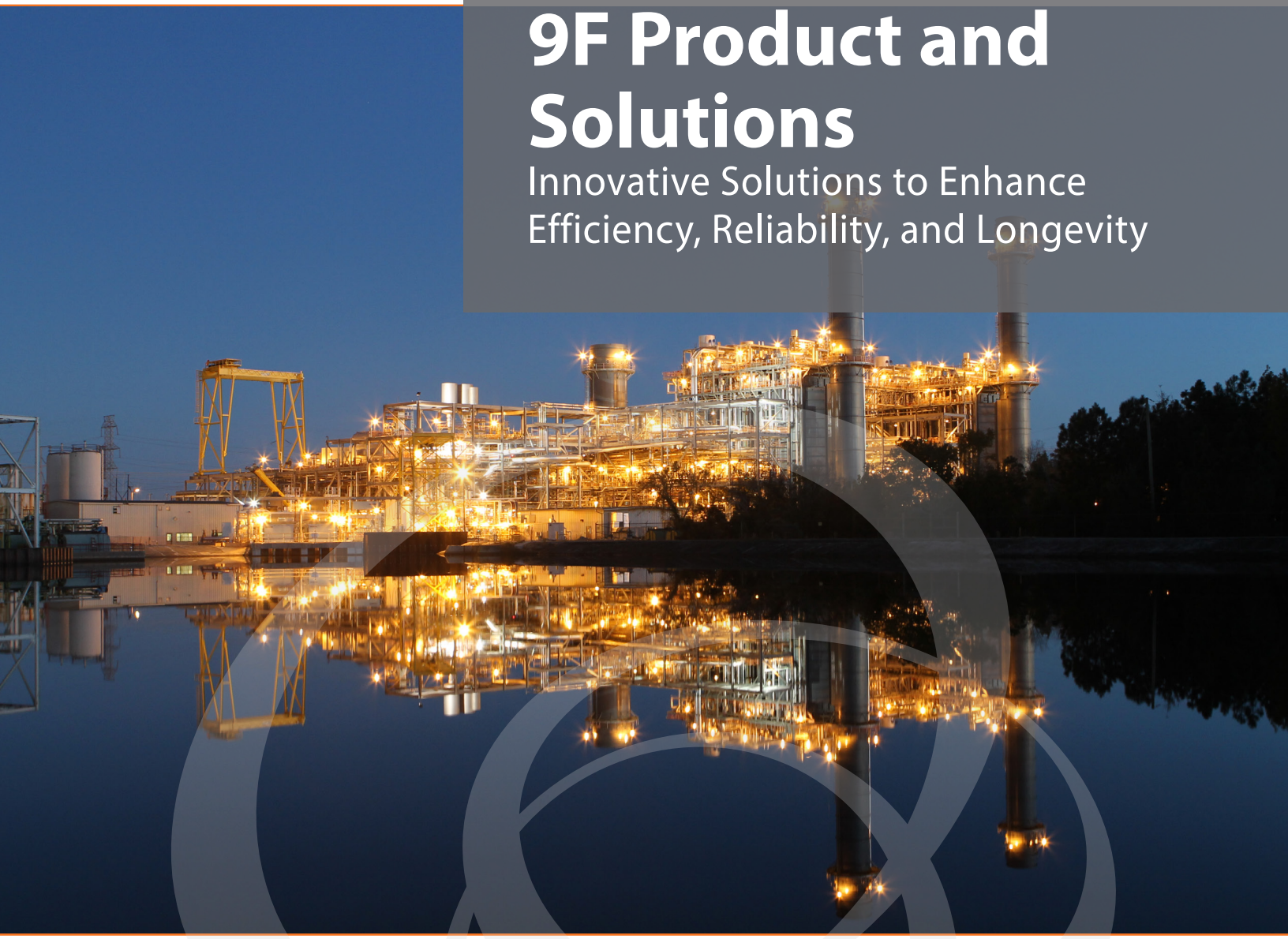
PSM
a Hanwha company

Innovative Clean Energy Solutions for Future Generations

9F Product and Solutions

Innovative Solutions to Enhance Efficiency, Reliability, and Longevity



PSM's advanced 9F solutions optimize performance, extend turbine life, reduce emissions, and improve reliability with proven engineering and cutting-edge technology.

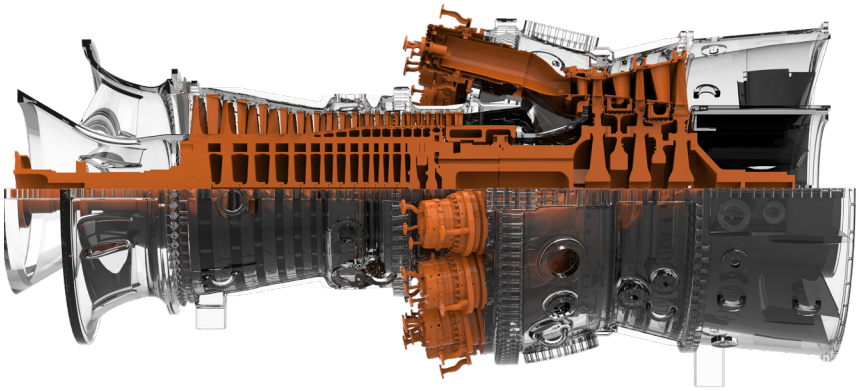
PSM 9F Products and Services

Built on our successful Frame 7F products, PSM offers combustor and turbine components for Frame 9F. Design improvements developed for the 7F and validated across multiple applications form the foundation of PSM's 9F portfolio. We achieve improved durability and lower life cycle costs using our component and system-level product modeling and data evaluation tools to identify issues and failure modes in current OEM designs.

PSM is the industry-leading F-Class alternative products and services supplier, combining technical expertise, rapid market response, flexible solutions, advanced tools, and multi-OEM gas turbine platform experience.

