



# **ORAP® – A Reliability Monitoring System**

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# What I've Seen, Heard, Observed...

- Global Wind Market is Exciting...**High Expectations**
  - Expansion and growth
  - Technology improvement opportunities
  - Generation mix...**A Real Alternative**
- Reliability is an **Important Issue**
  - Performance relative to pro-forma expectations...ROI
  - Design issues vs. O&M experience...**Field Knowledge & Expertise**
  - Uniform performance metrics
- Young but Rapidly Maturing Industry
  - However, **infrastructure exists for value and payback**



# Who is SPS?

- Reliability Engineering and Information Technology Company
  - Initiated to meet industry need
  - Compile RAM data from global power plants through ORAP®
- Focus...
  - Gas and steam turbine plants
    - Power generation
    - Oil and gas
    - Mechanical drive
- Industry Methodology
  - Common coding structure (EBS & KKS)...**taxonomy to a component level**
  - IEEE and ISO standards
  - NERC and WEC compliant
  - Strong support from EPRI and DOE

***Applicable to Wind???***



# What is ORAP?

- RAM Database
  - All OEM gas and steam turbines
  - Simple and combined cycle
  - All applications
  - Duty cycles
- Benchmarking
  - **Your unit vs. the Fleet and best in class**
  - **Market comparisons**
- **Close Relationship With OEMs & Operators**
  - ORAP supports design improvement and enhanced O&M practices
- Open Minded...Unbiased

***Applicable to Wind???***

# So...is ORAP Applicable?



## Key Features

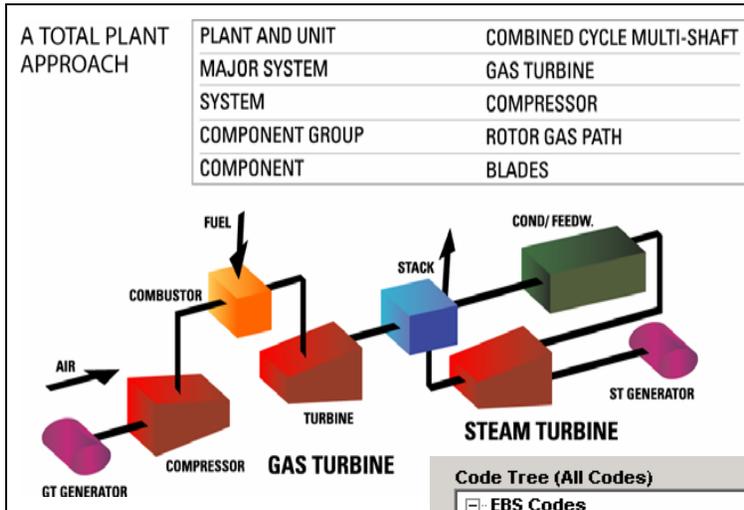
- Taxonomy...Component Level Detail
- Operating Data
  - Service Hours, MWH, Counters, Life Time Parameters, Starts, Reserve Hours, etc...
- Event Data
  - Forced Outages, Maintenance (Scheduled & Unscheduled) Outages, Concurrent Maintenance, Deratings, etc...
- Performance Data
  - Fuel (Wind), Energy...Efficiency

## Wind



***Standard Methodology***

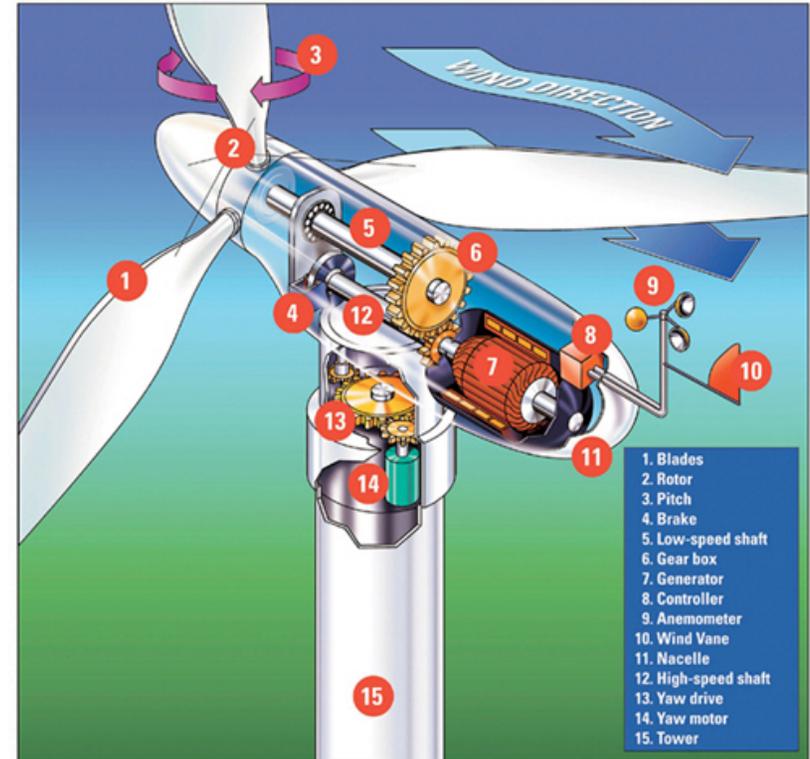
# The Taxonomy is the Key for ORAP<sup>®</sup>



