

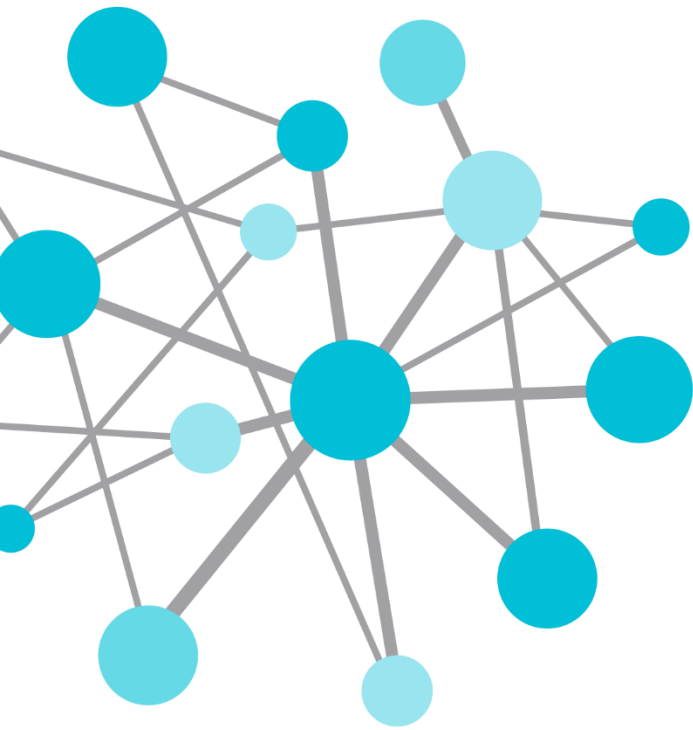
OSIsoft®

FEDERAL WORKSHOP 2014

The **Power** of **Data**

DECISION READY IN REAL-TIME

October 29, 2014 - Washington, DC



Shared Situational Awareness for US Nuclear Emergency Planning, Preparedness and Response (EP)

Presented by **Chris Crosby**

US Federal -- Global Nuclear and Renewable Energy

OSIsoft

Agenda

- Some Philosophy
- OSIssoft in Nuclear Context
- Security and Cybersecurity
- US Nuclear EP Story
 - Exelon EP
 - Industry ERDS
 - NRC ERDS

Situational Awareness Defined

“Continuous extraction of environmental information, integration of this information with previous knowledge to form a coherent mental picture, and the use of that picture in directing further perception and anticipating future events.”

Banbury, S.P., Andre, A.D., and Croft, D.G.

“...the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future.”

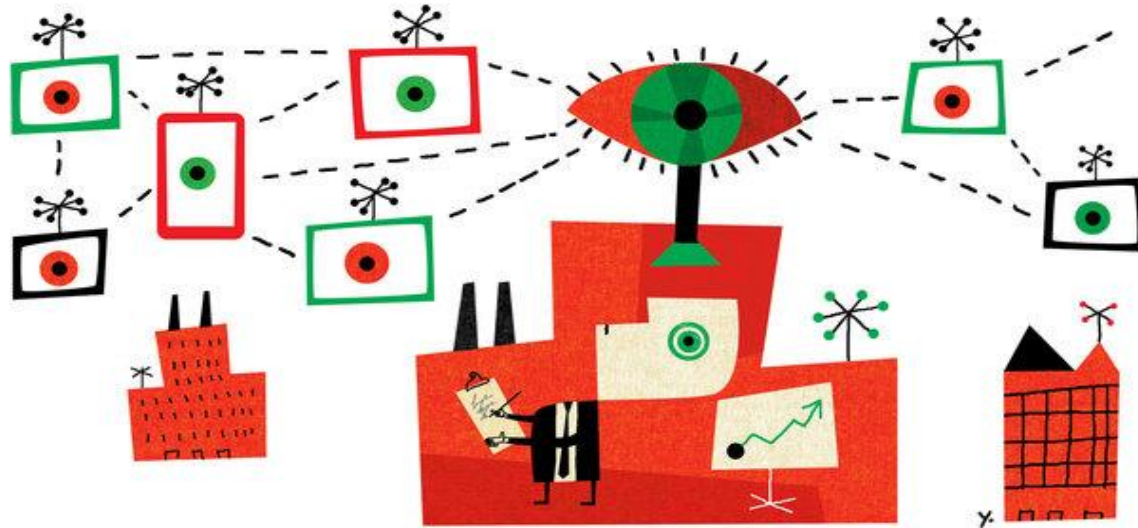
Endsley, M.R. (1988)



“Our mission is to maximize the VALUE our customers get from our product and services.”

“OSIsoft and the PI System exist to make you smarter, delivering operational intelligence.”

No Such Thing as Too Much Information



“Data Driven Decision Making Results in a Net Gain of 5 to 6 % on Output and Productivity.”

Reference: Brynjolfsson, et al., MIT, How does Data-Driven Decision making Affect Firm Performance, 2011.

<http://www.nytimes.com/2011/04/24/business/24unboxed.html>

“If you can’t measure it, you can’t manage it. If you can’t manage it, you can’t improve it.” Peter Drucker



Nuclear Power - The Safety View

“We need to work together--both domestically and internationally--to reduce the potential for another accident...I believe industry should consider international cooperation and essential component of ensuring nuclear safety.”

by

Allison Macfarlane, NRC Chairman

OSIsoft is Committed to the Nuclear Energy Industry



- Chris Crosby -- 34+ Years Nuclear Energy and Utility Experience
 - 20 years at Duke Energy -- Nuclear Scientist
 - 5+ years: at Various Technology Consulting and Services Companies
 - 5 years: at Life Cycle Engineering -- Operational and Reliability Excellence
 - 3 years: at OSIsoft -- Global Nuclear Energy Principal
- Keith Pierce -- 33+ Years Nuclear Energy and PI System Consultant and Architect
 - 10 years at APS Palo Verde Nuclear Station -- Digital Systems Engineer
 - 10 years at PSE&G Salem and Hope Creek -- IT Architect
 - 13 years+ Various Technology Consulting and Utility Companies, Including OSIsoft -- Solutions Architect; Center of Excellence Engineer
- Pablo Benvenuto -- 22+ Years Nuclear Energy, US NRC Inspector and Learning Experience
 - 2 years as a software specialist
 - 9 years in the US Nuclear Navy -- Nuclear Instructor and Engineer Duty Officer
 - 3.5 years at US Nuclear Regulatory Commission -- Resident Inspector
 - 1 year at Arizona Public Service Palo Verde NPP -- Nuclear Engineer
 - 6 years at OSIsoft as Learning Lead