Design Improvements

+ Interchangeability with OEM hardware
+ ≤ 9 ppm NOx & CO emissions over normal premix operating load rang
+ All parts designed for 32,000 Factored Hours (FH) and 900 Factored Starts (FS) inspection intervals or better



Our longer-lasting, more dependable 9F gas turbine parts enhance power plant availability and profitability. PSM's Frame 9F compatible parts feature redesigned elements to address life-limiting factors in existing designs. Our hot gas path components utilize advanced materials, coatings, cooling schemes, and design features to maximize durability and reliability.

PSM upgrades components following a proven design approach:

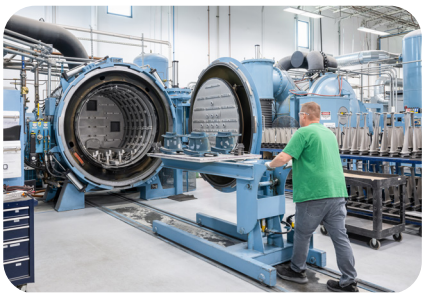
1. Identify current component issues/failures
2. Utilize state-of-the-art analytical tools, metallurgical evaluations, and engine test data to determine root causes
3. Design and fabricate new hardware with features that enhance durability and reliability

METROLOGY LABORATORY

By co-locating R&D engineering with our repair workshop, our design engineers continuously gather feedback on the performance of PSM's and competitors' designs, proactively addressing emerging fleet issues. These capabilities enable PSM to introduce designs that align combustion and hot gas path inspections and reduce repair scopes, offering customers reduced lifecycle costs.

AIRFLOW ANALYSIS

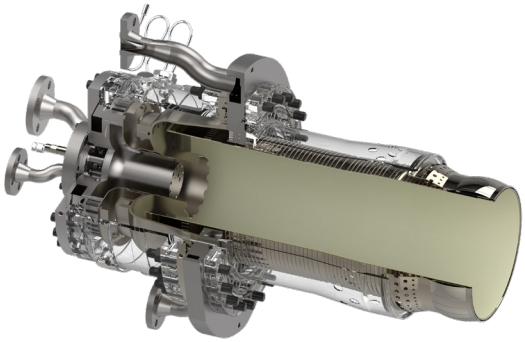
BELTING/FINISHING

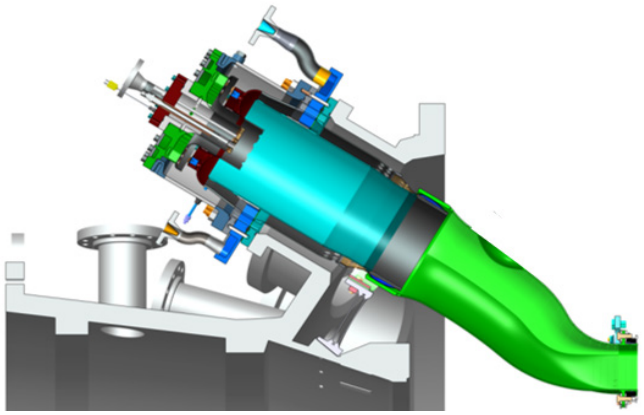


COATING

Superior Turndown, Fuel Flexibility, and Emissions Capability

Future-Proof your engine today! FlameSheet™ is the ultimate combustor solution to meet new operational needs. As the power generation market faces challenges from renewable energy penetration, low natural gas prices from fracking, and dynamic financial market changes, users must reevaluate their fleets to stay relevant. FlameSheet™ provides unparalleled flexibility, preparing your engine for both current operational demands and the future hydrogen economy.





CROSS SECTION VIEW. FLAMESHEET™ IS NOW AVAILABLE ON MOST ENGINE MODELS

FlameSheet™ Benefits

- \+ Up to a 30% increase in GT operating load range with single digit NOx and CO
- \+ Optional low-load HRSG protection setting
- \+ Superior Fuel Flexibility:
  - » 30% Modified Wobbe Index
  - » Ideally suited for alternate fuel operation, including hydrogen, ethane, and propane
    - + Up to 40-80% Hydrogen blend*
    - + Up to 40% Ethanes (C2)
    - + Up to 10% Butanes (C4-C6)
    - + Up to 20% Propane (C3)
  - » PSM is progressing towards 100% Hydrogen capability!
- \+ NOx as low as 5ppm
- \+ Peaking power at constant NOx emissions
- \+ Dual fuel capable
- \+ Inspection intervals up to 32K hours / 1,250 starts
- \+ Compatible with existing GT controllers and fuel skids
- \+ Turndown as low as 26% (even lower with Exhaust Bleed!)

FlameSheet™ = TWO Combustors in ONE

FlameSheet™ employs a simple, two-stage radially-inflow "combustor-within-a-combustor" concept, allowing staged operation at various load conditions. At high loads, both combustors are used, with the outer combustor flame structure forming an annular "sheet of flame" around the inner combustor. At low loads, the outer combustor is predominantly used. Leveraging trapped vortex stabilization aerodynamics, the outer combustor operates with excellent stability and remains sufficiently hot at very low loads to consume CO (which typically limits low-load operation).the outer combustor operates with excellent stability and remains sufficiently hot at very low loads to consume CO (CO typically limits low load operation).

Digital Products

Maximizing Plant Performance

PSM's Digital Technology Portfolio maximizes your plant's performance before, during, or after large equipment upgrades. Often, combining multiple engineered systems creates overlapping redundancy, which, when fully understood, provides significant optimization potential. Over the last decade, PSM has combined our domain expertise in GT technology, combustion system design, engine upgrades, engine operation from our M&D Center, and controls logic experience with balance of plant operations and advanced controls methods to create innovative optimization tools. Using proprietary and patented controls blocks, we offer multiple optimization features tailored to your individual needs.

