



Presentacion de los equipos de Generacion

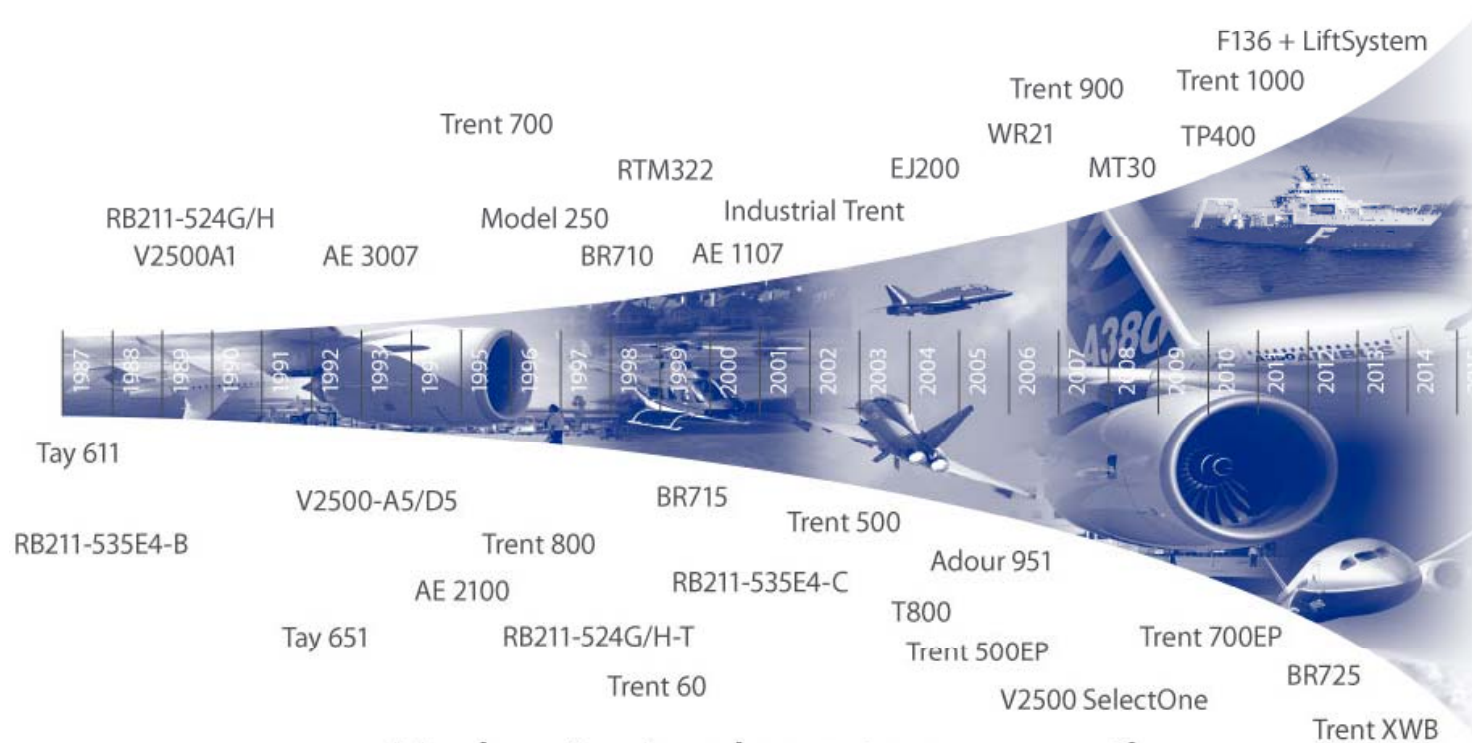


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Desarrollo de la Unidad Trent 60



Underpinning long-term growth

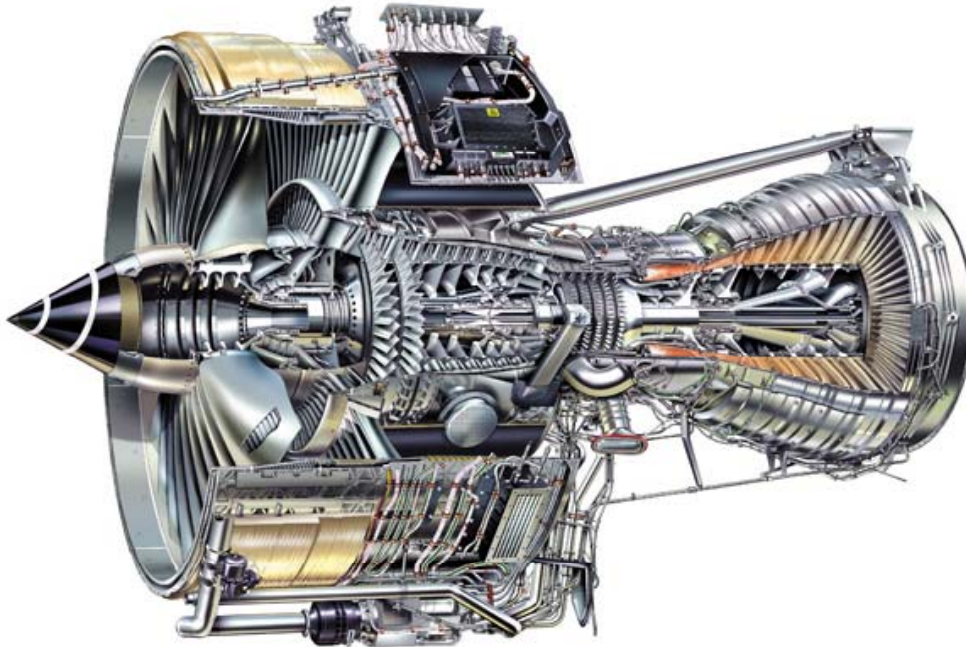
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Trent – Lanzamiento de las Turbinas para los aviones mas avanzados del mundo el Airbus A380 y el Boeing 787 Dreamliner



