OSIsoft® UC2010

Real Time Information — Currency of the New Decade

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OSIsoft® UC 2010

Best Practices in Rapid Deployment of PI Infrastructure and Integration with OEM Supplied SCADA Systems

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Invenergy

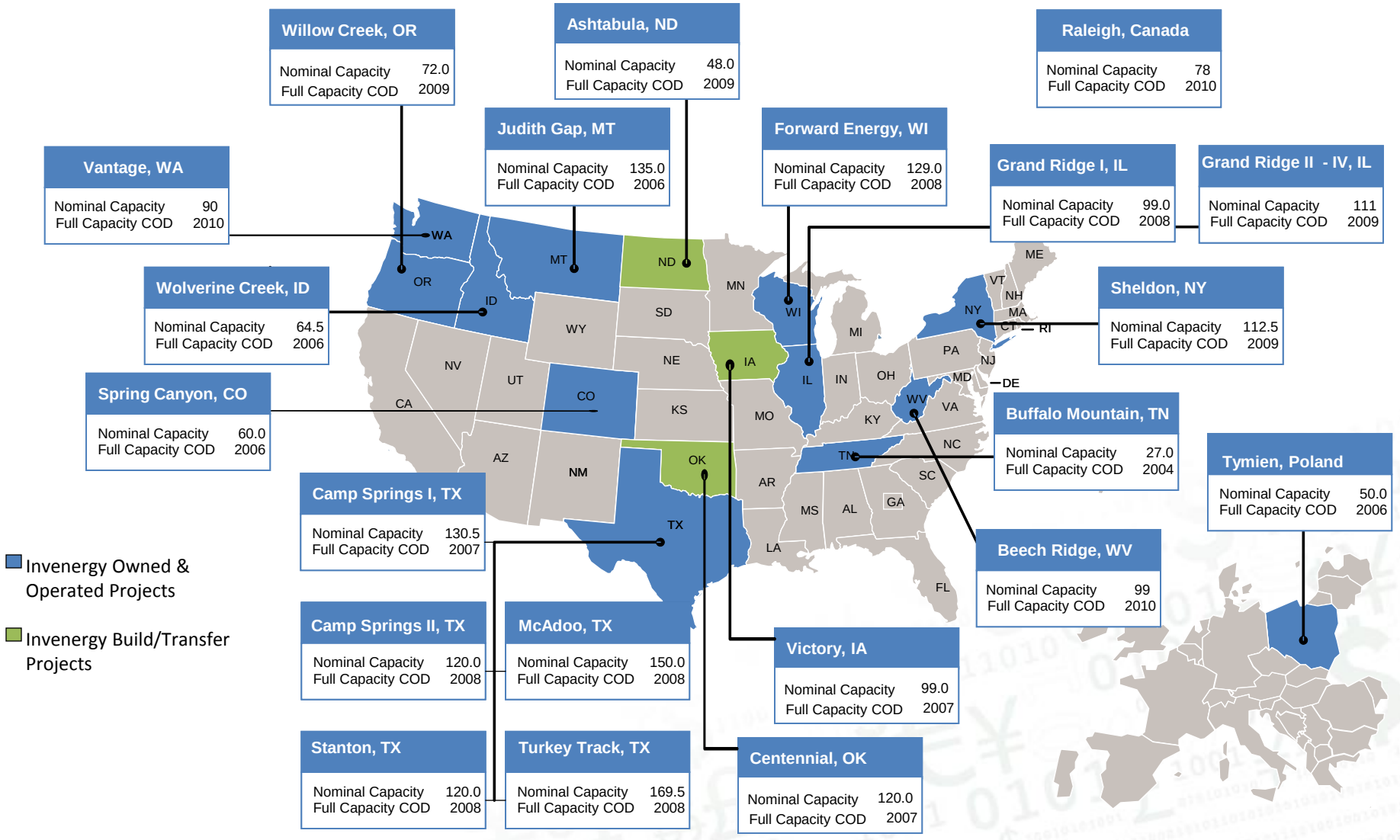
OVERVIEW

- Company Overview
- Data Background/History
- Challenges
- Solutions
- Benefits & Results
- SmartSignal
- Lessons Learned
- Next Steps
- Questions

ABOUT INVENERGY LLC

- Founded in 2001
- Based in Chicago, IL
- Independent Power Producer
  - Wind
    - Largest privately owned wind developer/owner/operator in the U.S.A.
    - 16 Operating Sites
    - 1610 MW
    - Several sites under construction and in development
  - Natural Gas
    - 5 Operating Sites
    - 2210 MW
  - Solar
    - Several projects in various stages of development

Invenergy Wind Projects



BACKGROUND

- Early wind farms had unique challenges
  - Basic SCADA tools were inadequate for trending/reporting data
  - No standard 3rd party interface
  - Custom communication solutions required for data transfers to 3rd parties (Markets, Utility Off-takers, Forecasting Firms)
- Small fleet size
  - No need for ad hoc analysis
  - Only executive summary information needed
- Tasked one vendor with creating tool
  - Data Access
  - Data Communication with 3rd Parties

INDUSTRY EVOLVED

- Quick Growth in 2007-2009
- Concern about long-term viability of original vendor
- OEM SCADA Systems Improved 3rd Party Interface
- Ad hoc analysis needed
- System flexibility needed

DECISION CRITERIA

- General
  - Ability to connect to multiple data sources
  - Established technical support
  - Screen design flexibility
  - Custom calculations
  - Scalable framework
  - Large customer base
  - Extensive use in power industry
  - Familiar tool to existing employees

DECISION CRITERIA

- Business Drivers
  - Automate reporting
  - Creation of new metrics/KPI's
  - Improve performance monitoring

SOLUTION

- OSIsoft PI Data Historian
- Enterprise Agreement
  - Why?
    - Limited internal resources
    - Need for interface monitoring for system/data reliability
    - Need for many tags
    - Unlimited licensing of client tools and interfaces