FlexSuite and AutoTune

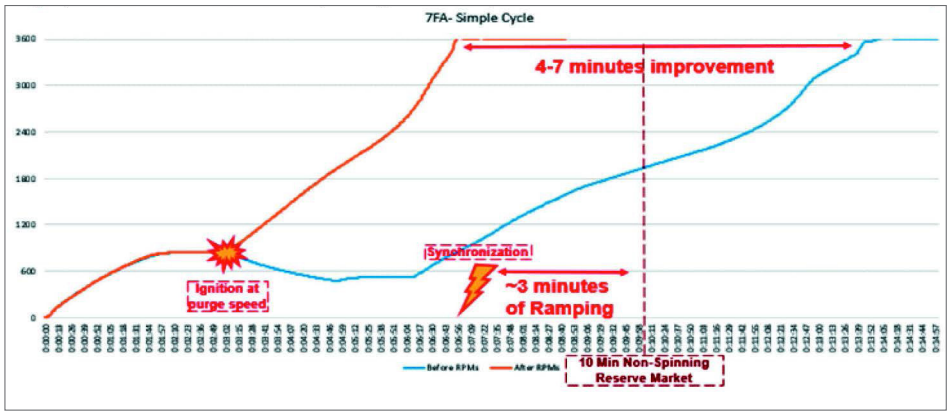
A portfolio of applications for your existing controller, FlexSuite from PSM, provides digital optimization for your power plant operations. Whether you seek operational reliability improvements or increased operational flexibility, there are multiple optimization features offered to suit your individual needs.

FlexSuite Building Blocks

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

Start-Up Optimization

FlexStart & FlexRamp: Increase Reliability and Availability through control logic improvements and adaptations that allow your GT's to better meet your performance needs. No matter if you are in a 10 minute start-up market or auxiliary services, being able to start faster and subsequently ramp fast both before and after heat soak can provide significant monetary value.



Example 7F rotor RPM with FlexStart controls logic optimization, gets SCGT to grid synchronization 7 minutes faster than originally commissioned allowing plant to operate in 10 minute spinning reserve market

AutoTune

Intelligent GT combustion optimization for emissions and combustion dynamics while maximizing operational range and fuel variation. Utilize in conjunction with FlexSuite, FlameSheet™, and GTOP™ to maximize the optimization potential.

System Features

+ AutoTune is an expert advisory system that provides extra level of intelligent protection to your existing controller
+ External to control system
+ HMI screen seamlessly integrated
+ Patented learning algorithms eliminate the need for seasonal tunes and provide significant system enhancement.

Tuning Optimization

+ **Dynamics:** Improved hardware life and Lean Blow Out mitigation
+ **Emissions:** Consistent emissions even with atmospheric/climate/seasonal changes at varying load points
+ **Learning:** Intelligent learning of known operational points reduces the need for tuning and minimizes errors

Transient tuning: Adapts to cycling of units and responds to dynamic changes.

Trip Avoidance: Provides ultra-fast reaction if the combustor is flaming out to prevent a trip.

AutoTune Learns

Patented learning algorithms capture information from successful and unsuccessful tuning events. Over time, AutoTune learns and significantly reduces the need for tuning under similar operating conditions.

FlexSuite – Flexibility Building Blocks

PSM's FlexSuite offers additional controller modules compatible with most control systems and designed to optimize your plant's performance.

Extended Turndown

+ Dynamic optimization of unit minimum load
+ AutoTune monitors emissions and combustion dynamics to safely meet load target or hold at lowest safe point of operation
+ Integrated with both manual load control or AGC drive load targets
+ Learns over time by saving ambient condition profiles, allowing for quicker load ramp when revisiting safe operating points

Operational Flexibility

With PSM's patented algorithms, it is possible to maximize the GT output according to climate conditions and actual system performance. For example, if you want to maximize seasonal peak power potential, Peak+ continuously seeks to maximize the load range while maintaining emissions and dynamics. Three optional modes are available:

+ **Power+:** Current firing temperature range with no impact on hardware life
+ **Peak+:** Option for increased peak firing mode to achieve greater improvements, with some hardware lifetime debit
+ **Turndown:** - minimizing low load point by maintaining output just above premix transfer

While running on AGC or remote dispatch: Peak+/Power+, Turndown & Transient Tuning all active during Automated Generation Control and do not require stable load conditions before optimizing.

9F Compressor Reliability Solutions

Common Fleet Stator Issues:

+ **Shim migration and liberation:** This can result in significant downstream compressor hardware impact damage.
+ **S0-S4 carrier ring corrosion and lock-up:** Can cause high cycle fatigue (HCF) failures and negatively impact maintainability, as corroded carriers can be difficult to remove, sometimes requiring a rotor lift and destructive removal.
+ **Excessive case hook fit wear:** This can result in stator rock or stepping, leading to forced outages, with wear issues most pronounced in the aft compressor stages.
+ **Tip rubs:** Can initiate tip cracks and cause pieces of stator tips to liberate, resulting in compressor hardware impact damage.

Enhanced Stator Reliability Design Features:

+ 100% shimless design to eliminate shim liberation risk
+ Squealer tips standard to minimize potential for tip cracks and stator material liberation due to rubs against the rotor during operation
+ Full radial machining geometry for optimum part damping
+ Shotpeening for enhanced material capability
+ Passivation for corrosion resistance
+ Interchangeable with OEM design by sets
+ Complete offering for flared and unflared compressor flowpaths available

Common Fleet Rotor Blade Issues:

+ **R0 HCF failures:** Can cause significant downstream damage.
+ **Attachment fretting and crack initiation**
+ **Tip rubs:** Cause material degradation, leading to tip crack initiation and material liberation, which can result in downstream compressor hardware impact damage.

Enhanced Rotor Blade Reliability Design Feature:

+ **Squealer tips standard** to minimize potential for tip cracks and blade material liberation due to rubs against the case during operation
+ **Shotpeening** for enhanced material capability
+ **Passivation** for corrosion resistance
+ **Attachment undercuts** to avoid fretting and potential cracks
+ **All required spacers available**
+ **Interchangeable** with OEM design by sets
+ **In-situ blade tip grinding capability** to ensure tip clearance requirements are achieved
+ **Complete offering** for flared and unflared compressor flowpaths available

First to Market with a Proven R0 Design Solution

Since its introduction, the 7F.03 R0 compressor blade has been a major maintenance issue for end users. PSM completely redesigned this component, delivering a design solution that met requirements in only 10 months. This solution has been operational since 2008.

