AERODERIVATIVE, INDUSTRIAL, AND LIGHT INDUSTRIAL GAS TURBINES—A COMPARISON

by
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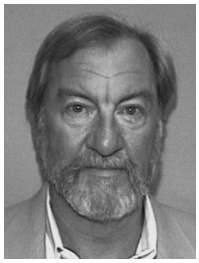

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Mr. Haught received his B.S. degree (Mechanical Engineering, 1979) from the University of California, Santa Barbara. He is a member of both ASME and PMI. He is a registered Professional Engineer in the States of Texas and California.

The following is a copy of the author's PowerPoint submittal. It has received no editing.

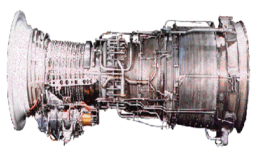
Aeroderivative, Industrial, and Light Industrial Gas Turbines A Comparison

The purpose of this Tutorial is to compare Industrial, aeroderivative, and light industrial gas turbine characteristics and their applications. It will also provide some example economic comparisons for different applications and constraints

Slide 1.

Aeroderivative Engines

- Based of aircraft flight engine
- Lightweight, fabricated casing
- Modular construction
- Rolling element bearings



- Two separate oil systems, gas turbine and driven equipment
- Synthetic oil required because of higher bearing temperatures

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Aeroderivative Engines

- Better response to load changes (less GG mass)
- Condition maintenance may be easier due to more inspection ports.
- Higher firing temperatures
- Higher efficency, better fuel consumption
- Higher NOX and CO

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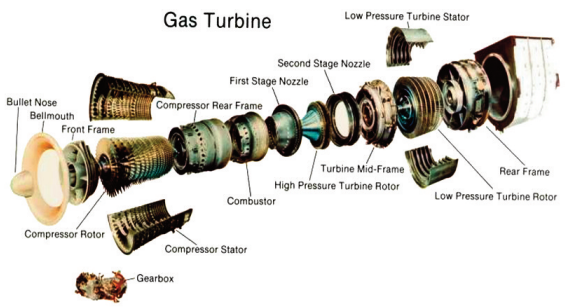
Aeroderivative Engines



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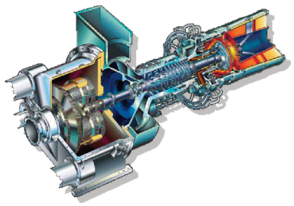
Industrial Engines

- Robust design
- Cast main casings
- Common lube oil system
- Mineral oil suitable
- Hydrodynamic bearings
- Lower firing temperatures



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Industrial Engines

- Lower in emissions than other engines
- Lower firing temperatures
- Lower efficiency, 32-25% simple cycle

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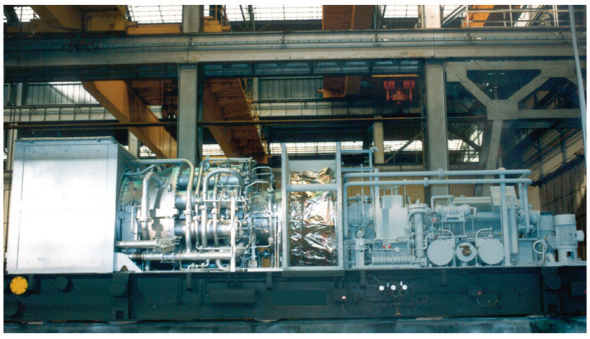
Industrial Engines



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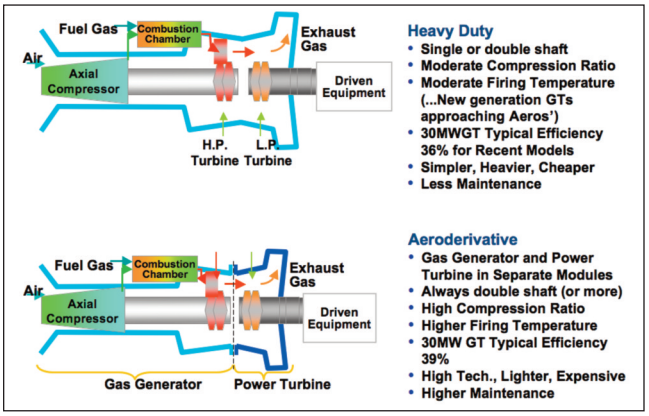

