‘Acting to Improve Wind Plant Reliability’–

ORAP® for Wind: From Innovation to Readiness for Service

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August 2, 2011

A Focus on Reliability

"For wind technology to effectively compete as a viable energy alternative, irrespective of the value of production tax credits or incentives, the reliability performance of manufactured components and full systems must improve."

Adapting ORAP® to Wind Plants:
Industry Value & Functional Requirements
2010

Who is SPS???

- Reliability Engineering and Information Technology Company… **since 1987**
  - Initiated to meet industry need
  - Compile RAM data from global power plants through ORAP®
- SPS 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

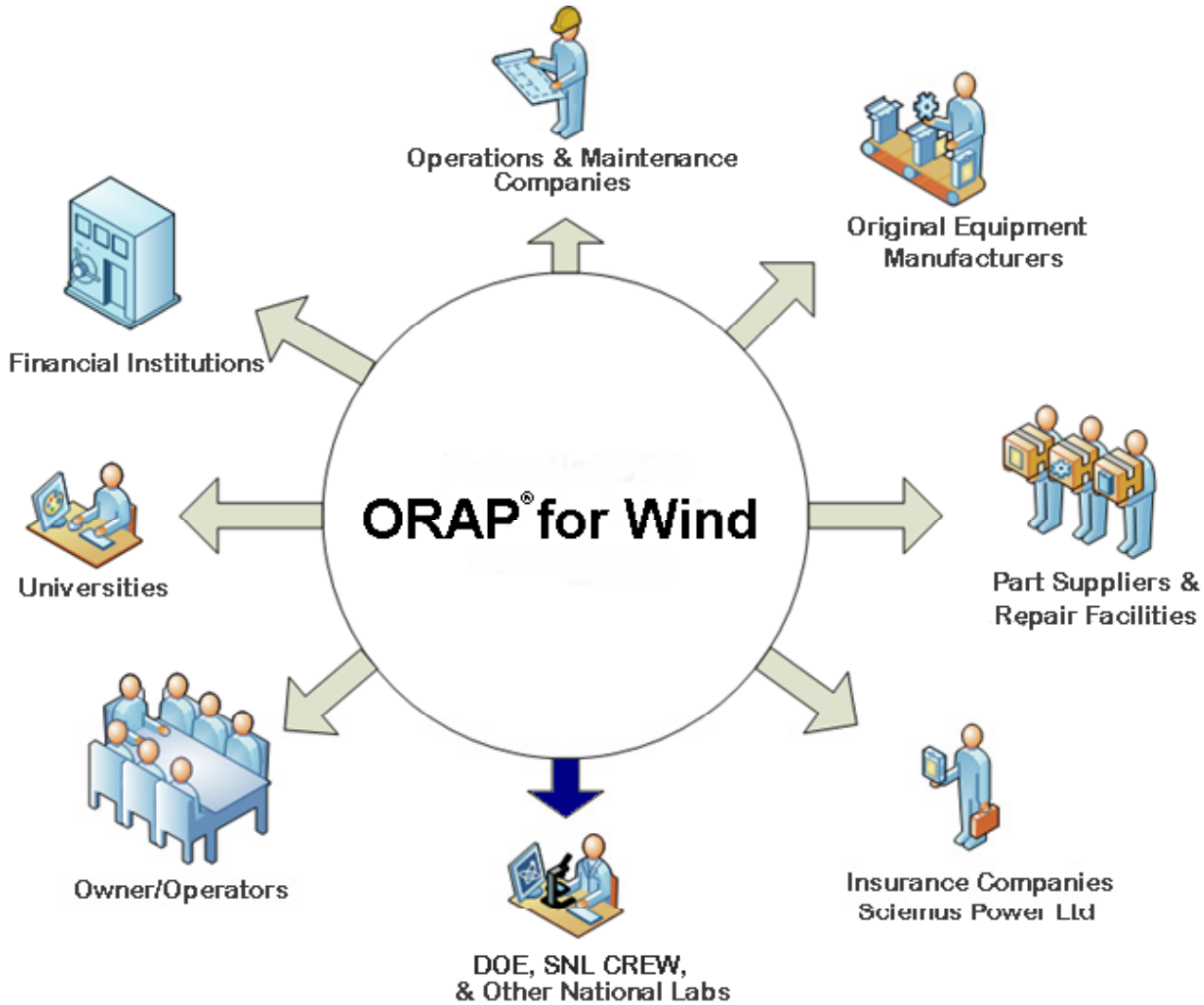
ORAP Applicable to Wind???