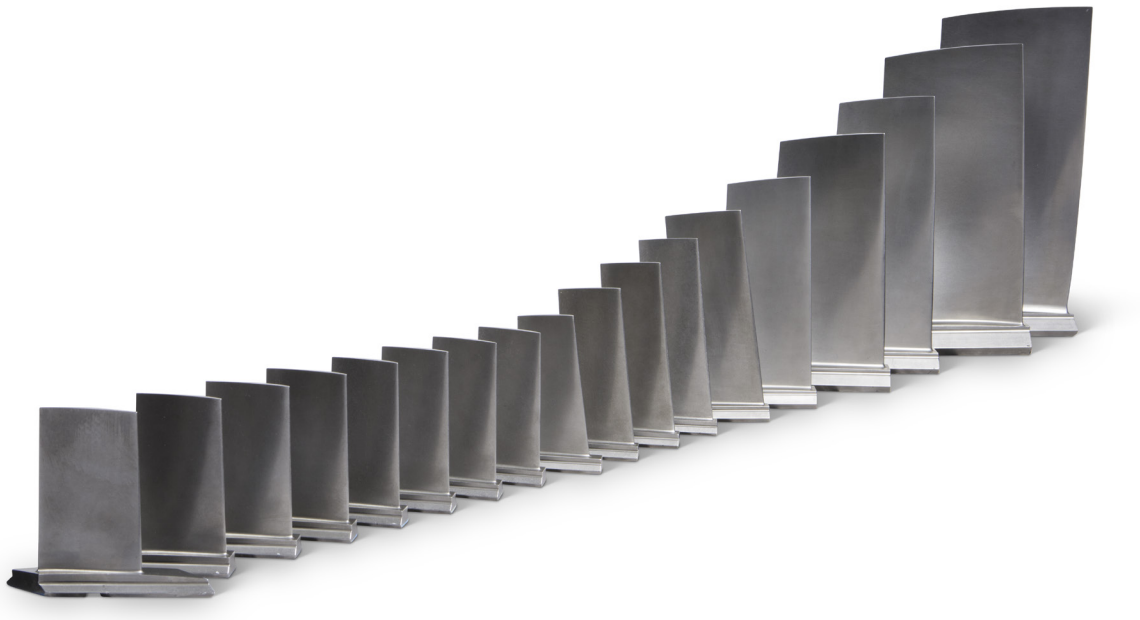
+ Erosion and corrosion-tolerant design
+ Material upgraded to a higher strength alloy
+ Compound variable conical fillet introduced to reduce stresses
+ Airfoil restacked to reduce steady stresses along the leading edge
+ Retuned airfoil to reduce vibratory stress response
+ PSM's patented R0 Blade retention design replaces the OEM "Biscuit Mod" retention feature and does not rely on staking to retain R0
+ No IGV modifications required for installation
+ No requirements for replicas or extraordinary inspections

Providing Proven Compressor Solutions for Over a Decade

PSM offers a complete compressor flowpath product line for flared and unflared 9F units, with reliability upgrades to solve common compressor durability issues. The product line was developed using PSM's proven compressor design approac.

1. **Customer Need Identification:** Addressing issues from stator wear to R0 HCF failures, which limit operators' ability to reliably and profitably operate their machines.
2. **Problem Identification:** Understanding the root cause through detailed analytical models, engine testing, stator strain gauging, rotor blade vibration monitoring, and metallurgical evaluations.
3. **Design Solution Implementation:** Implementing design enhancements once the root cause is understood, rigorously evaluated through PSM's internal gate review process.
4. **Validation:** Using engine instrumentation to validate performance and tracking fleet leader components to ensure reliability meets expectations.

PSM's compressor design approach consistently provides timely, high-quality design solutions.

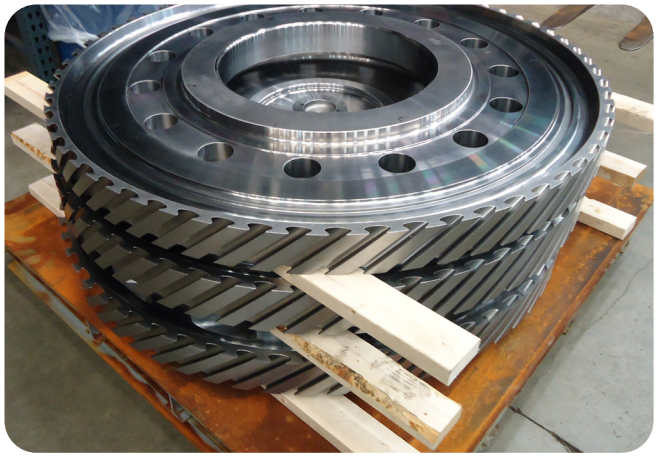


Rotor Management Solutions

Capitalizing on a portfolio of rotor and blading design upgrades, along with full 3D steady-state and transient analysis models, PSM offers a comprehensive exchange rotor service. With a PSM LTE rotor, you can minimize downtime and optimize your capital investment.

