Wood Group GTS

Keep on turning

OSISoft Regional Seminar - Denver
October 19, 2010

Gas Turbine Remote M&D with the PI System

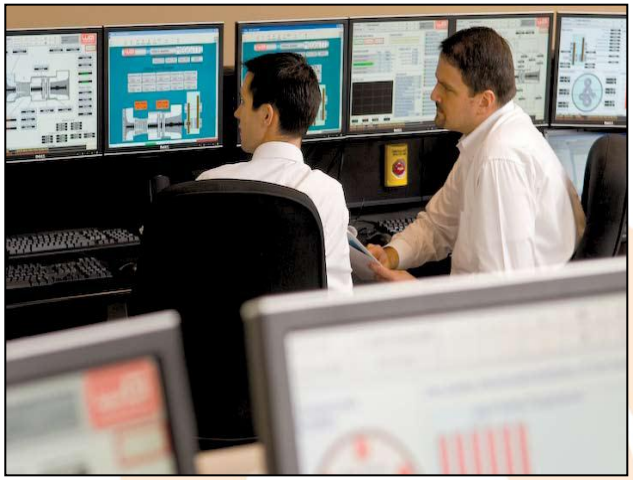
Dave Olsheski – Wood Group Gas Turbine Services (GTS)

Gas Turbine Remote M&D with the PI System

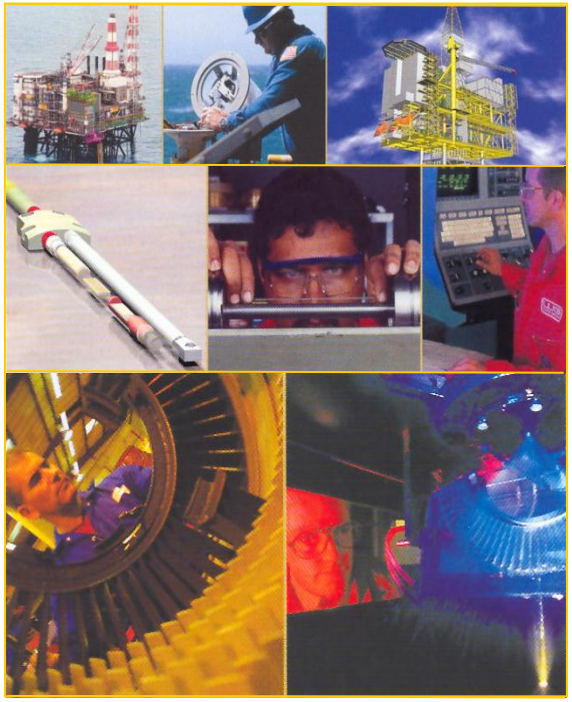
Presentation Outline

- Wood Group GTS Overview & Background
- Wood Group RM&D Approach & Strategy
- Case Studies – Business Value of PI System

Wood Group RM&D Engineering
is based in Loveland, CO USA



Wood Group Global Business Overview



Established in 1961, John Wood Group PLC, "**Wood Group",** has grown to become the global market leader in engineering design, production support and industrial turbine services for customers in the **Power Generation** and **Oil & Gas** industries.

Wood Group's three core business groups actively operate in 50 countries and employ over 29,000 people worldwide.

Wood Group Global Business Overview

Wood Group – Three Core Business Groups

Engineering & Production Facilities

Engineering design, project & construction management, modifications, and operations & maintenance support for oil & gas customers

SYNERGIES
CLIENTS
GLOBAL OPERATIONS
INTEGRATED SERVICES
TECHNOLOGY & KNOW-HOW
PROJECT AND RISK MANAGEMENT SERVICES
PERFORMANCE CONTRACTING

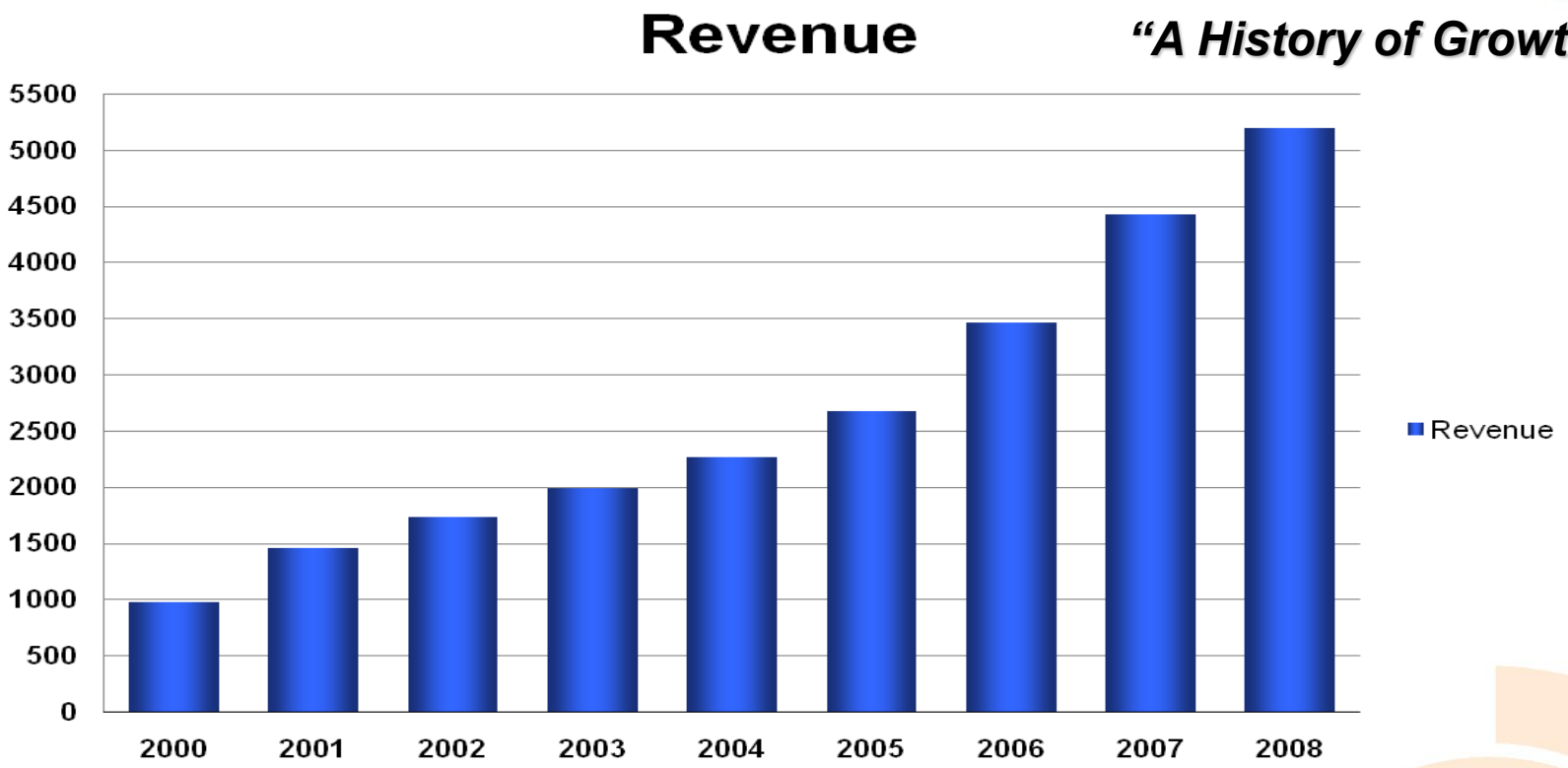
Well Support

Solutions, products & services to enhance production and recovery from oil & gas reservoirs

Gas Turbine Services (GTS)

Operations, maintenance, repair & overhaul services for gas, wind and steam turbines, generators, controls and other high-speed rotating equipment.

