19th SYMPOSIUM ON INDUSTRIAL APPLICATIONS OF GAS TURBINES

RB211-H63 Advancements and Meeting Future Demand of Oil & Gas Requirements for Midstream Applications

by

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RB211- Through the Years

- **1974** 1st Unit into service – TCPL Canada @ Burstall
- 1980 24B variant introduced
- 1983 24C variant introduced
- 1987 1st Dual Fuel Onshore Water Injected Unit
- 1987 100th Sale Achieved
- 1989 First Big Order – 24 units in Middle East.
- 1990 1st GG to surpass 100,000 hours.
- 1991 200th Sale Achieved
  1 million Hours
- **1992** 24G variant introduced at TCPL in October
- 1994 Dry low emission variant launched – PGT Starbuck, USA
- **1995** 5 Million Hours
  2 million Hours Offshore
- **2000** 24GT variant introduced
- 2005 30th anniversary of industrial RB211
  500th RB211 delivered
  First Run of Dual Fuel DLE
- 2008 Next generation gas generator – Aero Trent technology in development
- 2010 Introduction of the RB211-H63
- **2011** Introduction of the RB211-Gzero

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RB211 Fleet Statistics (Sep 2011)

Total engines sold	**696**
Total running hours	**28.2 million**
Fleet leader running hours – 24C	**193,000 (TCPL)**
Fleet Leader – DLE	**109,000 (TCPL)**
Fleet Leader – RB211-GT61	**50,000 (Port of Liverpool)**
Mechanical Drive running hours	**22.5 Million (>500 Engines)**
Power Generation hours	**5.7 Million (>160 Engines)**
DLE units sold	**162**
Total DLE running hours	**4.1 Million**

Product distribution:

Mark	**Number**	**Experience (hours)**
22	18	866,000
24A	17	1,718,000
24B	10	926,000
24C	117	8,571,000
RB211-G	338	11,662,000
DLE	99	3,458,000
RB211-G DLE DF	3	1,700
RB211-GT DLE	60	640,000
RB211-GT PhII	34	348,000
TOTAL	**692**	**28.2 Million hours**

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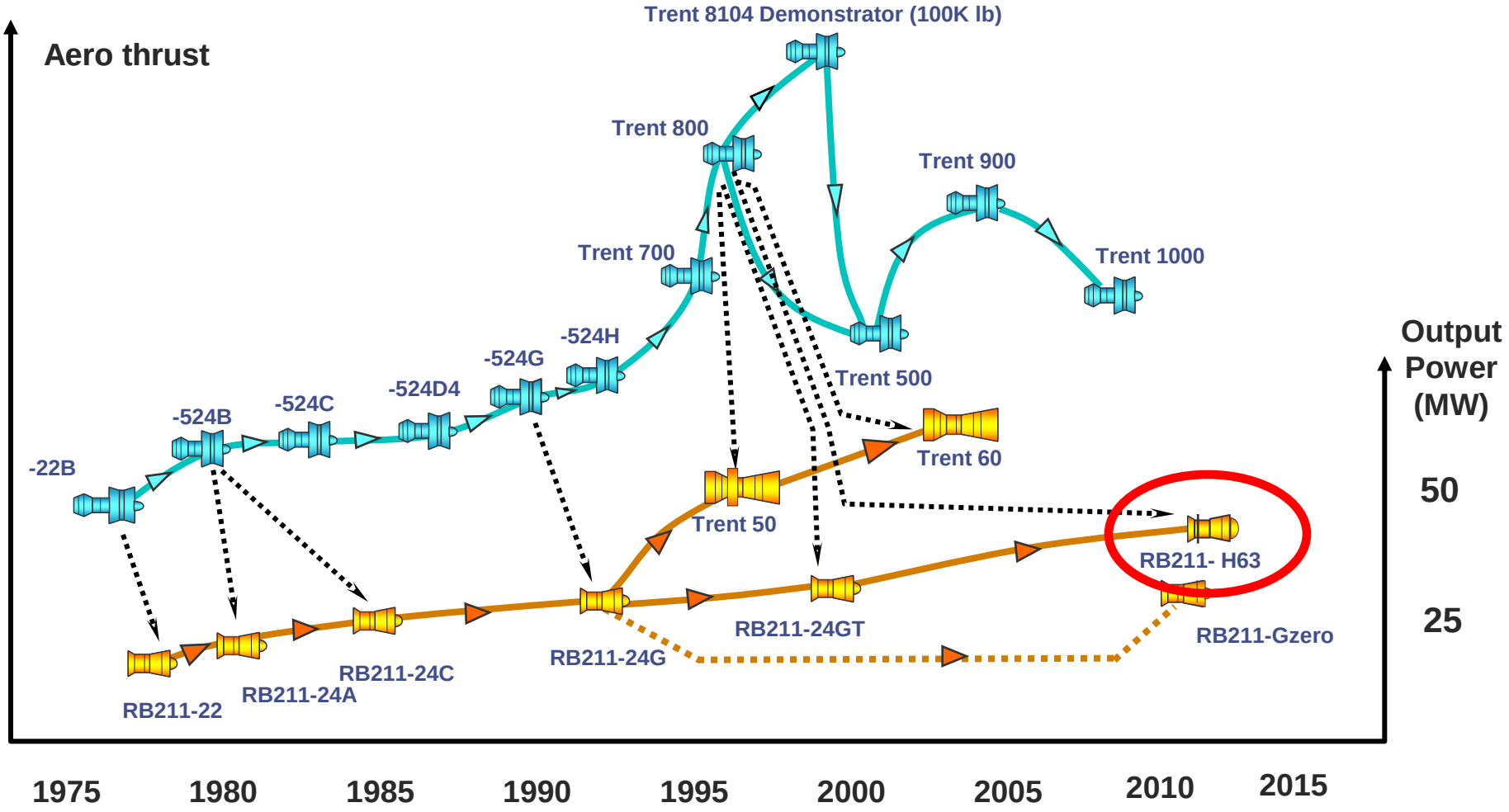
RB211/Trent Engine Family

Utilisation of components & technology from aero for industrial product development