Capabilities

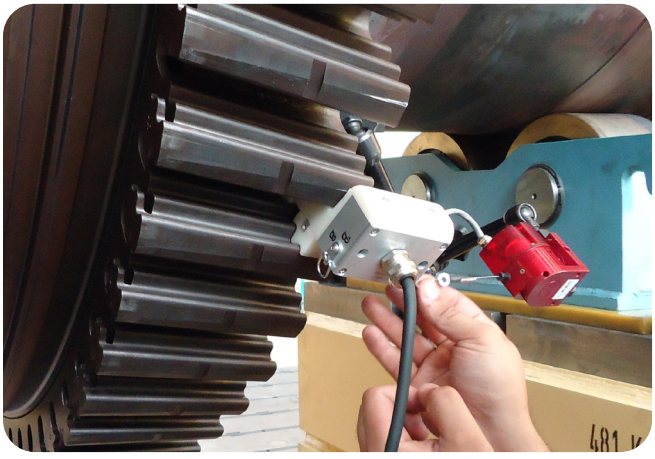
+ Unstack and deblade
+ Reblade and tip grind new blades
+ R0 retention plug modification
+ Compressor clocking optimization
+ Patch ring repairs
+ Complete rotor structural analysis to support repairs
+ Proprietary design flared and unflared compressor blading with reliability improvements
+ Seed rotor to support rotor exchange program



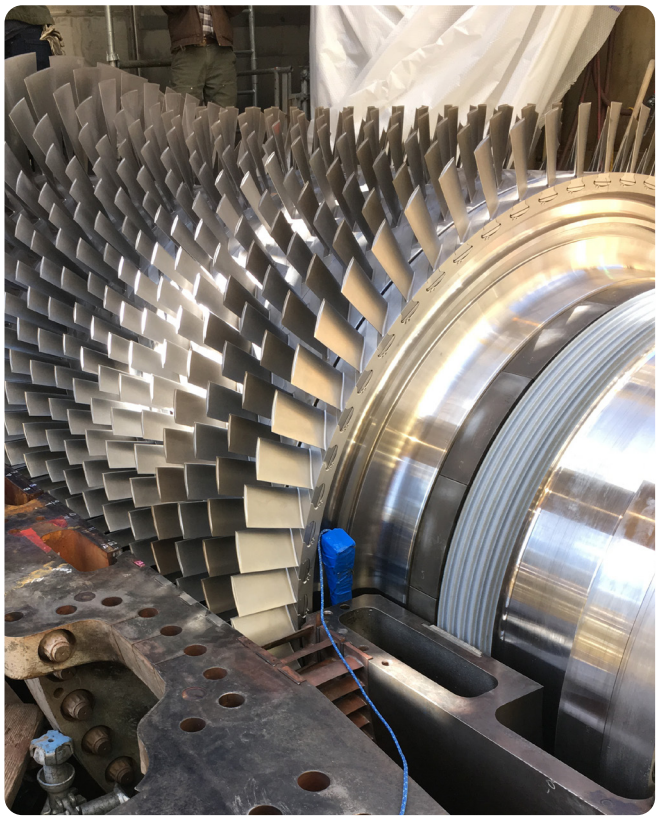
SEED ROTOR DISASSEMBLY

PSM Rotor Exchange

+ Seed rotor supports rotor exchange program
+ In-situ blend, polish, and peen of first turbine disk cooling slot
+ Additional life-enhancing solutions available upon full destack



ROTOR BEING TESTED



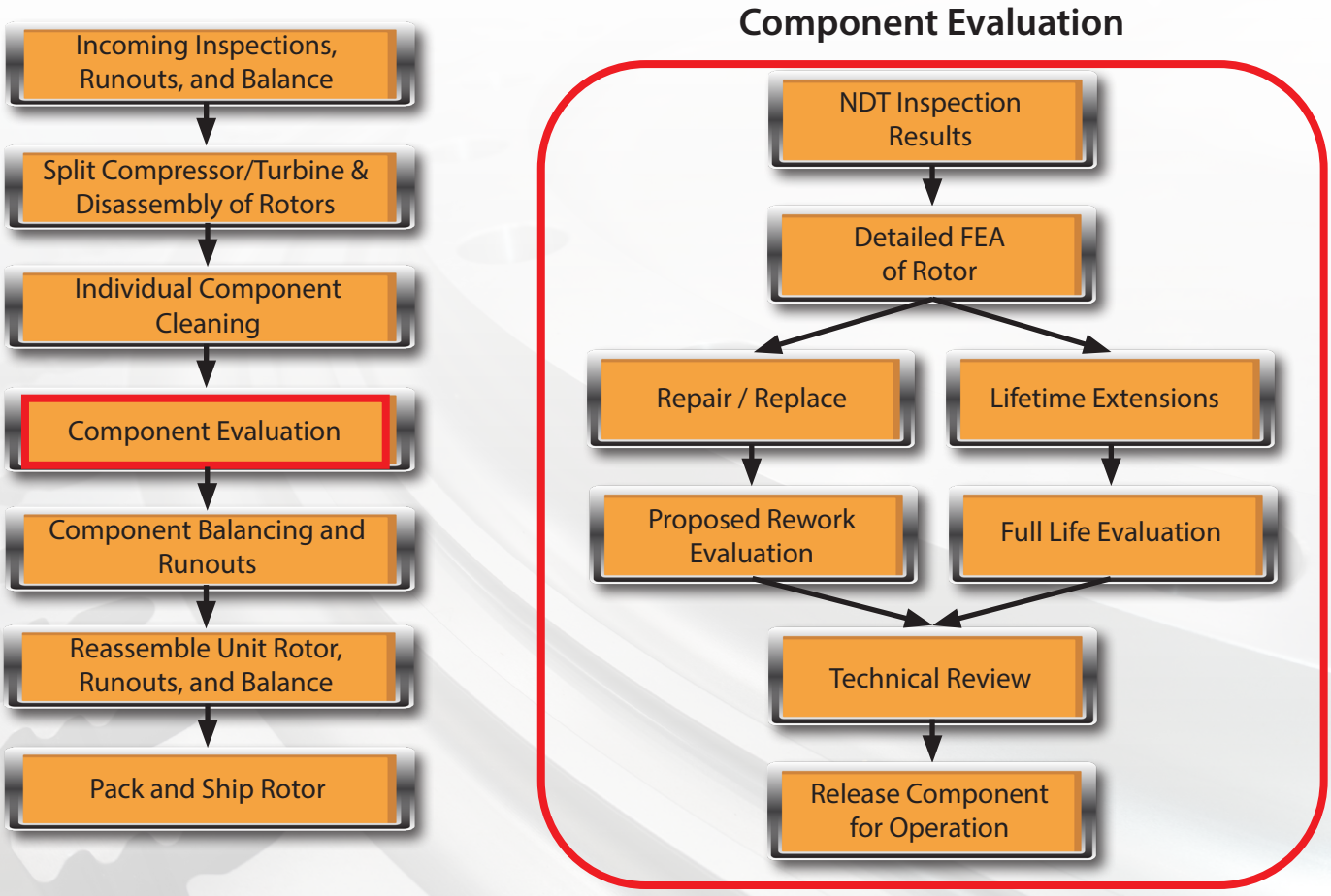
SEED ROTOR INSTALLED AFTER COMPRESSOR

Rotor Lifetime Extension (LTE)