ORAP® - Today

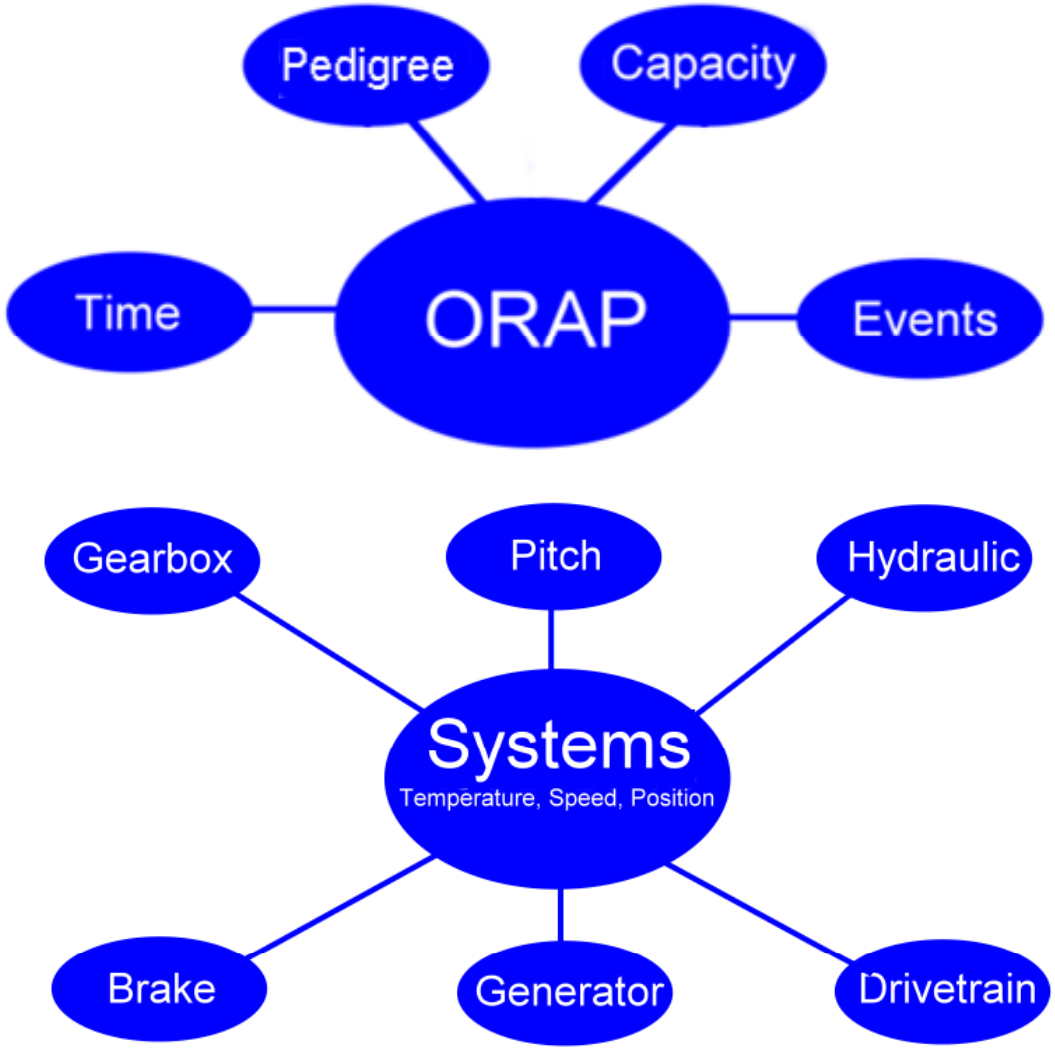
- **RAM Database**
  - All OEM gas and steam turbines (50 & 60 Hz)
  - Pedigree Data; Application, Arrangement, Duty Cycle, Fuel, Location, etc.
  - ORAP supports **design for reliability** project efforts
- Benchmarking
  - Your unit vs. the Fleet and Best-in-Class
  - **Market comparisons**
- **Third-Party… Unbiased**
- Market Representation –
  - ALSTOM, GE, Mitsubishi, Rolls-Royce, Pratt & Whitney, Siemens, Ansaldo…
- **Customer Focus**
  - +2,000 Units Worldwide
  - ~ 21,000 Unit Years of Data
  - +280,000 Forced and Scheduled Outages

Applicable to Wind???