INSTALLATION PLAN

Key Work Items

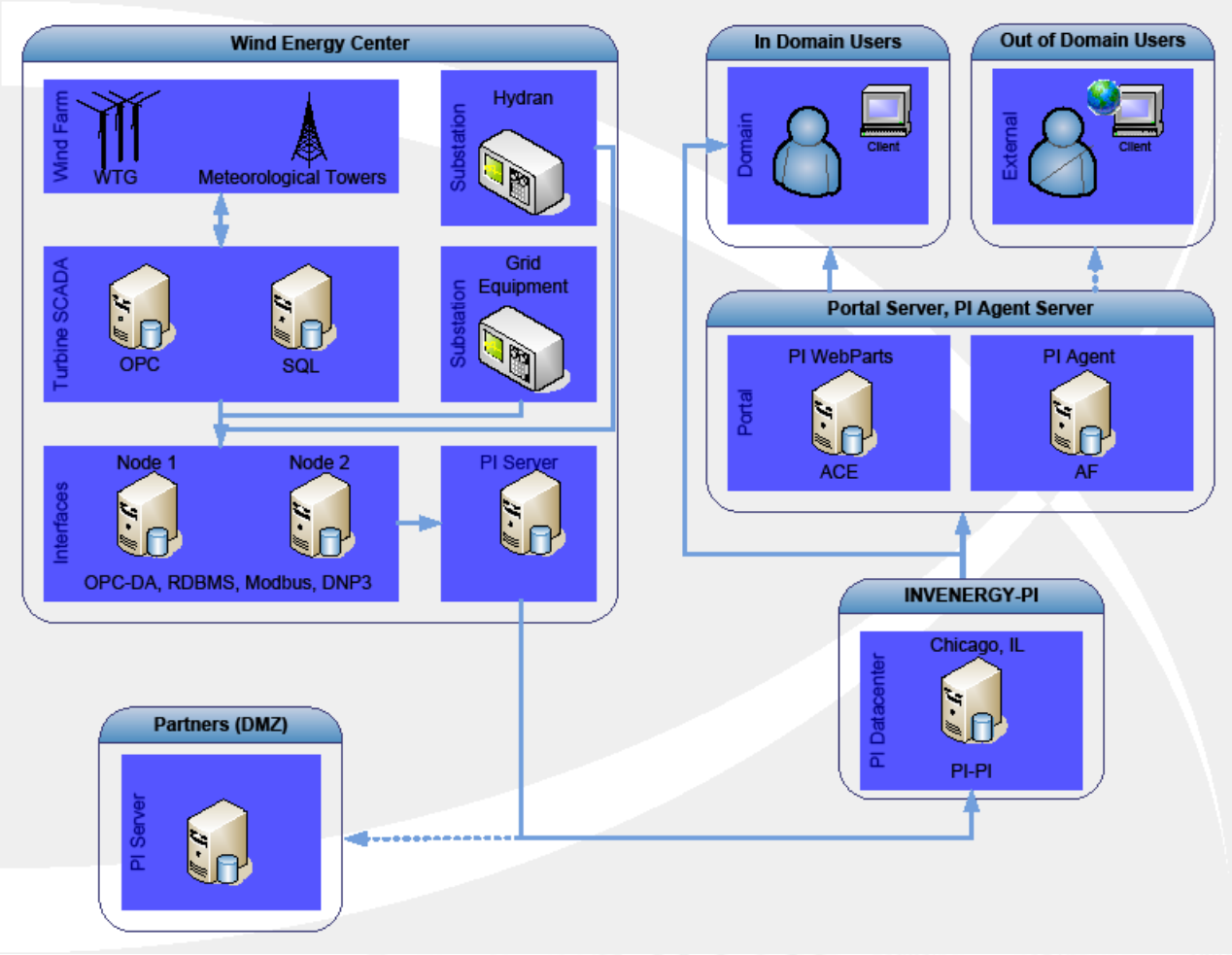
- Design network architecture
- Order & configure hardware
- Create deployment schedule
- Define data sources, tag naming convention, etc…
- Installation of first site
- Remote installation of all other sites
- Create basic screens
- Training of key people
- Create additional screens, calculations, reports, etc…

PI SYSTEM ARCHITECTURE

- Architecture Goals
  - Robust
  - Cost effective
- Production Environment
  - Wind Farm
    - 1 PI server per wind farm
    - 2 interface servers per wind farm
  - Corporate
    - 1 PI server
    - 1 Portal Server
    - 1 Special Purpose Server (Bomgar, ACE, AF Notifications, PI Agent, etc…)
- Development Environment
  - Located in the corporate office
  - 1 Server, multiple interfaces

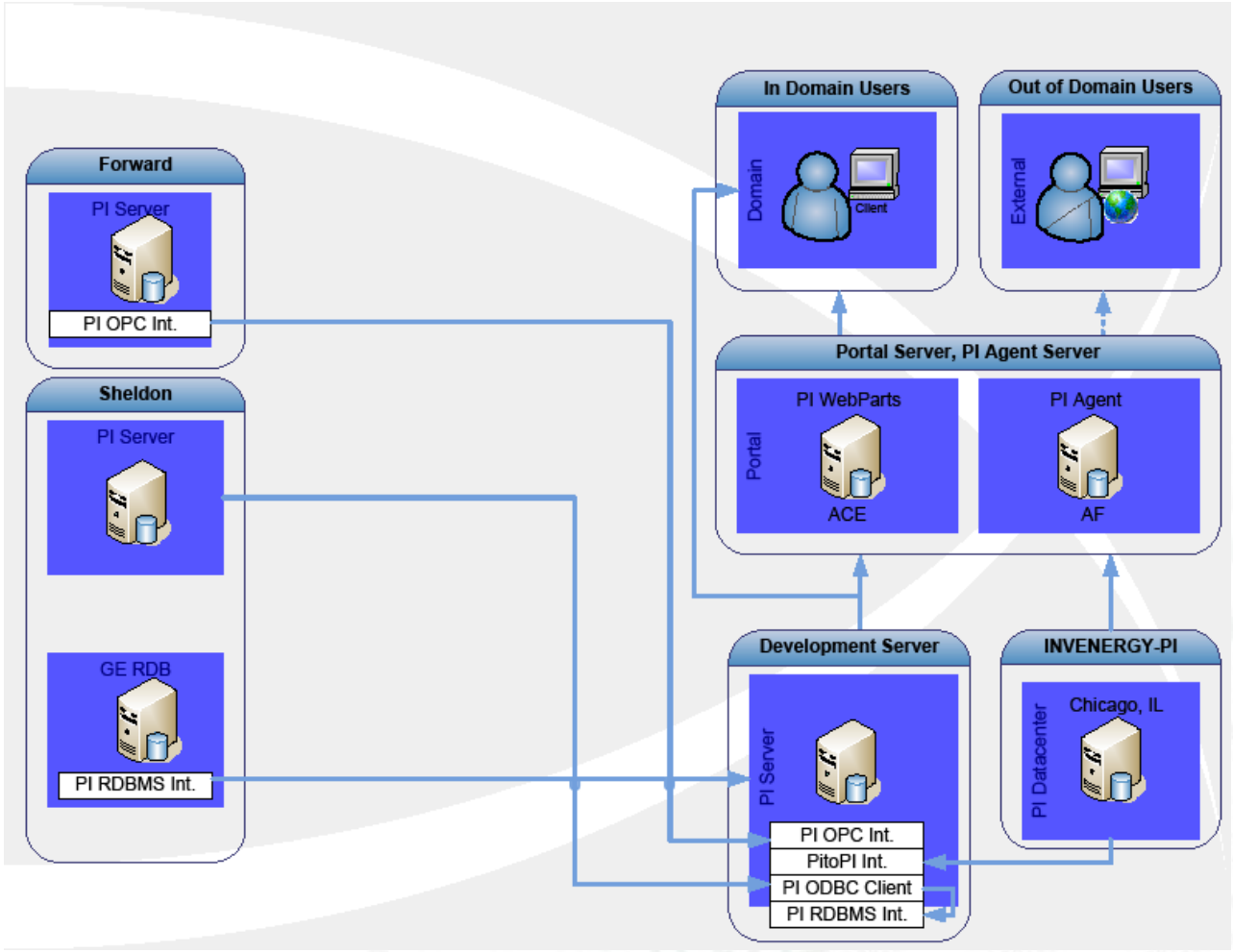
PI SYSTEM ARCHITECTURE

PRODUCTION



PI SYSTEM ARCHITECTURE

DEVELOPMENT



PI SYSTEM ARCHITECTURE

- Current Data Sources
  - Wind turbines
    - OPC Interface – Real Time Data
    - RDBMS Interface – 10 minute averages
  - Substation RTU
    - DNP3 Interface
  - Hydran (GSU Fault Gas & Moisture Monitor)
    - DNP3 Interface

