

20th SYMPOSIUM ON INDUSTRIAL APPLICATIONS OF GAS TURBINES



13-IAGT-206 - Advantages of aeroderivative
Gas Turbines: Technical & operational
considerations on equipment selection

by

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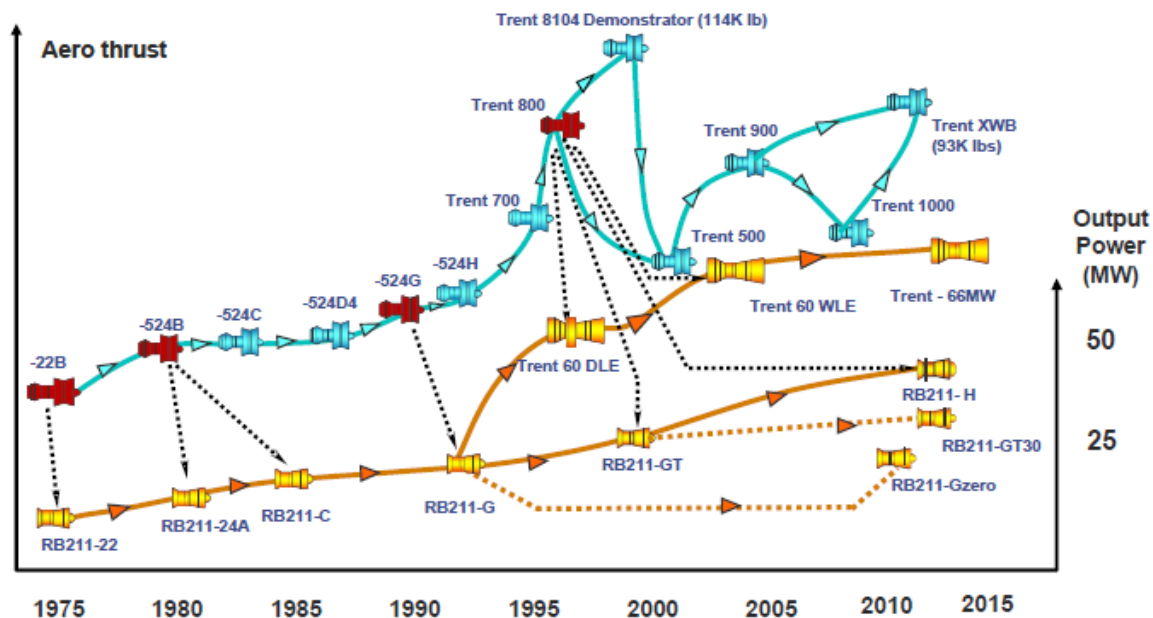
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Variations

Aero	Heavy	Light Industrial	Hybrid
Up to 66MW	Up to 340MW	Up to 50MW	Up to 100MW
High power density	High Power Output	Specifically for Energy	Aero at the heart
Low Weight – offshore & civil works	Generally has lower emissions	Keep Aero benefits, no aero heritage	Additional industrial hardware
High Efficiency ~40% Lowest Fuel Cost	Lower initial Cost Higher Fuel Cost	Lower initial cost than pure Aero	Sheer size and complexity can extend commissioning
High Cycle Flexibility	Low Cyclic Capability – Good for base load ops	Little experience operationally	
Fast Start	High tolerance to off gas fuels		
Transient Capability	Large step load changes		
More Frequent but short Maintenance times	EOH can impact actual hours available		
Generally no EOH – hours for hours. No penalty for fast starts / trips			

Aero Derivative

- Heritage is Aerospace based. Time on the wing.
- Mostly Civil Airlines
- Defense capability also used
- Millions of hours of Aero experience can be applied to Energy Gas Turbines
- Minimum changes –
 - Dual Fuel
 - Shaft Power not Thrust
 - Low Emissions Combustion technology



Basic considerations must be made...

From Aircraft engine	To Industrial Gas Turbine
Intermittent operation over short periods	Continuous operation over long periods
Wide Range of altitudes experienced	Narrow range of altitudes experienced
Only high grade aviations fuels used	Wide range of liquid and gas fuels used
Both high & cruise power used every flight cycle	Base or part load operation over long periods

For specific benefits...