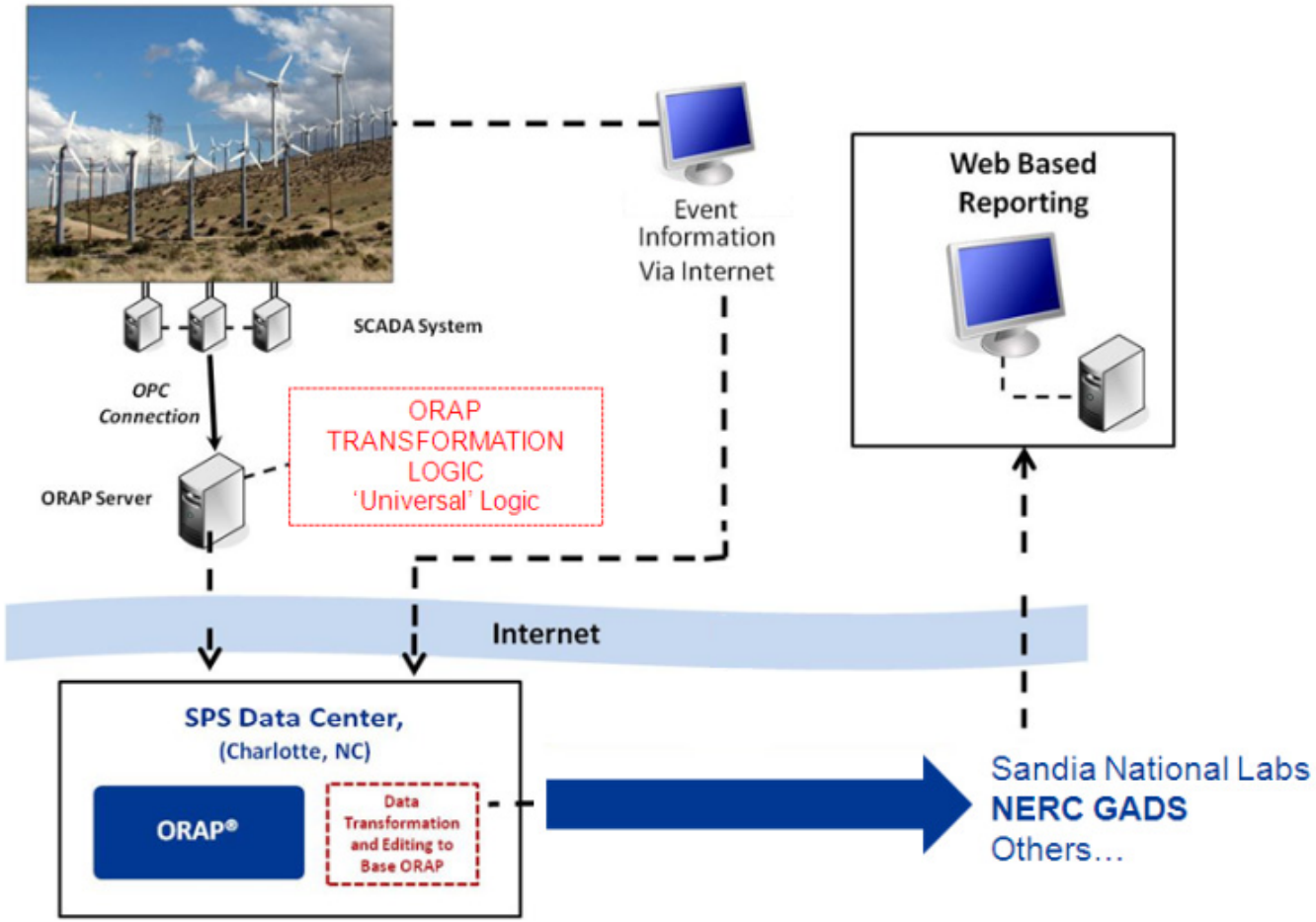
Setting the Vision…



Pedigree, RAM, Performance, System & Component Reliability



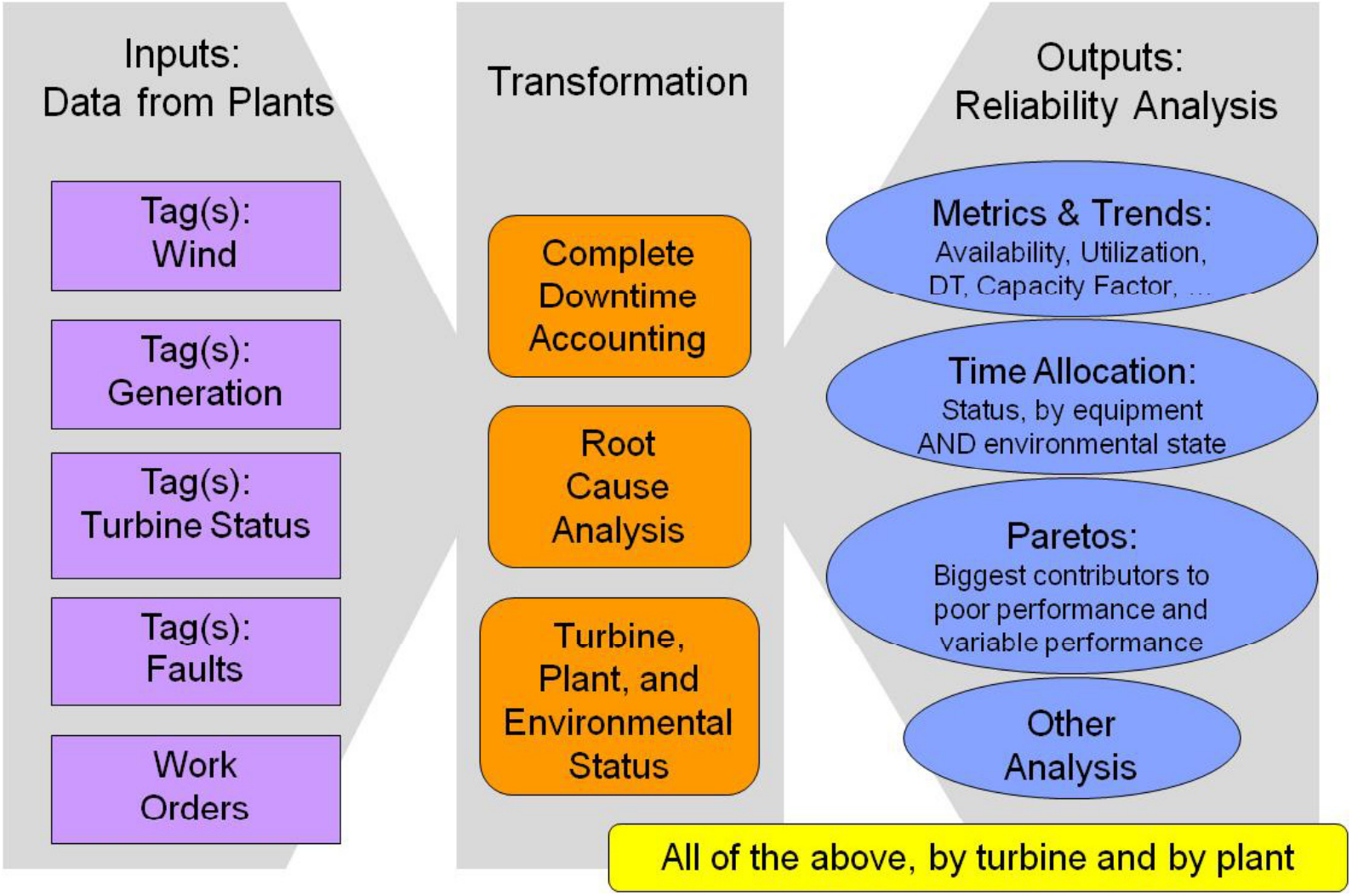
Vision… All About Data Flow



Vision – Relies on a Process

- Collect Site Based Data
  - SCADA
  - Maintenance Events (e.g. CMMS)
- Develop **Transformation Logic** - Convert Data to Information
  - Time, Capacity, Events
  - RAM Metrics
  - Performance Metrics
- Execute Pilot Projects
- Flow Data to **CREW**… NERC GADS Reporting by 2013
- Provide Information & Knowledge to Broad Market

