

# GTOP™ Gas Turbine Optimization Package

Maximize efficiency, extend turbine life,  
and reduce emissions



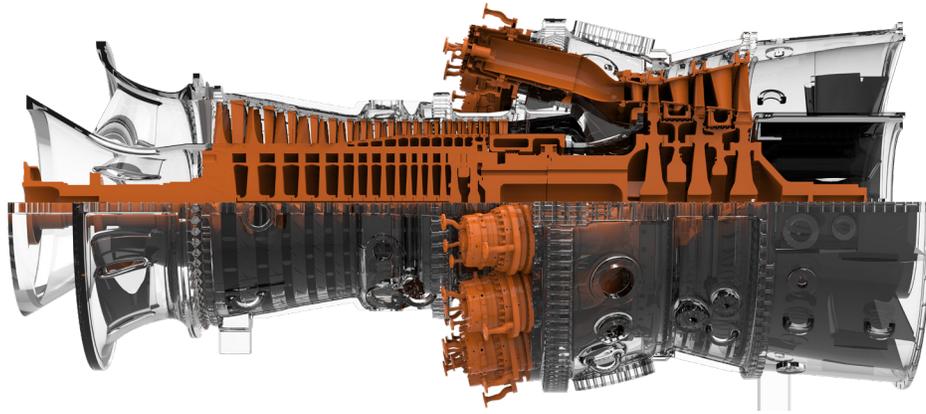
GTOP™ enhances performance, extends component life, reduces emissions, and improves reliability for gas turbines with advanced upgrades and optimization solutions

# PSM Products and Services

Combining technical expertise, rapid market response, flexible solutions, advanced tools, and extensive OEM cross-platform experience, PSM is the industry-leading supplier of alternative products and services.

Specializing in retrofitting gas turbine to meet current and future market demands, PSM offers over 25 years of experience in upgrading gas turbines and their components, providing tailored solutions to fit your plant's specific needs.

PSM continues to deliver innovative, high-quality design solutions for fleet issues, ensuring reliable performance for gas turbine power plants.



In today's challenging markets, gas turbine operators need lower generation costs, greater flexibility, and freedom to operate and maintain their gas turbines under their capital and operational priorities.

## Gas Turbine Optimization Package (GTOP™)

Since 2001, PSM and Thomassen Energy have provided performance upgrades for gas turbine operators for B/E-class engines. Upgrade GTOP™ packages are tailored specifically for the required application, from extending intervals, allowing peak firing, or lowering emissions. The GTOP™ components are compatible with GE AGP and are completed during regular outages.

## Benefits

Combining design innovations, advanced materials, and proven empirical-based AutoTune control software, the state-of-the-art GTOP™ advanced design delivers B/E-class fleet customers many benefits.



### Improved Output and Efficiency

Increased Power Output  
Lower Heat Rate



### Low Emissions

Minimal NOx and CO\*



### Extended Maintenance Intervals

Factored Maintenance Counters  
Eliminate Combustion Inspections\*



### Operational Flexibility

Performance and Maintenance Modes  
Maximum Premix Operating Range\*

# GTOP™: Gas Turbine Optimization Package

PSM's upgrade packages provide flexibility, enabling users to optimize performance and maintenance schedules to their individual requirements.

	Maintenance Mode (32K):	Performance Mode (24K):	Peak Mode:	Hardware and Logic Upgrades
<b>GTOP Lite</b> 	Up to +2.8% MW			Minimal hardware scope New R0, S0, & S1 aerodynamic design IGV schedule change
<b>GTOP3.0</b> 	Up to +3.3% MW, -1.5% HR	Up to +6% MW, -1.8% HR	Up to +8.8% MW, -2.3% HR	AutoTune with mode-switching logic Low ΔP combustor, low cooling flow S1 & S2 nozzles
<b>GTOP3.1</b> 	Up to +6% MW, -2.0% HR	Up to 8.8% MW, -2.3% HR	Up to 11.7% MW, 2.7% HR	Combines both GTOP Lite & GTOP3.0 Add compatible GTOP4 S3 bucket & shroud for an increase to 207MW (+10MW) on a cold day
<b>GTOP4.0</b> 	Up to +9% MW, -4% HR	Up to +12% MW, -5% HR	Up to +14.6% MW, -5.3% HR	New aerodynamic HGP section – SX S1B, modular S1N with printed vane Compatible with AGP hardware New technology! AutoTune with mode-switching logic
<b>GTOP4.1</b> 	Up to +12% MW, -5% HR	Up to +15% MW, -5% HR	Up to +17.4% MW, -5% HR	Includes GTOP Lite & GTOP4.0
<b>FlameTOP</b> 	Turndown as low as 26% Up to 80% hydrogen			Combine FlameSheet™ with any GTOP Program!

\*Quoted benefits are for ISO day operation. Simple Cycle benefits assume from prior published 7F.03 capabilities

\*\*See PSM representative for interchangeability on all GTOP™ programs

# Gas Turbine Optimization Package: GTOP4

GTOP4 and GTOP4.1 deliver exceptional results in power output and efficiency by utilizing the latest technology for superior performance. GTOP4 components are set-wise compatible with AGP/7F.04 hardware.\*\*

## 1st stage nozzle

- + Utilizes proven 501F R1 vane and additive technology!
- + Optimized aerodynamic design
- + 3D-printed airfoil with most capable alloy powder
- + Improved cooling flow system
- + Revolutionary cooling designs (only 3D printing)
- + Enhanced durability (reduced thermal gradients)
- + Competitive overall life cycle cost

## 1st stage buckets

- + New airfoil aerodynamic design for efficiency gains
- + Optimized Core design
- + Improved cooling efficiency, resulting in lower metal temperatures
- + 2nd Generation single crystal alloy for enhanced capability
- + Cast in tip