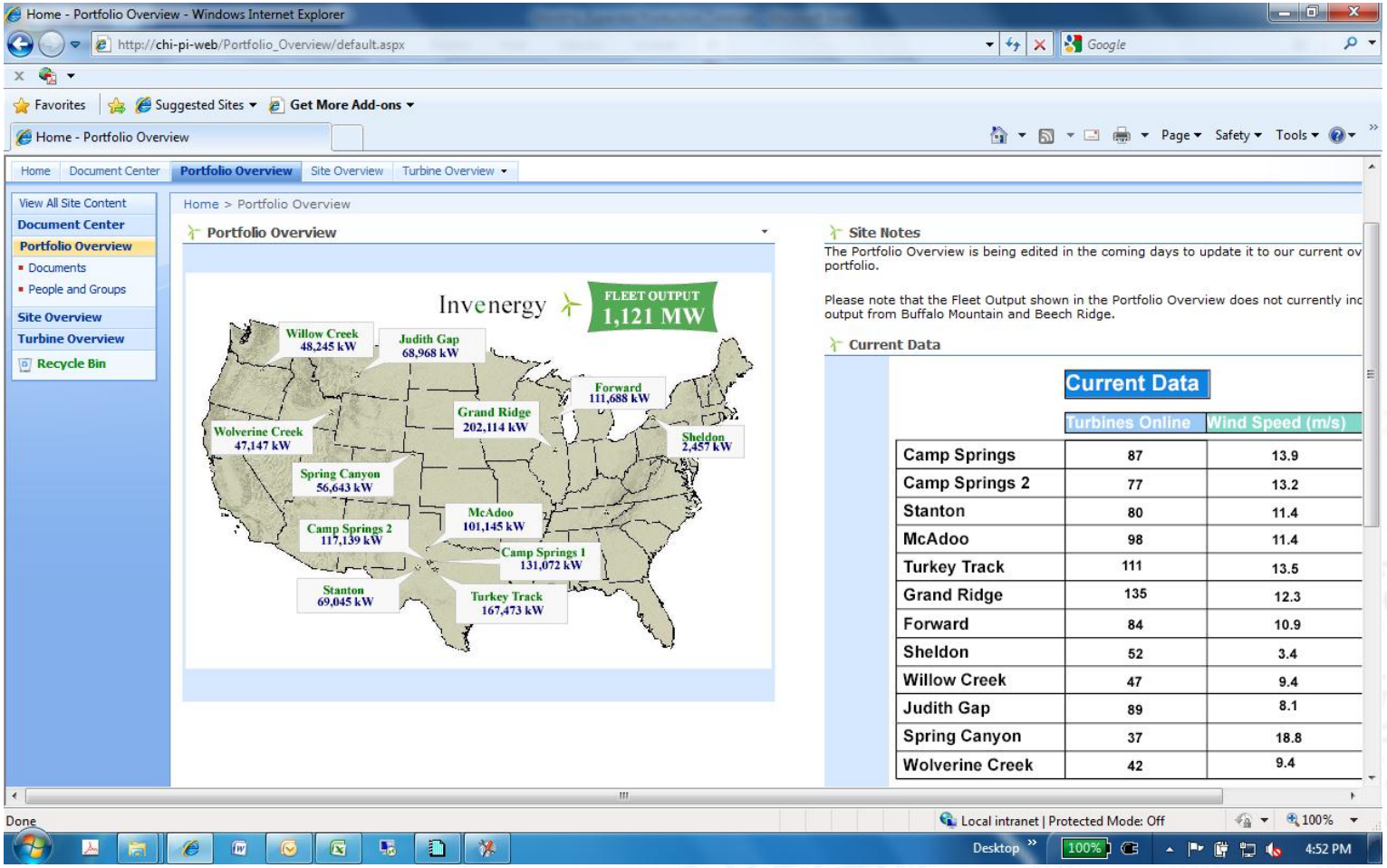
OSIsoft SOFTWARE AND SERVICES USED

- Field Services
- Enterprise Project Manager (EPM)
- Network Operation Center(NOC)
- Center Of Excellence (COE)
  - Architecture Guidance
  - Recommended Best Practices
  - Value Realization Plan (VRP)

BENEFITS & RESULTS

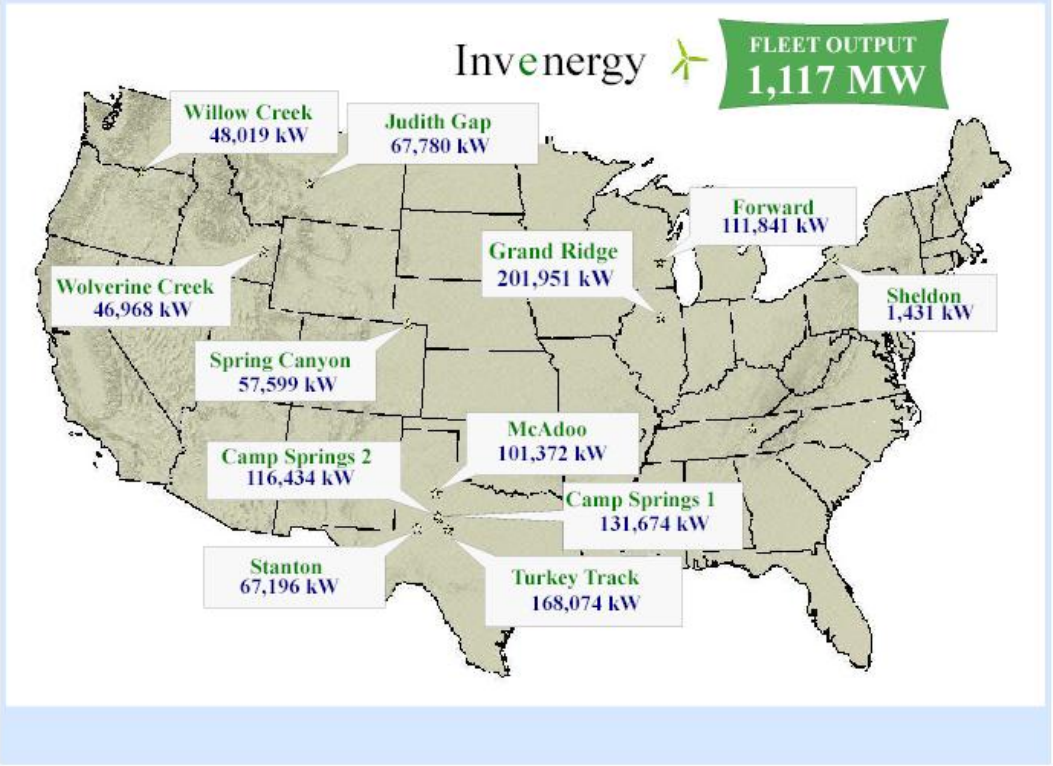
- Storage & utilization of multiple data sources
- Ad hoc trending & analysis
- Flexibility
- Visibility
- Scalability
- One version of the truth
- Compliance