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Rolls-Royce - Trent 800

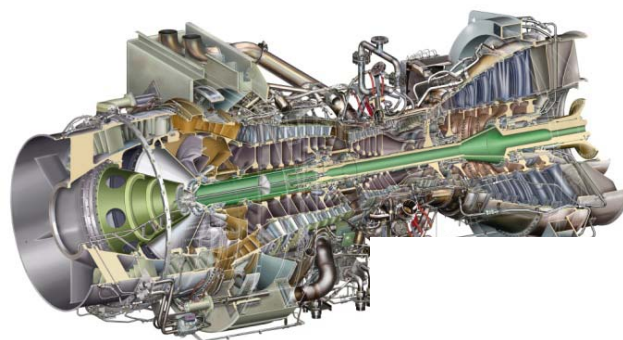
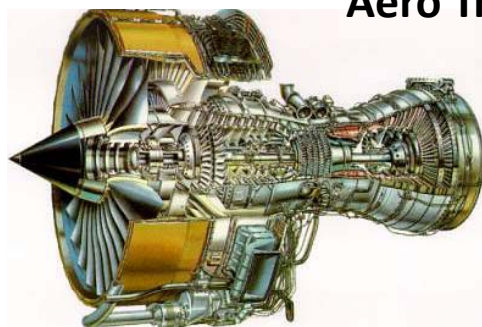


Thrust	75,000 – 95,000lb
Fan Diameter	110 in
Bypass ratio	6.1
Weight	13,100 lb
Total aircraft in-service	221
Total engines in-service	506
Service engine hours Over	14 Million

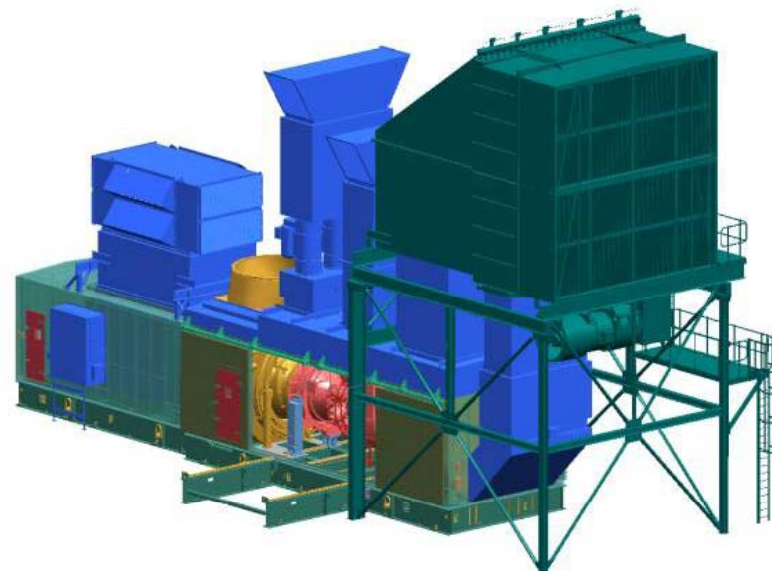
- Three Independent Shafts
- Annular combustor
- designed for liquid fuel
- Low speed power turbine
- designed to balance power
- between LP shaft and thrust
- output

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Aero Trent 800

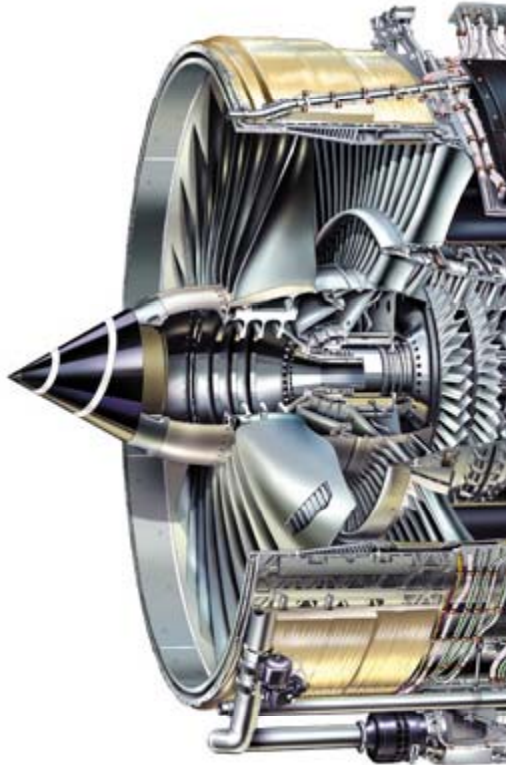


Industrial Trent 60



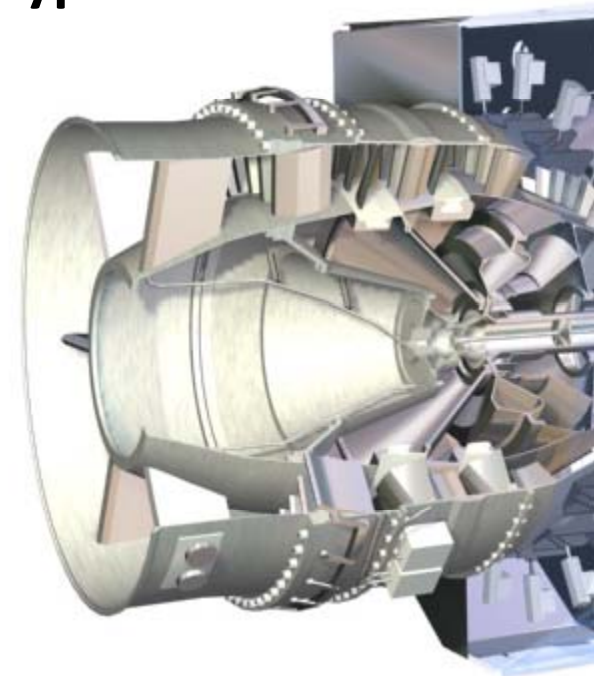
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Trent 60 - Low Speed Bypass Fan



Trent 60 LP High Bypass Fan Removed

- Used on aero engine for thrust and pressure boosting into core engine



Replaced with two axial stages

- Produces the same pressure ratio as the bypass fan
- Addition of LP Bleed System for low load operation
- Control Bearing Load by Modulating Thrust Piston Trent