Aero to Industrial

Parameter	Aero	Heavy Industrial
Starting	Fast starts – 10mins to full load possible.	No fast start capability.
Personnel Logistics (engine change)	1-2 OEM for advising and re-starting. Actual changeout by customer.	4-10 personnel required Mobilisation and resource heavy.
Gas Generator Changeout	From engine stop command to full load, 72 hours / 3 days. Include Power Turbine Inspection. 2 Reps from OEM, 2 from Customer.	Very limited. 28 days average. 4-10 Reps from OEM, 4-6 from Customer at a minimum.
Maint. location alternatives	Either on site or at an off-site facility as requirements dictate	On-site maintenance only practical alternative. Requires large lay down areas.
Parts Logistics	Engine sent to site as a single unit. Minimal spares – consumables,	Parts needed for engine not fully known until strip down has occurred. Time taken whilst parts are shipped to site from OEM facility to be considered

Starting

- **Aeroderivative GT's have very fast start capability:**

~10 minutes

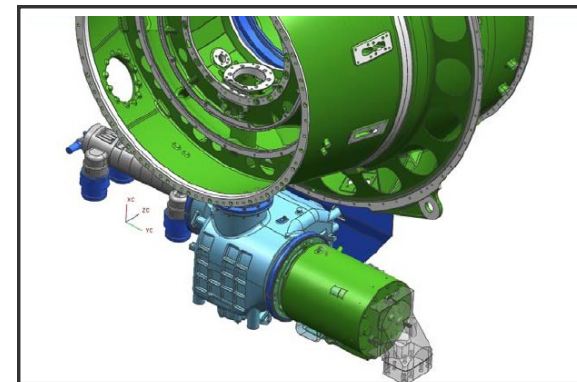
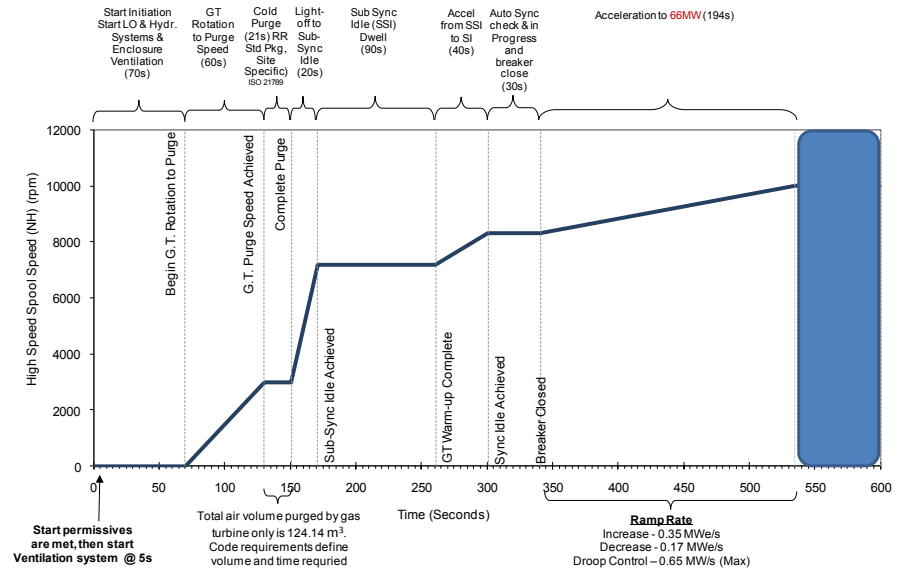
- Load Demand
- Standby
- Not Idling
- Fuel & Fired hr savings

- **Electric Starters**

- Black Start 200-400kw
- Global Starters - 390-680 v 50/60 Hz
- Simplification of hydraulic systems

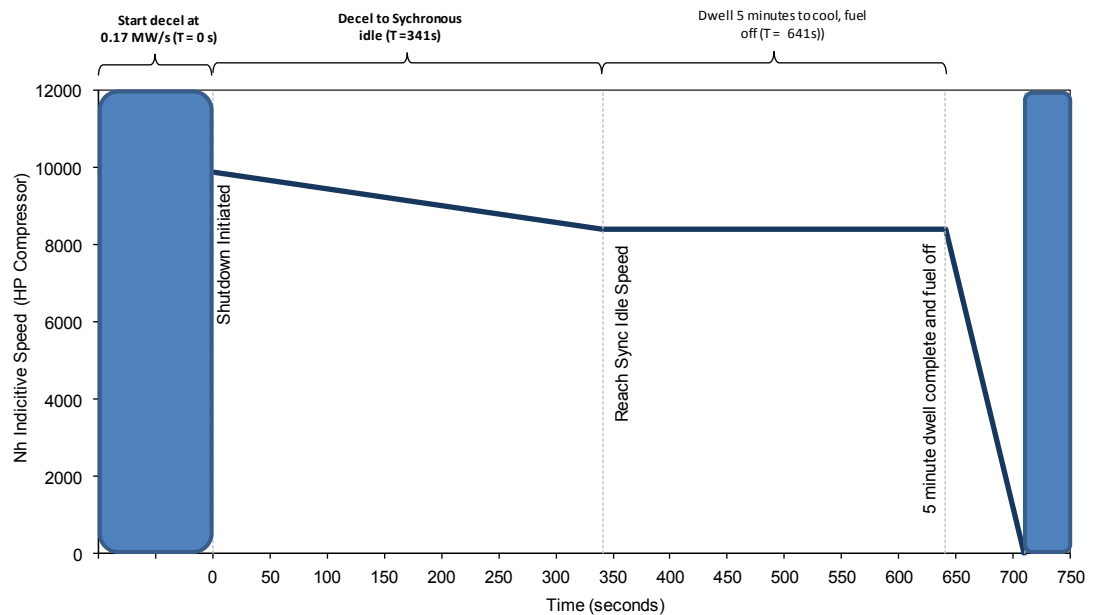
- **Multiple Shafts = high Break Away Torque**