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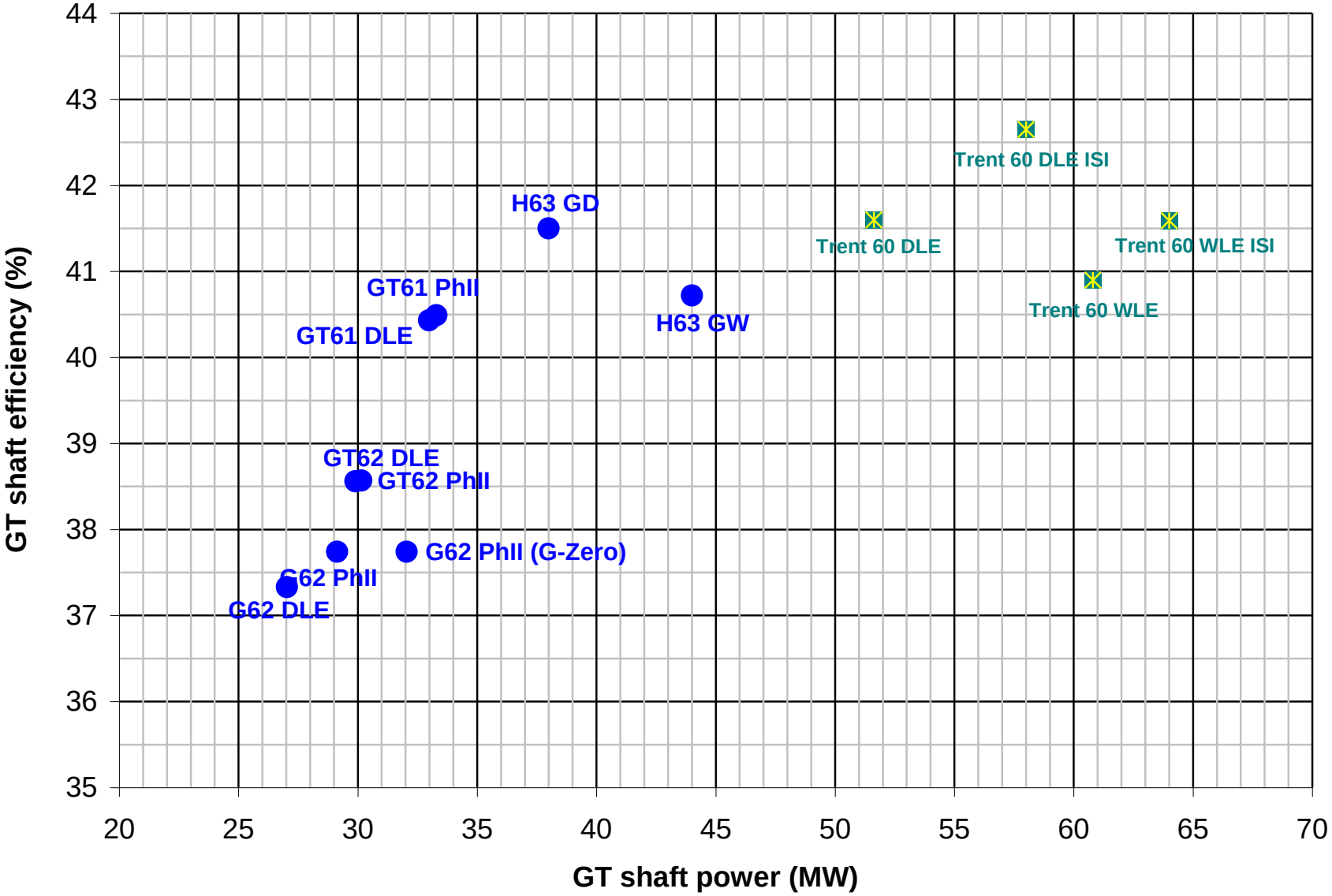
RB211-H63: Product Placement



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RB211-H63 Product Overview

- Designed for both peak lopping duty thereby giving Operators greater availability to provide generation capacity at times of peak loading and also continuous duty thereby delivering an economically friendly product across a wide dispatch range.

Power generation market

- All shipped Packages will be Equipment Health Monitoring (EHM) enabled, which will further enhanced operational flexibility and lower the cost of ownership through faster fault diagnostics and prediction of engine component failures before they occur.

Oil and gas market

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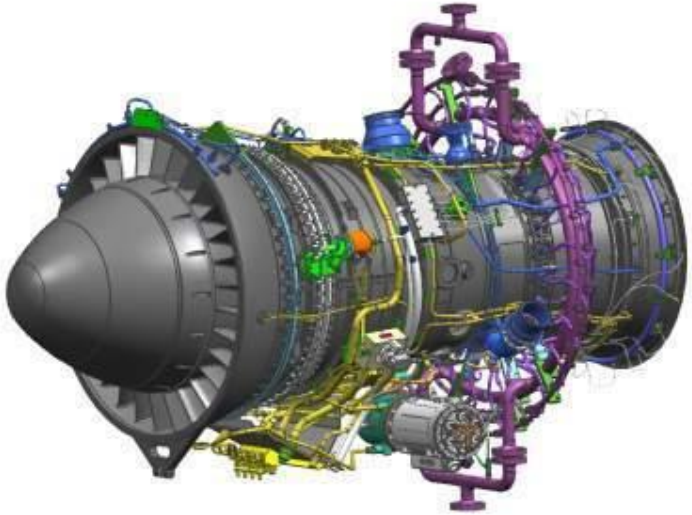
RB211-H63 Product Overview

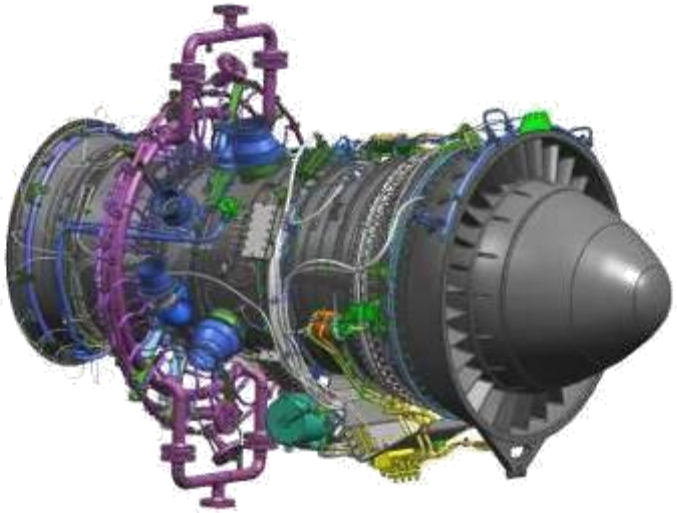
- The RB211-H63 is the most powerful RB211 gas turbine model produced by Rolls-Royce Energy Systems, with a current ISO rating of:
  - 44MW - WLE (Wet Low Emissions)
  - 38MW - without WLE water injection.

- The unit will deliver **5MW** more power and **2**% more efficiency than the current RB211-GT61 unit without any increase in firing temperature. (38MW Rating). This will enable our customers to meet their power demands with few units leading to a smaller footprint, lower weight, lower initial cost and lower maintenance cost.

- Robust RB211 architecture and design experience combined with proven technology advancements of the Trent to provide the most powerful and efficient RB211 gas turbine on the market.

- The modular GG construction and the package have been designed for reliable operation, easy maintenance and quick installation.