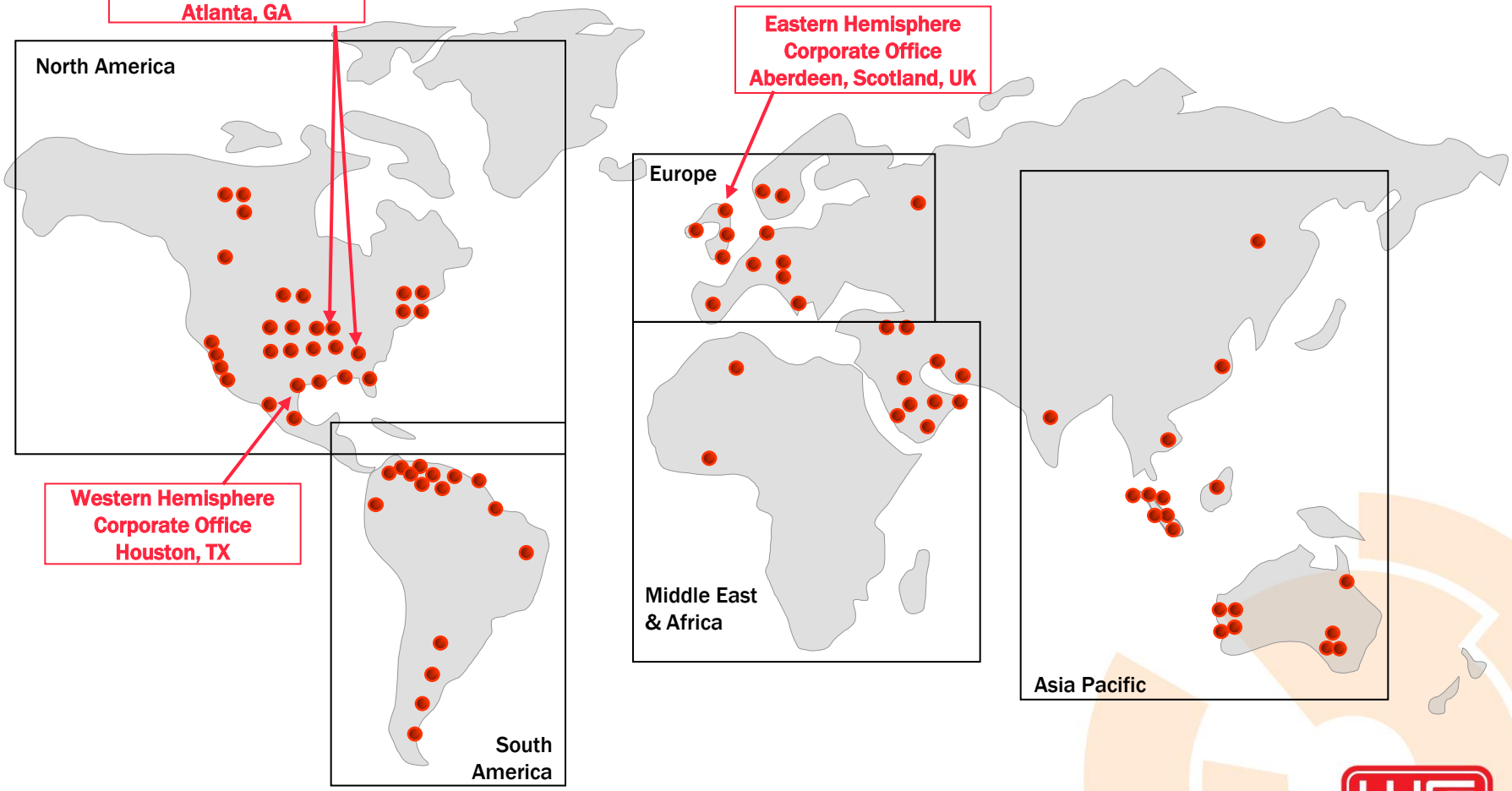
Wood Group – Financial Strength



2009 Highlights:
$4.9 Billion in Total Revenues (including share of JV Revenues)
$358 Million in EBITA

Wood Group Worldwide Service Support

Wood Group – Global Platform, Local Delivery



Wood Group GTS - Power Services

Wood Group GTS

Wood Group, through its' Gas Turbine Services (GTS) business, provides Complete Turnkey Solutions for the Operation and Maintenance of Power Plants that serve the global power generation and related markets

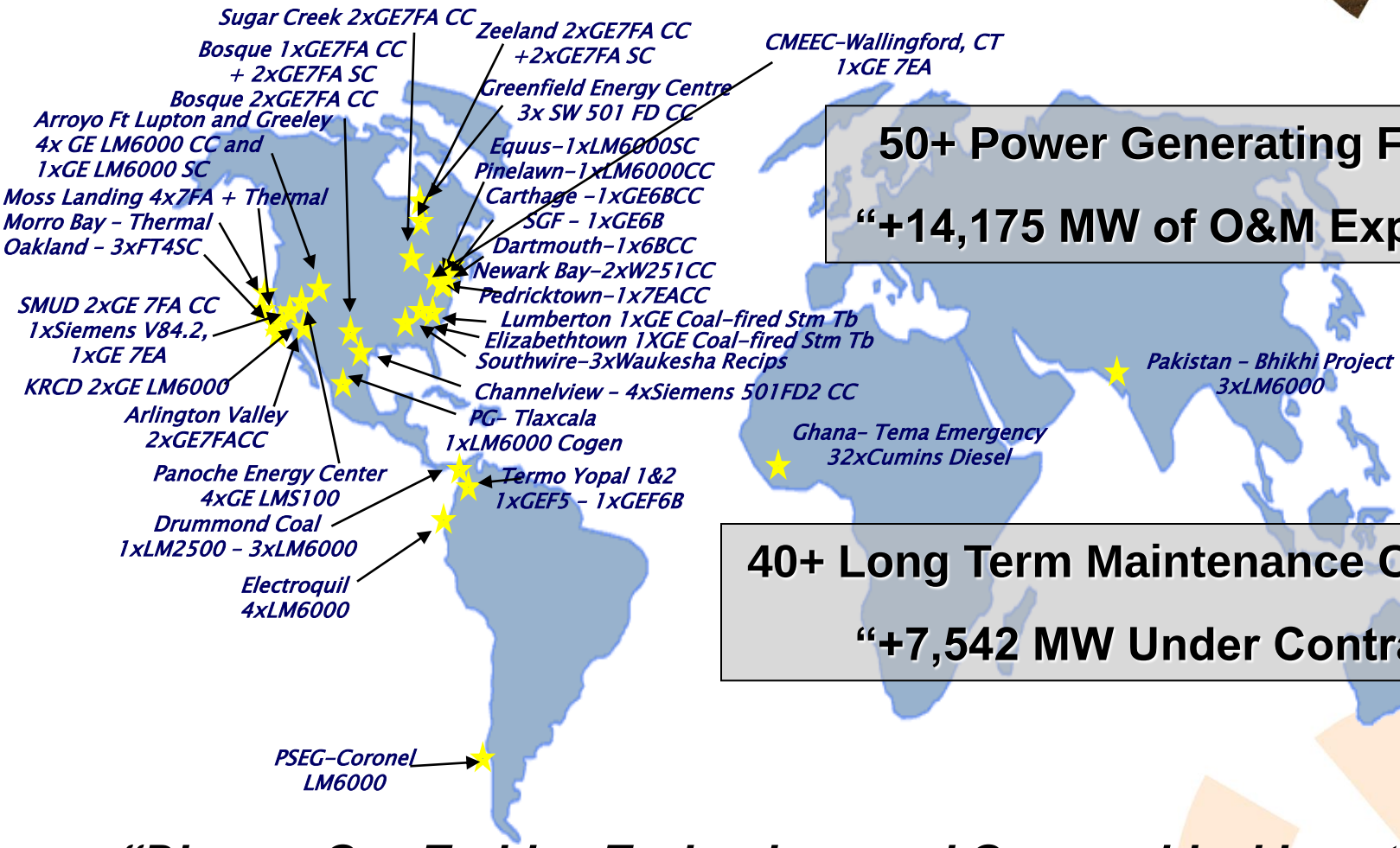
WG GTS is the Leading Independent Service Provider for:

- Industrial Gas, Wind and Steam Turbines
- Generators
- Controls
- Pumps, compressors, power turbines
- Industrial and aero gas turbine accessories and components

WG GTS Provides Contractual Solutions for:

- Power Plant Operations and Maintenance (O&M)
- Term Maintenance & Service Agreements
- EPC Services (engineering, procurement and construction)

Wood Group GTS
Contractual Service Asset Portfolio



50+ Power Generating Facilities

"+14,175 MW of O&M Experience"

40+ Long Term Maintenance Contracts

"+7,542 MW Under Contract"

"Diverse Gas Turbine Technology and Geographical Locations "

Wood Group GTS
Remote Monitoring & Diagnostics

Wood Group GTS Remote Monitoring & Diagnostics

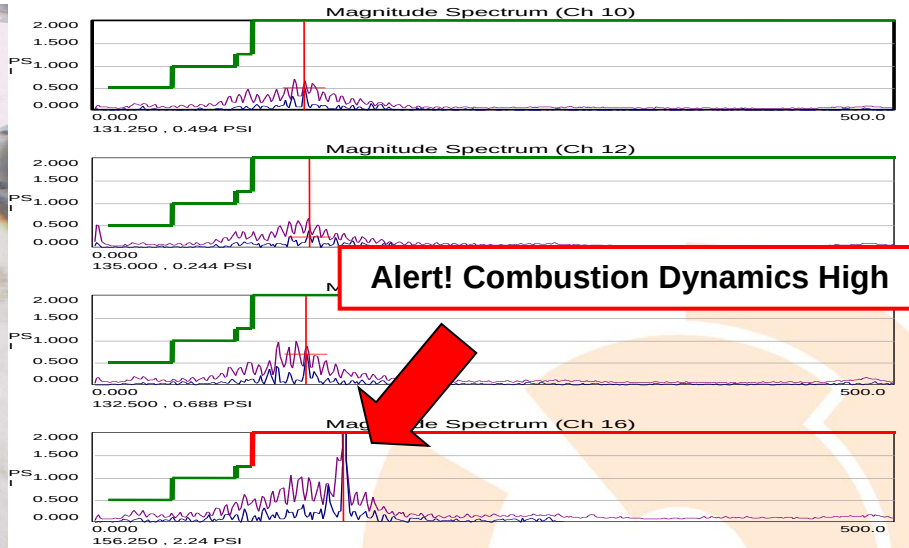
Leverage IT Technology to Provide World-Class Remote Engineering Service & Support

Allow Real-Time Wood Group Engineering Interface With Global Service Asset Fleet

Enhance All Wood Group GTS Contractual Service Offerings (O&M, LTSA)

Avoid This….

By Utilizing This!



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Remote Monitoring & Diagnostics

Primary RM&D Components

PI Infrastructure – On-Site
- PI Historian with robust process data set (i.e. interfaces to all relevant control systems)
- PI Interface Node Only for some applications (data buffering)
- Secure, Reliable Remote Access – WAN/LAN, VPN or similar network technology

PI Infrastructure – Wood Group Data Center
- Central PI Server – 50k Tags, Robust, Secure, Scalable
- Advanced Diagnostics Software Applications (ACE) – Calculations, Models, etc.
- Client Tools – Process Book, Datalink, Sharepoint Component Integration
- Automated Response Infrastructure – Alarms and Notifications

Response - Engineering / Subject Matter Expertise
- Data interpretation and contextualization – convert data into actionable recommendations
- Provides Critical Response Component
- Reporting & associated remote technical support

Staffing is Aligned Accordingly – Infrastructure/Applications, Gas Turbine Engineers