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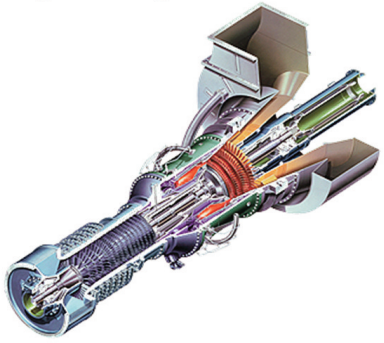
"Lightweight" Industrial



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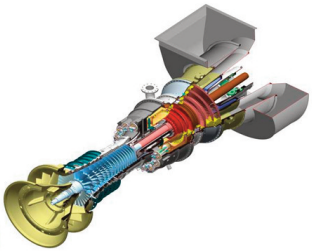
"Lightweight" Industrial

- Fabricated Main Casings
- Hydrodynamic bearings
- Mineral lube oil
- Common lube oil system



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Application Considerations

- Original capital cost
- Sparing philosophy
- Maintenance turn-around time
- Maintenance access
- Field service availability
- Cost of fuel gas
- Weight of package
- Emissions requirements

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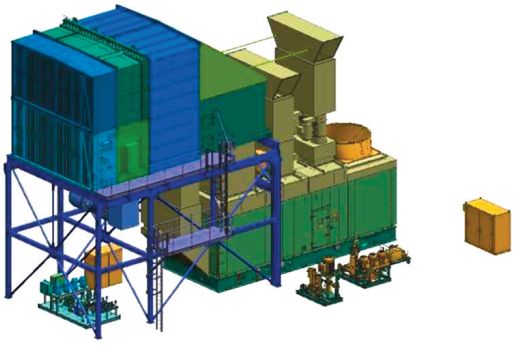
Typical Package Layout



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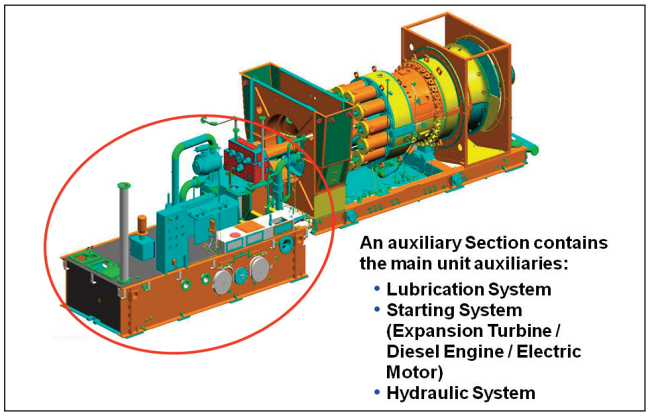

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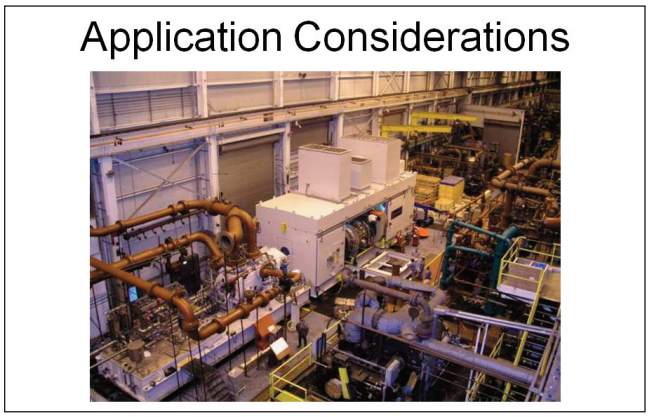