ONLINE PORTAL



ONLINE PORTAL

Portfolio Overview



Current Data

Current Data

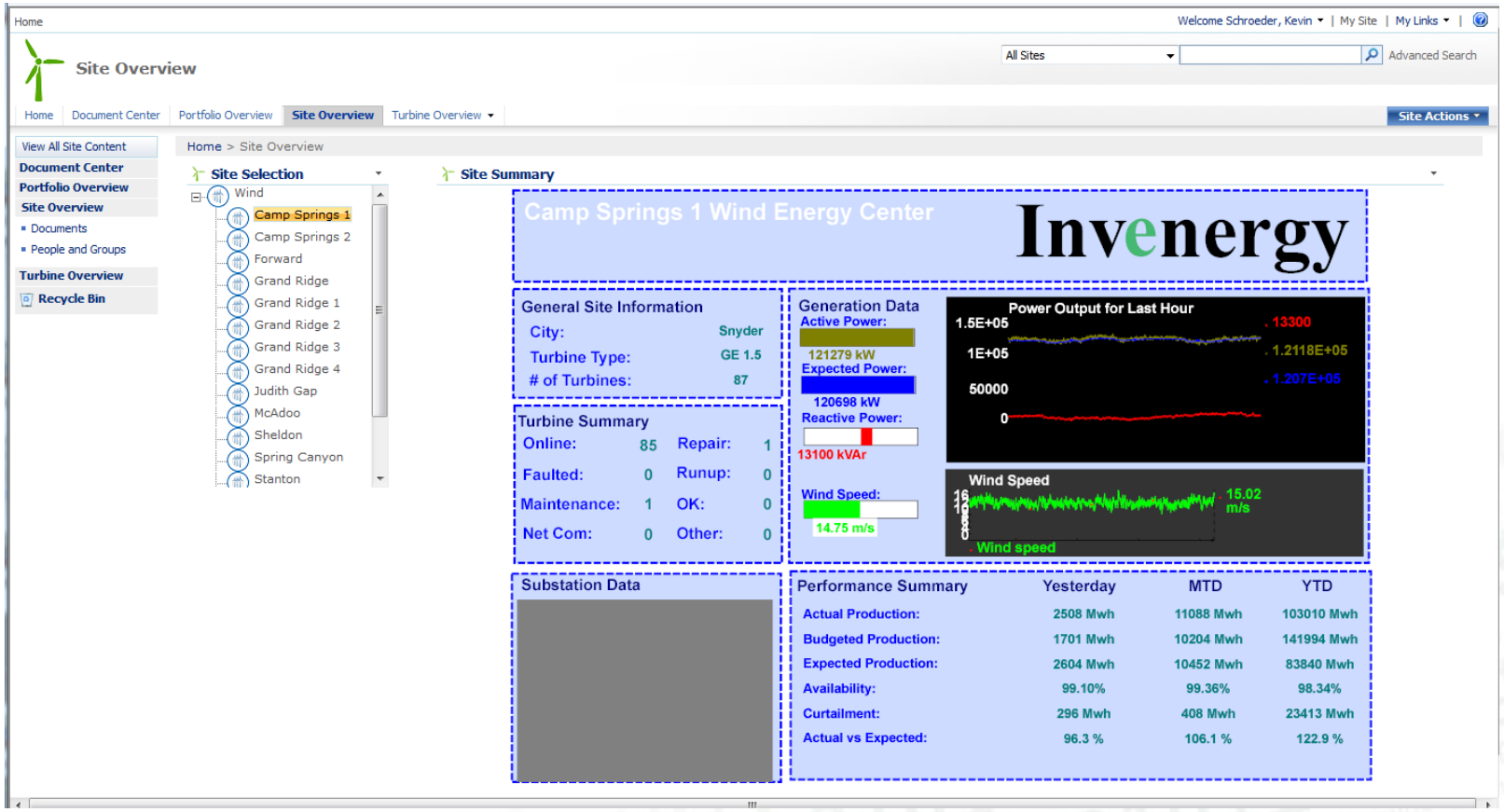
	Turbines Online	Wind Speed (m/s)
Camp Springs	86	14.1
Camp Springs 2	77	14.0
Stanton	80	11.2
McAdoo	97	11.2
Turkey Track	111	12.8
Grand Ridge	136	10.1
Forward	81	3.1
Sheldon	75	4.1
Willow Creek	48	7.0
Judith Gap	88	8.0
Spring Canyon	39	12.8
Wolverine Creek	18	2.8

24 Hour Site Summary

Yesterday's Data

	Total Production (MWh)	Avg Wind Speed (m/s)	Availability(%)
Camp Springs	2931	12.6	99.35%
Camp Springs 2	2638	12.5	97.34%
Stanton	1406	11.4	99.85%
McAdoo	2930	13.2	98.69%
Turkey Track	3021	10.5	98.61%