In Place

Code Tree (All Codes)

- [-] EBS Codes
  - [-] Aero Engine (GG)
    - [+] Accessory Drive (GGAD)
    - [+] Bearings (GGBR)
    - [+] Combustion (GGCB)
    - [+] Cooling/Extraction Air (GGCA)
    - [+] Gas Fuel (GGGF)
    - [-] High Pressure Compressor (GGCH)
      - [+] Casing - HPC (GGCHCS)
      - [+] Ducts - HPC (GGCHDU)
      - [+] Inspections-HPC (GGCHIN)
      - [+] Instrumentation - HPC (GGCHIC)
      - [+] Rotor - HPC (GGCHRO)
      - [-] Rotor Gas Path - HPC (GGCHRG)
        - Blade Locks and Retainers (GGCHRG031)
        - Compressor Rotor Blades - 10th Stage (GGCHRG032)
        - Compressor Rotor Blades - 11th Stage (GGCHRG033)
        - Compressor Rotor Blades - 12th Stage (GGCHRG034)
        - Compressor Rotor Blades - 13th Stage (GGCHRG035)
        - Compressor Rotor Blades - 14th Stage (GGCHRG036)
        - Compressor Rotor Blades - 15th Stage (GGCHRG037)
        - Compressor Rotor Blades - 16th Stage (GGCHRG038)
        - Compressor Rotor Blades - 1st Stage (GGCHRG039)
        - Compressor Rotor Blades - 2nd Stage (GGCHRG040)



Easily Applied



# So...is ORAP Applicable?

## Key Features

- Taxonomy...Component Level Detail
- Operating Data
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  - Fuel (Wind), Energy...Efficiency