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Trent 60 - LP Power Turbine

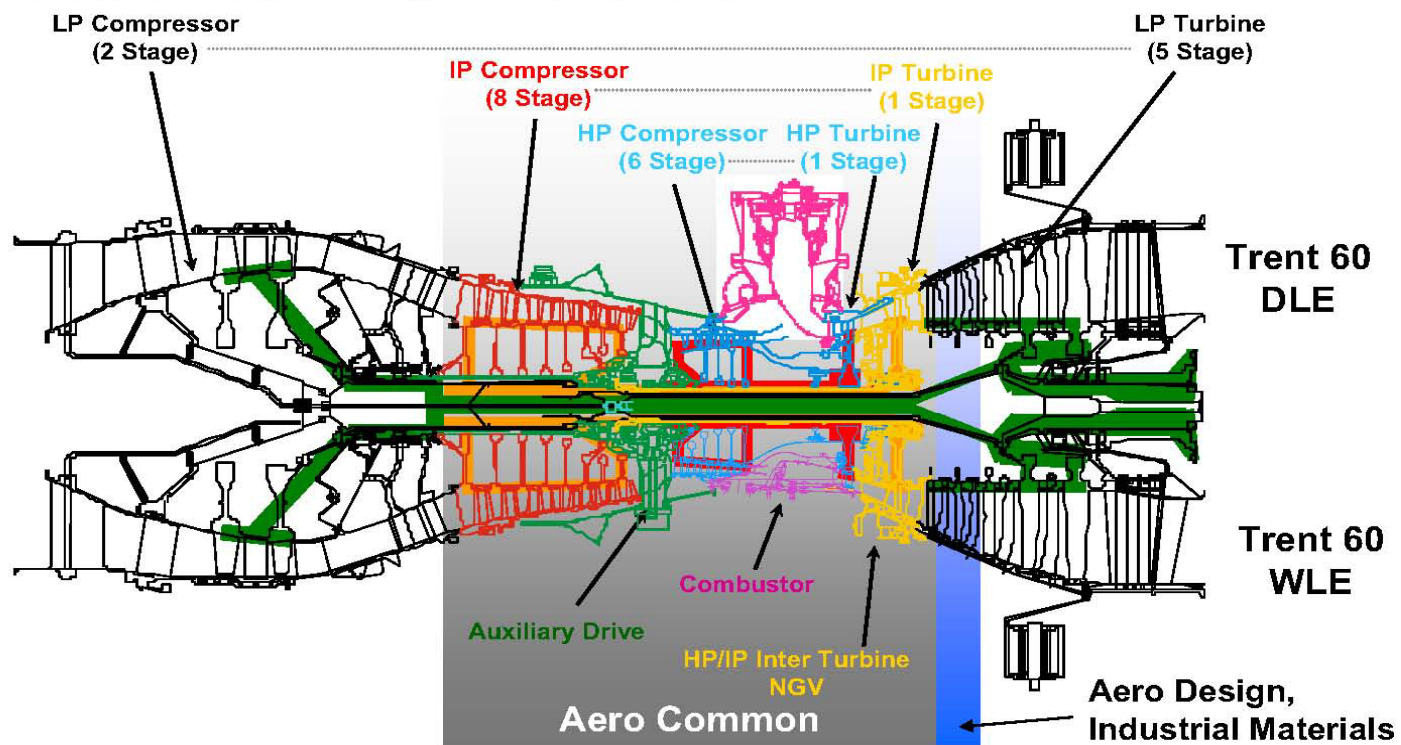


- Last two blade rows lengthened to recover all potential thrust
- Rear Drive Added
- Capability to operate at 3000 rpm (50Hz) or 3600 rpm (60Hz)



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Trent 60 - Gas Turbine



Trent Presentation

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Rolls Royce Trent 60



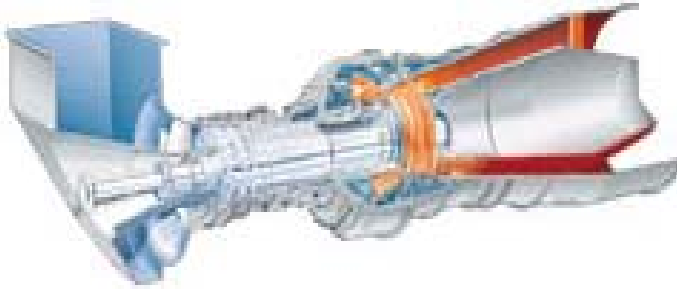
The Rolls-Royce Trent 60 is the most advanced aeroderivative gas turbine available today. Delivering up to 64MW of electric power in simple cycle service, at 42 per cent efficiency, the Trent 60 has established a new benchmark for fuel economy and cost savings. It also offers operators fast delivery and installation times and beneficial environmental Performance.

Trent 60 – Wet Low Emissions (WLE)

The Trent 60 WLE uses an annular combustor system from the Trent aero engine modified to operate with liquid and gas fuel. The injection of water is used to reduce emissions and boost performance. At ISO conditions the engine is rated for 64 MWe.

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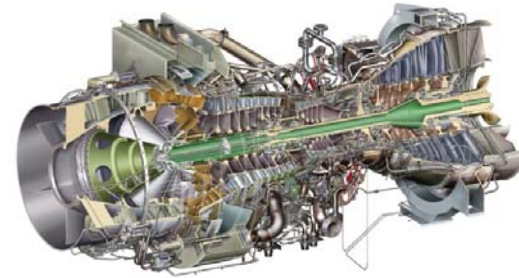
Comparacion entre la RR Trent 60 y la Siemens SGCT 800



Siemens SGT 800

Power generation: 47MW(e)

- Frequency: 50/60 Hz
- Electrical efficiency: 37.5 %
- Heat rate: 9,597 kJ/kWh (9,097 Btu/kWh)
- Turbine speed: 6,608 rpm
- Exhaust gas flow: 131.5 kg/s (290lb/s)
- Exhaust temperature: 528° C (983° F)
- NOx emissions (with DLE corrected to 15 % O2 dry)
 - Gas fuel: ≤15 ppmV
 - Liquid fuel: ≤42 ppmV
- 3 Units
- 3 Installations
- 3 Maintenances



Rolls Royce Trent

Power generation: 64.001MW(e)

- Frequency: 50/60 Hz
- Electrical efficiency: 41 %
- Heat rate: 8,656 kJ/kWh (8,204 Btu/kWh)
- Turbine speed: 3,000 rpm
- Exhaust gas flow: 173.7 kg/s (382.9 lb/s)
- Exhaust temperature: 416.2° C (781.2° F)
- NOx emissions (with DLE corrected to 15 % O2 dry)
 - Gas fuel: ≤25 ppmV
 - Liquid fuel: ≤42 ppmV
- 2 Unit
- 2 installation
- 2 Maintenance

Trent 60 – Performance Simple Cycle

GT Package Performance	WLE	WLE ISI
Output at Generator Terminals, kWe	61,180	64,000
Heat Rate (LHV), kJ/kWe.hr	8,784	8,755
(BTU/KWe.hr)	(8,326)	(8,365)
Thermal Efficiency (LHV), %	41.0	41.6
Exhaust Flow, kg/s	168.0	171.2
(lb/s)	(370.4)	(382.9)
Exhaust Temperature, °C	432.2	408
(°F)	(810.0)	(781.2)