OSIsoft Selected Nuclear Energy Experience

Reactors

- Global Operating - 178 of 434 (41%)
- USA - 75 of 100 (75%)
- Canada - 17 of 17
- United Kingdom - 17 of 18
- Korea - 23 of 23
- China - 18 of 43
 - 10 of 17 (Operable)
 - 4 of 26 (Under Construction); 6 more (Under Construction) expected 2014
- KEPCO APR 1400 -- incorporated in Standard Design
- mPower -- Small Modular Reactor Test Facility
- Westinghouse AP1000 -- offered as firm option to current customers (1st China customer has purchased)
- Russian VVER-TO -- proposed on standard design for Turkey and standardizing domestic reactors

Nuclear Fuel Cycle (Selected Examples)

23 Companies Outside Reactor Segment

- R&D -- Canadian Research
- Regulator -- US Nuclear Regulatory Commission (US NRC)
- Mining -- Cameco
- Fuel Processing and Fabrication -- Japan Nuclear Fuel, Westinghouse Nuclear Fuels, B&W Nuclear Fuels, Global Nuclear Fuels, Areva Melox
- Waste Processing -- Savannah River Nuclear Solutions, Washington River Protection Solutions (Hanford), Oak Ridge National Labs

Making Nuclear Energy Safer with the PI System

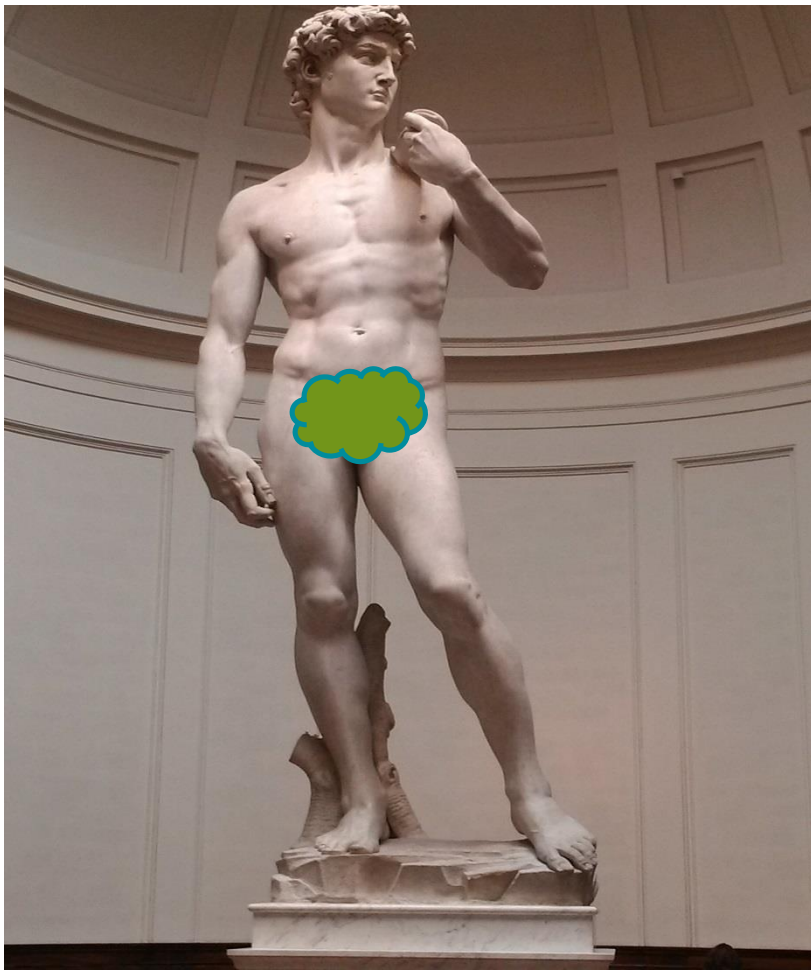
- Situational Awareness
- Operational Excellence
- Reliability Excellence
- Emergency Preparedness, Planning and Response
- Licensing
- Software Security
- Partnering with Cyber Security Infrastructure
- Advanced Reactor Designs
- Processing High-level Waste
- Supporting All Segments of Fuel Cycle



Representative Nuclear Use Cases

- System Engineer Desktop
- System Monitoring and Reporting Tool (SMART)
- Safety Parameter Display System (SPDS)
- Used Fuel Pool Level Monitoring
- Environmental/Radiological Emissions Monitoring
- **Emergency Preparedness, Planning & Response**
- Unit Start-up and Shutdown
- Conditioned-based Maintenance
- Advanced on-line Monitoring/Pattern Recognition
- Nuclear Liquid Waste Processing