ONLINE PORTAL



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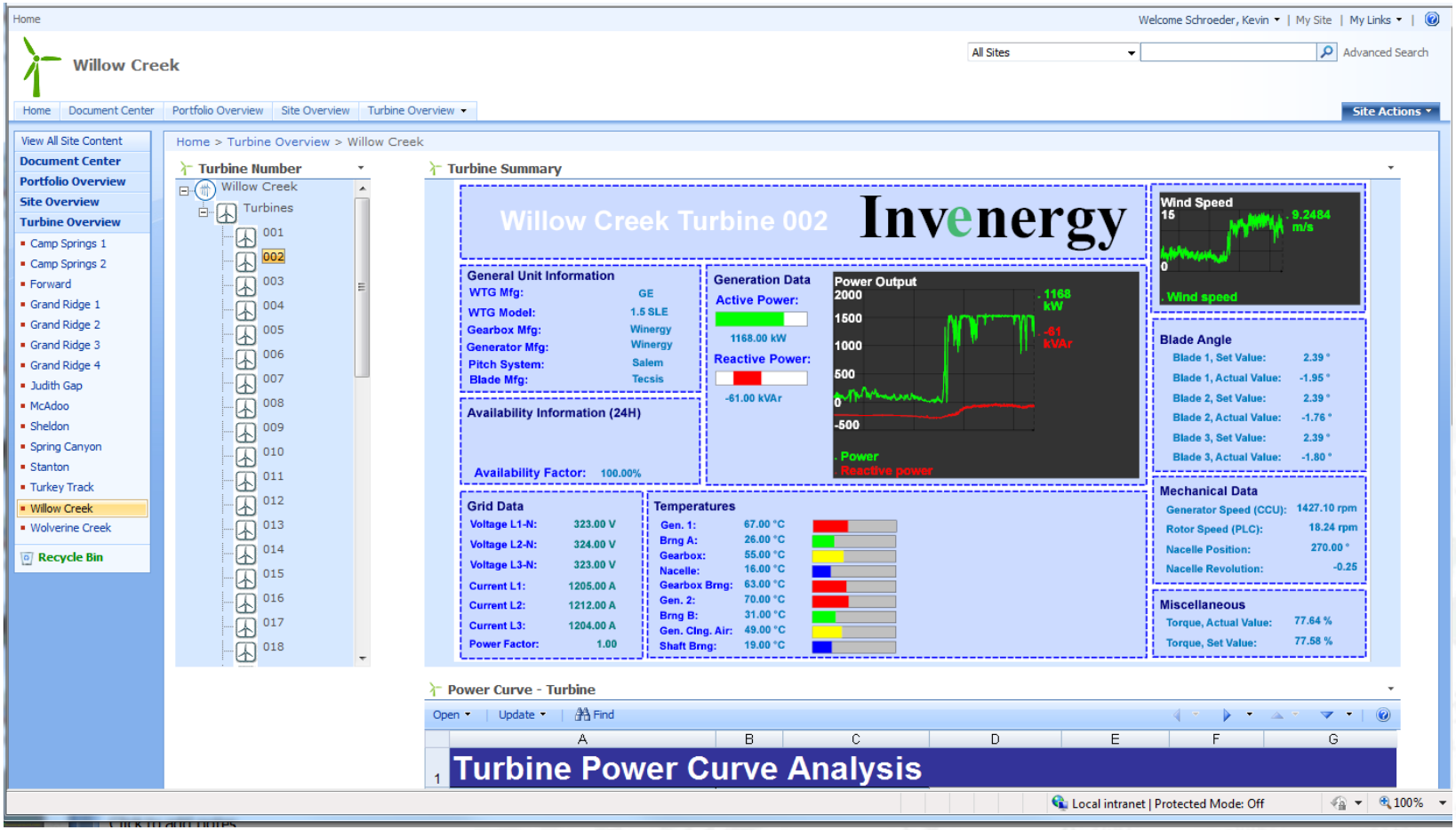