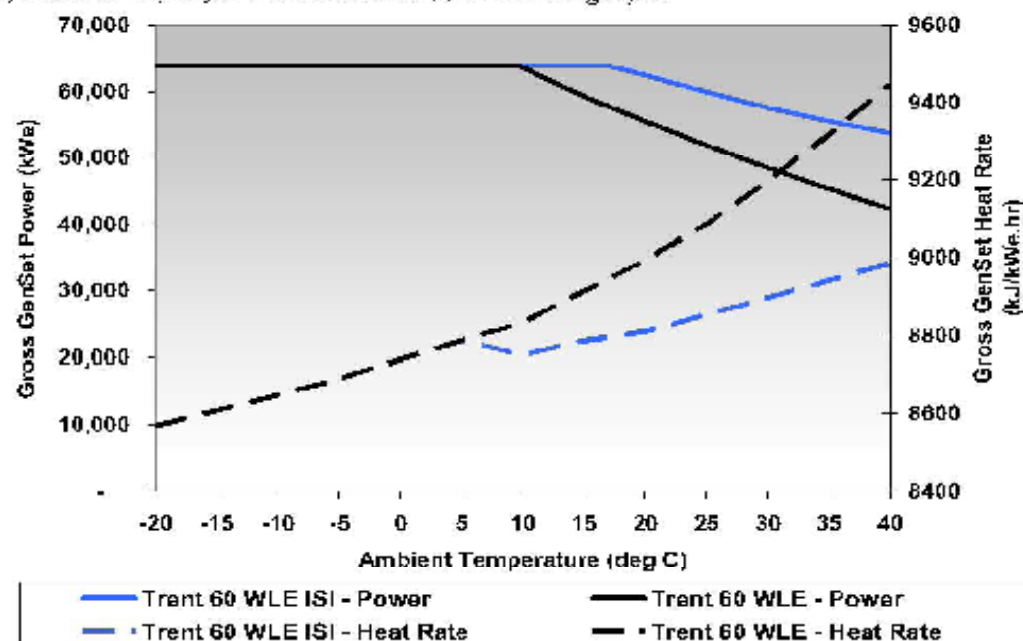
Simple Cycle – 15°C (59°F), 60% RH, zero installation losses, 50 Hz, gas fuel, 25 vppm NOx (dry 15% O₂)



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Trent 60 WLE - Performance

Simple Cycle, Sea level, simple cycle exhaust losses, 60% RH, natural gas fuel



Maximizing Power and Efficiency across Ambient Range

Trent Presentation

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Trent 60 – Combined Cycle

Trent 60 Combined Cycle Performance	WLE	WLE ISI
Net Plant Output, kWe	75,257	77,233
Net Plant Heat Rate (LHV), kJ/kWe.hr (BTU/kWe.hr)	7,056 (6,688)	7,126 (6,754)
Thermal Efficiency, %	51.0	50.5
Gas Turbine Output, kWe	59,474	62,452
Steam Turbine Output, kWe	17,104	16,156
Combined Cycle – 15°C (59°F), 60% RH, typical installation losses, 60 Hz, natural gas, 25 vppm NOx (dry 15% O2)		

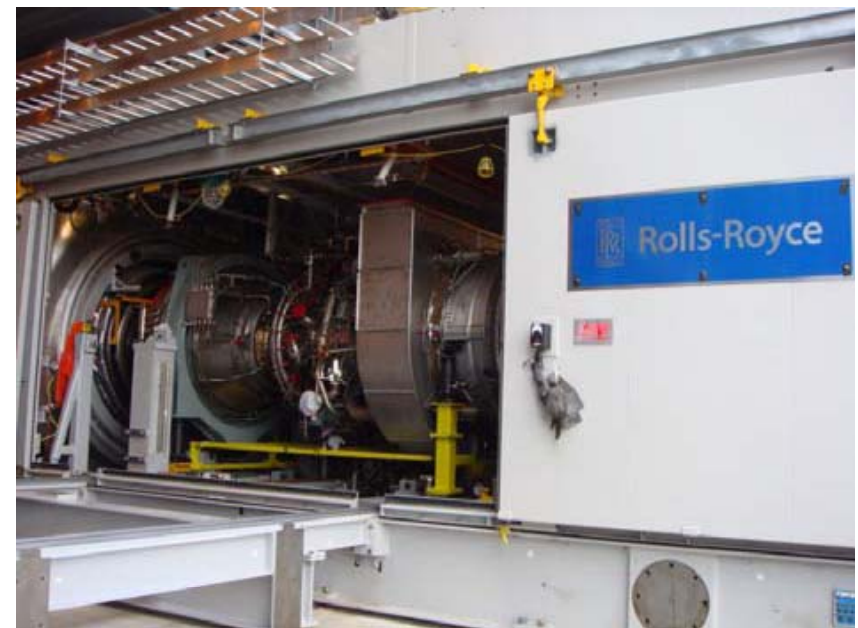
Dual pressure steam Cycle

Net Plant Output, kWe	101,899	107,499
Net Plant Heat Rate (LHV), kJ/kWe.hr (BTU/kWe.hr)	7,340 (6,957)	7,412 (7,044)
Thermal Efficiency, %	49.0	48.4
Gas Turbine Output, kWe	59,474	62,452
Steam Turbine Output, kWe	62,452	47,583
Combined Cycle – 15°C (59°F), 60% RH, typical installation losses, 60 Hz, natural gas, 25 vppm NOx (dry 15% O2)		
Single pressure steam cycle, supplementary fired to 730 °C (1346 °F)		