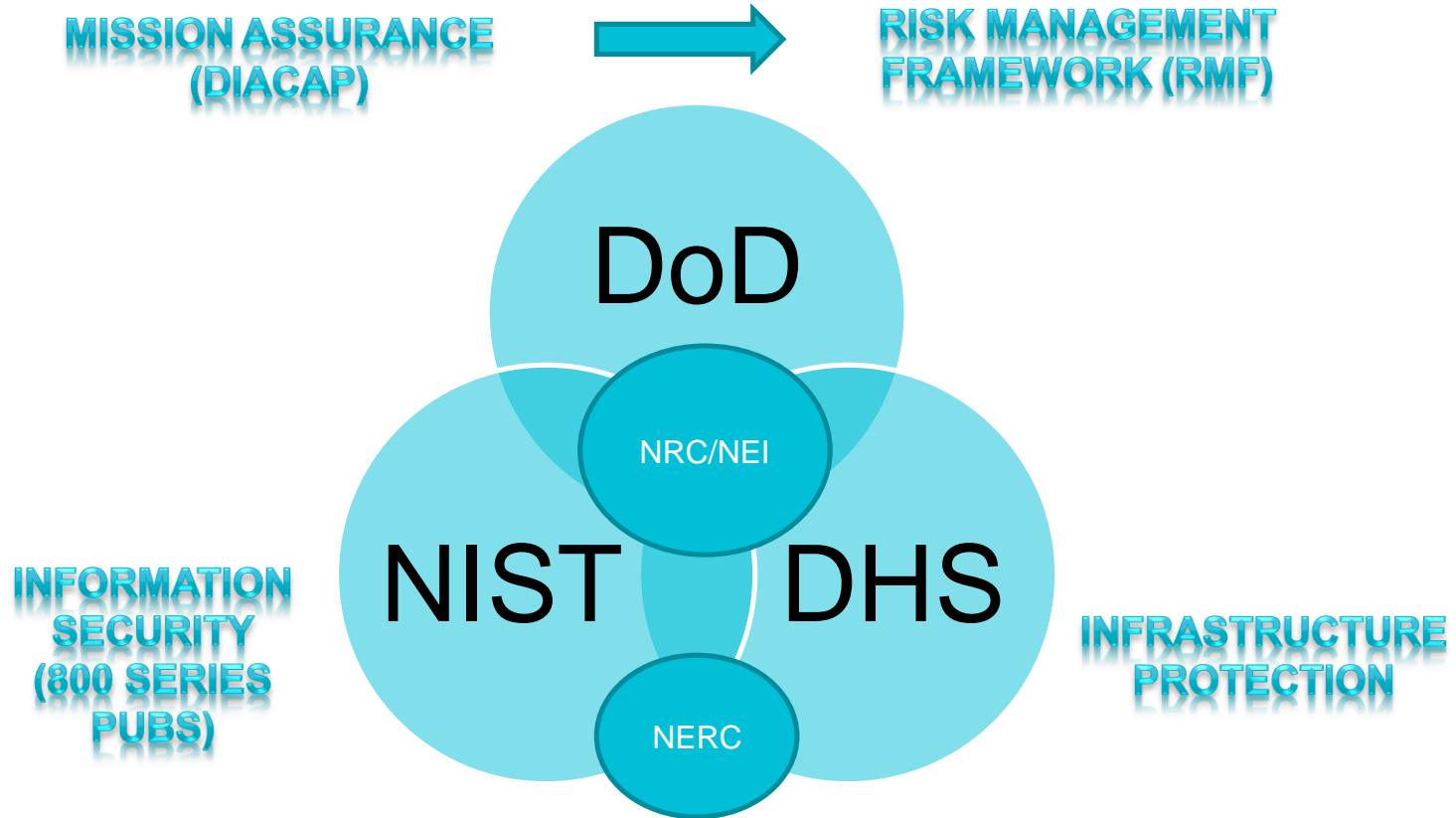
The Story of David and Goliath

OSIsoft and PI System Security

- OSIsoft “gets” security
 - OSIsoft is **NOT** a compliance consulting or security solutions company, but we do “get” security...
 - Collaboration with
 - Homeland Security
 - Department of Energy Labs (INL)
 - Microsoft (Security Development Lifecycle (SDL) and Security ACE team)
 - Infrastructure partners
 - Many large, experienced customers
- Regulations and standards – **supports** compliance (not **insures** it)
 - **10CFR73.54** -- “Protection of digital computer and communication systems and networks”
 - **NRC Reg. Guide 5.71** -- “Cyber security programs for nuclear facilities”
 - **NIST 800-53** -- “Recommended security controls for federal information systems”
 - **NIST 800-82** -- “Industrial control system security”
 - **NEI 08-09** -- “Cyber security plan for nuclear power reactors”
 - **DHS Control Systems Security Program** -- “Secure architecture design”