PSM's Rotor LTE program extends the useful lifetime of your rotor. By harnessing advancements in computing power, material properties, fracture mechanics methodologies, and inspection techniques, we can now assess the potential to operate rotors beyond their original published limits. Rotor LTE is facilitated by:

+ Advanced non-destructive inspection techniques to detect surface and volume flaws
+ Comprehensive rotor material characterization
+ Full 3D Finite Element Analysis (FEA) models for thermal and structural analysis
+ Integration of inspection results and operational history into the FEA model

Any identified problematic flaws are thoroughly analyzed, and a detailed report predicting the remaining rotor capability is generated. This empowers owners to make informed decisions about their rotor assets. Optional rotor modifications, designed to extend rotor lifetime in known life-limiting locations, can also be applied.



Rotor Management Solutions

Compressor Solutions Available

+ Developed in response to the emerging fleet Compressor Wheel 0 (CW0) dovetail slot cracking issue, PSM's CW0 incorporates a new dovetail profile to reduce stresses in the known crack locations.
+ PSM replacement Compressor Wheels 9-17 (CW9-17) feature the latest 7F.03 / 7F.04 upgraded geometries:
  - » Round bottom dovetail geometry (CW12-17) to eliminate cracking associated with the original flat bottom dovetail geometry
  - » Robust Back End (RBE) CW14-17 disk geometry
  - » CW9-17 wheels feature the latest conical flowpath, enabling 9F.01 compressor rotor upgrades from the original cylindrical flowpath
  - » In-situ blend, polish, and peen of first turbine disk cooling slot, with additional life-enhancing solutions available upon full destack

New Turbine Components

PSM is First in the aftermarket with new Stage 1 Turbine Wheel!

+ Features include an upgraded nickel alloy with recontoured slot to address known field issues with the OEM-style slots.
+ For existing OEM turbine wheels, PSM offers CoolMod, mitigating the risk of cracking and potentially extending life without replacement.

PSM's Upgraded 1-2 Spacer

+ Features include upgraded nickel alloy and an improved drop-in compatible design to address limiting factors, particularly affecting starts-based units.

Contact your PSM representative for additional rotor solutions!

TURBINE ROTOR IN STACK

9F Turbine Section: Hot Gas Path

Design Improvements leveraged from 15 years of 7F Experience

Turbine Buckets

1st Stage Bucket

+ Directionally Solidified (DS) casting for improved capability.
+ Latest design features a cast-in, TBC-coated tip plate for enhanced reliability and reduced repair scope.
+ Advanced cooling technology to address tip and platform durability issues.
+ Full platform trailing edge (TE) undercut to eliminate TE cracking.
+ Includes attachment relief cuts to address turbine wheel cooling air slot and lockwire tab cracking.
+ Externally coated with durable Strain Tolerant Micro Cracked Thermal Barrier Coating (STMC-TBC®) and internally aluminide coated.

2nd Stage Bucket

+ Conventionally cast from patented PSM 116 material for improved durability and repairability.
+ Improved cooling scheme with fully turbulated cooling holes.
+ Tip shrouds feature several design upgrades to eliminate shroud lifting and localized creep cracking.

+ Buckets are externally TBC-coated and internally aluminide coated.
+ Includes attachment relief cuts to address turbine wheel cooling air slot and lockwire tab cracking.

3rd Stage Bucket

+ Conventionally cast from patented PSM 116 material for improved durability and repairability.
+ Features scalloped shrouds to counteract shroud lifting. Z-Notch features a larger hard face surface area to reduce wear and fretting.

+ Externally MCrAlY coated.

Turbine Shrouds

Standard Features

+ Segment-to-segment seals are PSM's patented flexible seals, providing superior intersegment gap sealing and improved efficiency. PSM flexible seals have proven reusability post repair.

1st Stage Shroud Block

+ Shroud tiles are externally coated with durable Strain Tolerant Micro Cracked Thermal Barrier Coating (STMC-TBC®).
+ Improved cooling design provides positive cooling outflow margins, eliminating hot gas ingestion issues.

2nd Stage Shroud Block

+ Manufactured from Haynes® HR 120® alloy.

3rd Stage Shroud Block

+ Manufactured from 310 SS alloy.

9F Turbine Section: Hot Gas Path

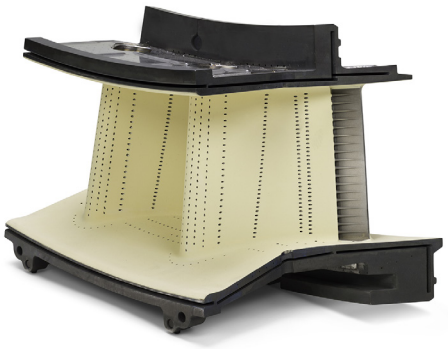
Turbine Nozzles

Standard Features

+ Nozzles are conventionally cast from PSM 109, a nickel-based material with superior mechanical integrity and creep properties relative to cobalt-based alloys, providing reduced life cycle cost. PSM 109 has proven weldability at repair.
+ Segment-to-segment seals are PSM's patented flexible seals, providing superior intersegment gap sealing and improved efficiency. PSM flexible seals have proven reusability post repair.