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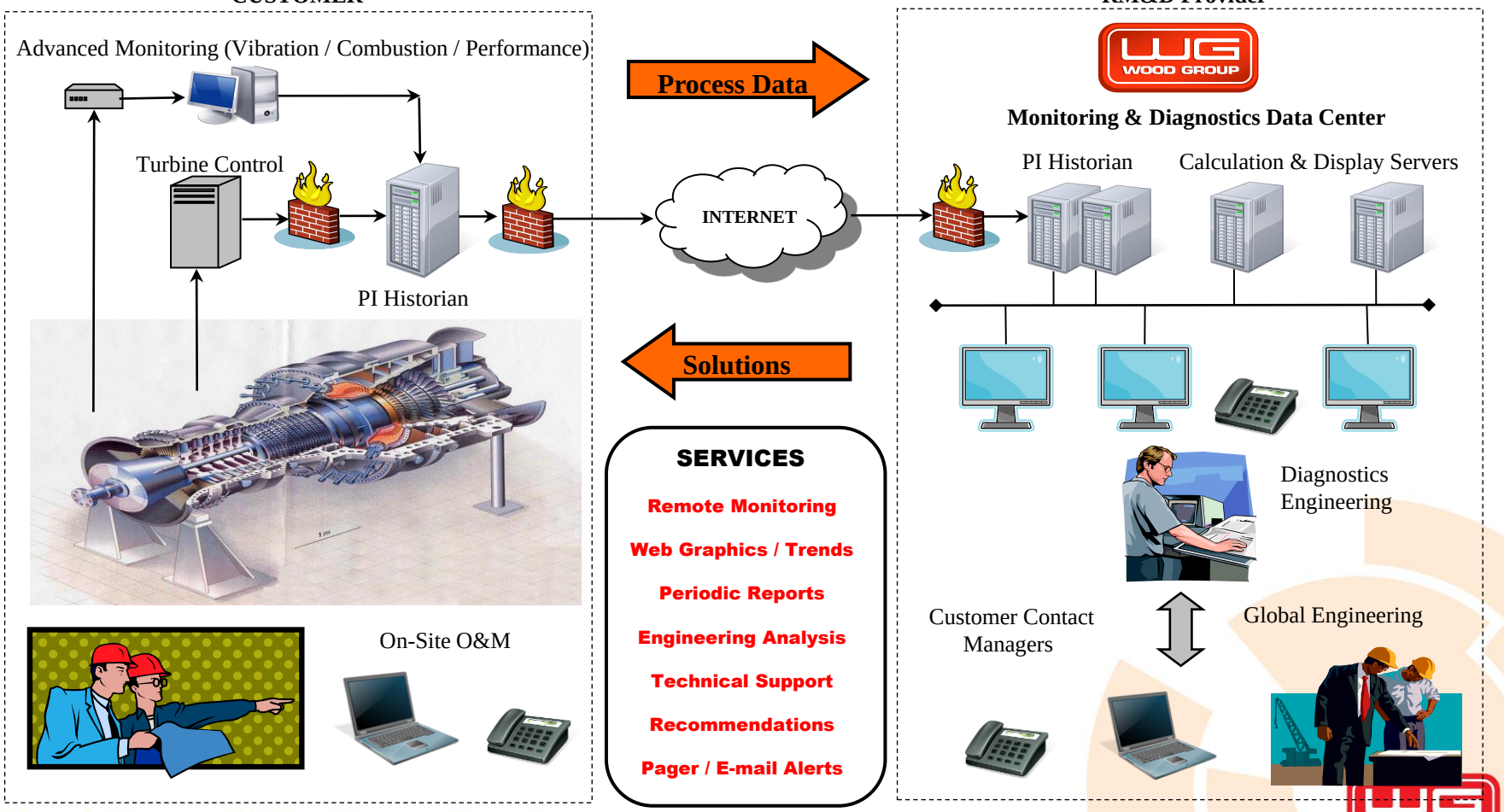
Remote Monitoring & Diagnostics

Wood Group GTS RM&D PI Infrastructure



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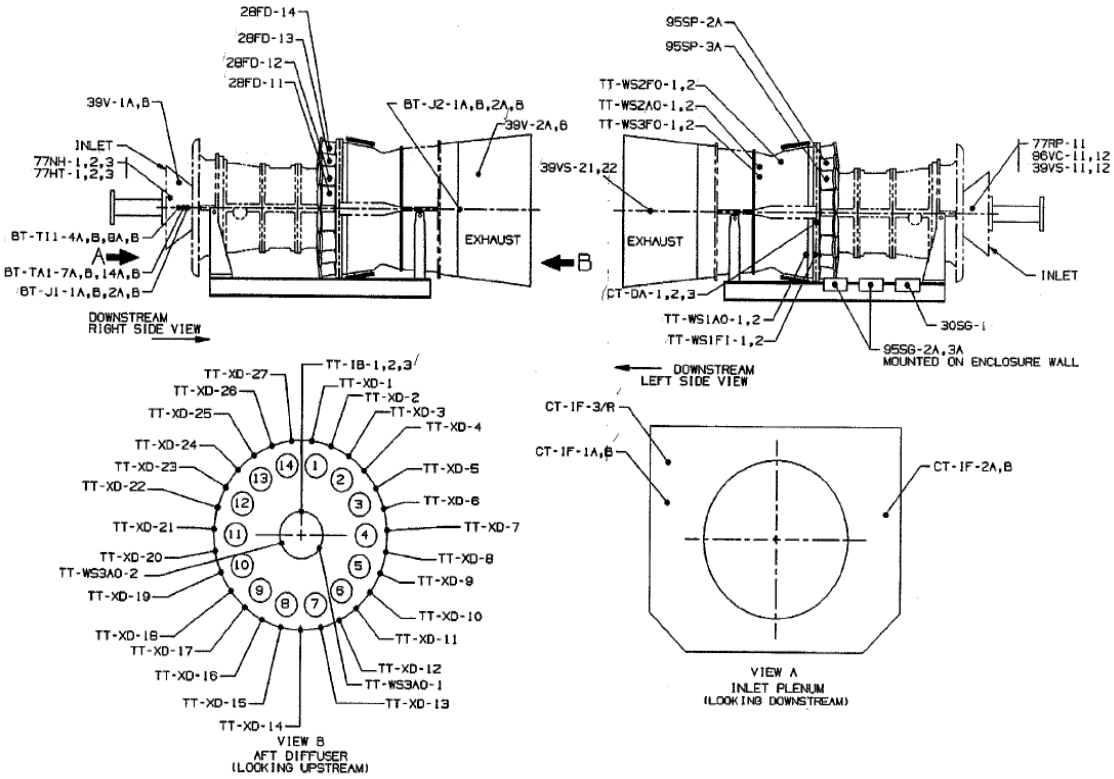
Gas Turbine – PI Interface



- OEM-Provided Gas Turbine Control System w/HMI(s)
- Various PI Interfaces Utilized including OPC
- 50-200 I/O Field Devices (On-Engine and Auxiliaries)
- 500-1,000 Control System Tags (Alarms, Calcs, Control Ref, etc.)
- 1K-2K tags per CTG Typical

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Remote Monitoring & Diagnostics

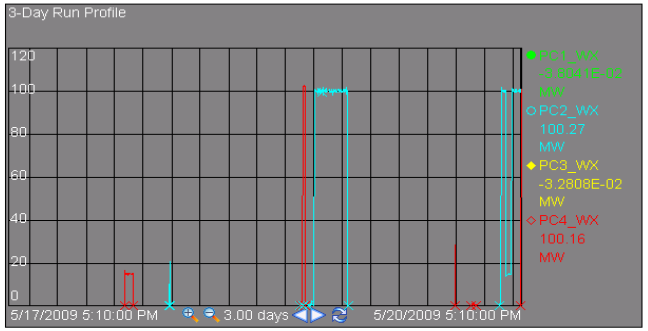
Gas Turbine Remote Monitoring – PI Client Applications

GE LMS100 provides the highest simple cycle efficiency in the industry today.

		Gross MW	Gross HR	GG RPM	PT RPM	Load Status	Regulator	Inlet Status
	CTG1	-0	Offline	0	0	Offline	Offline	Evaps Off
Fuel 1,722 MMBtu/h	CTG2	100	8,584	9,004	3,601	Part Load	NSD Spd/Ld	Evaps On
Gross 201 MW	CTG3	-0	Offline	0	0	Offline	Offline	Evaps Off
HR 8,628 Btu/kwh	CTG4	100	8,589	9,082	3,600	Part Load	NSD Spd/Ld	Evaps On

Site Time	5/20/2009 5:10:00 PM
Dry Bulb	88 Deg F
Barometer	29.56 in HG
Relative Humidity	Bad Input %

TURBINE SPEEDS	INST	CTG1	CTG2	CTG3	CTG4	UNITS
LP N44SEL	SE-8083	0	5,344	0	5,337	rpm
HP N25SEL	SE-8082	0	9,004	0	9,082	rpm
PT NSDSEL	SE-8013	0	3,601	0	3,600	rpm
FUEL & WATER						
Fuel Flow - Mass	FT-2000	0	39,234	0	39,121	lb/h
Fuel Manifold Temp SEL	TE-2059	83	120	78	110	Deg F
Fuel Manifold Press	PT-2028	0	625	-1	617	psig
Water Flow	FT-2003	0.0	42.8	0.0	42.7	gpm
Water Manifold Temp SEL	TE-2037	87	97	80	89	Deg F
Water Manifold Press	PT-2098	-1	448	-1	444	psig
VARIABLE GEOMETRY						
IGV Feedback SEL	ZE-8072	0.74	91.56	0.38	91.89	%
VBV1 Feedback SEL	ZE-9053	0.60	-0.08	1.12	-0.03	%
VBV2 Feedback SEL	ZE-9054	71.99	-0.02	0.70	0.10	%
VSV Feedback SEL	ZE-8073	1.20	81.27	0.84	80.67	%
TURBINE TEMPS						
Ambient Temp T0SEL	TE-4037	100	89	95	92	Deg F
LPC Inlet Temp T2SEL	TE-4078	90	64	86	65	Deg F
LPC Outlet Temp T23SEL	TE-8035	83	345	79	344	Deg F
HPC Inlet Temp T25SEL	TE-8036	87	80	85	86	Deg F
HPC Outlet Temp T3SEL	TE-8039	88	679	85	680	Deg F
PT Inlet Temp T48SEL	TE-8045	42	1,569	81	1,586	Deg F
T48 Inner Spread	B,D,F,H	-9,999	78	4	66	Deg F
T48 Outer Spread	A,C,E,G	5	27	6	45	Deg F
TURBINE PRESSURES						
Ambient Press P0SEL	PT-4080	14.5	14.5	14.5	14.5	psia
LPC Inlet Press P2SEL	PT-4079	14.5	14.4	14.5	14.3	psia
LPC Outlet Press P23SEL	PT-8068	14	57	14	58	psia
HPC Inlet Press P25SEL	PT-8059	14	54	14	55	psia
HPC Outlet Press PS3SEL	PT-8025	15	574	14	569	psia
PT Recoup X-Ovr PTBH1	PT-8086	14	321	14	288	psia
PT Recoup CDP PTBH2	PT-8087	15	123	14	142	psia
Combstr Acous 1 PX36A	PT-8090A	0.00	1.76	0.00	1.88	ppsid
Combstr Acous 2 PX36B	PT-8090B	0.00	1.71	0.00	1.82	ppsid
IPT Clg Mnfld Press PCLSEL	PT-8091	14	275	14	272	psia
IPT Bal Press PS46BPSEL	PT-8092	14	245	14	257	psia
PT Inlet Press P48	PT-8065	15	112	14	109	psia