Strategic Security Standards

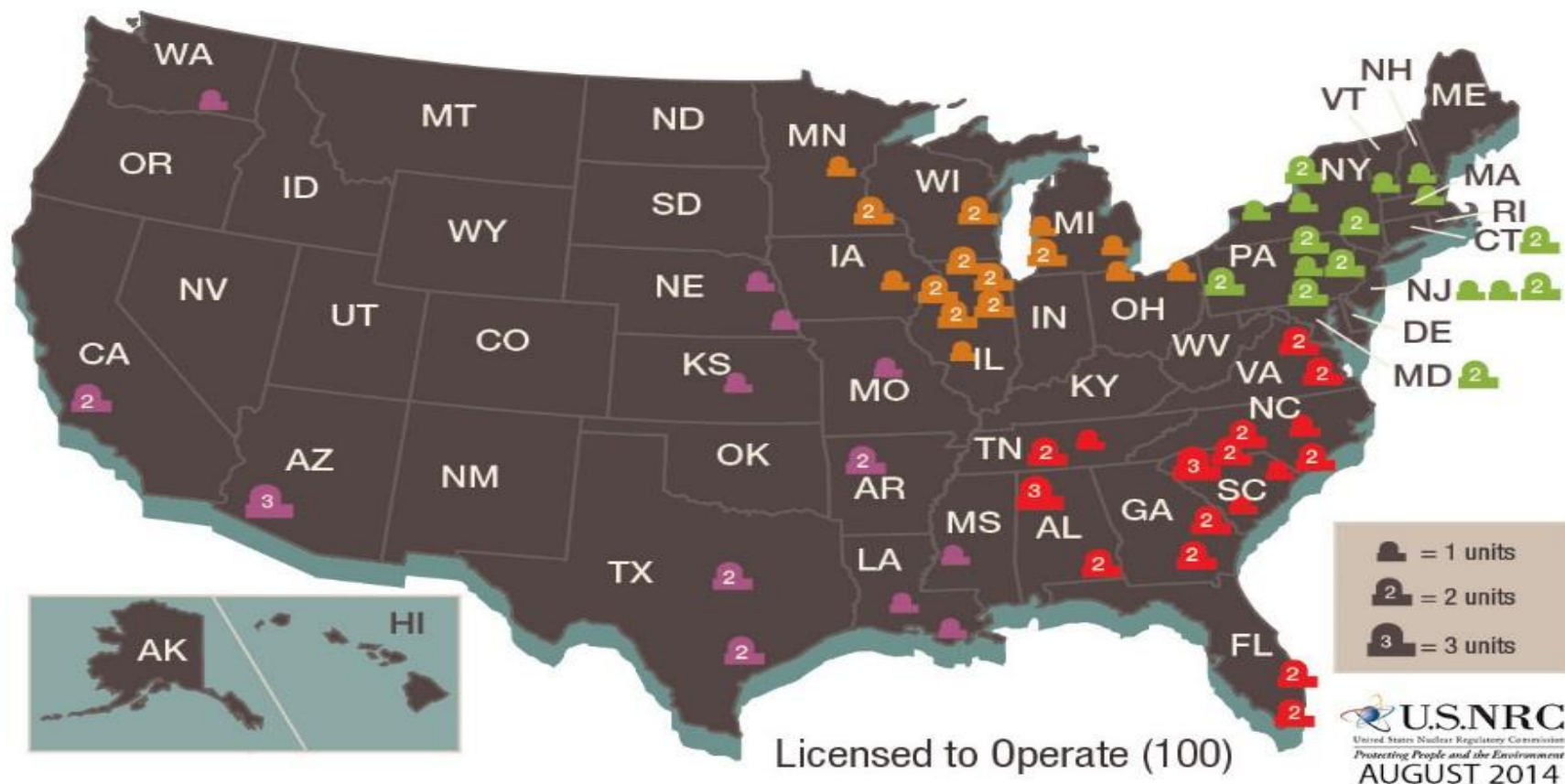


OSIsoft Security Partners

- Data Diodes /Unidirectional Gateways
 - Waterfall
 - Owl
 - FoxIT
 - BEA
- McAfee (Intel)
 - Security Information and Event Management (SIEM)
 - Consulting
- Alert Enterprises
 - Software across IT infrastructure
 - Consulting
 - Physical Security Solution



U.S. Operating Commercial Nuclear Power Reactors



Exelon Nuclear & NRC Incident Response Center



Operating Plants in 5 States

- Control room and EOF
- Regional HQ EOF IL and PA

Bethesda, MD
100 operating plants connected

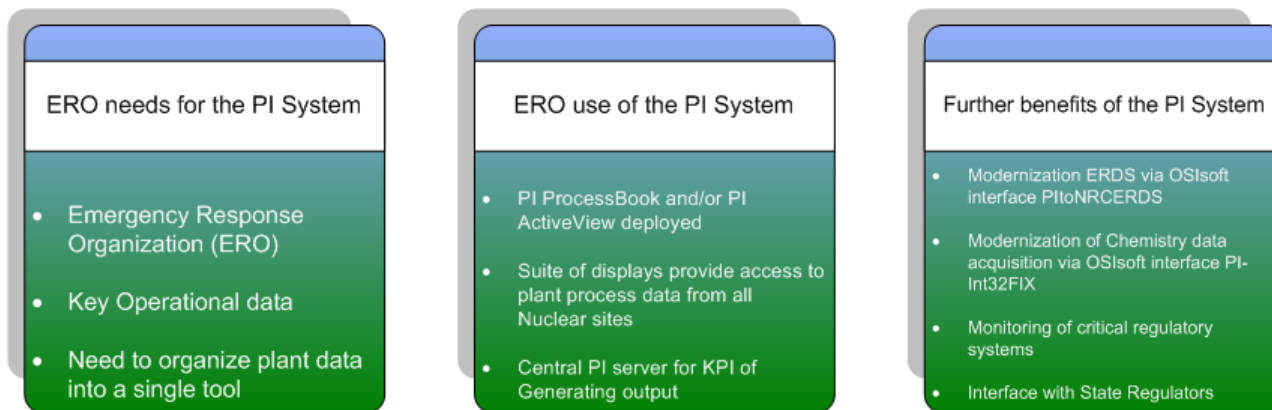


About Exelon

- Exelon Corporation Headquartered in Chicago has operations and business activities in 47 states, the District of Columbia and Canada.
- Exelon owns 34,600 MW of generating capacity.
- Exelon Nuclear, a division of Exelon Generation, operates the largest fleet of nuclear plants in the nation - >19,000MW. The fleet consists of 23 reactors at 14 locations in Illinois, Maryland, Nebraska, New Jersey, New York, and Pennsylvania.
- Exelon Nuclear also operates Fort Calhoun Station, owned by Omaha Public Power District, in Nebraska, and has ownership interest in PSEG's Salem Generating Station in New Jersey.

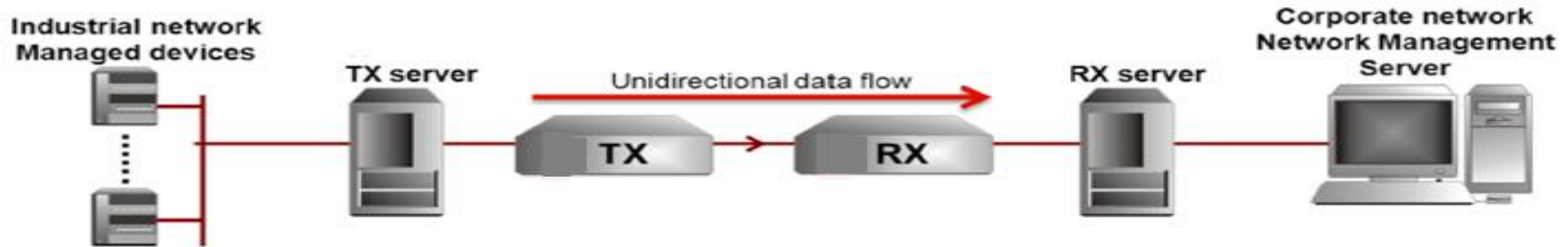
OSI PI at Exelon Nuclear

- PI servers deployed at:
 - Generating Stations in 2 Operating Regions (MidWest in IL, MidAtlantic in PA)
 - Generating Stations from acquisition of Constellation Energy Group
 - Nuclear Corporate offices in IL and PA
 - Decommissioned Zion Generating Station
- PI server in the Process Computer network for data acquisition and interface to DAQ hardware
- PI server outside the Process Computer network for plant access and general user interaction
- User interaction with the PI System via PI ProcessBook, PI ActiveView and PI Datalink (Piloting PI Coresight)