1st Stage Nozzle and Outer Retaining Ring

+ Fully externally coated with MCrAlY metallic bond and TBC for oxidation resistance and reduced metal temperatures.
+ Cooling air is redistributed to the platform and sidewalls for improved durability.
+ ID rail redesigned to reduce stiffness that contributes to high airfoil stresses and cracking.
+ Parallel chordal hinge to seal between nozzle ID and support ring.
+ PSM 109 alloy provides a proven reduction in Thermo-Mechanical Fatigue (TMF) cracking compared to cobalt-based alloys.



2nd Stage Nozzle

+ Fullyexternally coated with MCrAlY metallic bond coat and TBC for oxidation resistance and reduced metal temperatures.
+ Upgraded trailing edge cooling design.
+ Furnished with attached diaphragms made from 310 SS, an upgraded alloy, to address field oxidation issues.

3rd Stage Nozzle

+ Furnished with attached diaphragms.

9F Drop-In Replacement Combustion Systems

For over two decades, PSM has manufactured combustion systems with enhanced durability and reliability as direct replacements for OEM equivalents.

Our hardware is designed to deliver:

+ Inspection intervals of at least 24,000 Factored Hours (FH) and 900 Factored Starts (FS) or better
+ ≤ 9 ppm NOx & CO emissions over normal premix operating load range

DLN2.0+ and DLN2.6+

PSM Drop-In replacements are directly compatible with OEM combustion systems, allowing interchangeability without conversion or modification. Both DLN2.0+ and DLN2.6+ share these key features:

Transition Piece

+ Enhanced durability through PSM design features
+ Patented cooling features reduce metal temperature
+ Thermally free mount to 1st stage nozzle

Liner

+ Improved durability with conical design and upgraded material
+ Enhanced impingement cooling for increased longevity
+ Optimized assembly and sealing with double-ply, forward-facing hula seal design

Liner Cap

+ Improved durability through PSM design features
+ Upgraded Effusion plate material to Haynes 282 for increased Low Cycle Fatigue (LCF) capability

Cover Assembly, including Swozzles

+ All-machined and welded design eliminates recurrent braze joint failures found in brazed designs
+ Compatible with PSM and OEM fuel nozzles
+ PSM Swozzle matches OEM flow and emissions characteristics, available as scrap replacement to cover fallout during repair

Long Term Agreements

Summary of Offerings

As a leading parts provider, PSM offers comprehensive and flexible Long Term Agreements for 7F, 501F, 6B, and 7E models, aimed at reducing lifecycle costs for the end user. Our engineered part designs increase component life and extend program intervals, eliminating inspections and providing significant cost savings over the contract's life. Additionally, our improvements to OEM designs and reconditioning processes reduce the fallout of hot gas parts. PSM has also assembled a highly skilled and experienced field service team capable of industry-leading outage performance.

Flexible Agreements — to fit the customer needs

Types of PSM Service Agreement Offerings			
Included Product Offereings	**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

PSM has developed a flexible concept for Long Term Agreements tailored to meet dynamic market conditions and customer needs. Our agreements aim to offer competitive pricing and leverage the full portfolio of PSM offerings. They can include not only gas turbines but also generators, steam turbines, and auxiliary systems. The focus is on optimizing maintenance budgets, guaranteeing part life, minimal parts fallout, coverage during unscheduled inspections, inventory control, and proactive contract management for total coverage.

In summary, our diverse agreement offerings are designed to optimize your maintenance budget. They provide competitive guarantees on parts life, minimal parts fallout, comprehensive coverage during unscheduled inspections, effective inventory control, and proactive contract management, all to ensure complete coverage.

Scope of Supply — based on the customer requirements

Customers define the scope of Long Term Agreements, which can range from full service to specific pricing agreements. Services offered by PSM include:

+ 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 incuding Monitoring & Diagnostics

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

+ Reliable coverage from basic support through complex root cause analysis.
+ Service Engineering extends beyond traditional support to incorporate best practices from all platforms & systems.
+ Strong processes & infrastructure position PSM to further grow capabilities.

Engineering Assessment

+ A dedicated team supports 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 access to all parts of the PSM organization ensures quick event disposition.