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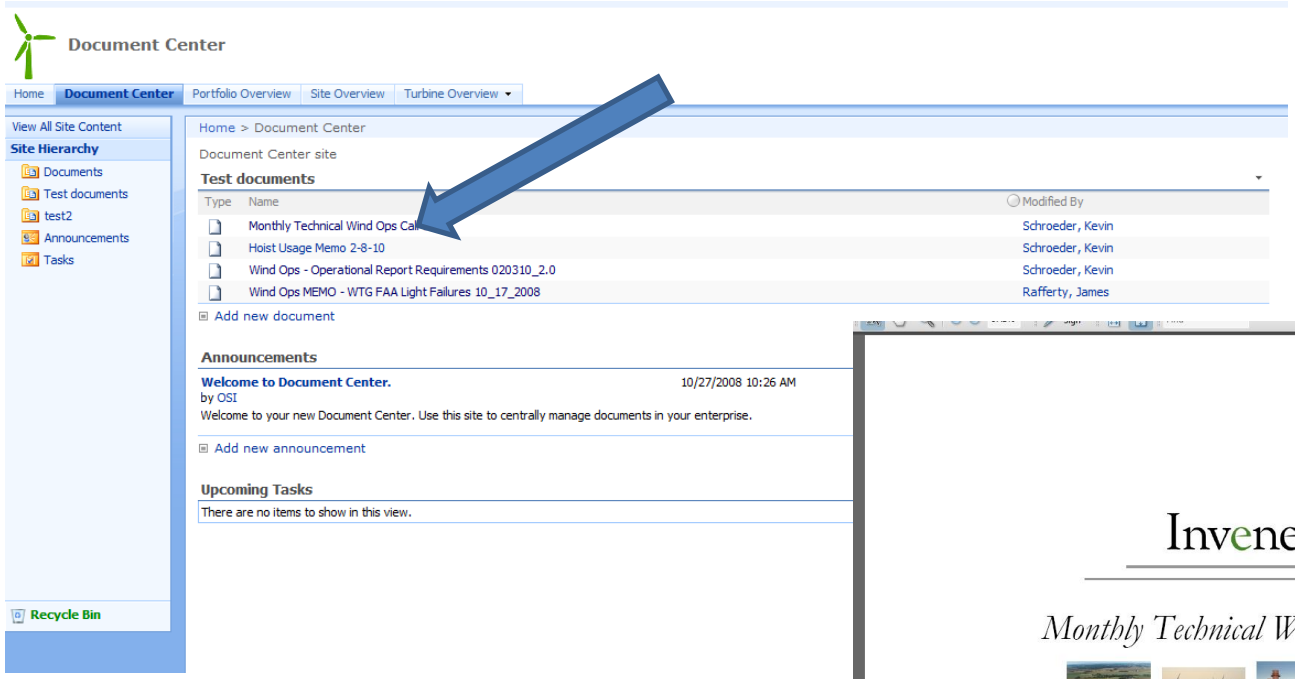
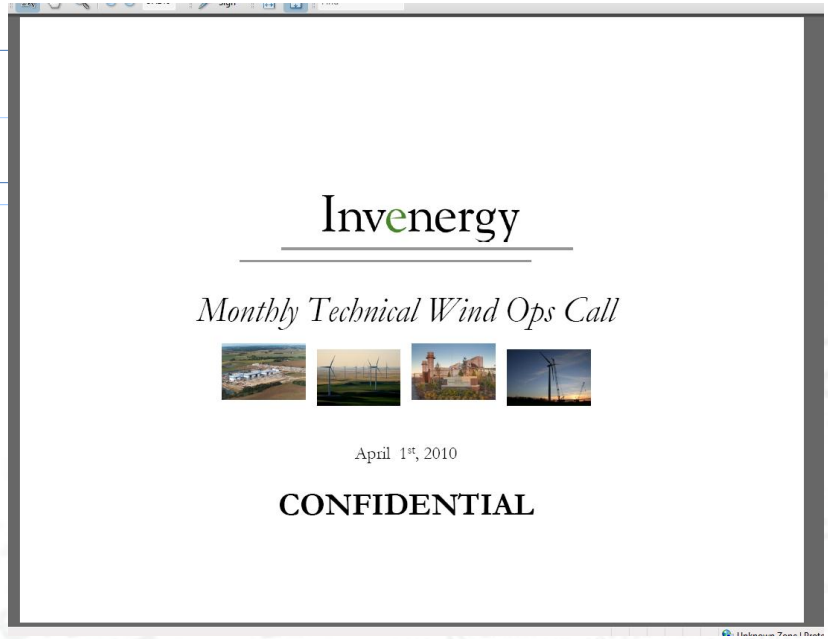
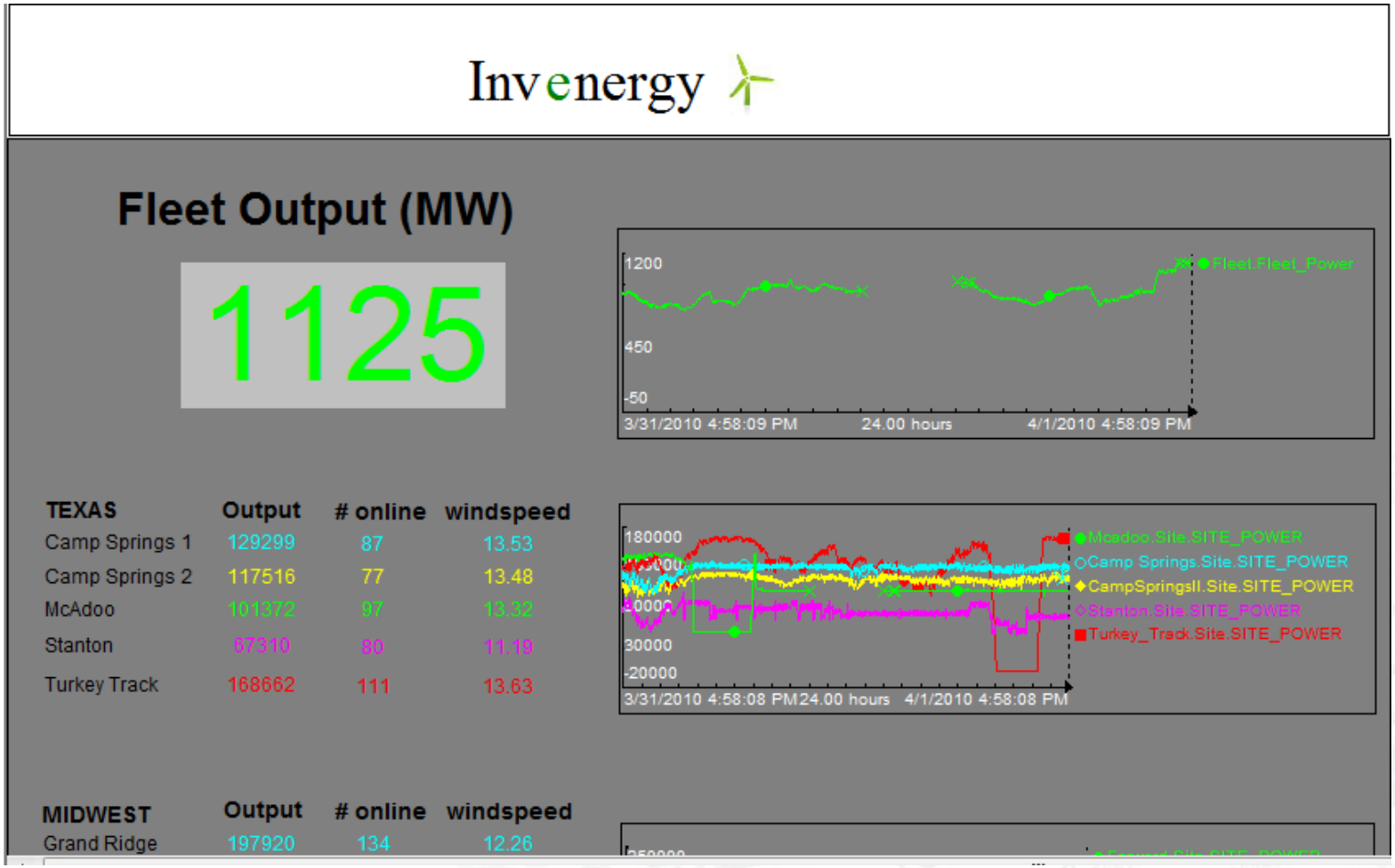