From Vision to Execution…
Technical Challenges



Innovators and Ideas - Required to Address Technical Challenges

- **Pilot Companies**
  - enXco: September 2010
  - Shell Wind: November 2010
  - Xcel: March 2011
  - Wind Capital Group: June 2011
  - enXco (Pilot 5): Mid August 2011
  - Pilot 6: Currently being Negotiated
- **Coverage (first 4 Pilots)**
  - 23k turbine-days of data
  - Associated met towers

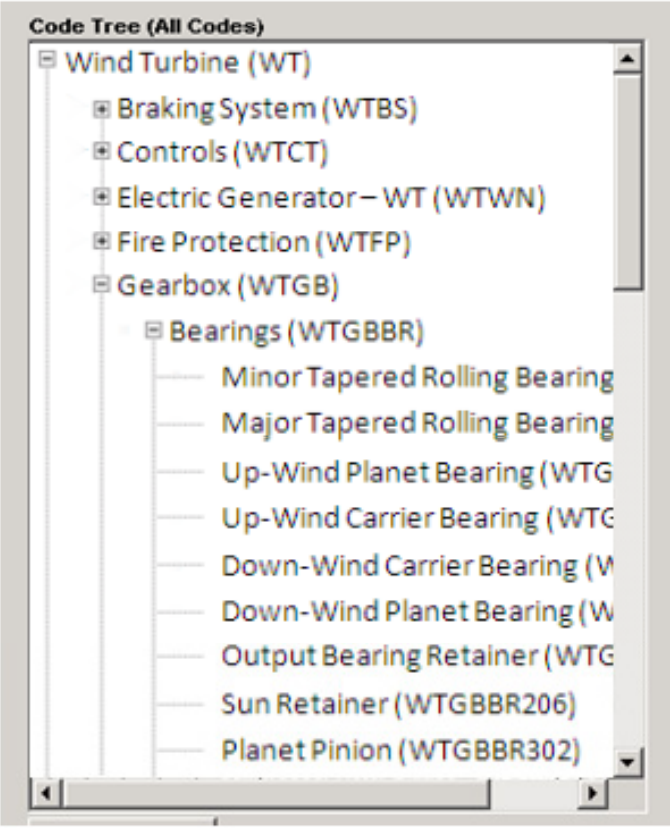
Proprietary Agreements

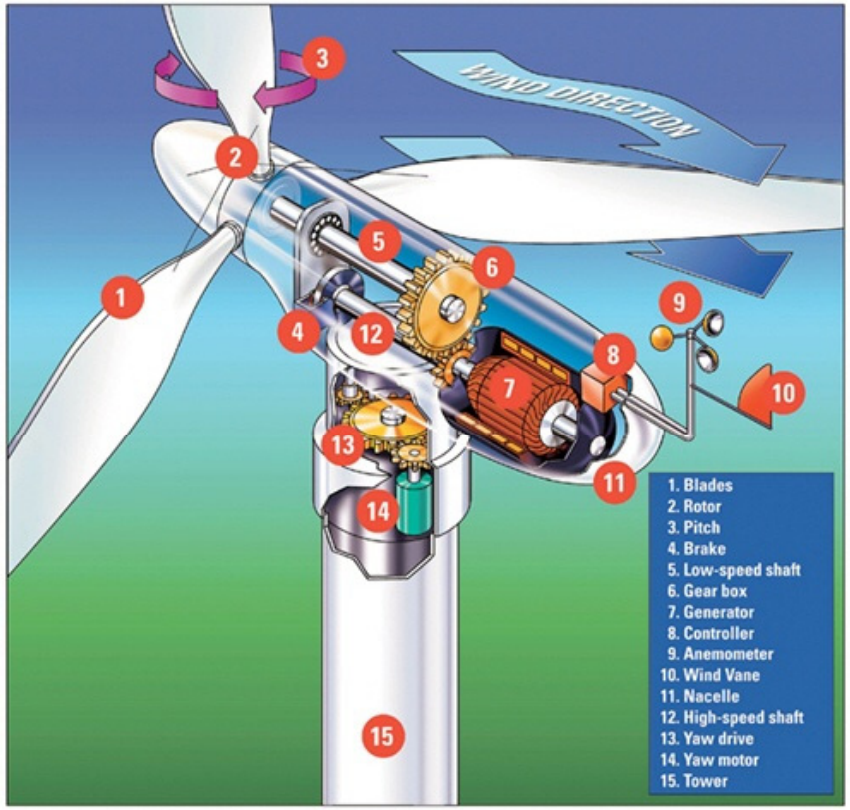
- All Data is Owned by Submitting Owner/Operator
- 2 Party Non Disclosure Agreement Signed with each Pilot Partner
  - No company specific data to be released
  - Sandia National Labs are provided unit data
- 2 Party Non Disclosure Agreement – SPS & Sandia National Labs
  - No company specific data to be released
  - Specific Aggregated Data used in Public Reports
  - Supports DOE Funding Decisions