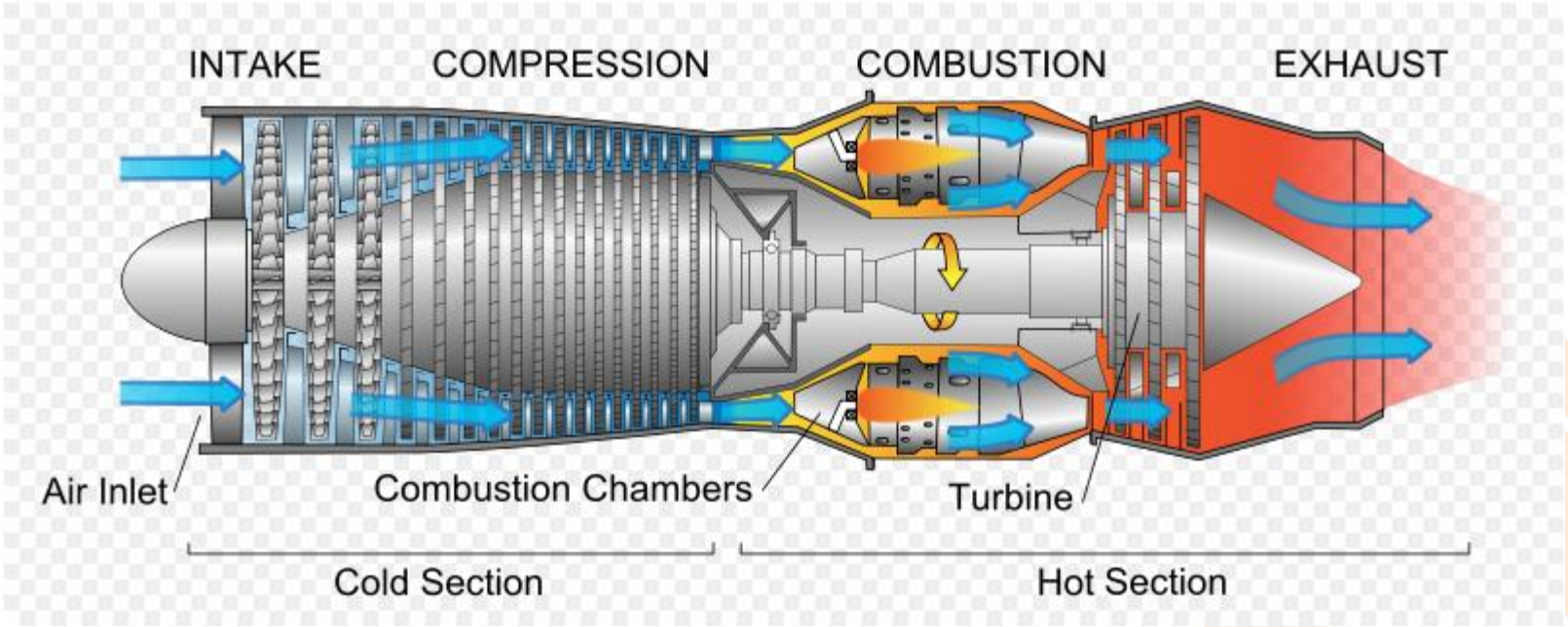


GENERATOR	INST	CTG1	CTG2	CTG3	CTG4	UNITS
Real Power	WX	-0.0	100.3	-0.0	100.2	MW
Reactive Power		0.00	-17.17	0.00	-8.15	KVAR
Power Factor		0.00	-0.99	0.00	-1.00	
Total Power		0.0	101.2	0.0	99.9	KVA
Bus Voltage	GVX	-0.0	140.2	0.6	144.2	KV
Bus Frequency	BFX	60.0	60.2	60.2	60.2	Hz
Gen Frequency		0.0	60.0	0.0	60.0	Hz
Phase Volt A-B		0	13,824	0	13,966	KV
Phase Volt B-C		0	13,864	0	14,019	KV
Phase Volt C-A		0	13,877	0	14,051	KV
Current Phase A		0	4,267	0	4,171	Amps
Current Phase B		0	4,172	0	4,073	Amps
Current Phase C		0	4,211	0	4,105	Amps

EMISSIONS	INST	CTG1	CTG2	CTG3	CTG4	UNITS
CT Exhst NOx	AT-99*01	-0.01	0.01	0.0	0.0	PPMVD
CT Exhst CO	AT-99*05	0.32	-0.21	0.17	0.02	PPMVD
CT Exhst O2	AT-99*03	20.95	20.93	20.96	20.97	%

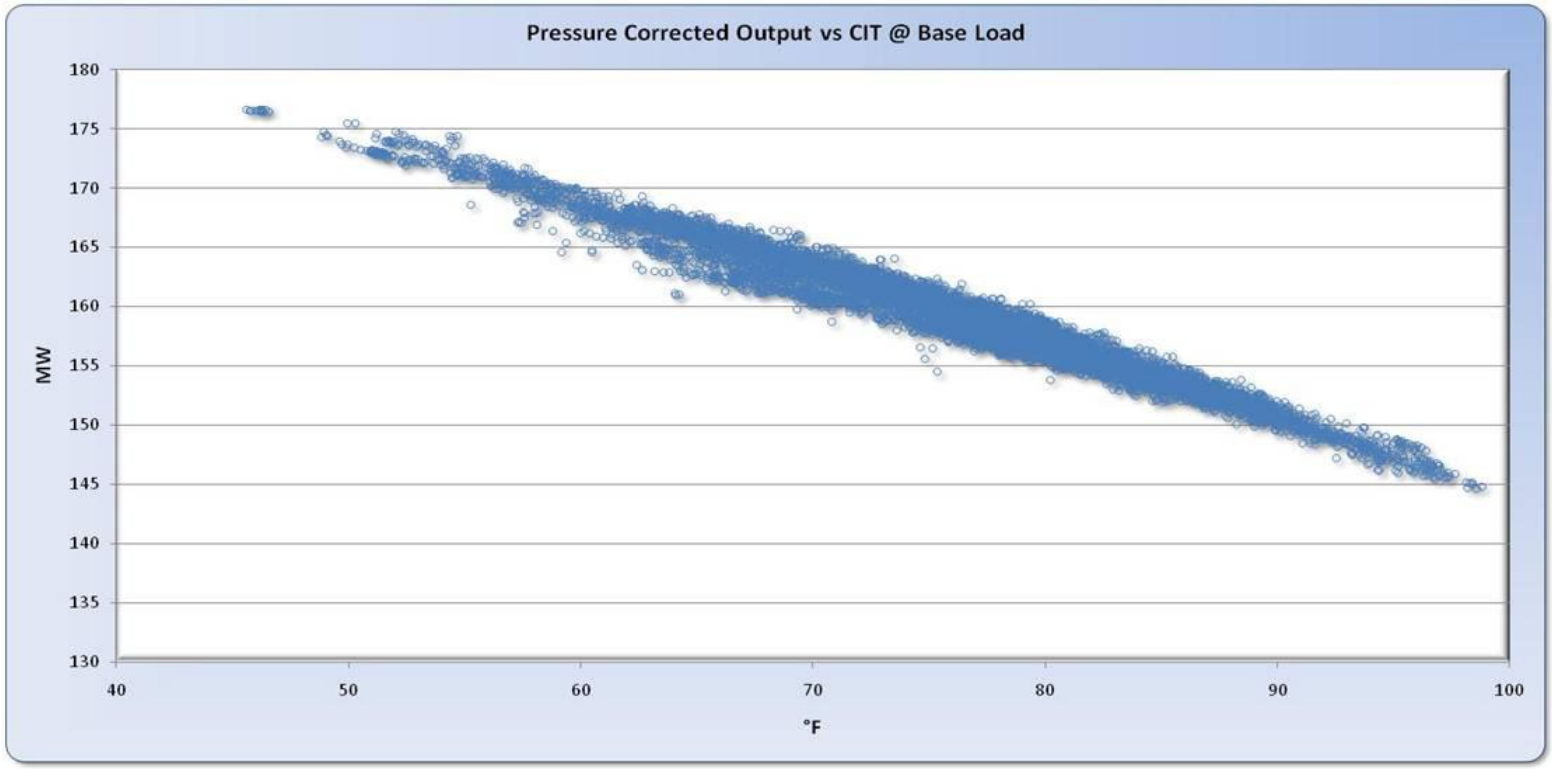
Gas Turbines Technology 101

- Thermodynamically Described by the Brayton Cycle
- Air is Compressed, Fuel is Added and Combustion Occurs, Hot Gas Expansion Over Turbine
- Higher Combustion Temperature = Increased Efficiency (Design Limitation)
- Of Total Fuel Energy Consumed: 1/3 Compression, 1/3 Texhst/Other Losses, 1/3 Power



Gas Turbines Technology 101

- Gas Turbine Performance is a function of Compressor Mass Flow
- Ambient Air Conditions (Air Density) Significantly Effects Maximum Gas Turbine Output
- F-Tech CTG: 30 MW Base Load Output Range Over 50 Deg F Inlet Temp Range