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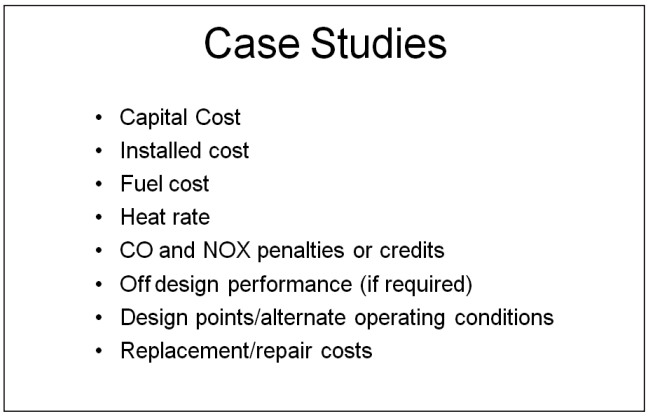

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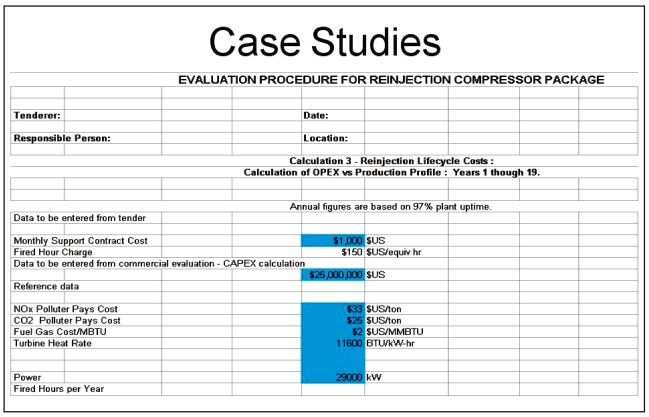

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Case Studies

	PRODUCTION PROFILE DATA		ANNUAL PERFORMANCE TOTALS				OPEX COSTS					LIFECYCLE COST	
	Annualised Gas Production	Instantaneous Gas Production Rate	Fuel Gas Consumption	NOx Emissions	CO2 Emissions	Fired Hour Consumption	Support Contract	Fuel Gas Consuption	NOx	CO2	Total OPEX	Lifecycle cost weighting factor	Lifecycle Cost Summation
	Annualised	Instant	Annualised	Annualised		Annualised	Annualised	Annualised	Annualised	Annualised	Annualised		$US
	10^6 Sm3/d	10^6 Sm3/d	MMBTU/yr	tonnes/yr		equiv hrs/yr							*NPV OPEX-CAPE*
													-$54,319,562
1		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.9535	-$5,751,228
2		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.9088	-$5,226,269
3		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.788	-$4,752,963
4		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.7164	-$4,321,102
5		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.6512	-$3,927,845
6		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.592	-$3,570,768
7		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.5382	-$3,246,253
8		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.4893	-$2,951,139
9		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.4448	-$2,682,900
10		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.4044	-$2,438,227
11		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.3676	-$2,217,254
12		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.3342	-$2,016,795
13		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.3038	-$1,832,423
14		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.2762	-$1,665,958
15		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.2511	-$1,514,562
16		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.2283	-$1,377,038
17		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.2075	-$1,251,579
18		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.1886	-$1,137,572
19		0.000	2,413,380,000	67	125	0.0	-$1,200,000	-$4,826,760	-$2,197	-$2,746	-$6,031,703	0.1715	-$1,034,437
												NPV OPEX	-$29,319,562

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Case Studies

	Turbine 1	Turbine 2	Turbine 3	Turbine 4	Turbine 5
Change	Base Case	Increased Heat Rate	Increased CAPEX	Increased Emmissions	Increased Monthly Support Contract
NPV OPEX	-$29,319,562	-$32,369,680	-$29,319,562	-$29,331,132	-$35,152,654
NPV CAPEX	-$25,000,000	-$25,000,000	-$30,000,000	-$25,000,000	-$25,000,000
NPV TOTAL Life	-$54,319,562	-$57,369,680	-$59,319,562	-$54,331,132	-$60,152,654

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