- Starting only on one shaft
- Very high levels of break away capable
- Usually, No Barring / Helper Motors Req'd



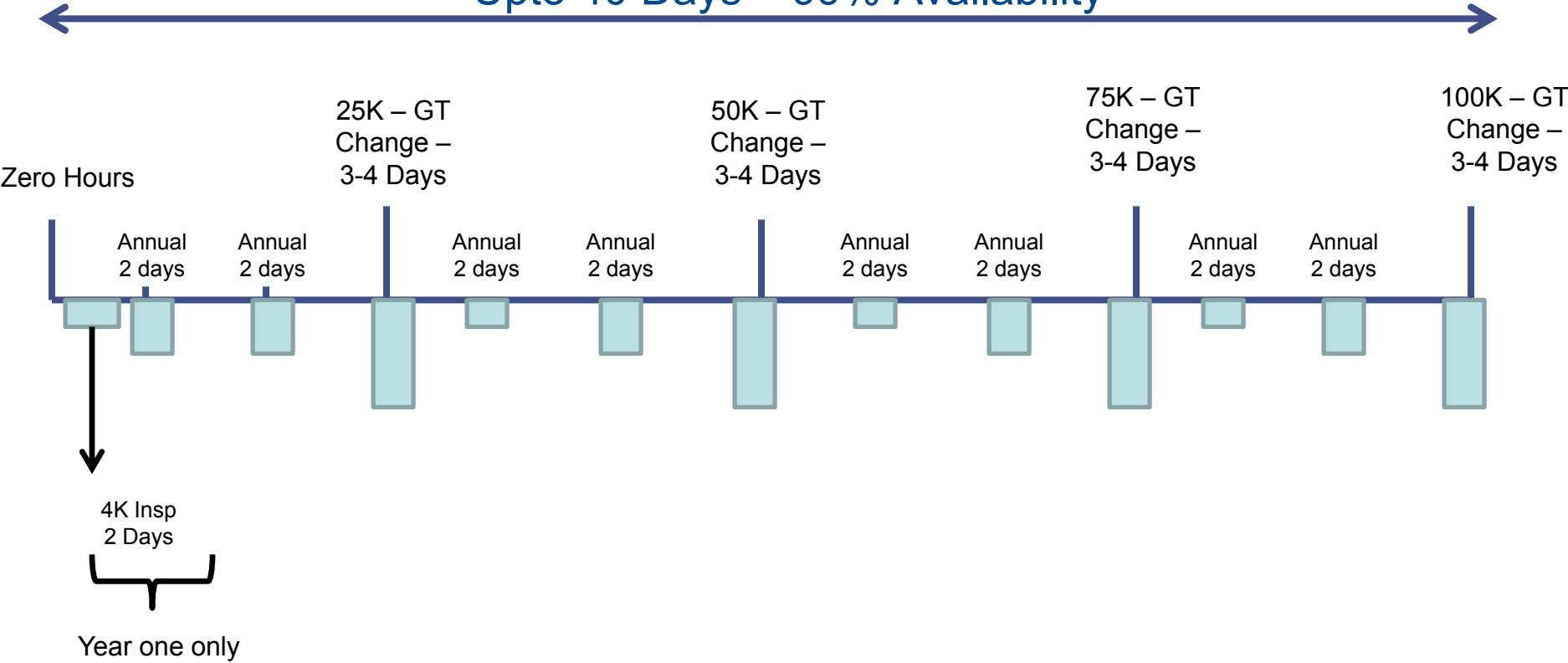
Shutdown

- Aeroderivative GT's generally have a fast stop capability .
 - Load Demand
 - Back on Standby
 - Not Idling
 - Fuel & Fired hr savings
 - Available for Immediate restart with no lockout