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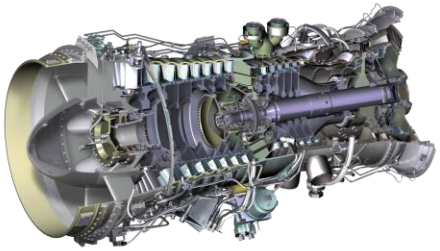
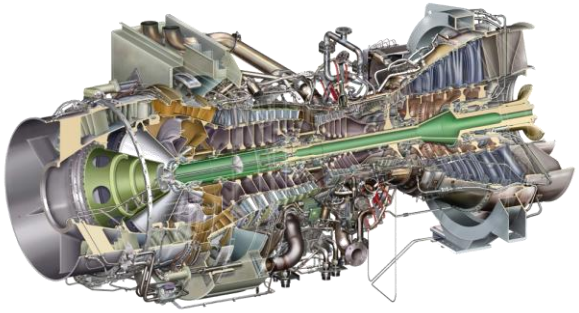
RB211-H63 Product Overview

Industrial RB211

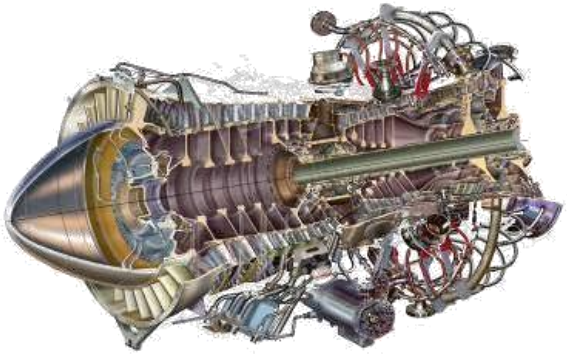


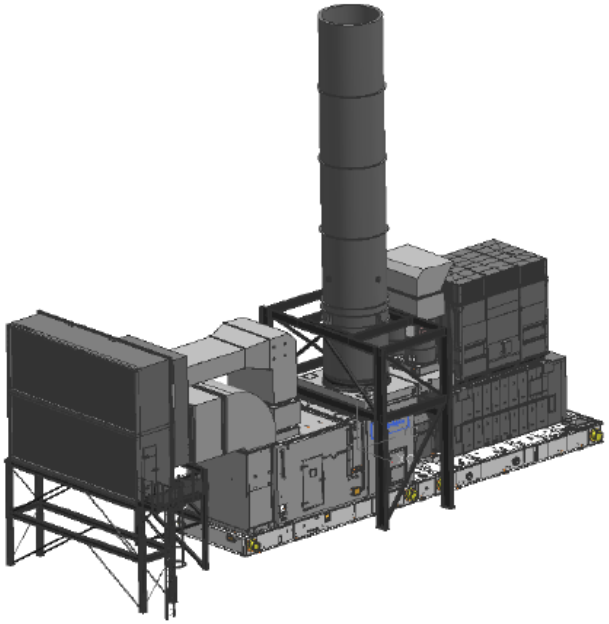
Industrial Trent



Design experience & commonality + Technology advancements + RB211 - GT61 footprint

The RB211 - H63





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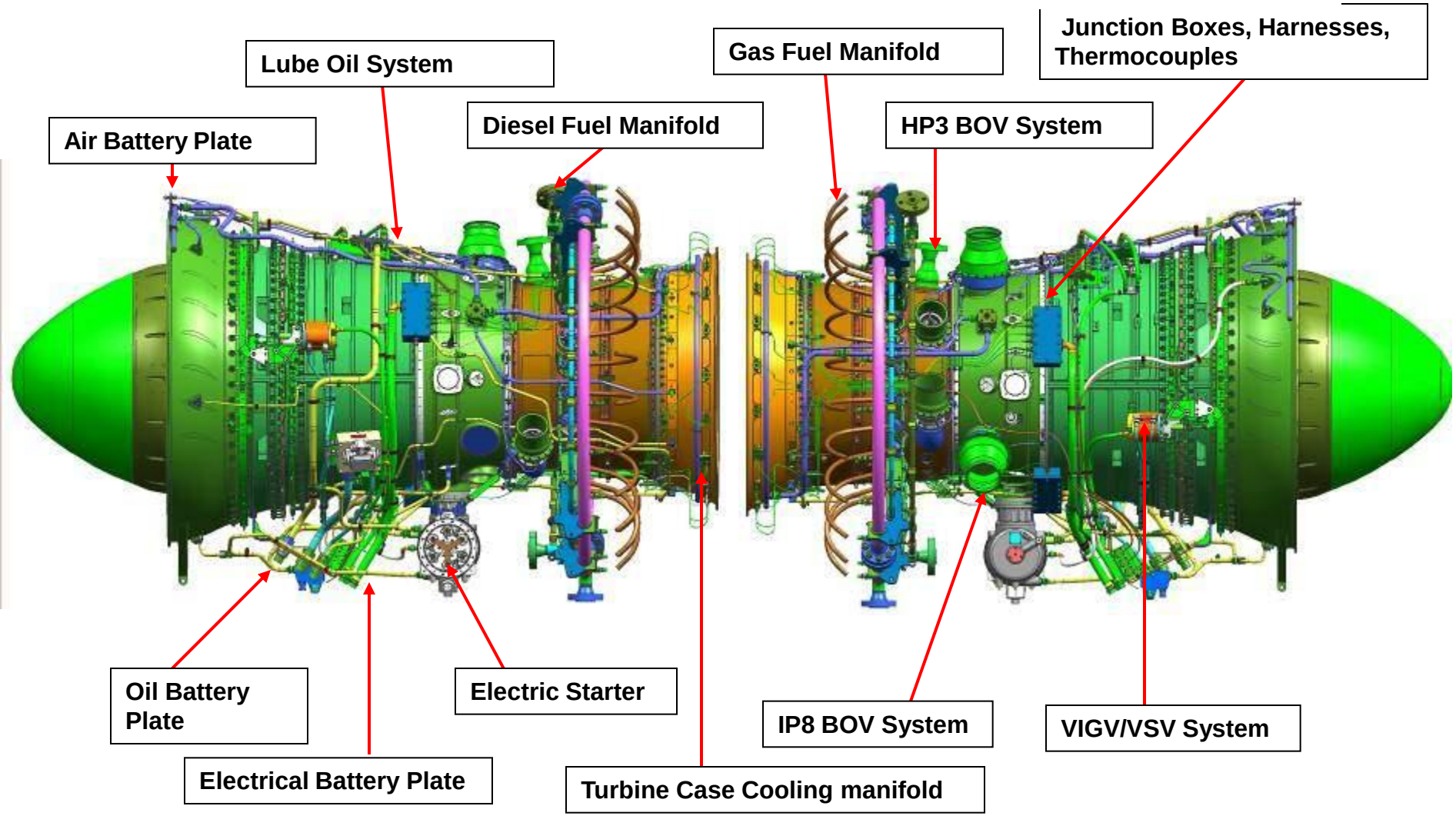
The RB211-H63 – Design and Heritage