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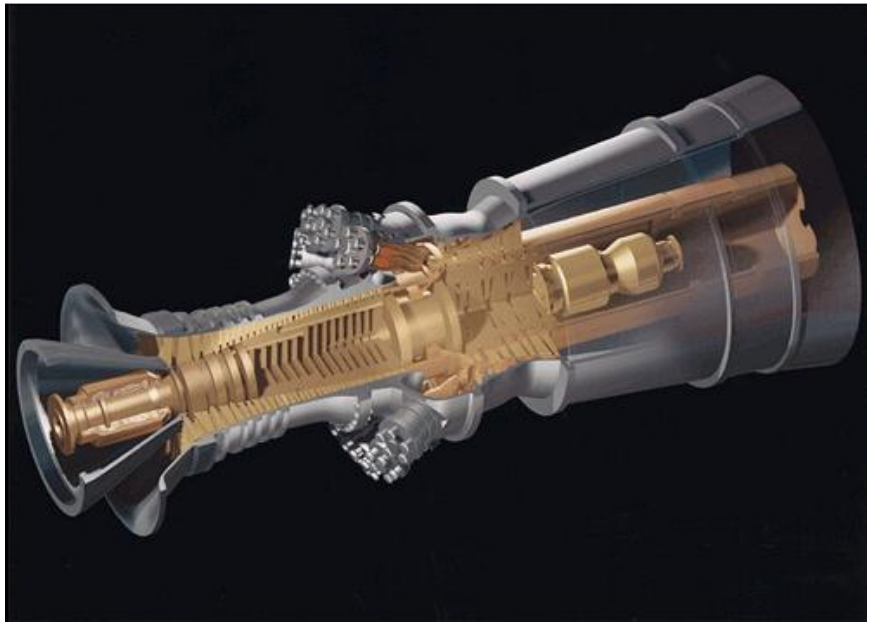
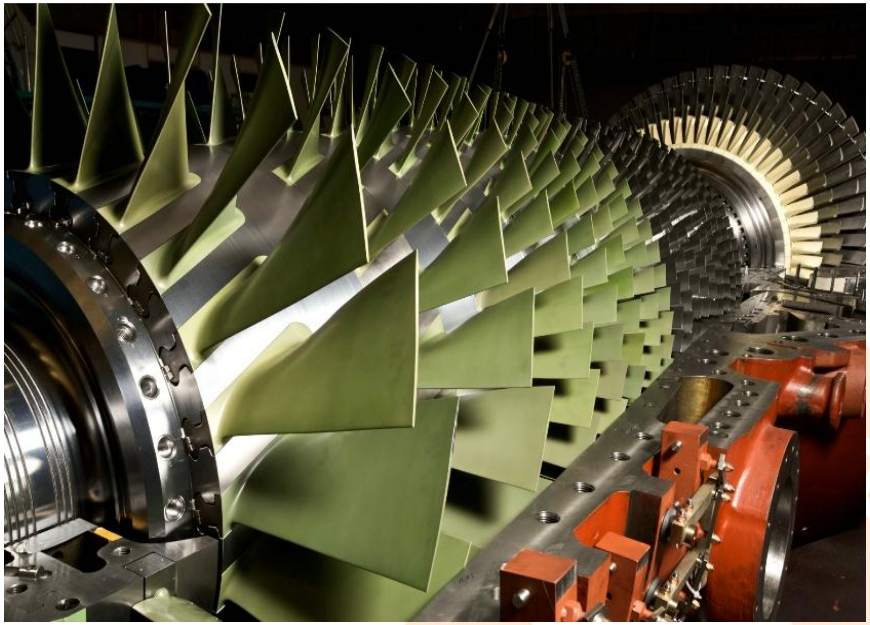
Gas Turbines Economics 101

Profitability is Dictated by CTG Efficiency (Heat Rate) and Availability (Max Run Time)

- Gas Turbine Drives a Generator (GTG, CTG)
- Operation Costs = Fuel + Maintenance
- Revenue = Electricity Generation MWh's





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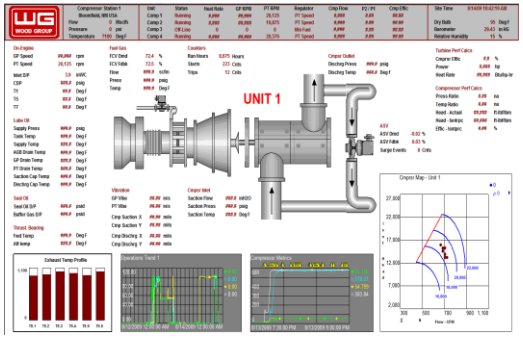
$ Wood Group RM&D PI Infrastructure Enables Increased Asset Profitability $

Thermal Performance Management
- Proactive Degradation Management
- Operation Optimization

Maintenance Optimization
- Condition Based Maintenance vs. Time/Hours Based Maintenance
- Proactive Maintenance Strategies vs. Reactive Maintenance Strategies
- Early Issue Detection - Minimize Forced Outages - Avoid Catastrophic Failures

Improved Resource Utilization
- Let computers collect, store, calculate and disseminate information – Not People



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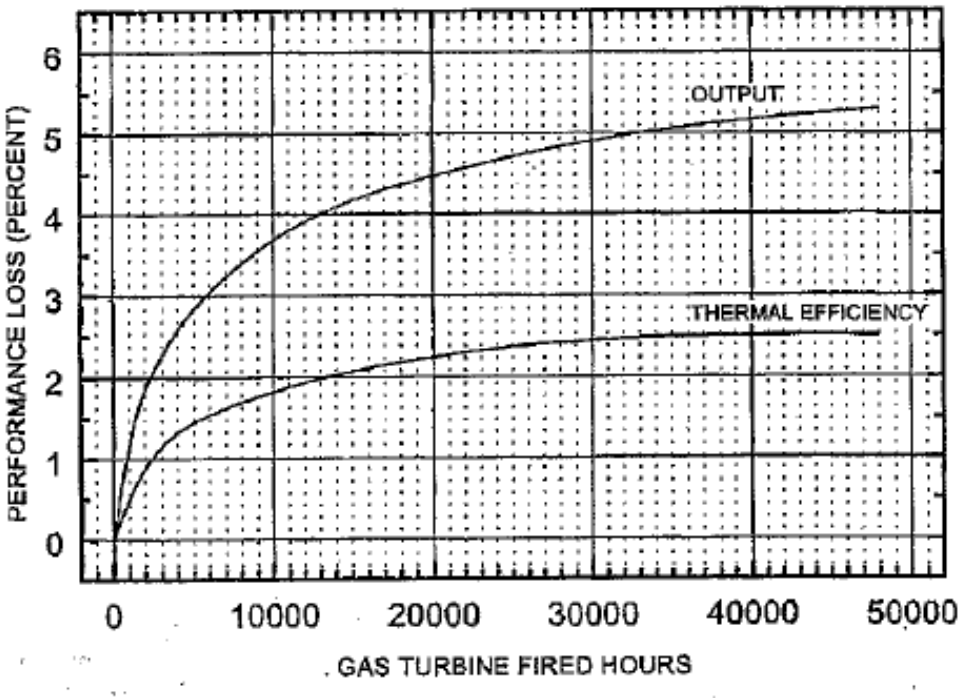
Case Study 1 – Degradation Management

Gas Turbine Degradation Management

How Much Does Naturally Occurring Gas Turbine Degradation Cost Me?



Recoverable Degradation May Occur Faster

- 1-3% of Base Load Capacity Annually
- 0.5% - 1.5% of Heat Rate Annually
- Single Unit CTG Only – Compounded for multi-unit or combined cycle plants

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Case Study 1 – Degradation Management

Gas Turbine Degradation Management

What Can I Do About It?

Quantify & Monitor Thermal Performance & Economics

- Thermal Performance Calculations
- Corrected Output, Corrected Heat Rate, Compressor Efficiency, Corrected CDP and Texhst
- Quantify the Economic Effects of Degraded Unit / Plant Performance
- Spark Spread = (Power Price – Fuel Cost) $ / Mwh

Proactively Address Degradation that is Negatively Effecting Asset Profitability

- Compressor Water Wash – On-Line vs. Off-Line
- Inlet Filter Replacement
- Proactive Maintenance
- Managed against lost production opportunity

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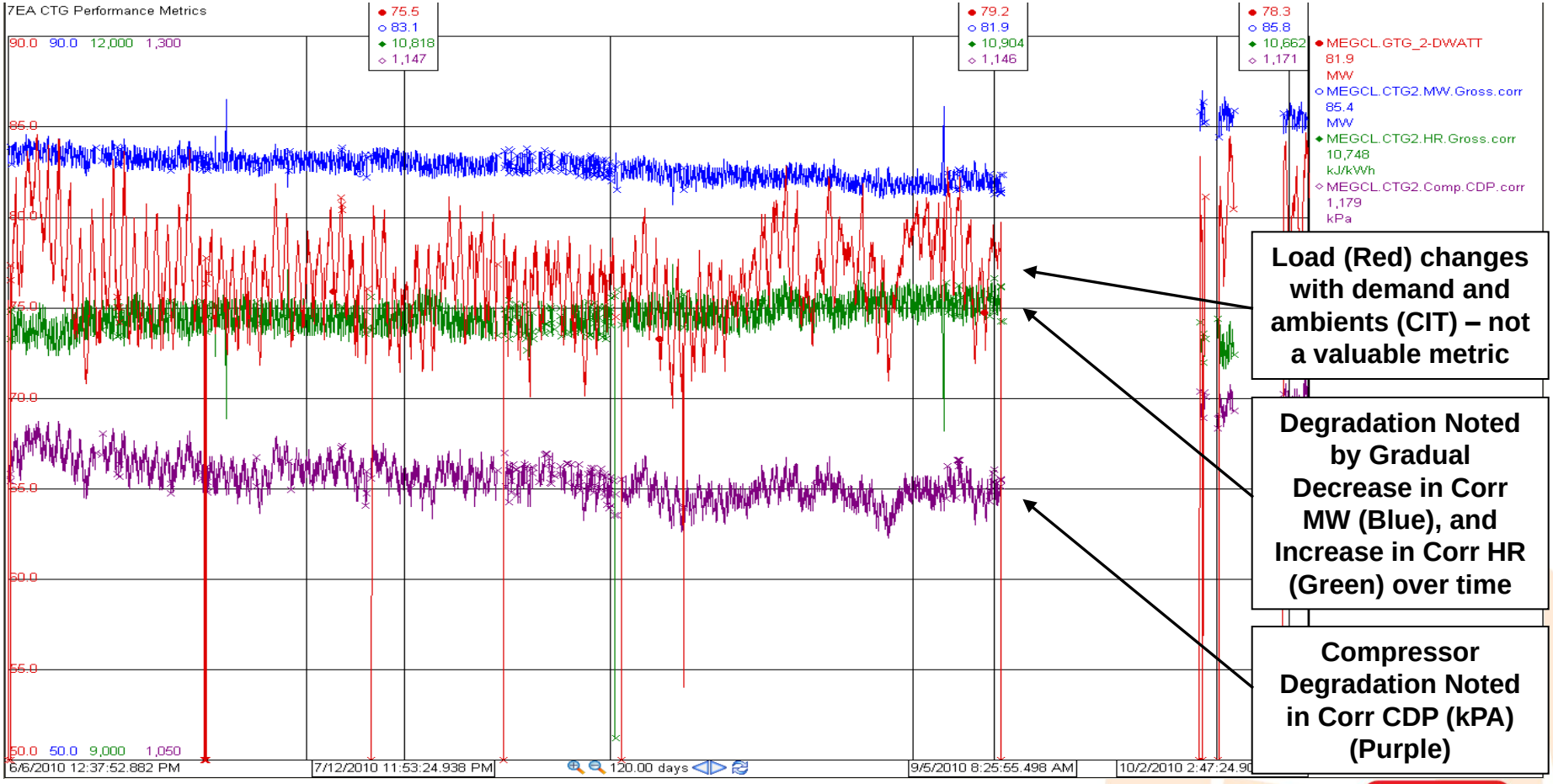
Case Study 1 – Degradation Management