Wind



**Yes... ORAP is Applicable**

# So...is ORAP Applicable?

- For Example...Two 400 MW Plants

## Combined Cycle Plant



## Wind Farm



***And the Technology Exists to  
Capture Data at the “Right” Level***



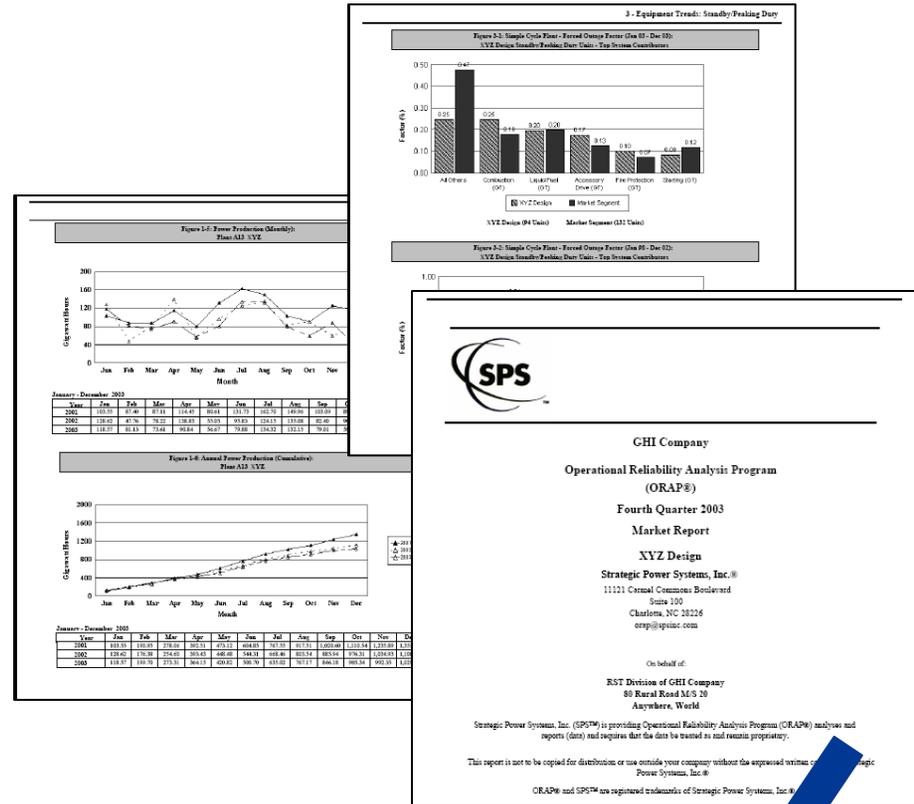
# We Believe ORAP is Applicable

- As an example...

E	F	G	H	I	J	K	L	M	N
Component	EBS Code	Mean Failure Rate per Unavail	90% Upper Chng FR	Number of Failures in Data Set	Data Set Total Fired hrs	Number of Parts Assumed per	Mean Time To Repair	Total Repair Time Hours	Std Dev Repair Time Hours
NULL	GGAD	0.33	1.28	1	3,043,839.59	1	0.77	0.77	-
NULL	GGAD	FS	House, Not W	Company 1	Site 1	Plant 1	Unit 1	SAC	11/05/2005 13:01
NULL	GGADBR	0.66	1.75	2	3,043,839.59	1	0.77	0.77	-
NULL	GGADBR	MU	Worn, Excess	Company 1	Site 1	Plant 1	Unit 1	SAC	05/11/2006 06:41
NULL	GGADBR	MU	Maintenance,	Company 1	Site 1	Plant 1	Unit 1	SAC	08/16/2006 06:32
Accessory Ge	GGADBR00	-	-	-	3,043,839.59	1	0.77	0.77	-
Accessory Ge	GGADBR00	-	-	-	3,043,839.59	1	0.77	0.77	-
NULL	GGADCS	0.33	1.28	1	3,043,839.59	1	0.77	0.77	-
NULL	GGADCS	CM	Inspection	Company 1	Site 1	Plant 1	Unit 2	SAC	08/04/2004 23:22
Accessory Ge	GGADCS00	0.99	2.19	3	3,043,839.59	1	0.77	0.77	-
Accessory Ge	GGADCS00	CM	Leaks	Company 1	Site 1	Plant 1	Unit 2	SAC	04/18/2003 07:00
Accessory Ge	GGADCS00	MU	Leaks	Company 1	Site 1	Plant 1	Unit 2	SAC	04/19/2003 07:00
Accessory Ge	GGADCS00	MU	Leaks	Company 1	Site 1	Plant 1	Unit 2	SAC	05/18/2003 07:00
NULL	GG	0.66	1.75	2	3,043,839.59	1	0.77	0.77	-

## Component & System Level Detail

- MTBF
- MTRR
- Failure Rate, etc.



## Customer Market Reports

- Benchmarking
- RAM Trends
- Inspection Data
- Unit Specific Information, etc.



# Our Approach is Applicable



- Information from SCADA
- Work Order System...

**For Input to ORAP®**

***Uniform Data with Minimum Effort***

# ORAP Benefits



- Preventative Maintenance
  - Trends across the Fleet and Market
  - Breakdown by components and sub-components (total plant)
  - Availability
  - Reliability
  - Service Factor
  - Outage Factors
  - Mean Time Values
  
- Benchmarking
  - Your unit vs. total Fleet and Market (all technology alternatives)
  - Your unit vs. Best in Class Performers
  
- Forecasting Major Maintenance and Forced Outages

# Revenue Opportunity & Risk Mgm't



- Full Management Reporting... Insurance, Financial, Executive Staff
- Extended Intervals Between Maintenance... Process for RCM
- Determine Source of Downtime... Frequency & Duration
- Define Parts Life Limits Empirically (Critical Spares Planning)
- Industry Expectations... Return on Investment
  - Reduction in inventory...
  - Reduction in planned maintenance...
  - Reduction in unreliability...
  - Reduction in RO costs...
- Structured Method to Measure Continuous Improvement for Your Units and the Fleet



If you are interested, a demonstration  
can be arranged.

Thank you

[www.spsinc.com](http://www.spsinc.com)