PROCESSBOOK



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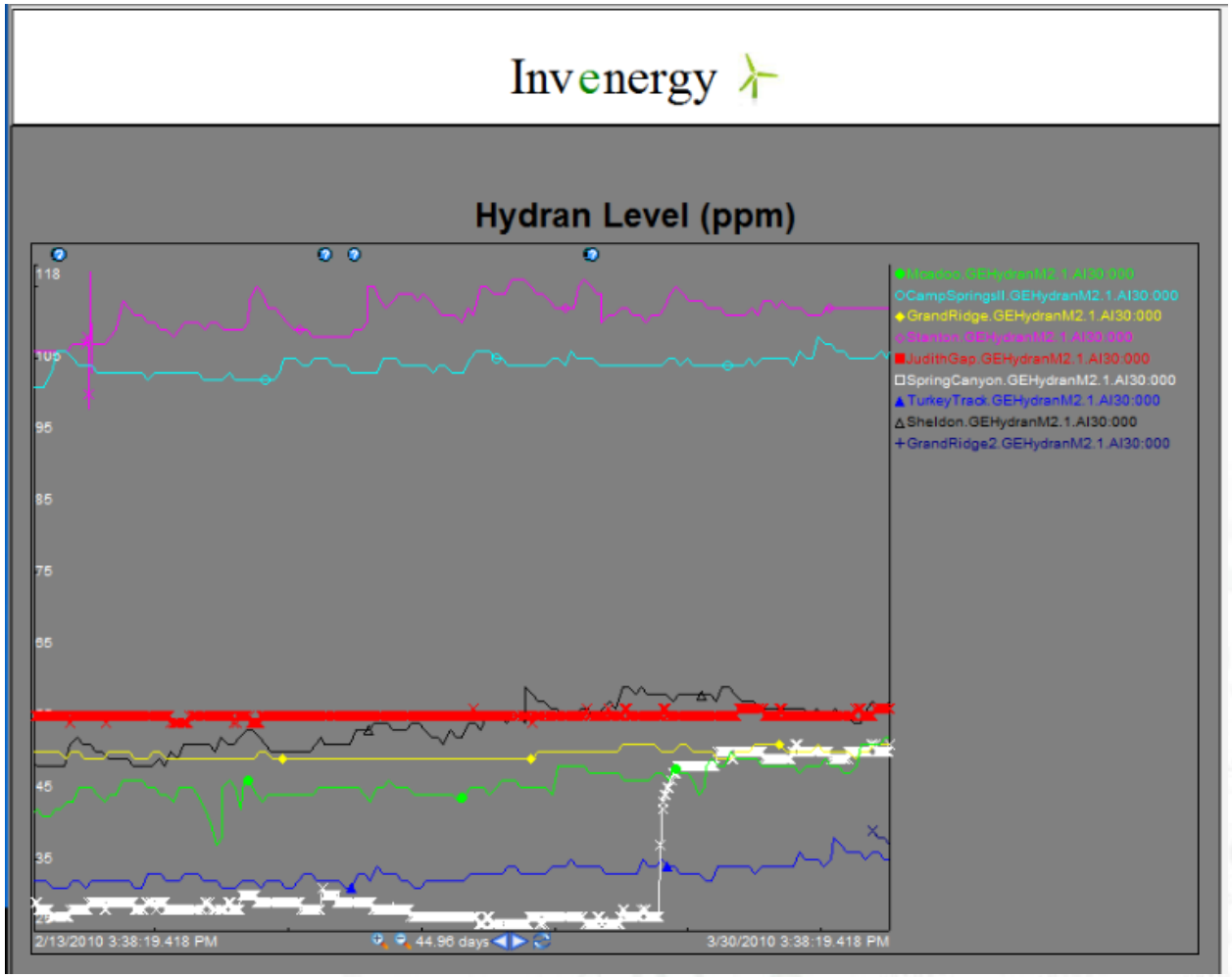
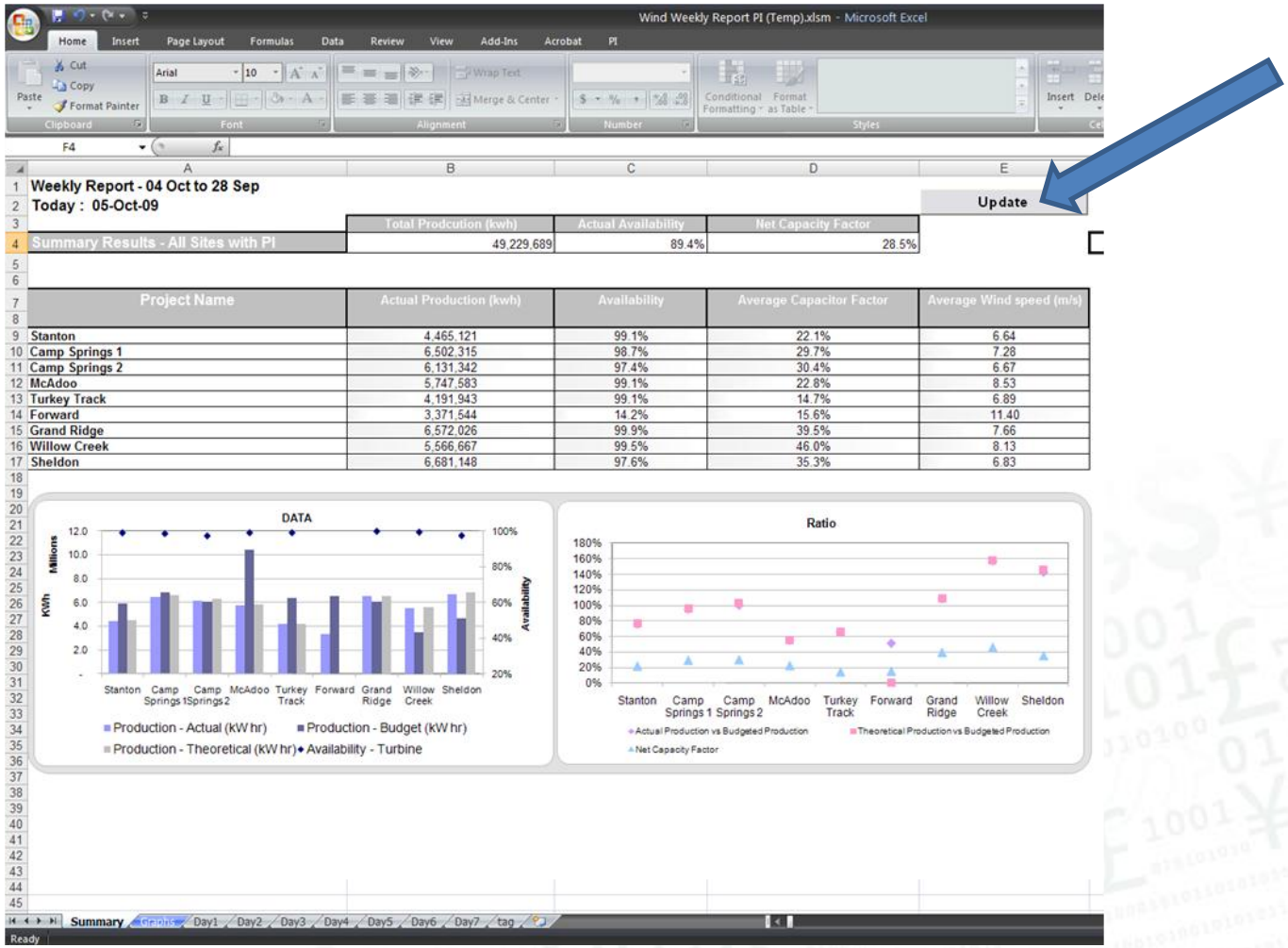