Tuning and Commissioning

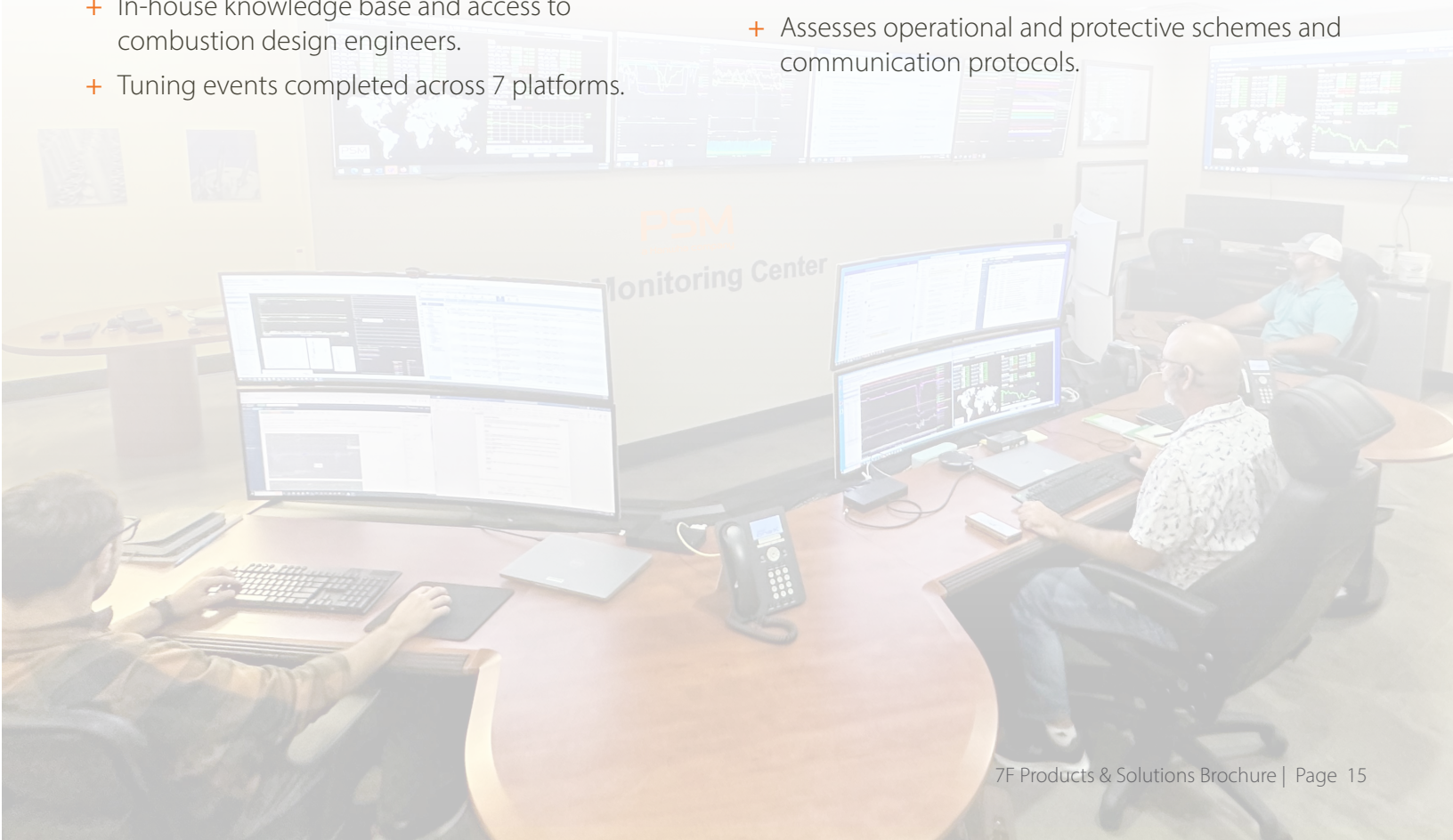
+ Over 200 tunes per year across a wide variety of combustion technology and control systems
+ Strong expertise in both OEM & PSM Combustion systems.
+ In-house knowledge base and access to combustion design engineers.
+ Tuning events completed across 7 platforms.

Monitoring and Diagnostics

+ Over 50 units and 10 GW monitored.
+ Global cloud-based infrastructure with redundancy.
+ 24/7 Monitoring.
+ Monthly Operational Assessment Reports (OAR's) included monitoring of customer-selected parameters.

Controls Design and Development

+ Controls-related services across seven different platforms.
+ Support customers and PSM technology initiatives.
+ Designed to support controls replacement, expansion projects, or technology development.
+ Assesses operational and protective schemes and communication protocols.

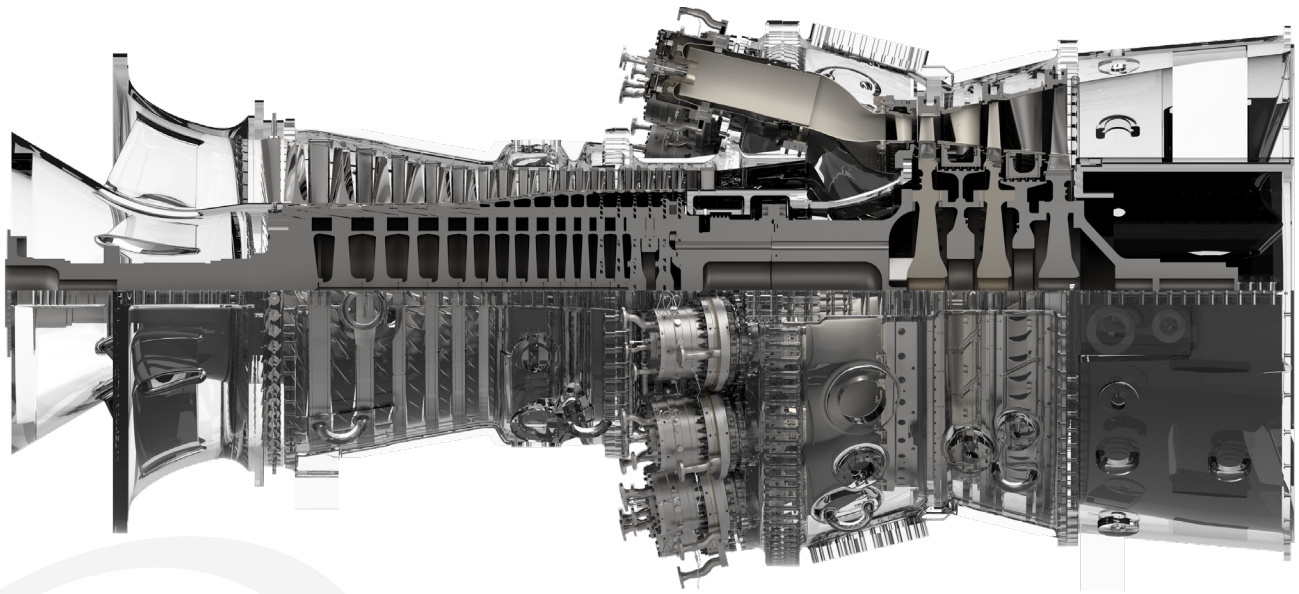


PSM - A Hanwha Company

The growing interest in the hydrogen economy is driven by the need to address climate change and transition to sustainable energy sources. However, challenges remain, including high production and storage costs, and extensive infrastructure requirements for distribution and transportation.

As a Hanwha subsidiary, PSM is uniquely positioned to leverage the expertise and resources of the Hanwha family to accelerate hydrogen development and adoption as a clean energy source. Hanwha's global presence and diverse business interests in areas like solar energy and defense provide PSM access to a wide array of technologies, markets, and partnerships.

Collaboration with Hanwha Q CELLS, a leader in large-scale solar projects, enables PSM to integrate hydrogen production with solar energy systems, fostering more sustainable and efficient energy solutions.



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