Thermal Performance Metrics Utilized for Degradation Management



Load (Red) changes with demand and ambients (CIT) – not a valuable metric

Degradation Noted by Gradual Decrease in Corr MW (Blue), and Increase in Corr HR (Green) over time

Compressor Degradation Noted in Corr CDP (kPA) (Purple)

Wood Group GTS RM&D
Case Study 1 – Degradation Management

Gas Turbine Degradation Management

How Did My Scheduled Maintenance Effect Gas Turbine Performance?
What's the Economic Bottom Line?

Asset Configuration CT Technology	E-Tech CTG Pre-Outage	E-Tech CTG Post-Outage	
Assumptions	**Base Cogen**	**Base Cogen**	**Units**
Nominal Capacity	82.2	85.7	MW
Nominal Heat Rate (HHV)	10,879	10,692	Btu / kwh
Service Factor	95%	95%	%
Base Load Run Time %	90%	90%	%
Part Load Run Time %	10%	10%	%
Nominal Fuel Cost	$3.25	$3.25	$ / MMBtu
Nominal Power Price	$38.00	$38.00	$ / Mwh
Nominal Spark Spread	$2.64	$3.25	$ / Mwh
Avg Daily Mwh's	1,827	1,905	Mwh / Day
Avg Hourly Revenue	$201	$258	$ / Hour
Avg Daily Revenue	$4,830	$6,194	$ / Day

- **Output Increased 4.3%**
- **Heat Rate Decreased 1.7%**
- **$0.60 Increase in Spark Spread**
- **$1,364 / Day Increase in Revenue**
- **$42,000 / Month = $252,000 over 6 months**

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Case Study 2 – Dispatch Optimization

Combined Cycle Plant Modelling Utilized for Dispatch Optimization

PLANT CAPABILITY & INCREMENTAL HEAT RATE TABLE

Fuel Cost	**$3.30**	**USD**
Power Price	**$24.00**	**USD**
Duration	**8**	**hrs**

Assumptions:
Evap Effectiveness of 75%
Evaps ON at ambient temperatures >69°F

1) Choose # of CTGs in operation from drop-down list in cell D11
2) Choose desired ambient temperature from drop-down list in cell E11

Last Updated 4/272009

# GT's	Tamb (°F)	CT Percent Load (%)	Duct Fire Operation (Off, Available, Min, Mid, Max)	CIT (°F)	RH (%)	**Net Output (MW)**	Total FuelCons (MMBtu/h)	**Net Heat Rate (Btu/kWh - HHV)**	MW Increment (MW)	**Incremental HR (Btu/MWh - HHV)**	FUEL $	MW $	Cost	Revenue	**Spark Spread**
2	95	Part Load	Off	71	15	**264.0**	2109	**7,988**		**8.0**	$3.30	$24.00	$55,676	$50,688	**($4,988)**
2	95	Part Load	Off	71	15	**289.0**	2238	**7,742**	25	**5.1**	$3.30	$24.00	$59,070	$55,488	**($3,582)**
2	95	Part Load	Off	71	15	**314.0**	2372	**7,554**	25	**5.4**	$3.30	$24.00	$62,623	$60,288	**($2,336)**
2	95	Part Load	Off	71	15	**339.0**	2513	**7,412**	25	**5.6**	$3.30	$24.00	$66,335	$65,088	**($1,247)**
2	95	Part Load	Off	71	15	**364.0**	2659	**7,305**	25	**5.9**	$3.30	$24.00	$70,203	$69,888	**($315)**
2	95	Part Load	Off	71	15	**389.0**	2812	**7,228**	25	**6.1**	$3.30	$24.00	$74,227	$74,688	**$461**
2	95	Part Load	Off	71	15	**414.0**	2970	**7,174**	25	**6.3**	$3.30	$24.00	$78,405	$79,488	**$1,083**
2	95	Part Load	Off	71	15	**439.0**	3134	**7,139**	25	**6.6**	$3.30	$24.00	$82,736	$84,288	**$1,552**
2	95	Base	Off	71	15	**462.2**	3291	**7,121**	23	**6.8**	$3.30	$24.00	$86,885	$88,735	**$1,850**
2	95	Base	Available	71	15	**472.0**	3366	**7,131**	10	**7.6**	$3.30	$24.00	$88,859	$90,624	**$1,765**
2	95	Base	Available	71	15	**497.0**	3620	**7,283**	25	**10.1**	$3.30	$24.00	$95,555	$95,424	**($131)**
2	95	Base	Max	71	15	**522.0**	3872	**7,418**	25	**10.1**	$3.30	$24.00	$102,220	$100,221	**($1,999)**
2	90	Part Load	Off	67	15	**264.0**	2113	**8,004**		**8.0**	$3.30	$24.00	$55,782	$50,688	**($5,094)**
2	90	Part Load	Off	67	15	**289.0**	2242	**7,757**	25	**5.2**	$3.30	$24.00	$59,184	$55,488	**($3,696)**
2	90	Part Load	Off	67	15	**314.0**	2377	**7,569**	25	**5.4**	$3.30	$24.00	$62,745	$60,288	**($2,457)**
2	90	Part Load	Off	67	15	**339.0**	2518	**7,426**	25	**5.6**	$3.30	$24.00	$66,463	$65,088	**($1,375)**
2	90	Part Load	Off	67	15	**364.0**	2664	**7,320**	25	**5.9**	$3.30	$24.00	$70,339	$69,888	**($451)**
2	90	Part Load	Off	67	15	**389.0**	2817	**7,242**	25	**6.1**	$3.30	$24.00	$74,370	$74,688	**$319**
2	90	Part Load	Off	67	15	**414.0**	2976	**7,187**	25	**6.3**	$3.30	$24.00	$78,555	$79,488	**$933**
2	90	Part Load	Off	67	15	**439.0**	3140	**7,152**	25	**6.6**	$3.30	$24.00	$82,893	$84,288	**$1,395**
2	90	Part Load	Off	67	15	**464.0**	3310	**7,134**	25	**6.8**	$3.30	$24.00	$87,384	$89,088	**$1,704**
2	90	Base	Off	67	15	**466.4**	3327	**7,133**	2	**6.9**	$3.30	$24.00	$87,822	$89,547	**$1,726**
2	90	Base	Available	67	15	**476.0**	3399	**7,141**	10	**7.5**	$3.30	$24.00	$89,734	$91,392	**$1,658**
2	90	Base	Available	67	15	**501.0**	3653	**7,291**	25	**10.1**	$3.30	$24.00	$96,431	$96,192	**($239)**
2	90	Base	Max	67	15	**526.0**	3905	**7,425**	25	**10.1**	$3.30	$24.00	$103,100	$100,992	**($2,108)**

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Case Study 2 – Dispatch Optimization

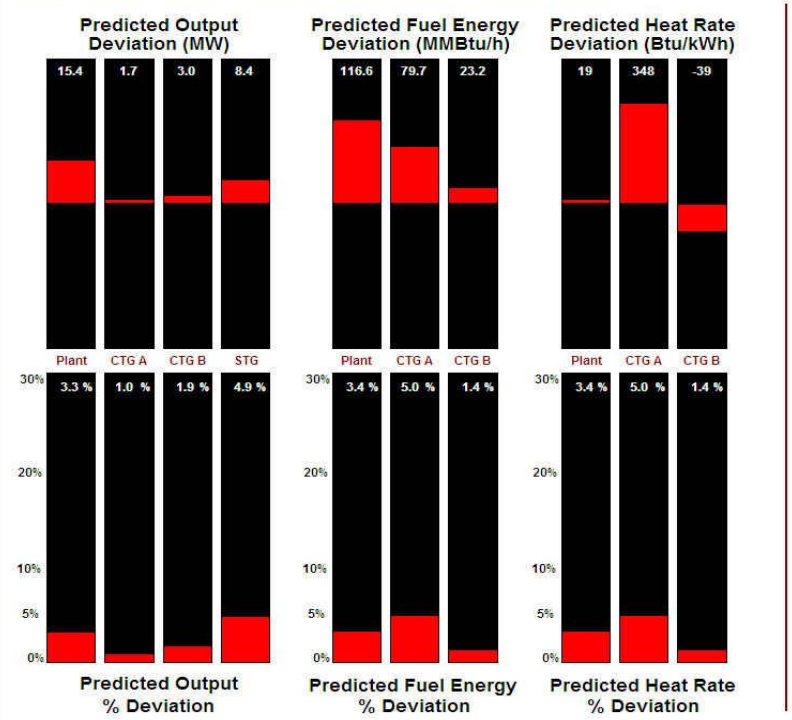
Plant Dispatch Models Derived from PI System Data - Recognized Savings of $50,000 / Month