View looking Port

View looking Starboard

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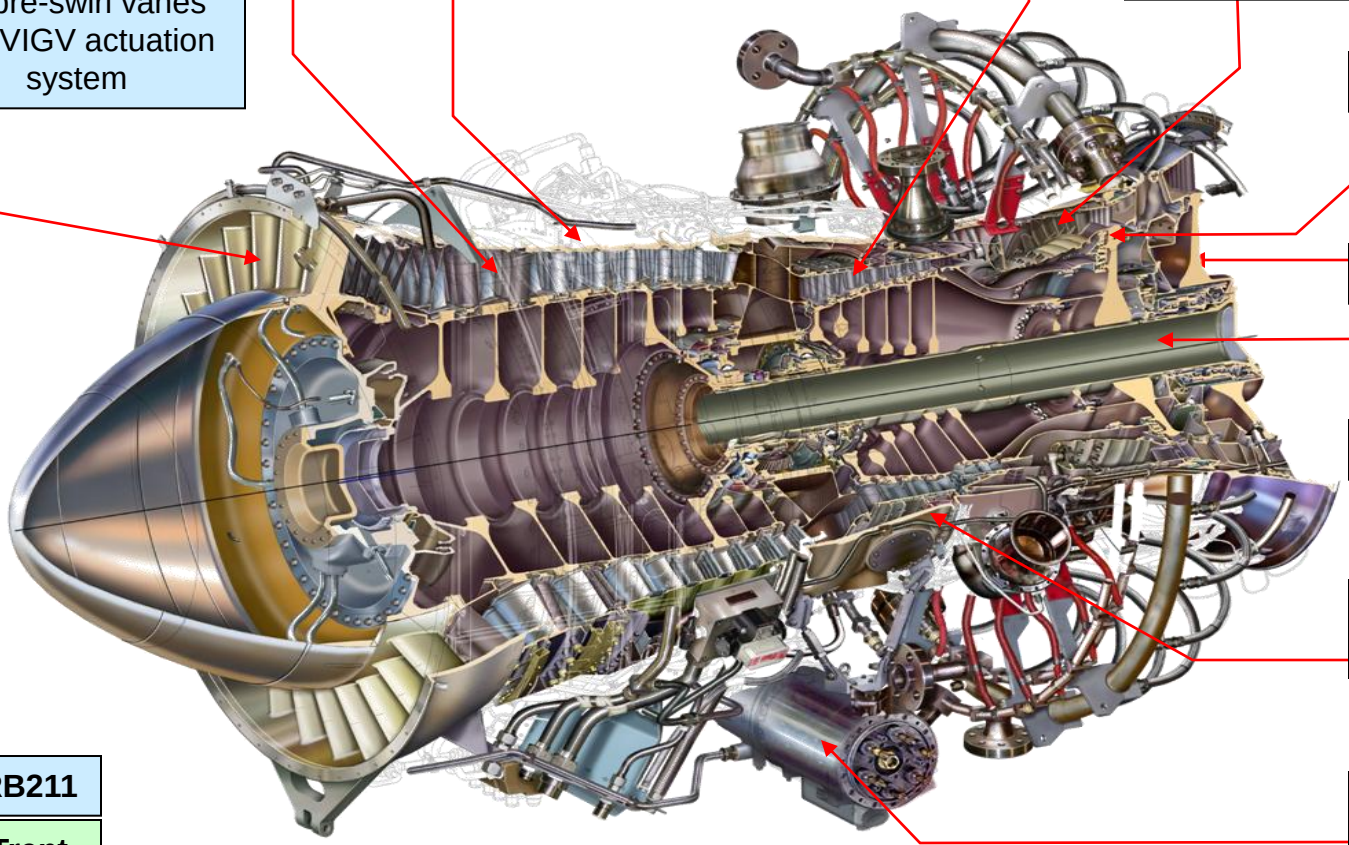
The RB211-H63 – Design and Heritage



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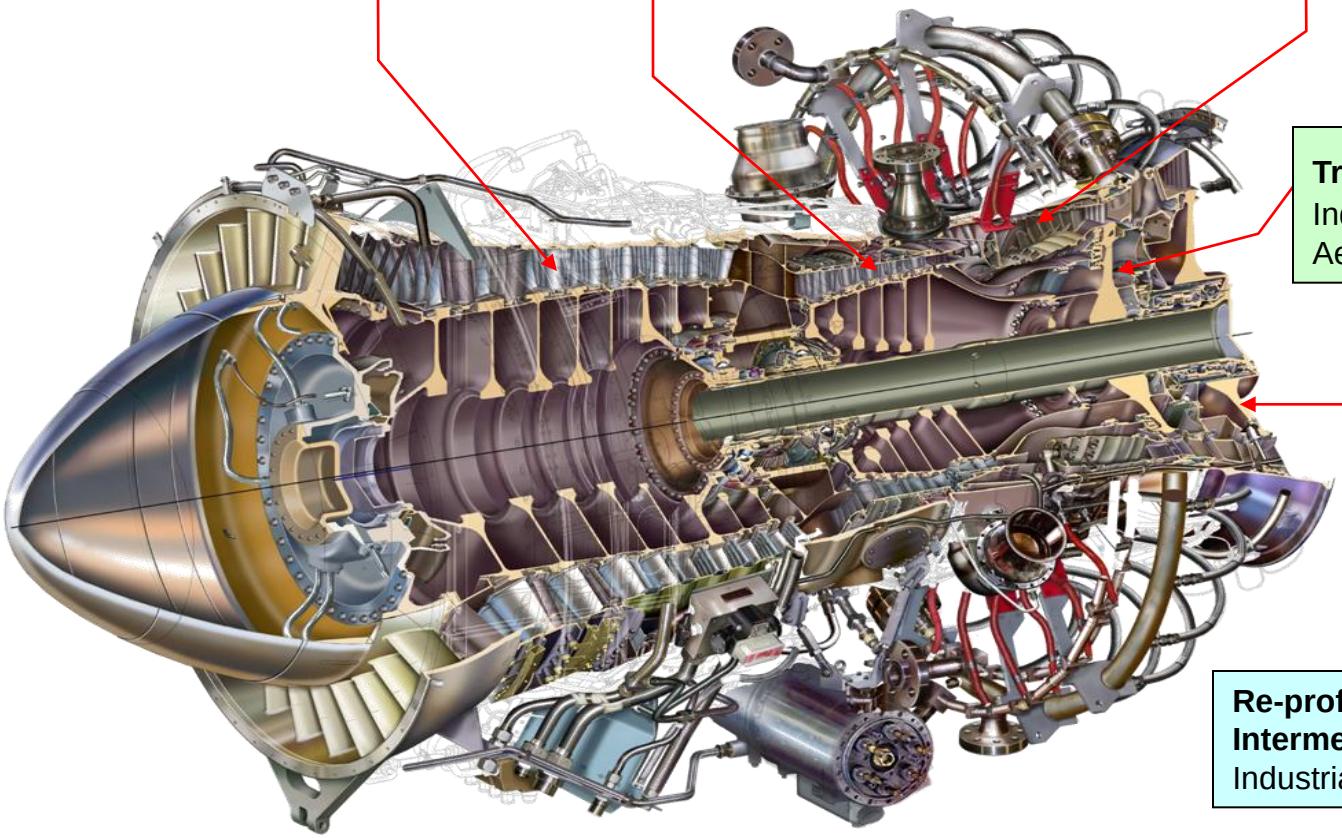
The RB211-H63 – Common running experience

