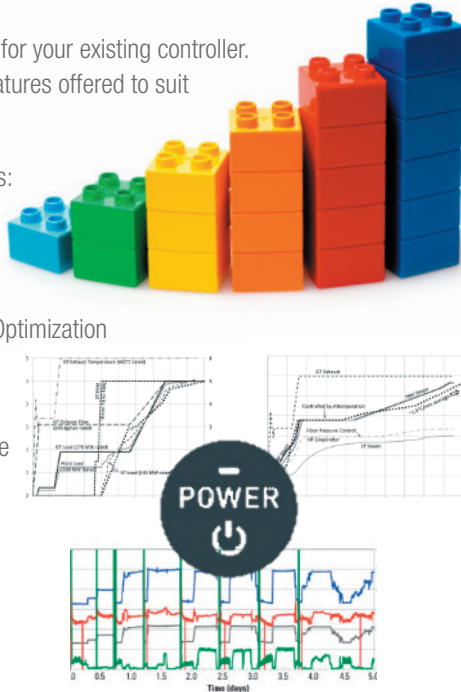
DIGITAL TECHNOLOGIES

FlexSuite™

Portfolio of applications for your existing controller. Multiple optimization features offered to suit individual needs.

FlexSuite building blocks:

- + Combustion Optimization
- + Start-up/Shut-down Optimization
- + Enlarged Load Range
- + Efficiency and Lifetime
- + Fuel Flexibility
- + Grid Support
- + Service Flexibility



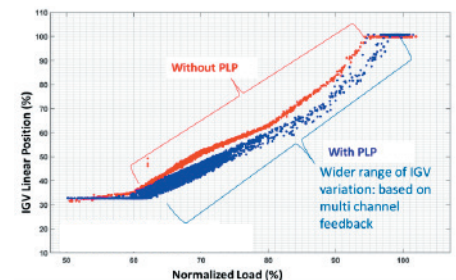
FlexSuite Example: Part Load Performance

Current part load temperature control is open loop

- + IGV's control: function of normalized load
- + No direct correlation between the exhaust temperature and the IGV setting

As turbine efficiency degrades, IGV settings are not optimized for:

- + Emissions
- + Combustion stability
- + Heat rate



FlexSuite solution introduces a closed loop control scheme

- + Providing part load heat rate and improved turn down for 501F units
- + Accurate control of the IGV's via exhaust temperature feedback
- + Optimizes system performance at all part load and ambient conditions

FlexSuite™: AutoTune

Enables automated GT combustion tuning to maintain emissions and combustion dynamics compliance

Self Learning Algorithm

- + AutoTune's patented learning algorithm captures information from successful and unsuccessful tunes to quickly provide a tuned engine all - year long.
- + Fuel Fractions stored across varying CTIM and other parameters.

AutoTune Box Features

- + Compact, rack-mounted system
- + Logic external to control system
- + HMI screen seamlessly integrated
- + Highly customizable to each GT
- + Self learning tuning logic / highly adaptable
- + Contains fully functional CDMS
- + Industrial grade electronics (Non-PC)
- + Back-up safety logic



LONG TERM AGREEMENTS

Summary of Offerings

As a leading parts provider in the industry, PSM is offering comprehensive and flexible Long Term Agreements for 7F, 501F, 6B, and 7E aimed at decreasing lifecycle costs to the end user. Our PSM engineered part design enables us to increase the component life and extend the program intervals, eliminating inspections and providing the customer with significant price reduction over the life of the contract.

In addition, through our experience with component performance, PSM is able to reduce the fallout of hot gas parts due to the improvements made to the OEM design and reconditioning process. PSM has also assembled a highly skilled and experienced field service organization capable of industry leading outage performance.

Flexible Agreements — to fit the customer needs

Types of PSM Service Agreement Offerings			
Included Product Offerings	Long Term Agreement (LTA)	Long Term Maintenance Agreement (LTMA)	Frame Agreement
Parts Supply	✓	✓	✓
Reconditioning	✓	✓	✓
Field Services	✓	✓	Optional
Monitoring & Diagnostics (Remote Monitoring)	✓	Optional	Optional
Contract Manager	✓	Optional	Optional
Inventory Management	✓	✓	Optional

PSM has designed a flexible concept for the Long Term Agreements focused on your requirements. We understand the frequent change in market conditions, and PSM is willing to accommodate the changing conditions based on your needs. The intention of each agreement is to provide the customer with competitive pricing while taking advantage of the entire PSM portfolio of offerings. Our agreements can be structured to not only include the gas turbine, but also the generator, steam turbine, and respective auxiliaries.