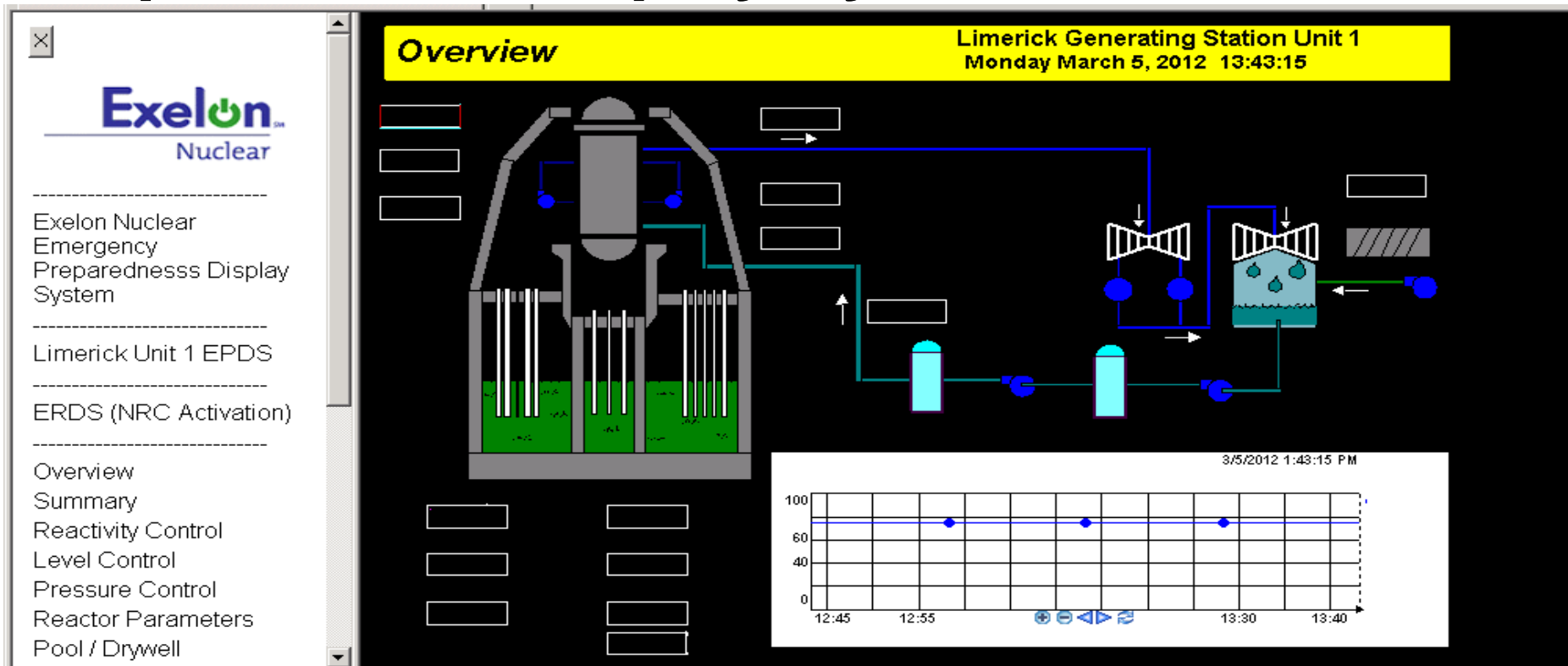


Exelon Nuclear -- Cyber Security

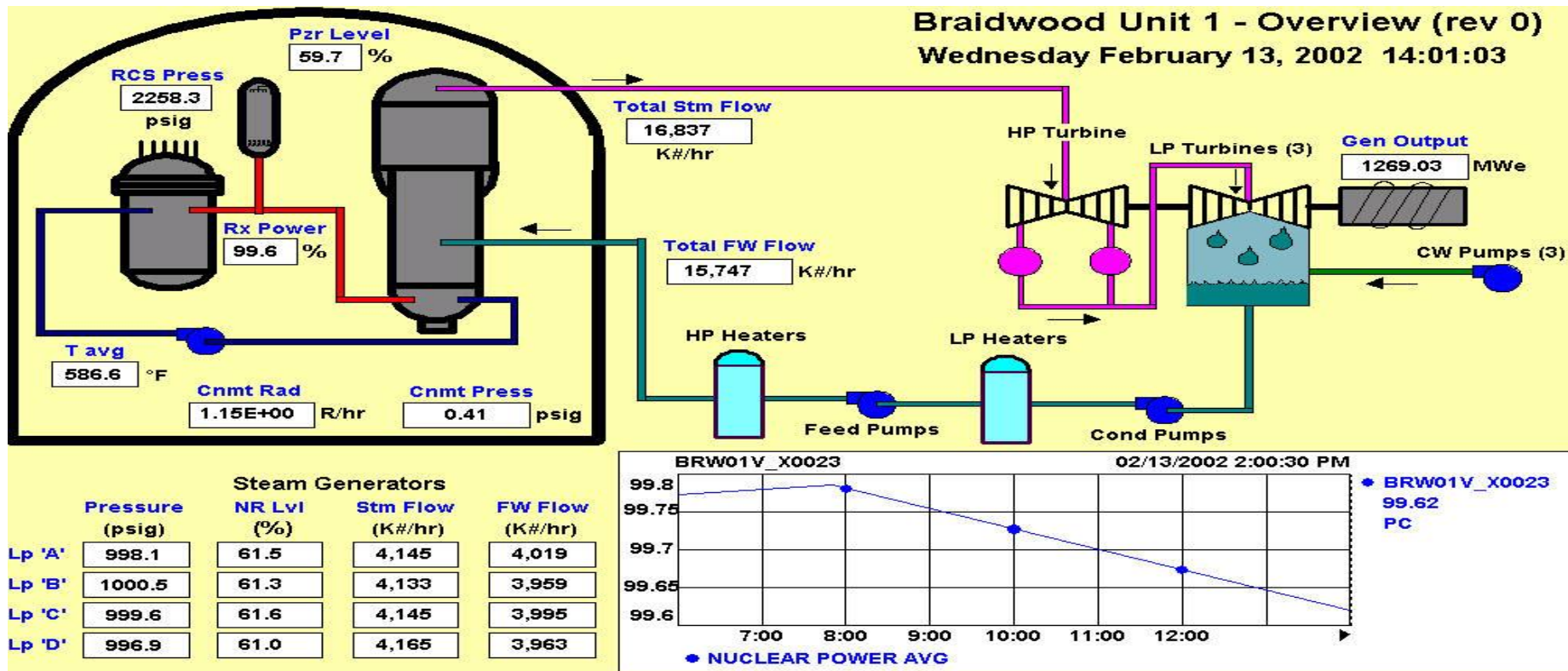
- Exelon Nuclear completed installations of unidirectional network devices, or Data Diodes, at all 10 Nuclear sites to isolate the real-time process network
 - 10 CFR 73.54
 - NEI 08-09
 - Reg. Guide 5.71
- PI servers were replicated outside the Process network
 - The Diode channels PULL data from process network PI and push to business network PI. When the Diode channels start, the Diode stream waits for a new value to be received in the L3 PI server for all points matching the associated pointsource for that channel.