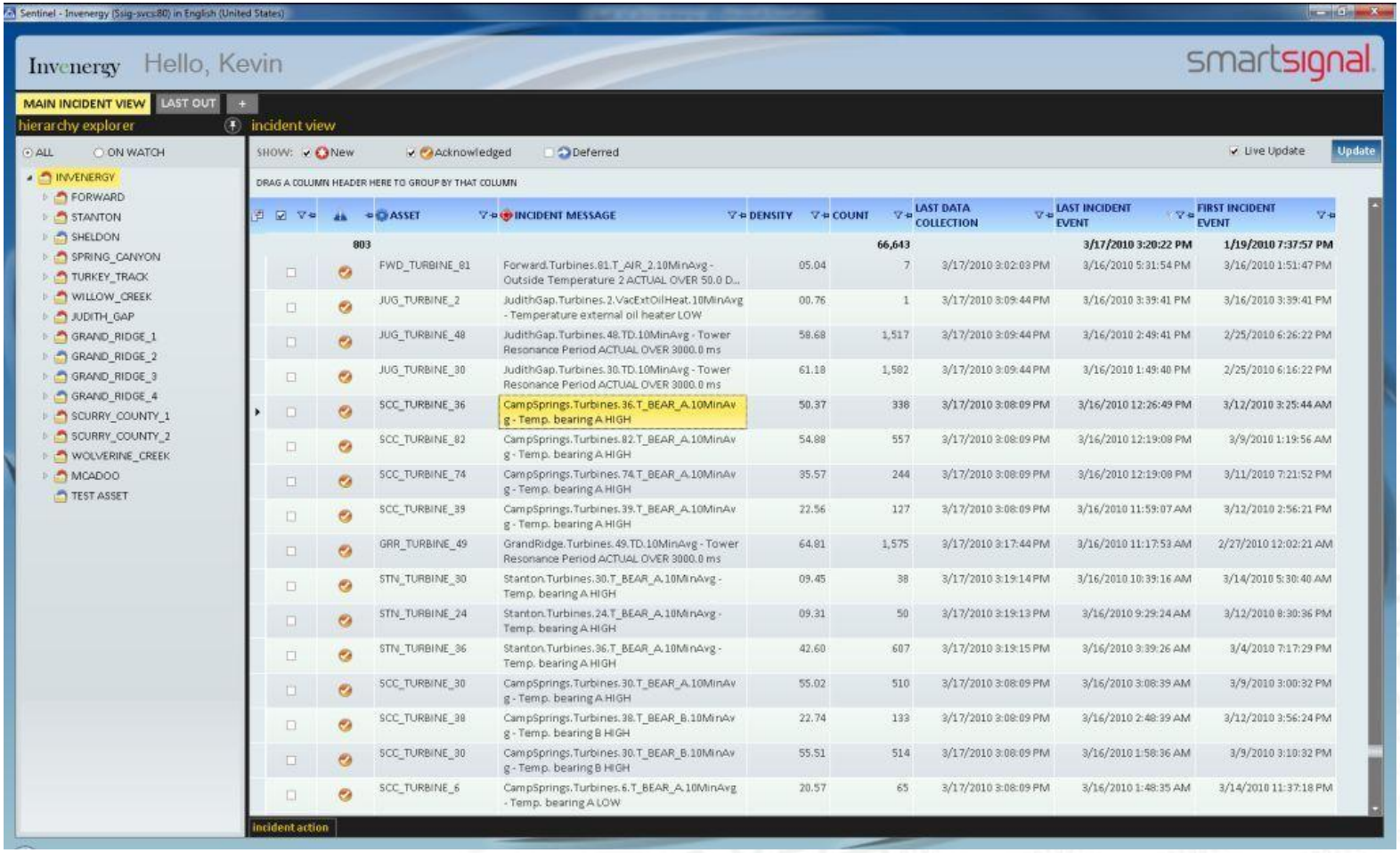
DATALINK



SMARTSIGNAL

- PI enabled us to quickly deploy SmartSignal, which detects, diagnoses, and prioritizes impending equipment and process failures
- Wind farms pose different issues in terms of monitoring and managing
- Pilot Project – Forward Wind Farm, Summer ‘09
- Fleet Implementation
  - 982 Wind Turbines, 13 Sites
  - December ‘09 – March ’10
- Project goals
  - Better utilize existing SCADA Data
  - Find low-level issues like failed sensors
  - Predict major items like generator and gearbox failures
  - Spot decreases in efficiency
- On-going work between Invenergy and SmartSignal

SMARTSIGNAL



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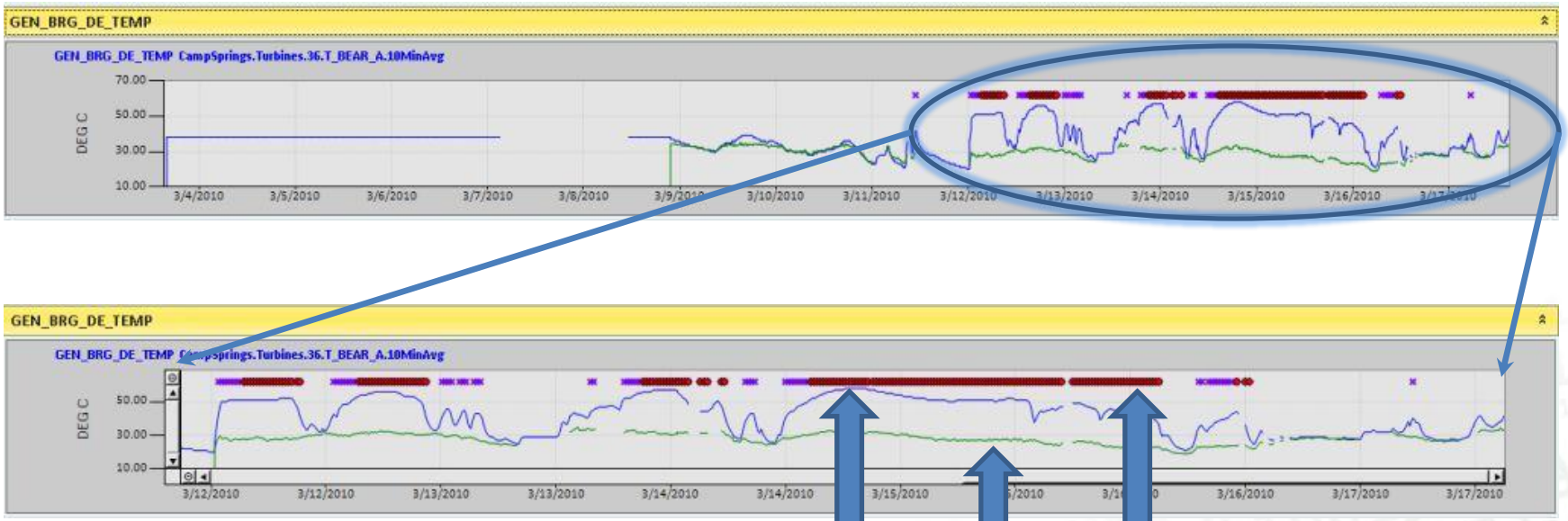

Actual

Model

Alerts…Incidents

LESSONS LEARNED

- What was successful?
  - Senior management support on purchase
  - Quick deployment – OSIsoft EA and EPM
    - 8 sites/ 27 machines in 2 months
  - Data visibility from corporate office
  - Built a platform for future reporting/analysis
  - Gained extensive understanding of WTG SCADA

LESSONS LEARNED

- What would we do different?
  - Have a dedicated PI team and/or admin but train many people on the tools
  - Engage executives on report and screen requirements early on
  - Create a development environment early on

LESSONS LEARNED

- The most important lesson…
- …data source quality and reliability is key.
- It is the foundation.
- Screens and reports are of low value if data quality and reliability is not high.

NEXT STEPS

- Increase data source system reliability
- More training
- Expand user base
  - Corporate
  - Site Personnel
  - Remote Operations Control Center (ROCC)
- Automate reporting
- Integrate other data sources
  - Market Data
  - Substation Data
  - Revenue Meters
  - Drive train Condition Monitoring

NEXT STEPS

- Utilize online portal
- Setup PI Notifications
- Develop KPI's
- Continue to Standardize
  - Tag Configuration
  - Module Database/AF
  - Software Versions, etc…)
- Improve & Expand Communication with 3rd Parties using PI

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Thank you