474.2 MW
7,200 Btu/kwh
5/21/2009 3:36:51 PM

Unit	Gross Output	Heat Rate (HHV)	Load Indication	Configuration Status	Duct Burner Fuel Flow
CTG A	157.9 MW	9,960 Btu / kWh	Base Load	Evap On, Pag Off, DB On	96 MMBtu / h
CTG B	157.5 MW	10,395 Btu / kWh	Base Load	Evap On, Pag Off, DB On	96 MMBtu / h
STG	173.8 MW		Steady State		

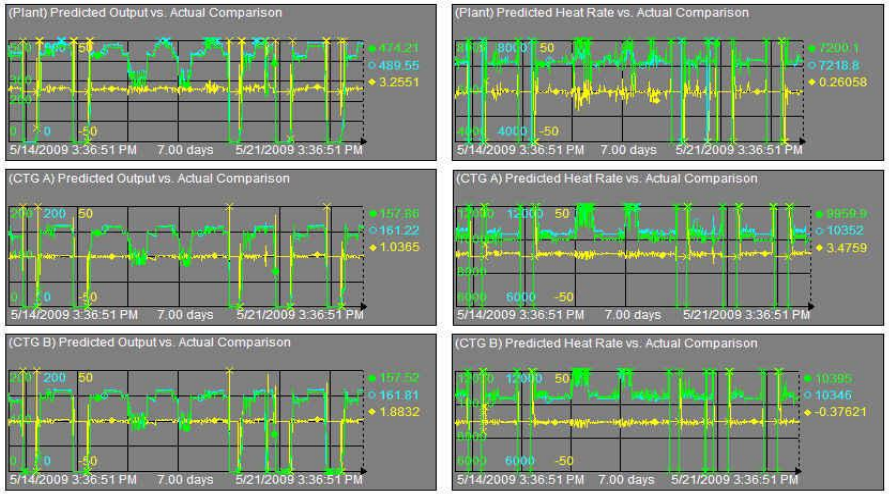
Dry Bulb	92	Deg F	
Wet Bulb	61	Deg F	
Dew Point	53	Deg F	
Rel Hum	16	%	
Bar Press	27.13	inHGA	

Plant | CTG | HRSG | STG | ACC | Power | Fuel | xls



Predictive Model Performance

MDS Model Comparisons	Plant	CTG A	CTG B	STG	Units
Predicted Fuel Gas Flow - energy	3,535	1,668	1,675		MMBtu / h
Fuel Gas Flow Deviation	117	80	23		MMBtu / h
Fuel Gas Flow % Deviation	3.4	5.0	1.4		%
Predicted Output	489.5	161.2	161.8	181.0	MW
Output Deviation	15.4	1.7	3.0	8.4	MW
Output % Deviation	3.3	1.0	1.9	4.9	%
Predicted Heat Rate	7,219	10,352	10,346		Btu / kWh
Heat Rate Deviation	19	348	-39		Btu / kWh
Heat Rate % Deviation	0.3	3.5	-0.4		%

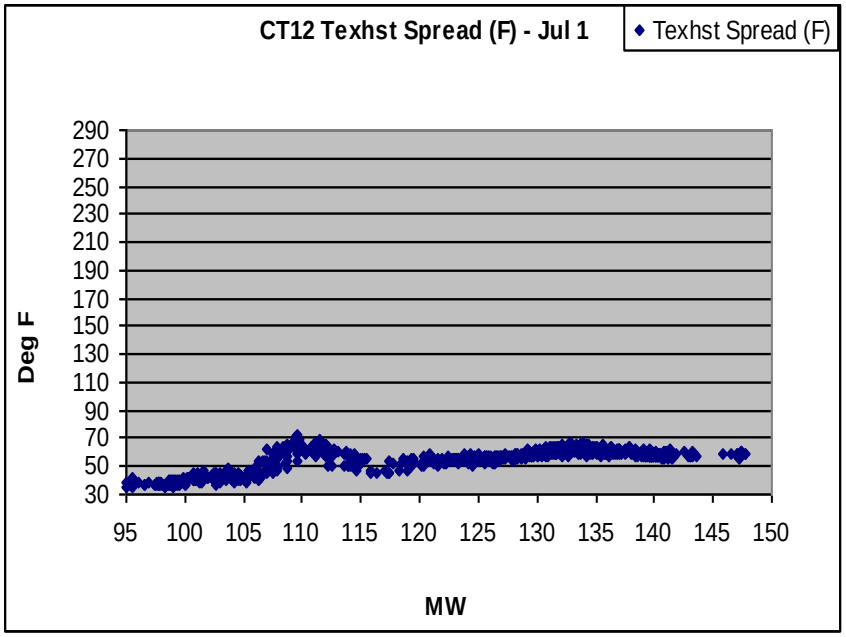


Wood Group GTS RM&D
Case Study 3 – Maintenance Optimization

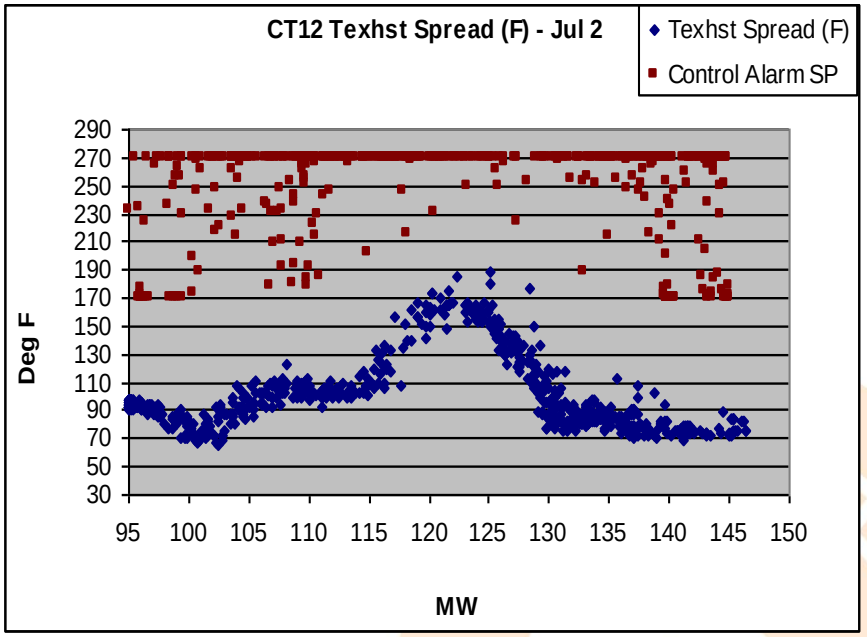
PI ACE Utilized for Early Identification of Component Failure

Unit Cycled July 1 - July 2. Noted Step Change in Texhst Spread +100F

July 1 - Load vs. Texhst Spread

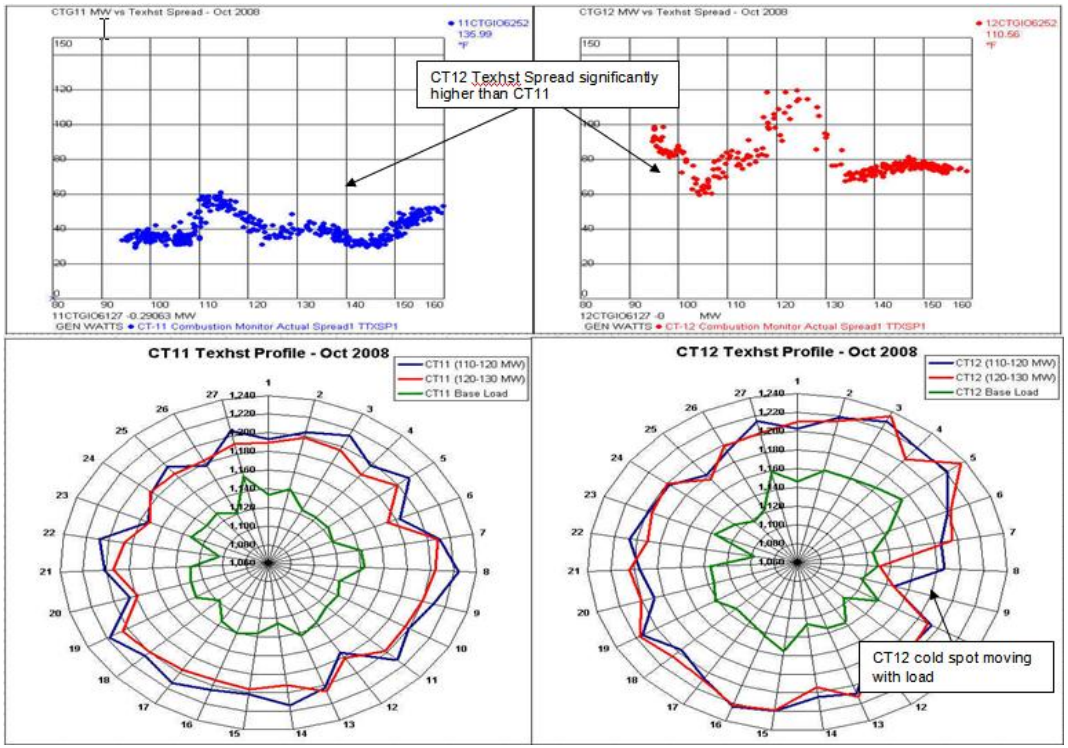


July 2 - Load vs. Texhst Spread



Wood Group GTS RM&D
Case Study 3 – Maintenance Optimization

$10k / Month of Additional NH3 Injection – Avoided Forced Outage



Damaged Cross-Fire Tube

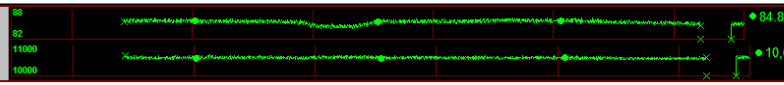
Unseated Transition Piece Floating Seal

Thank You ! Questions ?