Trent Intermediate Pressure Compressor
Industrial > 450,000 hours
Aero > 17 million hours

Trent High Pressure Compressor
Industrial > 450,000 hours
Aero > 17 million hours

Trent combustor
Industrial > 35,000 hours
Aero > 17 million hours



Trent High Pressure Turbine
Industrial > 450,000 hours
Aero > 17 million hours

Re-profiled RB211-GT Intermediate pressure turbine
Industrial > 750,000 hours

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The RT63 Free Power Turbine – Design and Heritage

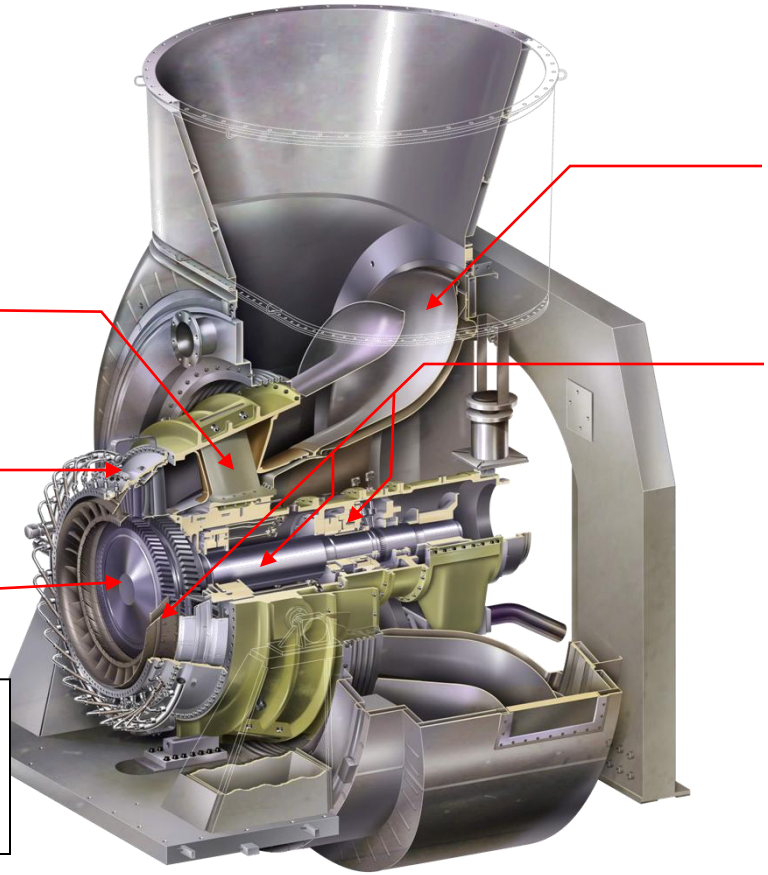
- RT63 is a 2 staged free power turbine with a rated speed of 6000 rpm and an aerothermal isentropic efficiency 93.4% providing 38 MW to 44 MW Shaft Power.

- The very latest aero engine performance technology has been employed in the design of the power turbine blade path, while traditional, rugged industrial design concepts have been retained in the mechanical design.

Rotor support via seven forged struts to the exhaust frame casing for improved rotor-stator concentricity.

Short low loss diffusing inter-turbine duct between gas generator and power turbine working blades.

Two moderately loaded reaction stages with orthogonally-shaped airfoil cascades to produce the very highest blading efficiencies.



Reinforced exhaust diffuser support for improved support stiffness and deflection control.

Modular Design for easy assembly, disassembly, transportation and replacement of the modules in field.

Forward pullout of the entire Duct and Turbine module reduces overhaul time to less than10 days from 21 days for current RT61s.

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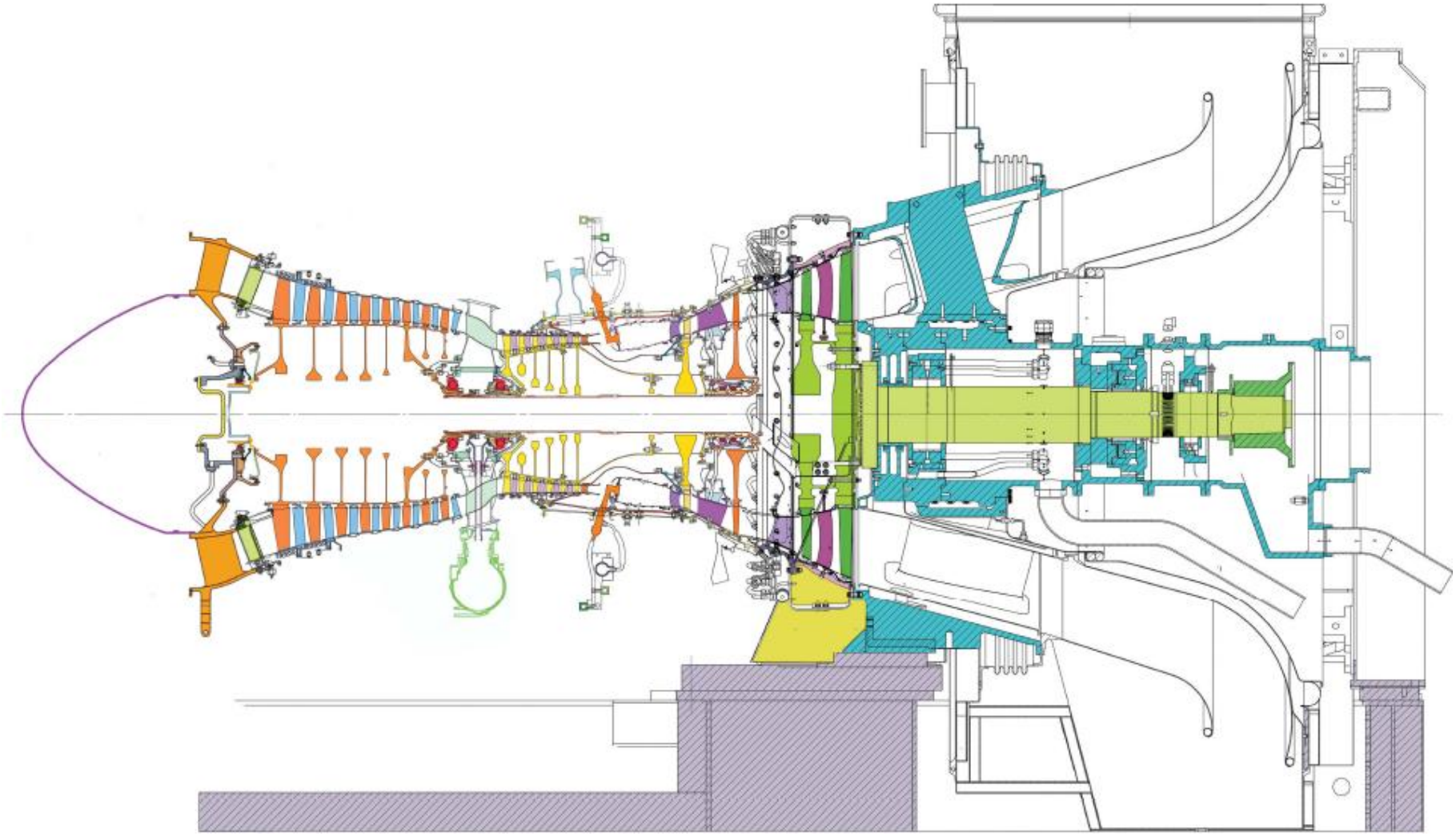
RB211-H63 Cross Section