In summary, the various agreement offerings are structured to optimize your maintenance budget by offering competitive parts life guarantees, minimal parts fallout, coverage during unscheduled inspections, control of inventory, and proactive contract management to ensure total coverage.

Scope of Supply — based on the customer requirements

The customer determines the level of scope for the Long Term Agreements, ranging from full service offerings to a pricing agreement. Service offered by PSM within a Long Term Agreement include, but are not limited to, the following:

- + Parts Supply
- + Reconditioning
- + Field Services — including craft labor
- + Monitoring & Diagnostics (e.g. Remote Monitoring)
- + Contract Management
- + Inventory Management
- + Parts Tracking
- + Engineering Assessments
- + System Technical Support
- + Emergency Response



SERVICE CAPABILITIES INCLUDING MONITORING & DIAGNOSTICS

PSM services a diverse portfolio of GT components, control and combustion system platforms

- + Reliable coverage ranging from basic support through Complex Root Cause Analysis
- + Service Engineering goes beyond traditional support to provide best practices from across all platforms & systems
- + Strong Processes & Infrastructure positions PSM to further grow capabilities

Engineering Assessment

- + Experienced and dedicated team supporting our Field Service, Project Management, Sales & Tendering, R&D, Fleet Management, Global Execution Centers, and Customers
- + Over 400 events per typical outage season evaluated and answered
- + Team can reach into all parts of PSM organization to ensure quick event disposition

Tuning and Commissioning

- + 150+ tunes per year
- + Wide variety of combustion technology and control systems
- + Strong expertise in OEM & PSM Combustion systems
- + In house knowledge base and access to combustion design engineers
- + Tuning events completed across 7 platforms including 9FA & 6FA

Monitoring and Diagnostics

- + Over 50 units and 10 GW monitored as of January 2018
- + Global infrastructure with redundancy
- + Follow-the-sun approach with manpower support
- + Monthly Operational Assessment Reports (OAR's) included monitoring of customer selected parameters

Controls Design and Development

- + Controls-related services across 7 different platforms
- + Support customers and PSM technology initiatives
- + PSM Virtual Plant available
 - A full tie-back simulator
 - Built to support controls replacement and expansion projects or technology development
 - Assesses operational and protective schemes and communications protocols





Additional Services and Product Offerings:

7F, 501F, 701F, 6B, 7B/E, 9E, 9F

Field Services & Outage Management including on-staff bladers and supply of labor for gas turbines, steam turbines and generators worldwide for GE B,E & F-class, SW & MHI F-class.

Reconditioning & Repair of all turbine airfoils and combustion system components, including fuel nozzle overhaul for GE 7F, SW & MHI 501F/701F, GE 6B & 7E (Standard & DLN-1).

Combustion System Engine Tuning including Monitoring & Diagnostics
Support for all rotating equipment (e.g. remote monitoring) of gas turbines worldwide.

Rotor Rebuild, Inspection & Replacement Components including disk repairs, low speed or high speed vacuum balance and rotor life extension/assessment.

R&D, Engineering Assessments, Root Cause Analysis and system technical support for gas turbines.

Flexible Long-Term Parts and Service Agreements (LTSA) combine all of PSM's products and services for a custom solution that meets your needs.

Power Plant Solutions provide integrated services and upgrades for all your critical power plant components and systems. PSM provides a single point of contact for maximizing your plant's performance potential, increasing operational flexibility, and outage management.

AutoTune offers autonomous, real-time combustion system control tuning packages for optimizing combustion dynamics/pulsations, emissions and output on multiple gas turbine frames.

GTOP Upgrade Packages for 7FA and 501F increase output and reduce heat rate, while extending component lifetime and inspection intervals.

Contact your PSM Sales Representative for more information.
Call: **561.354.1100** or email: **sales@psm.ansaldoenergia.com**

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