WOOD GROUP

7EA Sample Display
12/6/2009 2:00:00 PM
Load Indication
Base Load

Gross Output
96.3 MW
Heat Rate (LHV)
10,288 kJ/kWh



Total Starts	36 Counts
Fired Hours	1,449 Hours
Peak Fired Hrs	0 Hours
Emergency Trips	13 Counts

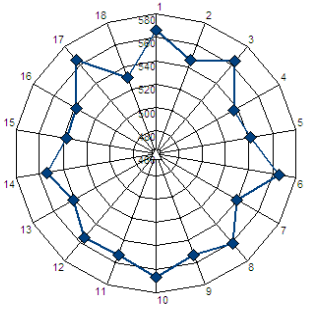
CTG Summary | CTG Alarms | CT Other | Generator

CTG Performance Summary

Measured Parameter			Units
Load	DWATT	96.3	MW
Load Ref - MK V	L90PSEL	85.0	MW
FSR Load	FSRN	88.5	%
FSR Temp	FSRT	84.2	%
Turbine Speed	TNH_RPM	3,600	rpm
Fuel Gas Flow	FQG	6.0	kg/s
Fuel Gas Temp	FTG	44.4	Deg C
Fuel Gas Pressure	FPG1	2,455	kPa
Inlet DP	AFPCS	56.7	mmWC
Cmprsr Inlet Pressure	AFPAP	968	mbar
Cmprsr Inlet Temp Max	CTIM	-15.8	Deg C
Cmprsr Inlet Specific Hum	CMHUM	0.60	g/kg
Cmprsr Inlet Dew Point	ITDP	2253.27	Deg C
IGV Postion	CSGV	84.0	DegA
IGV Ref	CSRGV	84.0	DegA
IBH Valve Position	CSBHX	7.7	%
IBH Valve Ref	CSRIH	0.0	%
IBH % Cmp Flow Dmd	CSRBH	255.0	%
Bleed Heat Enabled	L69BHEN	On	
DLN Bleed Heat Enabled	L83BHEN	On	
Cmprsr Discharge Press	CPD	1,250	kPa
Cmprsr Pressure Ratio	CPR	14.0	n/a
Cmprsr Discharge Temp	CTDA	319	Deg C
Exhaust Temp Median	TTXM	524	Deg C
Exhaust Temp Ref	TTRX	524	Deg C
Combustor Spread 1	TTXSP1	25	Deg C
Combustor Spread 2	TTXSP2	19	Deg C
Combustor Spread 3	TTXSP3	17	Deg C
Allowable Temp Spread	TTXSPL	51	Deg C
Exhaust DP	AFPEP	297.0	mmWC
Fuel System			
Fuel Gas Intrstg Press	FPG2	2,139	kPA
Fuel Gas SRV Press Ref	FPRG	2,142	kPA
SRV Feedback	FSGR	51.87	%
Primary CV Feedback	FSGP	77.10	%
Secondary CV Feedback	FSGS	41.56	%
% Fuel to Primary Nozzles	FSRXS	81.75	%
Fuel Split - % to Prim	FSRXSR	81.75	%
Fuel Transfer Setpoint	FSRXT	0.00	%
Fuel Transfer Dmd	FSRXTL	0.00	%

Calculated Performance		Units
Fuel Gas Flow - mass	21,495	kg/h
Fuel Gas Flow - volume	29,235	Nm3/h
Fuel Gas Flow - energy	991	GJ/h
Gross Heat Rate - LHV	10,288	kJ/kWh
Compressor Pressure Ratio	14.0	n/a
Compressor Efficiency	86.4	%
Compressor Temp Delta	334	Deg C
Compressor Disch Pressure Corr	1168.2	kPa
Corrected Output	84.9	MW
Corrected Heat Rate	10,600	kJ/kWh
Corrected Exhaust Temp	545	Deg C
Predicted Fuel Gas Flow - Energy	979	GJ/h
Fuel Gas Flow Deviation	12	GJ/h
Fuel Gas Flow % Deviation	1.2	%
Exhaust Temp Deviation	-0.2	Deg C
Comb Spread 1 Deviation	-2.0	Deg C
Comb Spread 2 Deviation	-8.3	Deg C
Comb Spread 3 Deviation	-9.6	Deg C

Exhaust Temp Profile



Measured Parameter			Units
Vibration			
Max Vibration	BB Max	153	mm/s
Turb Brg #1A - Vibration	BB1	55	mm/s
Turb Brg #1B - Vibration	BB2	62	mm/s
Turb Brg #2 - Vibration	BB3	154	mm/s
Turb Brg #3A - Vibration	BB4	127	mm/s
Turb Brg #3B - Vibration	BB5	132	mm/s
Gen Brg #4A - Vibration	BB10	43	mm/s
Gen Brg #4B - Vibration	BB11	40	mm/s
Gen Brg #5 - Vibration	BB12	136	mm/s
Bearing Metal & Oil Temps			
Turb Brg 1-1 - Mtl Temp	BTJ1-1	86	Deg C
Turb Brg 1-2 - Mtl Temp	BTJ1-2	85	Deg C
Turb Brg #1 - Drain Temp	LTB1D	62	Deg C
Turb Brg 2-1 - Mtl Temp	BTJ2-1	87	Deg C
Turb Brg 2-2 - Mtl Temp	BTJ2-2	83	Deg C
Turb Brg #2 - Drain Temp	LTB2D	76	Deg C
Turb Brg 3-1 - Mtl Temp	BTJ3-1	77	Deg C
Turb Brg 3-2 - Mtl Temp	BTJ3-2	112	Deg C
Turb Brg #3 - Drain Temp	LTB3D	69	Deg C
Gen Brg 1-1 - Mtl Temp	BTGJ1-1	80	Deg C
Gen Brg 1-2 - Mtl Temp	BTGJ1-2	79	Deg C
Gen Brg #1 - Drain Temp	LTG1D	79	Deg C
Gen Brg 2-1 - Mtl Temp	BTGJ2-1	81	Deg C
Gen Brg 2-2 - Mtl Temp	BTGJ2-2	99	Deg C
Gen Brg #2 - Drain Temp	LTG2D	79	Deg C
Thrust Brg 1-1 - Active Side	BTTA1_1	71	Deg C
Thrust Brg 1-2 - Active Side	BTTA1_2	74	Deg C
Thrust Brg 2-1 - Inactive Side	BTTI1_1	65	Deg C
Thrust Brg 2-2 - Inactive Side	BTTI1_2	64	Deg C
Bearing Oil Supply Temp	LTTH1	55	Deg C
Generator - Mechanical			
DTGSF1	DTGSF1	90	Deg C
DTGSF2	DTGSF2	91	Deg C
DTGSF3	DTGSF3	91	Deg C
DTGSA4	DTGSA4	90	Deg C
DTGSA5	DTGSA5	90	Deg C
DTGSA6	DTGSA6	90	Deg C
DTGGC10	DTGGC10	40	Deg C
DTGGC11	DTGGC11	39	Deg C
DTGGH18	DTGGH18	70	Deg C
DTGGH19	DTGGH19	69	Deg C

Measured Parameter			Units
Cmprsr Discharge Temp1	CTDA1	319	Deg C
Cmprsr Discharge Temp2	CTDA2	317	Deg C
Cmprsr Discharge Temp3	CTDA3	319	Deg C
Whlspc Stg 1 Fwd Inner 1	TTWS1FI1	353	Deg C
Whlspc Stg 1 Fwd Inner 2	TTWS1FI2	353	Deg C
Whlspc Stg 1 Aft Outer 1	TTWS1AO1	407	Deg C
Whlspc Stg 1 Aft Outer 2	TTWS1AO2	403	Deg C
Whlspc Stg 2 Fwd Outer 1	TTWS2FO1	390	Deg C
Whlspc Stg 2 Fwd Outer2	TTWS2FO2	391	Deg C
Whlspc Stg 2 Aft Outer 1	TTWS2AO1	353	Deg C
Whlspc Stg 2 Aft Outer 2	TTWS2AO2	349	Deg C
Whlspc Stg 3 Fwd Outer 1	TTWS3FO1	391	Deg C
Whlspc Stg 3 Fwd Outer2	TTWS3FO2	397	Deg C
Whlspc Stg 3 Aft Outer 1	TTWS3AO1	232	Deg C
Whlspc Stg 3 Aft Outer 2	TTWS3AO2	220	Deg C
Inner Barrel Temp	TTIB1	176	Deg C
Exhaust Temp 1	TTXD1_1	521	Deg C
Exhaust Temp 2	TTXD1_2	534	Deg C
Exhaust Temp 3	TTXD1_3	520	Deg C
Exhaust Temp 4	TTXD1_4	549	Deg C
Exhaust Temp 5	TTXD1_5	509	Deg C
Exhaust Temp 6	TTXD1_6	525	Deg C
Exhaust Temp 7	TTXD1_7	536	Deg C
Exhaust Temp 8	TTXD1_8	510	Deg C
Exhaust Temp 9	TTXD1_9	544	Deg C
Exhaust Temp 10	TTXD1_10	516	Deg C
Exhaust Temp 11	TTXD1_11	522	Deg C
Exhaust Temp 12	TTXD1_12	534	Deg C
Exhaust Temp 13	TTXD1_13	522	Deg C
Exhaust Temp 14	TTXD1_14	502	Deg C
Exhaust Temp 15	TTXD1_15	533	Deg C
Exhaust Temp 16	TTXD1_16	508	Deg C
Exhaust Temp 17	TTXD1_17	528	Deg C
Exhaust Temp 18	TTXD1_18	524	Deg C
Flame Detectors			
Flame - Ch 1	L28FDA	Off	
Flame - Ch 2	L28FDB	Off	
Flame - Ch 3	L28FDC	Off	
Flame - Ch 4	L28FDD	Off	
Flame - Ch 5	L28FDE	On	
Flame - Ch 6	L28FDF	On	
Flame - Ch 7	L28FDG	On	
Flame - Ch 8	L28FDH	On	