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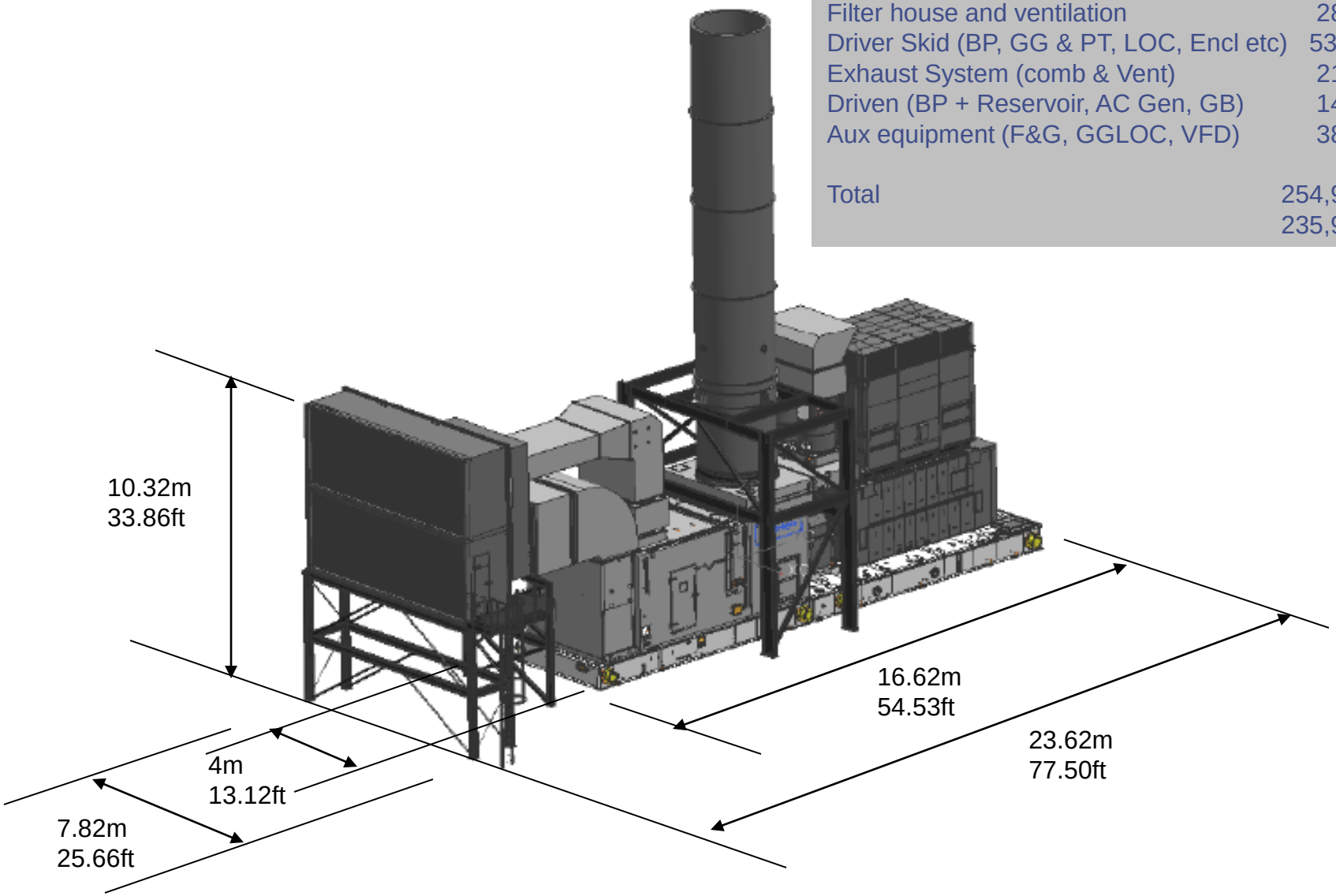
The RB211-H63 Package

Estimated Weights (kg & Wet)	
Filter house and ventilation	28500
Driver Skid (BP, GG & PT, LOC, Encl etc)	53500
Exhaust System (comb & Vent)	21200
Driven (BP + Reservoir, AC Gen, GB)	147900
Aux equipment (F&G, GGLOC, VFD)	3800
Total	254,900 Wet
	235,900 Dry