Execution Milestones

- Develop Functional Requirements Document
- Develop Standard Wind Turbine Taxonomy
- Start Rapid Application Development
- Engage Pilot Partners – Expanded from 3 to 6 sites
- Validate Data Collection & Transformation Capabilities
- Validate Reporting Capabilities
- Commercialization

Wind Turbine – Taxonomy
Following EPRI EBS





Opportunity – IEC Standardization

Key Accomplishments

- Completed full Equipment Breakdown Structure (EBS)
- Proved automated data collection system
  - **Receiving data from sites at a two second scan rate**
- Validation of Process
- Full Transformation Implementation
  - **ORAP Data**
  - **Systems Data**
- Other wind turbine technologies – Scalability
- Review Industry Standards & RAM Metrics… **NERC Compliance**

Experience – First 4 Pilot Sites

- Collecting 47 tags on majority of units

Number of Tags	Scan Rate
21	2 sec
2	1 min
13	10 min
11	30 days

- Varying SCADA Systems
- 3 Data Connections using OSIsoft (PI) Historian
- Maintenance Events - CMMS - 1
- Data Collection Points - 1 Central Operations Center & 3 Site Based

Overcoming Technical Challenges

- Competing Use of Servers Increases Likelihood of Data Gaps… Increases Costs Associated with Installation
- Variation in Security Policy – Site to Site
  - CIPS Compliance
  - Multiple Installation Options Required
- Tag Names and Usage Not Consistent – Site to Site
- Maintenance Data & CMMS – Variation High
- CMMS & SCADA Data – Not Easily Correlated
  - Root Cause of Failure Not Easily Defined: Faults vs. CMMS

What's Required for Success?

- Initial communication between Owner/Operator & SPS is critical to installation process
- Owner/Operator IT support required during the installation phase and to ensure ongoing communications
- IT infrastructure and security policies vary from site to site, so multiple installation options Required… Flexibility
- The available SCADA tags are different at each site
- Not all sites collect maintenance data in a database
- Reliable IT network communications is a key success criteria

ORAP for Wind – System Architecture

Wind OSIsoft.
Historian or SCADA

OPC Xi Wrapper / Data Collection Services

- High Security
- Quick Installation
- Light Weight Installation

SPS
WindDataUpload Service
Secure Web Service w/ Proprietary Encoding

SPS Data Center

ORAP
Transformation Logic

Transformed Data Store

ORAP
Automated Data Validation

ORAP Wind Data Warehouse

ORAP
Web Based Reporting

From Innovation to early Adopters…

- **Scalability**
  - **Going from 300 to 30,000 wind turbines requires a robust system that is simple to install and operate**
- **IT Infrastructure**
  - **Server utilization, Reliable Communications, Bandwidth, Storage**
- **Maintenance Event Data**
  - **Automated determination of root cause requires timely, consistent use of a CMMS or equivalent system.**

Readiness for Service – Early Adopters

- Start Accepting Early Adopters 10/1/11
- Meet NERC 2013 Mandatory Reporting Requirement for Wind Farms
- Available Reports:
  - Customer
  - Fleet
  - Market
  - Systems