## 1st stage shroud block

- + IN738 shroud alloy
- + Multilayer abrasion resistant coating technology
  - » Hot rub rig testing conducted at engine conditions
- + Optimized cooling design

## 2nd stage nozzle

- + Repairable nickel-based alloy
- + New aerodynamic design
- + Full thermal barrier coating (TBC) coating
- + Improved sealing

## 2nd stage bucket

- + PSM116 Material
- + Optimized 3D aerodynamic shape with full TBC coating
- + 11 STEM cooling holes
- + Cored tip with perimeter shroud cooling
- + Optimized shroud profile

## 3rd stage bucket

- + Redesigned airfoil and shroud geometry to improve flutter margin:
- + Applicable for both GTOP4 and GTOP3 applications
  - » Allows GT output limit increase in GTOP3 applications from 197MW →207MW
- + Redesigned shroud configuration to address creep issues with OEM AGP/7F.04 design
- + PSM GTOP4 R3B design setwise compatible with .03, GTOP3 and AGP/7F.04 turbines\*\*



GTOP4.0	Maintenance Mode (32k)	Performance Mode (24k)	Peak Mode
SC Power*	Up to +9%	Up to +12%	Up to +14.6%
SC HR*	Up to -4%	Up to -5%	Up to -5.3%

GTOP4.1	Maintenance Mode (32k)	Performance Mode (24k)	Peak Mode
SC Power*	Up to +13%	Up to +15%	Up to +17.4%
SC HR*	Up to -4%	Up to -5%	Up to -5.6%

\* Quoted benefits are for ISO day operation. Simple Cycle benefits assume from prior published OEM 7F.03 capabilities

\*\* PSM buckets require PSM style shroud blocks on installation



COMPRESSOR AND HOT GAS PATH



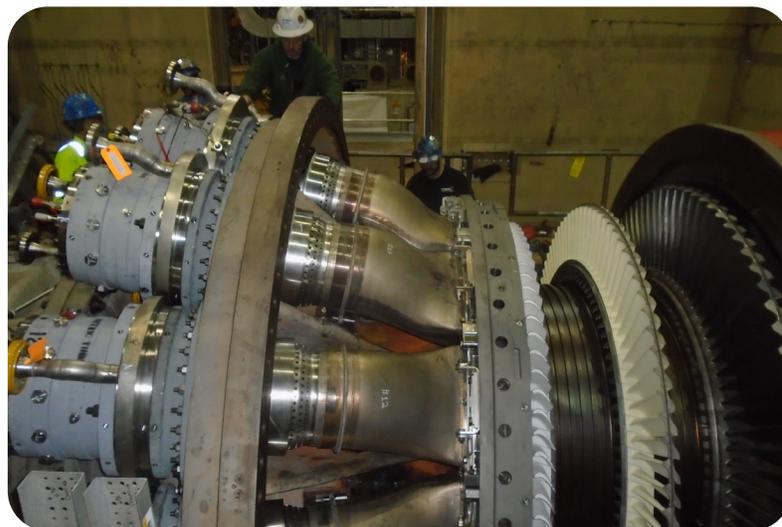
NOZZLE RING ASSEMBLY



COMBUSTION OPTIONS WITH LEC-III™, NEXT-GEN, OR T-DLN



COMBUSTOR



GTOP INSTALLATION

# 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.

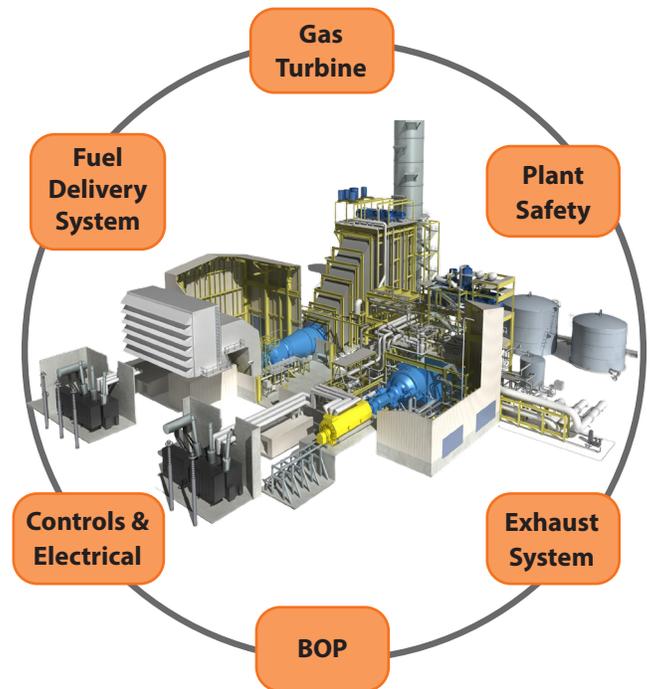
Collaboration with Hanwha Q CELLS, a leader in large-scale solar projects, enables PSM to integrate hydrogen production with solar energy systems, fostering more sustainable and efficient energy solutions.

## Hydrogen Ready

As gas turbine combustion technology advances, the need to prepare power plants for hydrogen combustion becomes evident. PSM offers a holistic approach and extensive evaluation to assist power plants in making a future-proof investment in hydrogen fuel. This contributes to a cleaner and more sustainable energy future. Converting power plants to use hydrogen as fuel requires a detailed assessment of plant specifications and the customer's decarbonization goals.

This evaluation is crucial in determining the scope of work and establishing a realistic timeline for the conversion project. Our expertise in retrofit solutions makes us the ideal partner during the energy transition.

Contact PSM today to learn more about our Clean Energy solutions and schedule an energy transition consultation.



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