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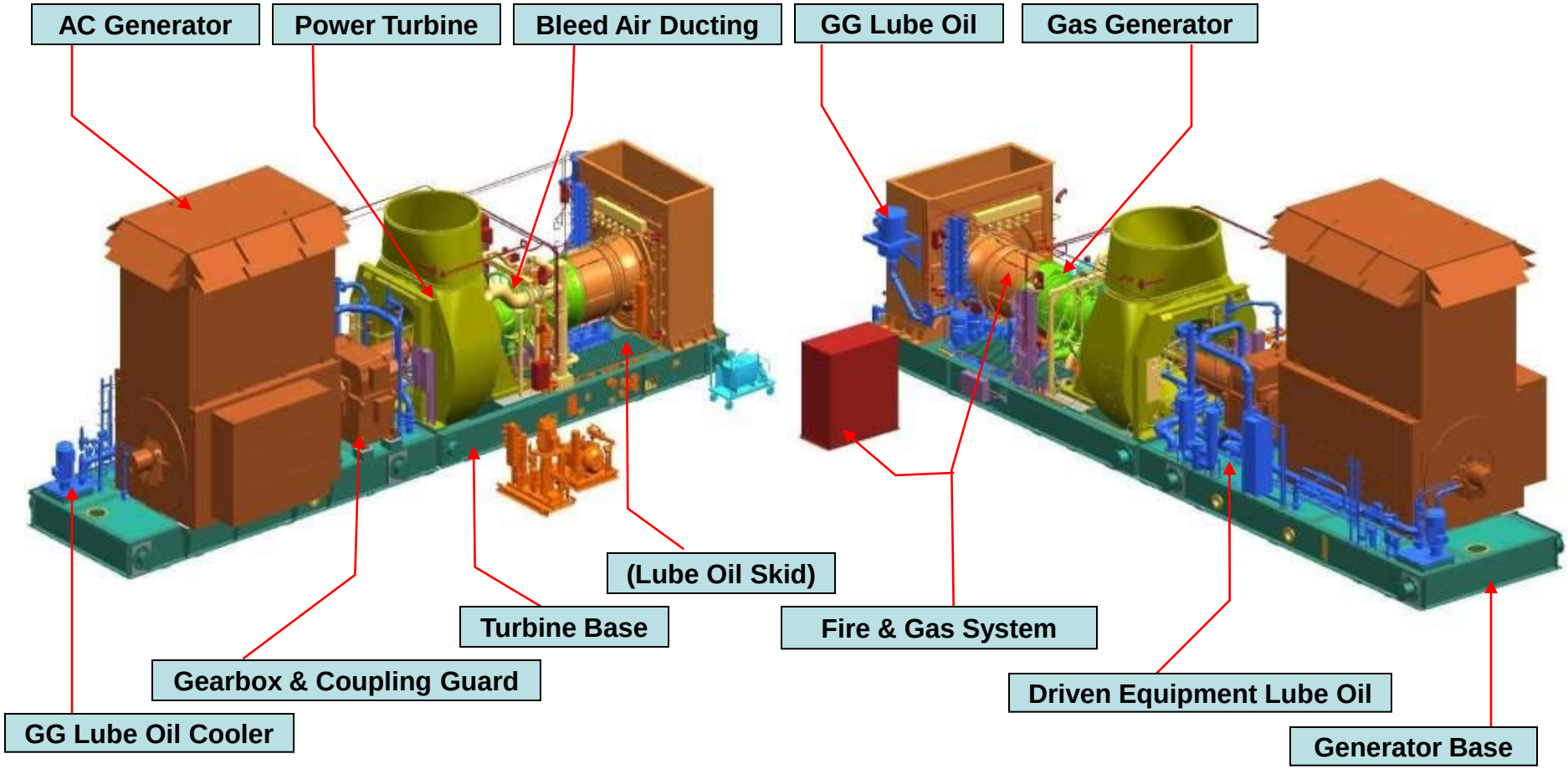
The RB211-H63 Package



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RB211 – Simple Cycle Performance

	G62 PhII	G62 DLE	GT62 DLE	GT61 DLE
• Power, kWs	29136	27934	29901	32987
• Heat Rate, kJ/kW.hr	9538	9645	9335	8903
• PT Exit Temp, ^{o}C	488	502	491	504
• Thermal Efficiency, %	37.74	37.33	38.5	40.43
• PT Exit Flow, kg/s	93.9	91.9	95.1	94.3

	Gzero PhII
• Power, kWs	32054
• Heat Rate, kJ/kW.hr	9479
• PT Exit Temp, ^{o}C	497
• PT Exit Flow, kg/s	102.4
• Thermal Efficiency, %	38.01

	H63 GD	H63 GW	H63 LD	H63 LW
• Power, kWs	38000	44000	35683	41610
• Heat Rate, kJ/kW.hr	8679	8839	8874	9027
• PT Exit Temp, ^{o}C	486	482	495	491
• PT Exit Flow kg/s	106.5	115.5	103.4	112.3
• Thermal Efficiency, %	41.5	40.72	40.56	39.87

Simple Cycle –15°C(59°F), 60% RH, 0 MASL, zero installation losses, 50/60 Hz, gas fuel, 25 vppm NOx (dry 15% O2)

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RB211 – Combined Cycle Performance

Model	G62 DLE	GT62 DLE	GT61 DLE
− Net Plant Output, kWe	37,725	39,760	42,640
− Net Plant Heat Rate kJ/kWe.hr(BTU/kWe.hr)	7,175 (6,801)	7,005 (6,639)	6,820 (6,464)
− Thermal Efficiency, %	50.2	51.4	52.8
− Gas Turbine Output, kWe	26,716	28,626	31,171
− Steam Turbine Output, kWe	12,045 #	12,205 #	12,593 #

Model	H63 WLE	H63 WLE
− Net Plant Output, kWe	54,019	68,232
− Net Plant Heat Rate kJ/kWe.hr(BTU/kWe.hr)	7,085 (6,715)	7,428 (7,040)
− Thermal Efficiency, %	50.8	48.5
− Gas Turbine Output, kWe	40,935	40,935
− Steam Turbine Output, kWe	14,189 #	29,125 +

Combined Cycle –15 °C (59 °F), 60% RH, 50/60 Hz, gas fuel, 25 vppmNOx(dry 15% O2), Dual pressure steam Cycle

+ Combined Cycle –15 °C (59 °F), 60% RH, 50/60 Hz, gas fuel, 25 vppmNOx(dry 15% O2), Single pressure steam cycle, Supplementary fired to 750 °C (1382 °F)