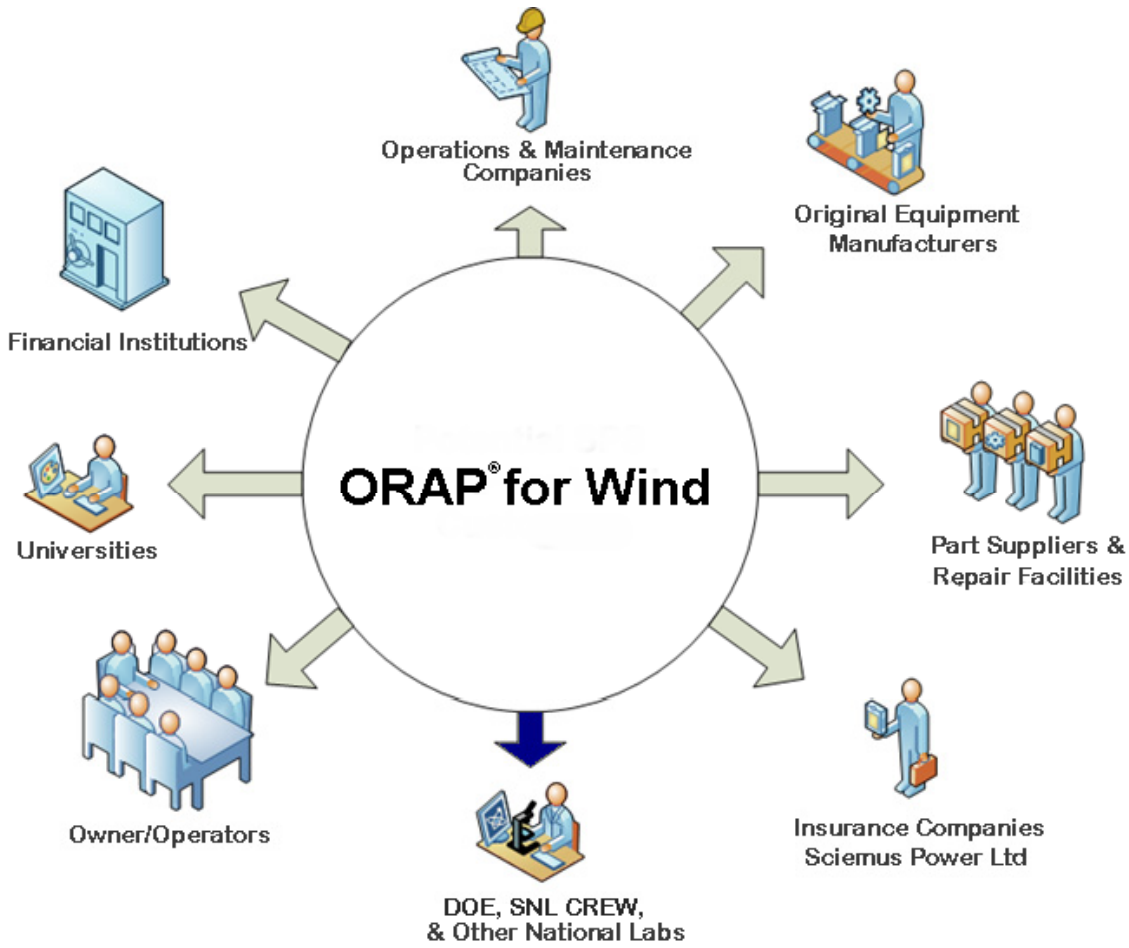
Data… Information… Knowledge

- **Type of Analysis**
  - **RAM Metrics**
  - **Performance Metrics**
  - **Maintenance Management Metrics**
  - **Pareto Charts**
  - **Weibull Analyses**
  - **Power Curves**
- **Customized Engineering Studies**

Future Direction

- OSIsoft (PI) Partnership – August 2011
- Commercial Release of ORAP for Wind
  - Early Adopters – October 2011
- Fleet & Market Reports
- NERC GADS Reporting Tool
  - 2013 mandatory reporting requirement for wind farms
- Additional Technologies
  - Direct Drive
  - Multi-Generators
  - Offshore

Commercialization Strategy



Generation Parity…

400 Mw Combined Cycle Plant

400 Mw Wind Farm

Production, O&M Cost, & Reliability…

Thank You

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