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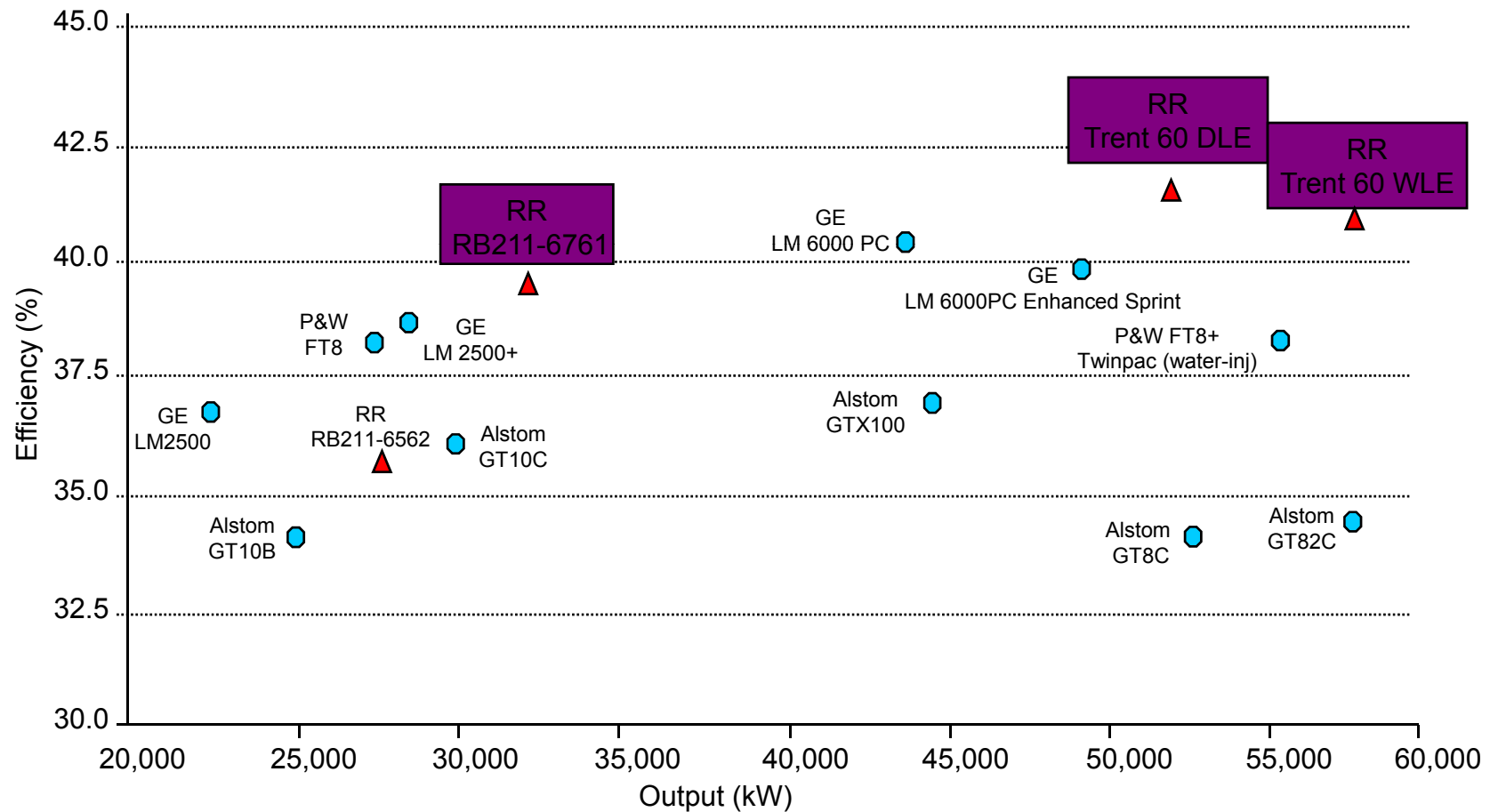
Trent 60 - Benefits

- **Highest Power Aero derivative Gas Turbine**
- **Highest Simple Cycle Efficiency Aero derivative Gas Turbine**
- **Efficient Package for Installation and Maintenance**
- **Proven History from Aircraft Engine Lineage**
- **Meet stringent NOx and CO requirements**
- **Modular design allows minimal installation time**
- **Starting and restarting as fast as ten minutes**
- **No maintenance penalty for starts**
- **Ideally designed for both the peaking and base load market**
- **Up to 4500 starts without overhaul**



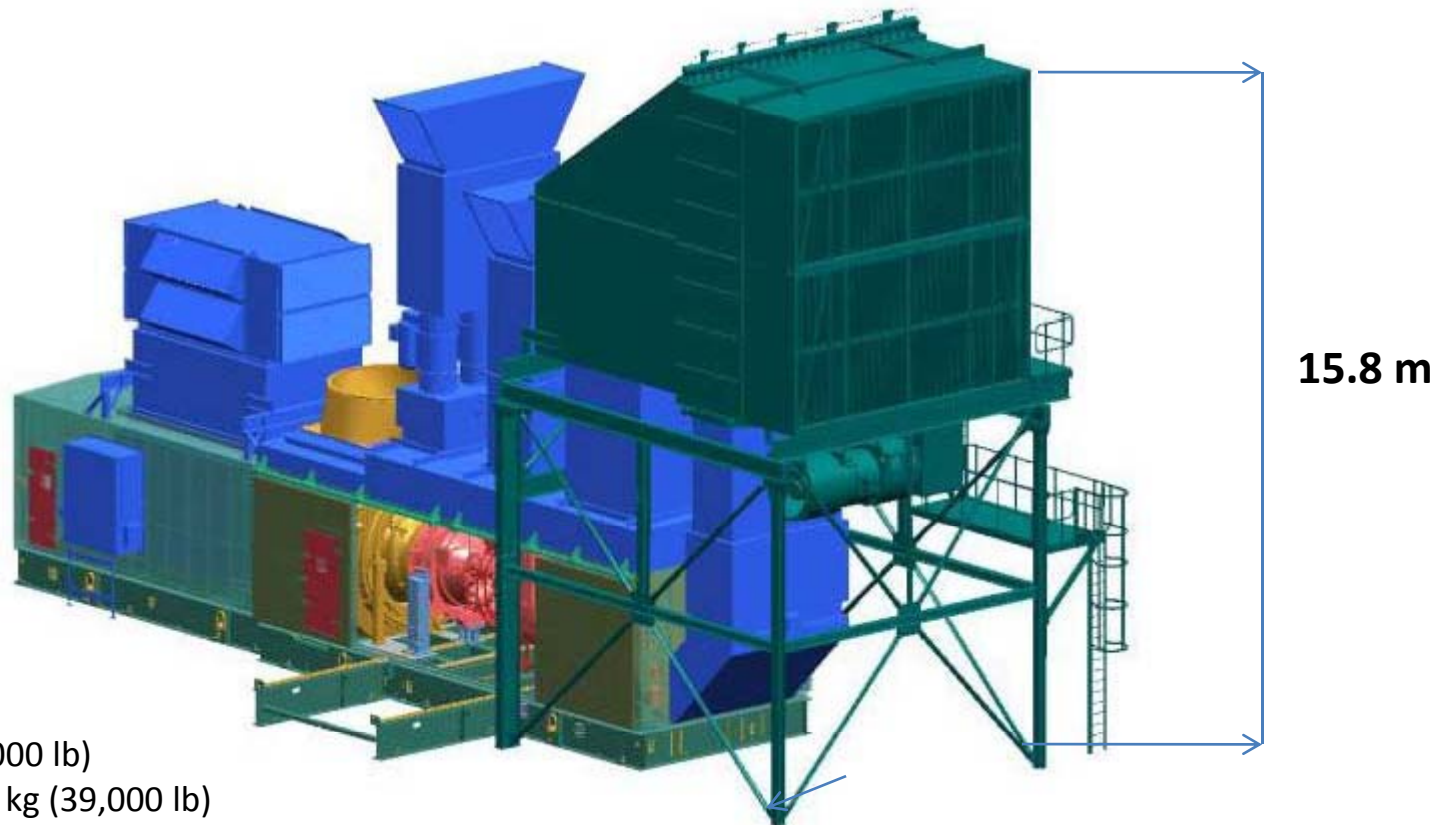
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Industrial Trent 60 Competitive Position