Typical Aero Availability

Upto 40 Days – 99% Availability

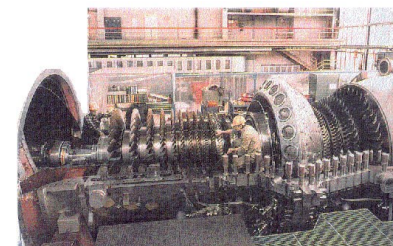


Overhaul - Heavy

- **Combustion inspection** – 2-5 Days minimum + cool down (~24 hours)
 - Every 800-8000 hrs – as contract dictates
 - Assumes parts are available if anything is seen to be wrong. Very few components can be borescoped prior.
 - Requires removal of fuel nozzles and combustors.
- **Hot gas path** - ~5 Days + cool down (~24 hours)
 - As above with the need to remove top half of casings.
- **Overhaul** - ~3+ Weeks – Manpower intensive. Normally Longer



Picture – Weatherzone Australia

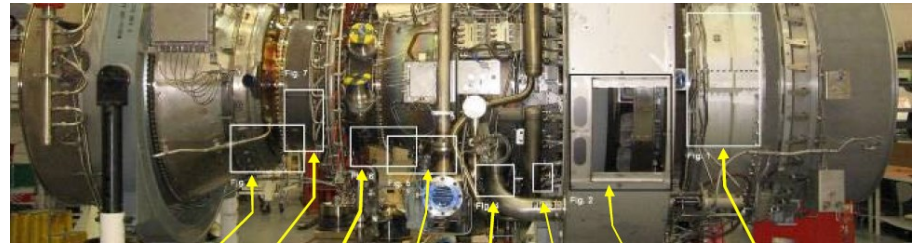


GAS TURBINE WITH ITS TOP HALF CASING REMOVED

Picture - EMT India.net

Overhaul - Aero

- **Annual** – 2-4 days including cool down
 - Borescope inspection
 - Instrumentation & Controls Calibrations
 - Package Functionality

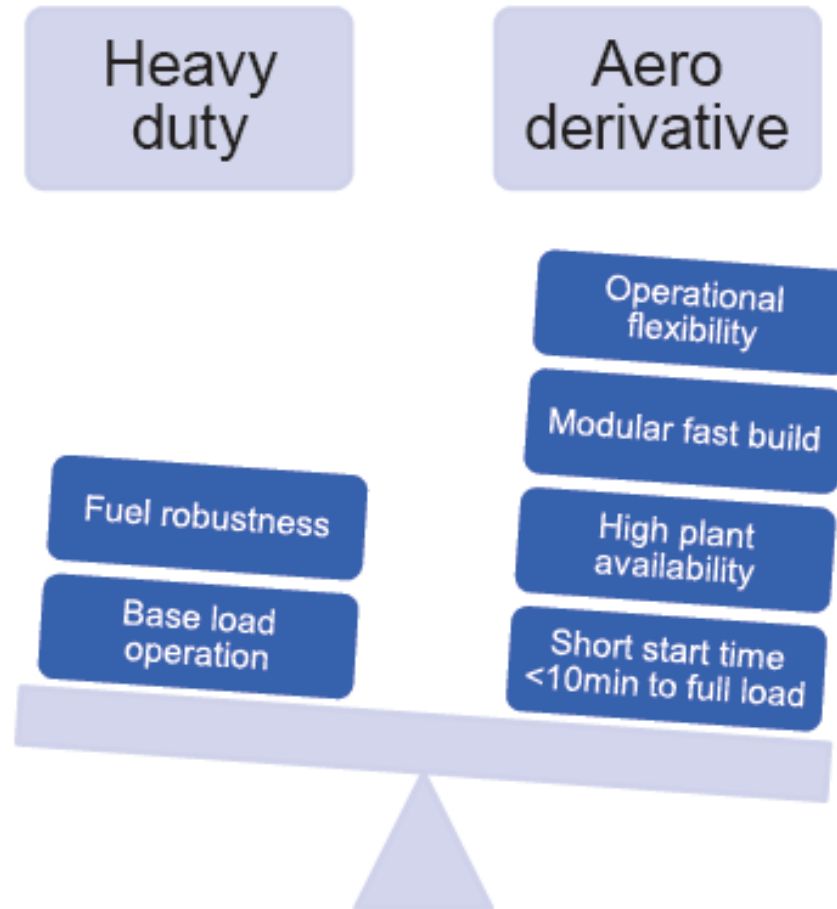


- **GT Change out** – 48 hours
 - Required Every 3 years or 25,000 hours.
 - GT is replaced as a whole unit.
 - Uses minimal spares and consumable parts for change



Pictures – Rolls-Royce

Balance



Thank you and Questions?