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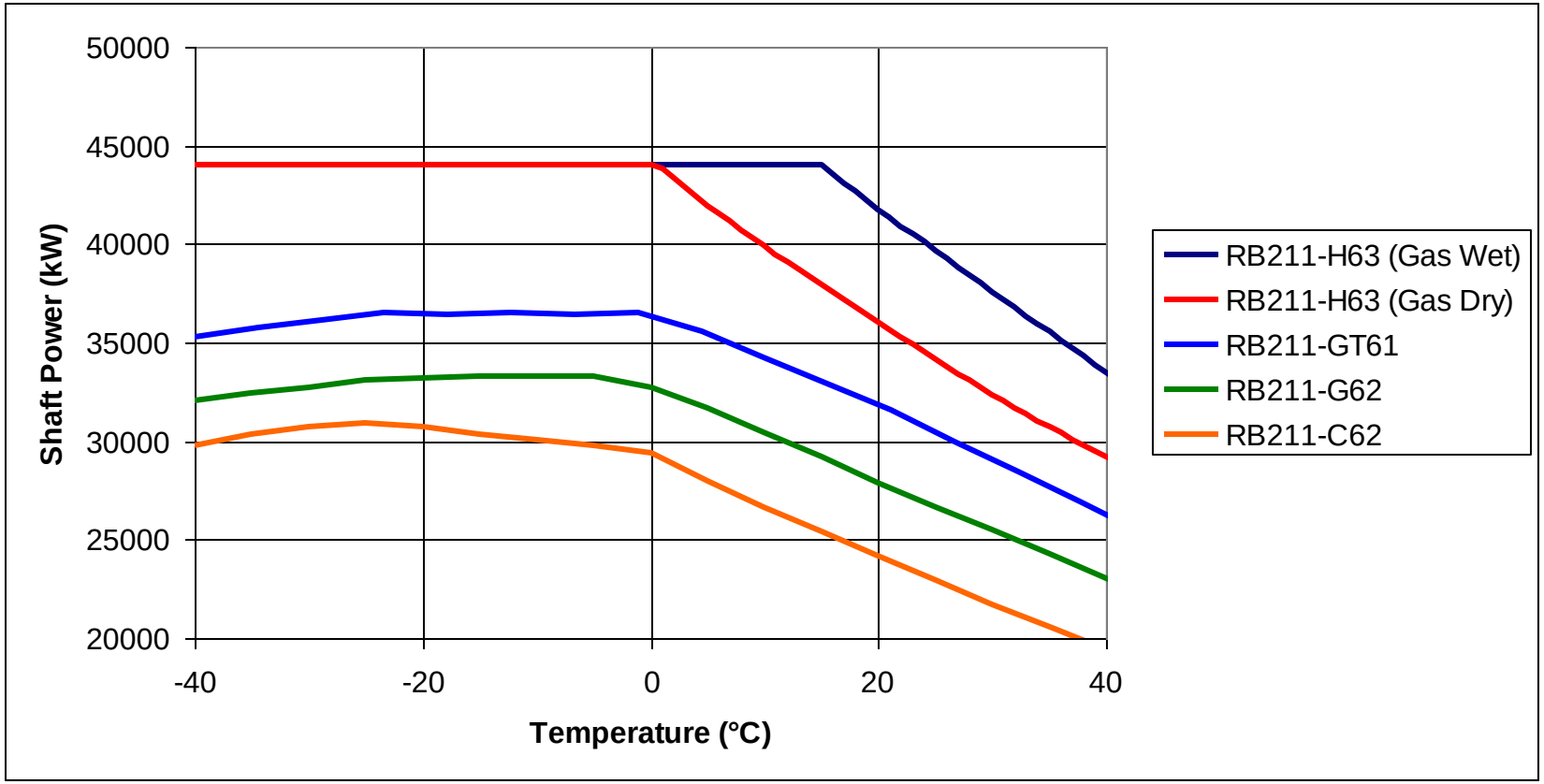
RB211 Predicted Power Rating



ISO Conditions, Zero Installation Losses, Natural Gas LCV = 49,111kJ/kg, Non-DLE (Dry)
Non-guarantee, for information purposes only

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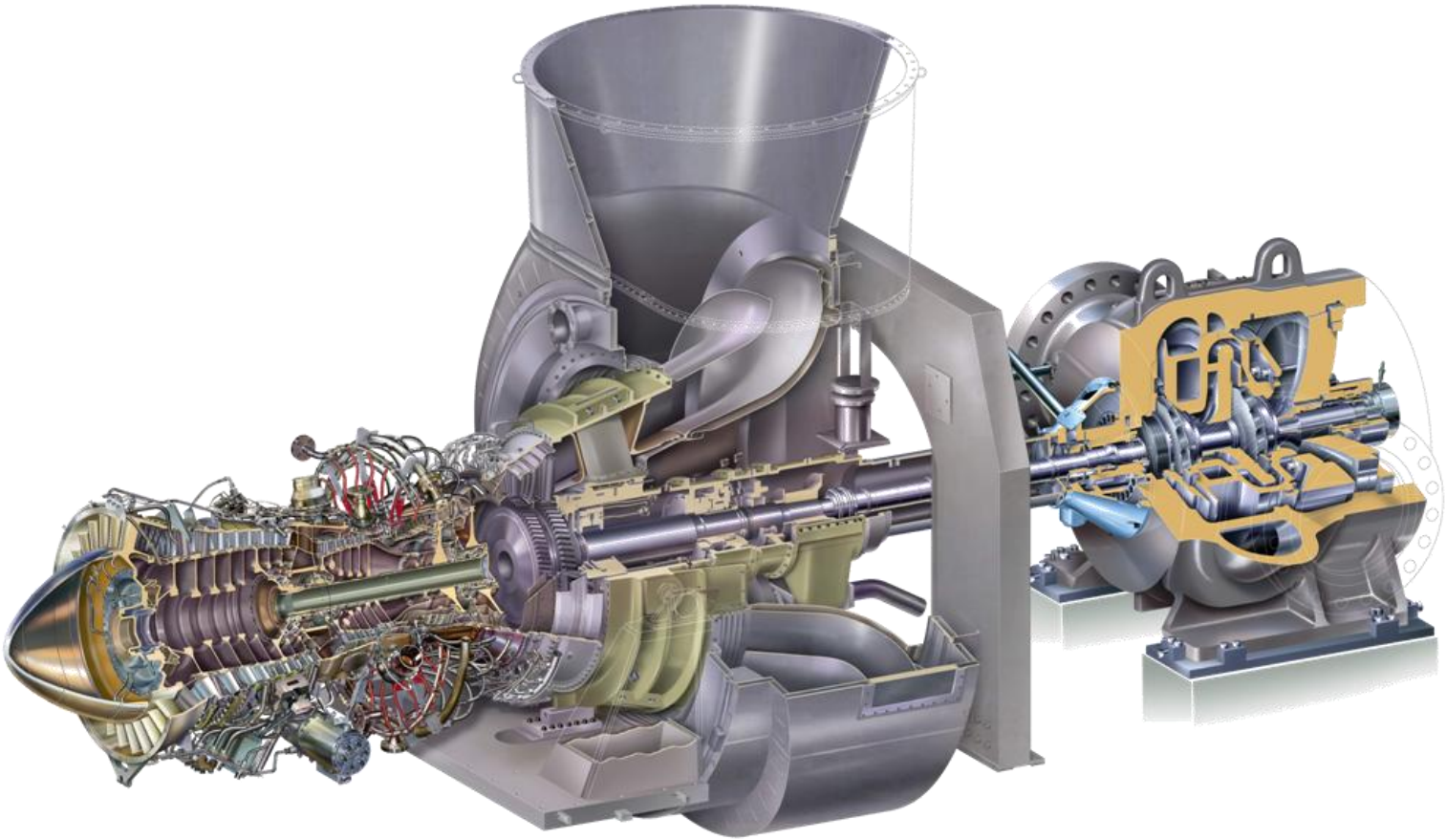
RB211-H63 Product Summary

- **Modular construction as per today's RB211**
  - Quick and easy maintenance
  - Six modules
- **Load acceptance capability over large degree of power range.**
  - Full load rejection capability
- **Fast start to full power within 10 minutes.**
  - Proven on Trent 60
- **Dual fuel capability**
  - Proven technology and reliability.
- **Fuel change-over with no noticeable change in power level (up to an including baseload levels) within 45 seconds.**
  - Proven capability and reliability on Trent60.
- **DLE capability to be available after WLE introduction**
- **All Units will come pre-equipped with Equipment Health Monitoring**

THANK YOU!



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