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Trent 60 - Package

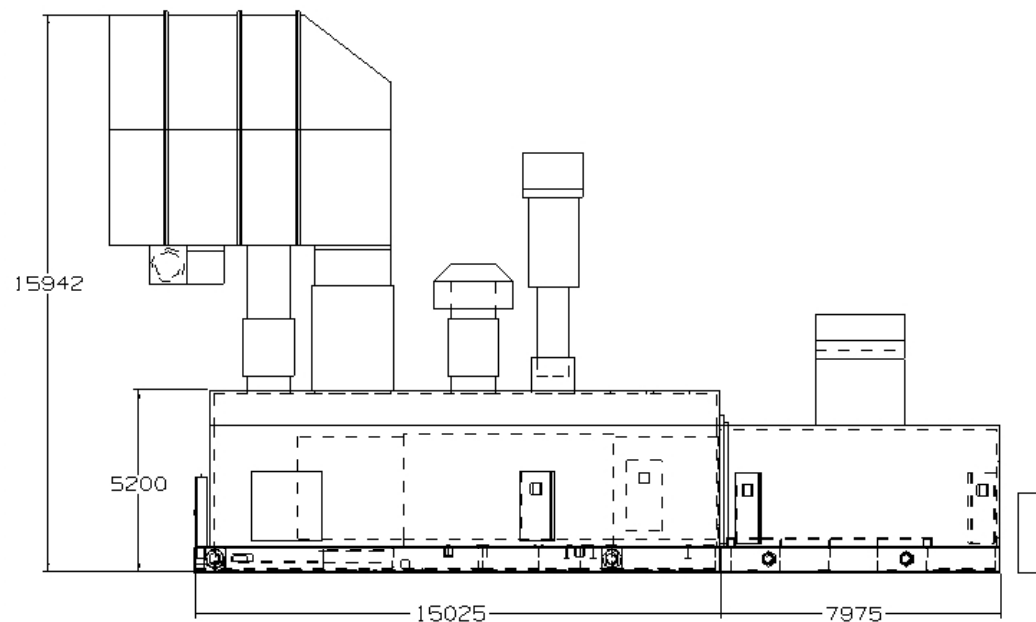
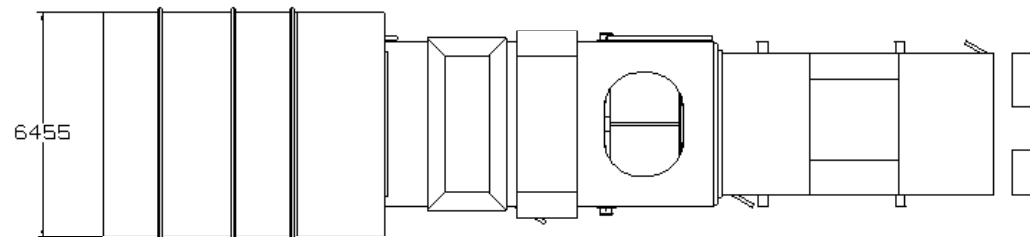


Trent 60 - Package Estimated Weights

GT Skid 74,800 kg (165,000 lb)
GT Package Roof 17,700 kg (39,000 lb)
GT Engine 13,600 kg (30,000 lb)
Filter 21,300 kg (47,000 lb)
Generator Skid 106500 kg (235,000 lb)

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Outline and Foundation-



Estimated Weight

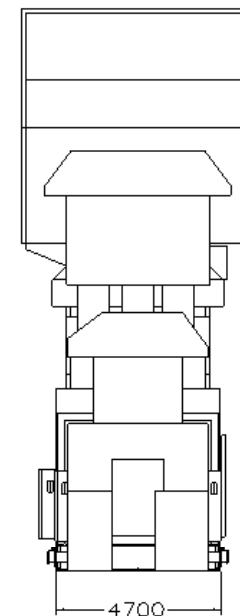
GT Skid - 66,000 KG

GT Package Roof-35,000 KG

GT Engine - 13,600 KG

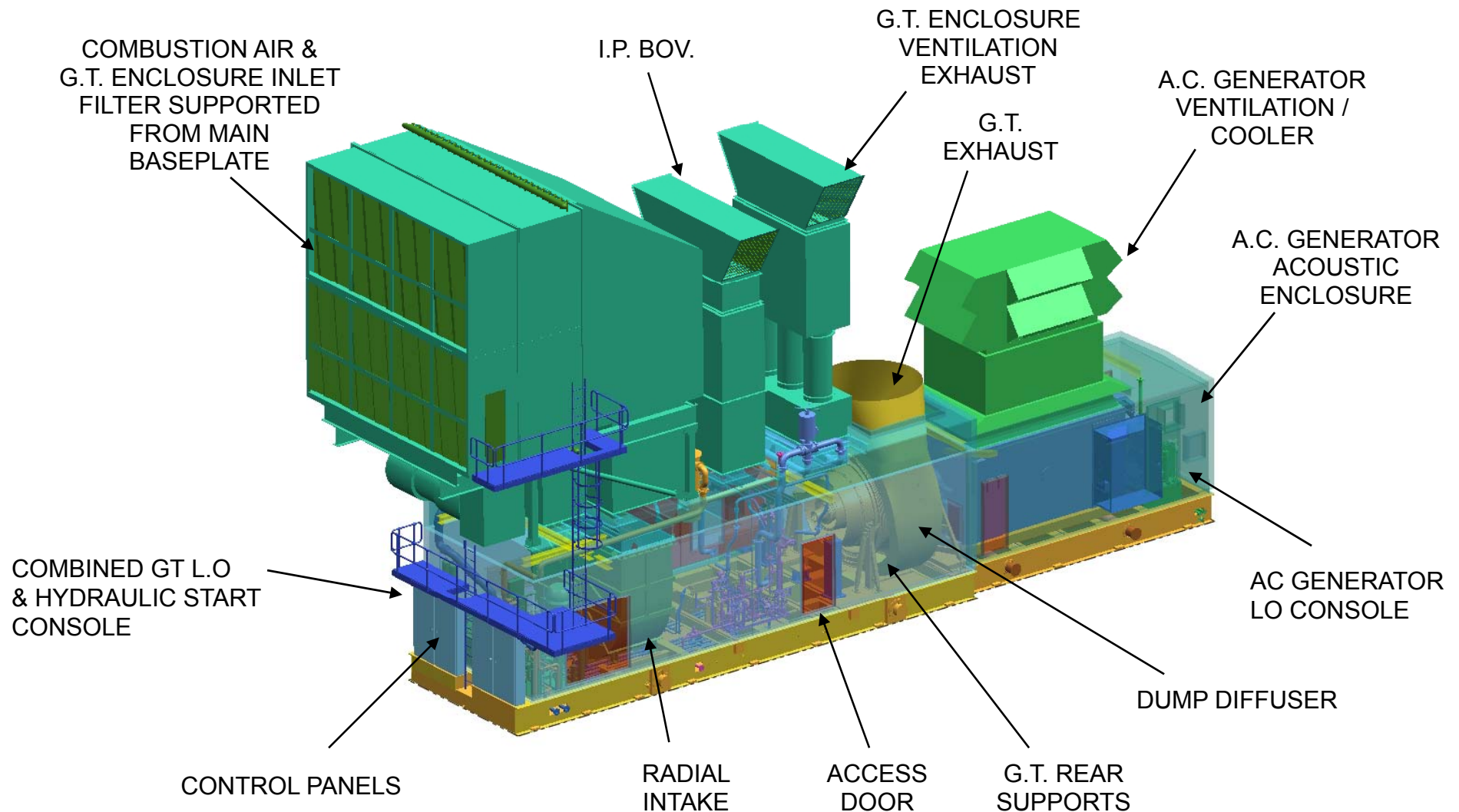
Filter - 25,000 KG

Generator Skid - 106,000 KG

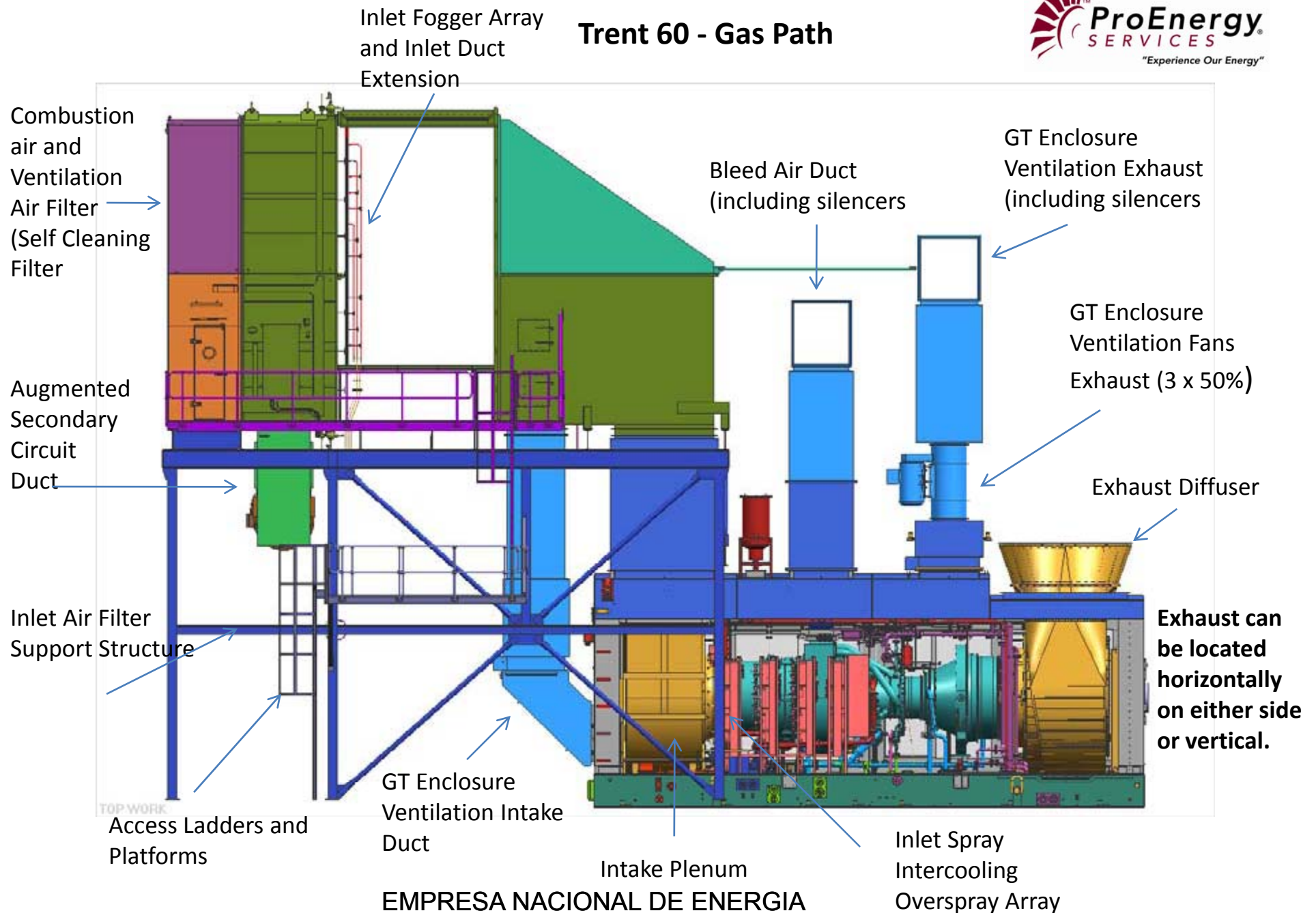


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Industrial Trent GenSet Package



Trent 60 - Gas Path



Trent 60 – Scheduled Maintenance

- A1 Class"

Boroscope of the hot end

- "A Class"

Function checks, boroscope and safety checks.

"B Class" (25,000 hrs) HP / IP core
Refurbishment

Inspection of hot end and
replacement or refurbishment of
worn parts.

Re-coating of gas-washed parts as
Required

"C Class" (50,000 hrs) Full engine
Overhaul

Total engine strip and refurbishment
of all parts for a further lifecycle

Utilize exchange engine for higher availability



Maintenance Base & Tooling

GT Change out

**Time to change gas turbine -
24 Working Hours**

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Trent 60 – Scheduled Maintenance

The Trent engine is also capable of being split into three interchangeable modules:

1. Low pressure compressor
2. Intermediate and high pressure compressors and turbines
3. Low pressure turbine

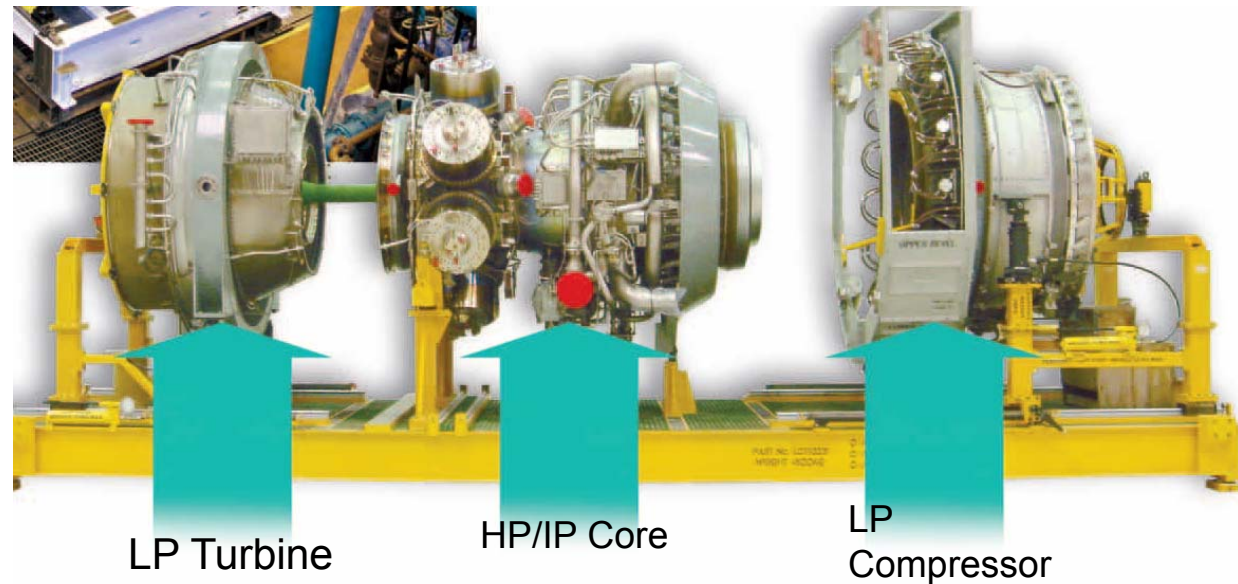
It is possible to swap these engine modules in under 72 working hours. This reduces overall transport and costs associated with inventory of a spare engine. Rolls-Royce can also offer access to a lease engine or module program.

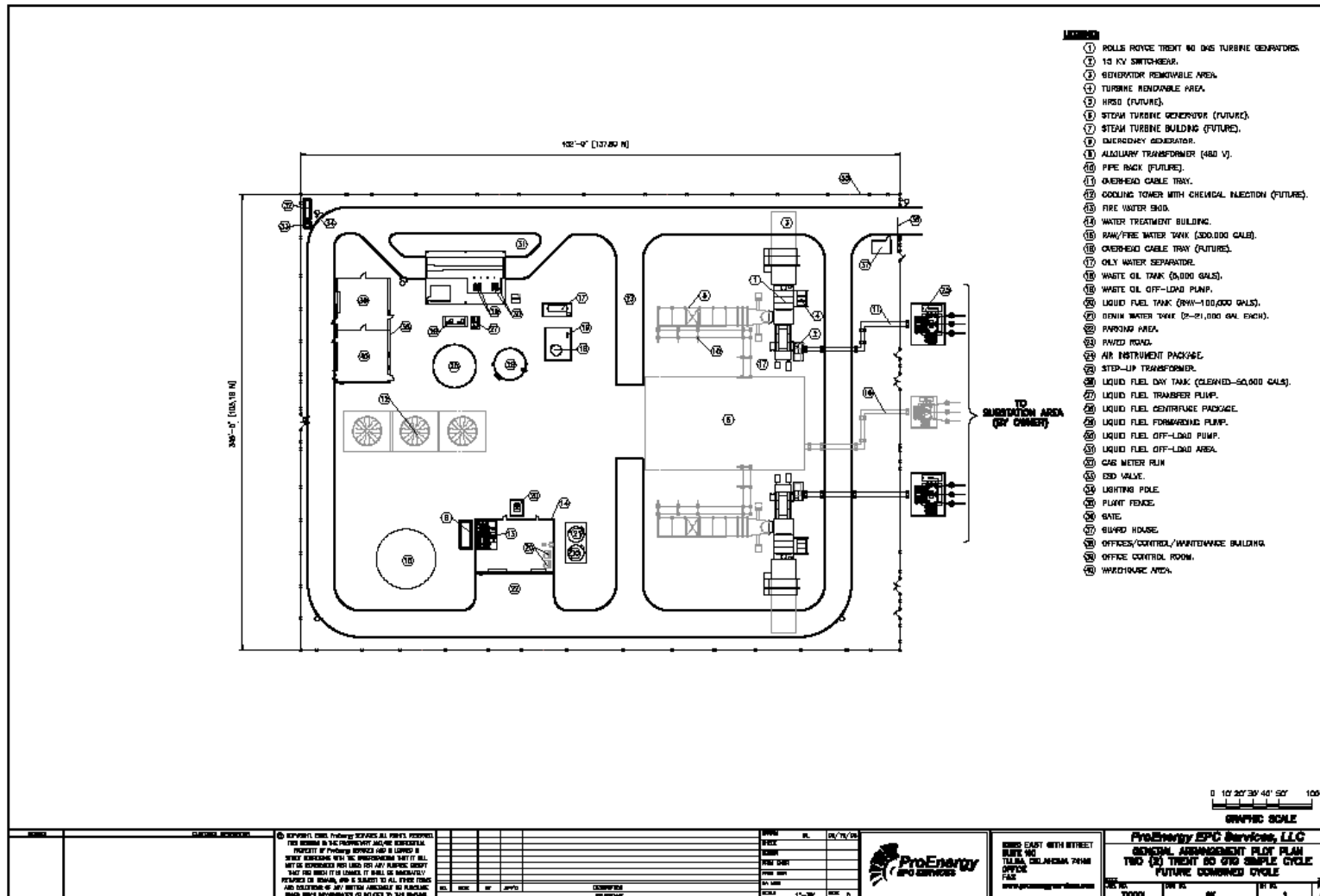
This program reduces the need for a spare engine and allows significant

flexibility in maintenance.

Flexible design

LP





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Instalaciones Típicas



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