Exelon Mid-Atlantic Emergency Preparedness Display System – Limerick

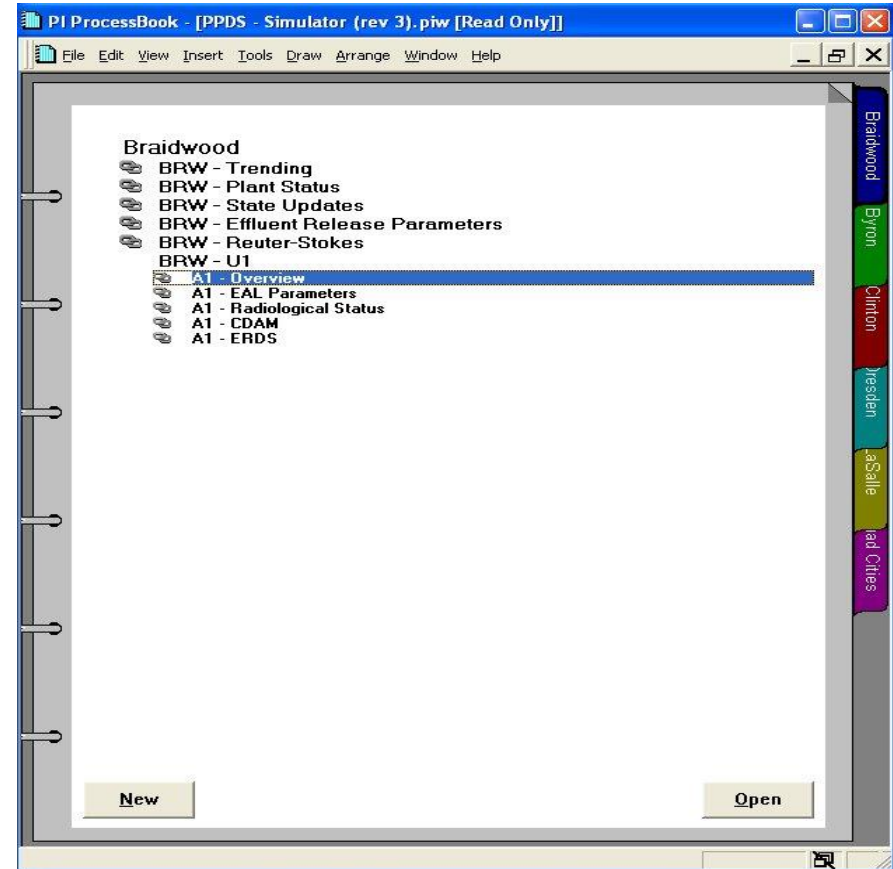


Exelon Nuclear -- PWR Overview

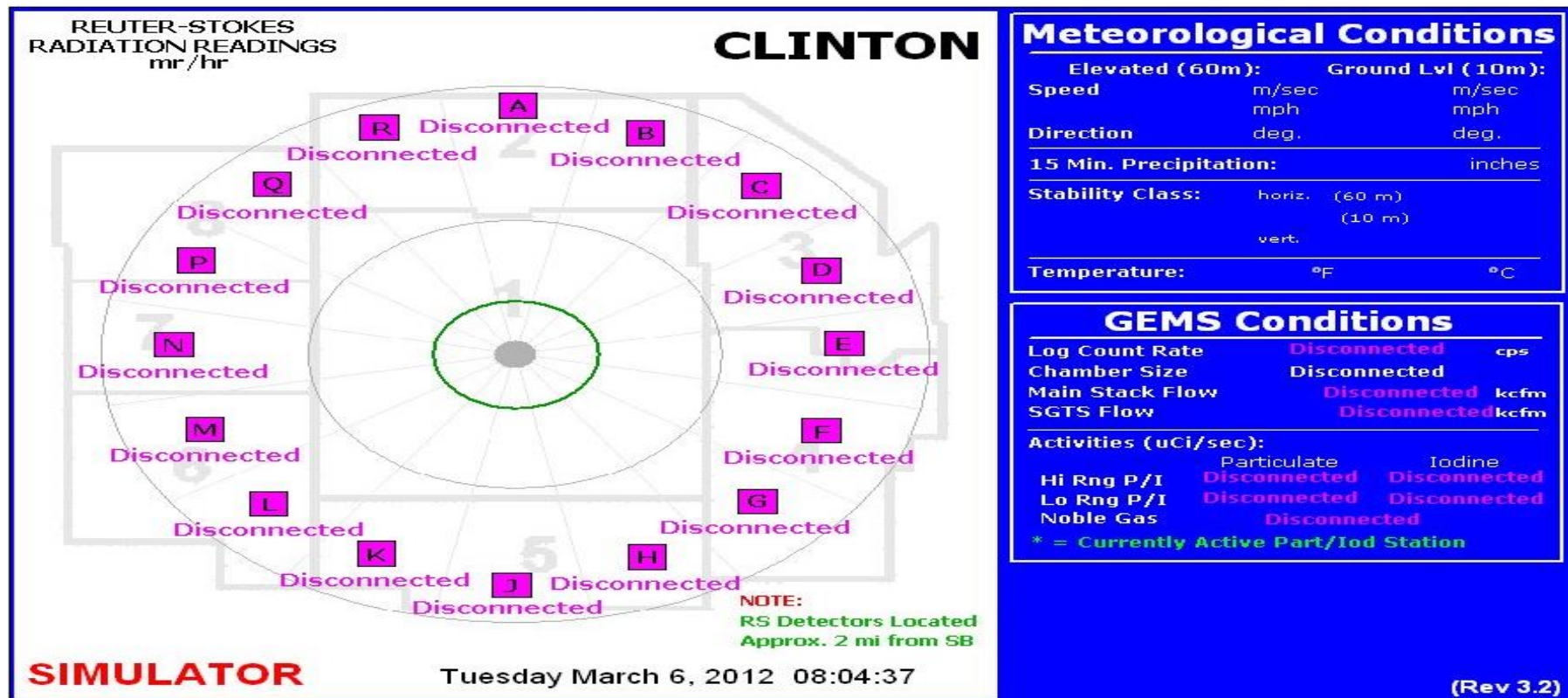


Exelon Nuclear -- Mid-West Plant Parameter Display System

- PI ProcessBook displays for all 6 sites stored at each Nuclear Station...accessed over internal network
 - Unit-specific data related to Core, Radiological, and Emergency Alert Level status
 - All Mid-West sites have copies of each station's PPDS Suite for additional support and analysis if needed
- ✓ Interfaces with the plant simulator for ERO drills



Illinois Emergency Management Agency Radiation Detectors (MD and PA Too)



(Rev 3.2)

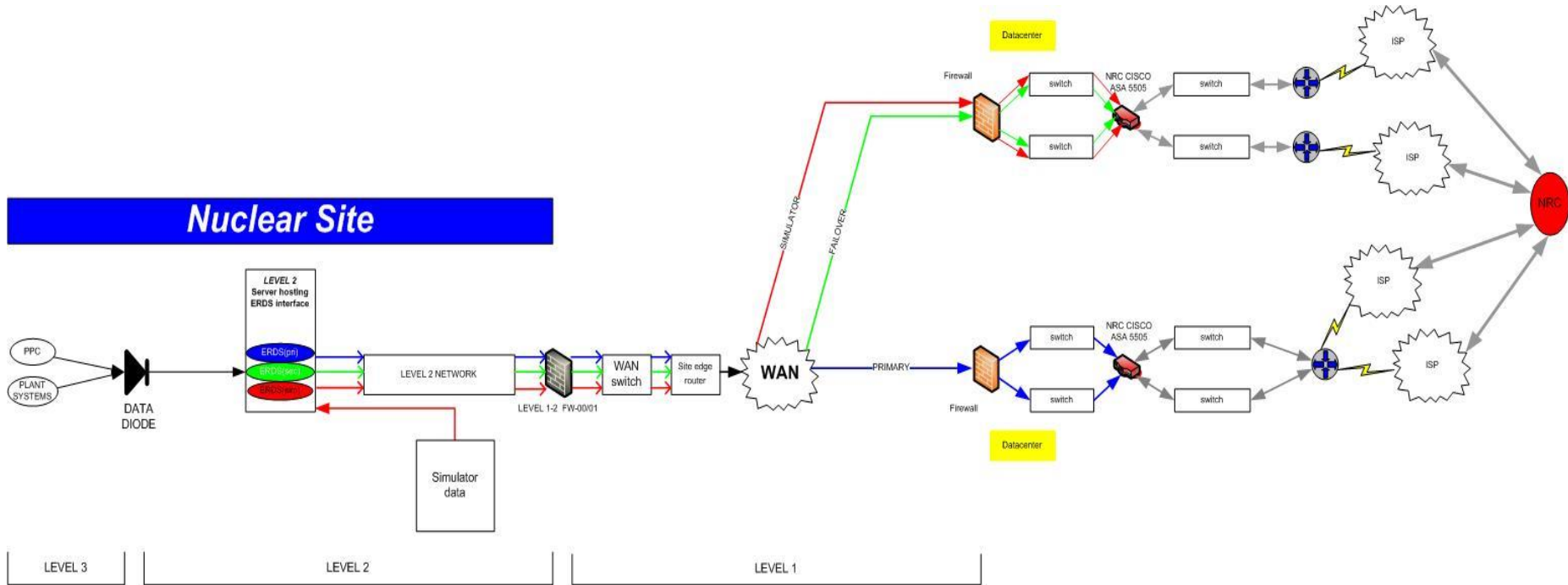
Exelon Nuclear -- ERDS Modernization Project

- Emergency Response Data System (ERDS)
- Pilot program started in 2008
- Legacy ERDS software was modified to use TCP/IP code to communicate to NRC VPN hardware
- Modernize the modem-based ERDS to internet-based communication for both Plant and Simulator data
- NITSL spec for modernized ERDS software sent to industry and OSIsoft responded with the PItoNRCERDS interface.
- The PItoNRCERDS interface sends Plant data from each site's PI system to the NRC ERDS Monitoring Desk.
- This interface makes a network connection thru the Exelon WAN to the Nuclear Regulatory Commission owned VPN switch which creates a secure VPN tunnel for data transmission.
- The Interface is continuously (24x7) transmitting data to the NRC.

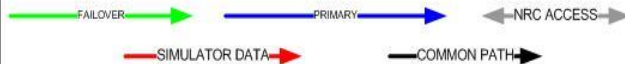


Exelon Nuclear – ERDS Modernization

Nuclear Site



LEGEND



Exelon

DWG TITLE:

DWG NO: 1

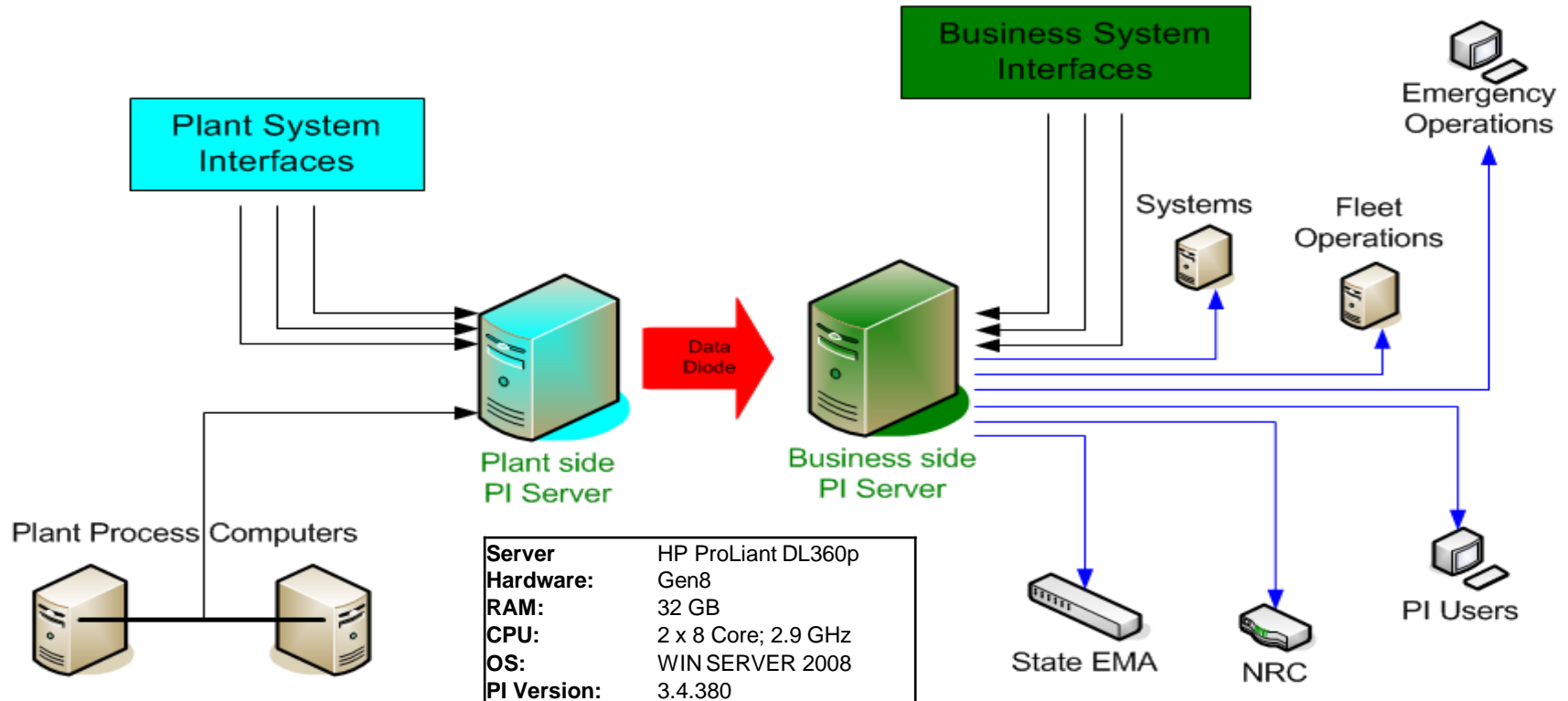
ENG NAME:

CREATION DATE:

RELATED DWG'S: None

REV DATE:

Exelon IT Architecture/Nuclear Plant (PI)



US NRC Emergency Response Data System (ERDS)

U.S. Nuclear Regulatory Commission (NRC)

- License / regulate civilian use of nuclear materials
 - 104 U.S. commercial nuclear power plants
- Incident response
 - Staff ready to respond
 - Monitor plant protective actions and mitigation strategies
- Emergency Response Data System (ERDS) used to receive plant data

US NRC ERDS Background

Emergency Response Data System (ERDS)

- NRC requirement of licensed nuclear power plants
- NUREG-1394 defines
 - ERDS protocol
 - Data Point Library (DPL) and Plant Attribute Library (PAL) files
 - Both sent by nuclear power plant to NRC
 - DPL is metadata about real-time data sent to ERDS
 - PAL is information about the connecting utility process computer and contact information.
- Actively receives near real-time Data
 - Quarterly Testing
 - Plant drills
 - Incidents
- Viewed by two different types of users
 - NRC Incident Response staff
 - State Regulators

US NRC Enterprise Customer

Complete OSIsoft Solution OSIsoft Software and Services used

- HA Replicated PI Servers
 - Allows NRC to keep the system online while doing software updates (patches, etc.)
 - No downtime for system maintenance!!!
- PI Module Database
- ProcessBook
- PI Webparts (PI Graphics)
- Custom Interface for ERDS protocol
- Enterprise Agreement (EA)
- Center of Excellence (CoE)

Federal and State Users

Users

- **NRC Incident Response Staff**
 - Connected to the NRC WAN
 - ProcessBook easily used
 - Allowed access to all 104 nuclear power plants
- **State Regulators**
 - Not connected to the NRC WAN.
 - Only allowed access to some nuclear power plants
 - within their state
 - in close proximity to their state's border.

US NRC ERDS Results

Results

- **Productivity** – More plants can connect at a given time – More can be monitored at once.
- **Visibility** – NRC supervision has recognized this system as a key tool in emergency response
- **Security** – Replacement System is much more secure than the original system.
- **Reliability** – Redundancy of servers has provided for a VERY reliable system (High Availability)
- **Compliance** – System was able to comply with stringent government (FISMA) security compliance as well as passing the NIST DISA Gold scan

US NRC ERDS Display

GENERIC BWR - ALL

- OVERVIEW
- CSF
- RAD
- MET
- ALL
- MANUAL
- ADHOC

1/19/2010 2:53:36 PM
HQ TIME
ACTUAL

NO_ERDS
SITE TIME

COND_AE_RAD1
CR_SPRAY_FL1
CR_SPRAY_FL2
CST_LEVEL1
DW_PRESS1
DW_RAD1
DW_RAD2x
DW_TEMP1
EFF_GAS_RAD1
H2_CONC1
HPCI_FLOW
LPCI_FLOW1
LPCI_FLOW2
MAIN_FD_FLW1
MN_STM_RAD1
MN_STM_RAD2
MN_STM_RAD3
MN_STM_RAD4
NI_INTER_RNG
NI_POWER_RNG
NI_SOURC_RNG

NO_ERDS
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NO_ERDS

O2_CONC
RCIC_FLOW1
RCS_PRESSURE
REAC_VES_LV1
REAL_SIM
SP_LEVEL1
SP_TEMP1
STAB_CLASS1
STAB_CLASS2
STAB_CLASS3
WIND_DIR1
WIND_DIR2
WIND_DIR3
WIND_SPEED1
WIND_SPEED2
WIND_SPEED3

NO_ERDS
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ACTUAL
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NO_ERDS

US NRC ERDS BWR Overview

GENERIC BWR - Overview

2/10/2010 7:43:10 AM

SITE TIME

OVERVIEW

CSF

RAD

MET

ALL

MAINTUAL

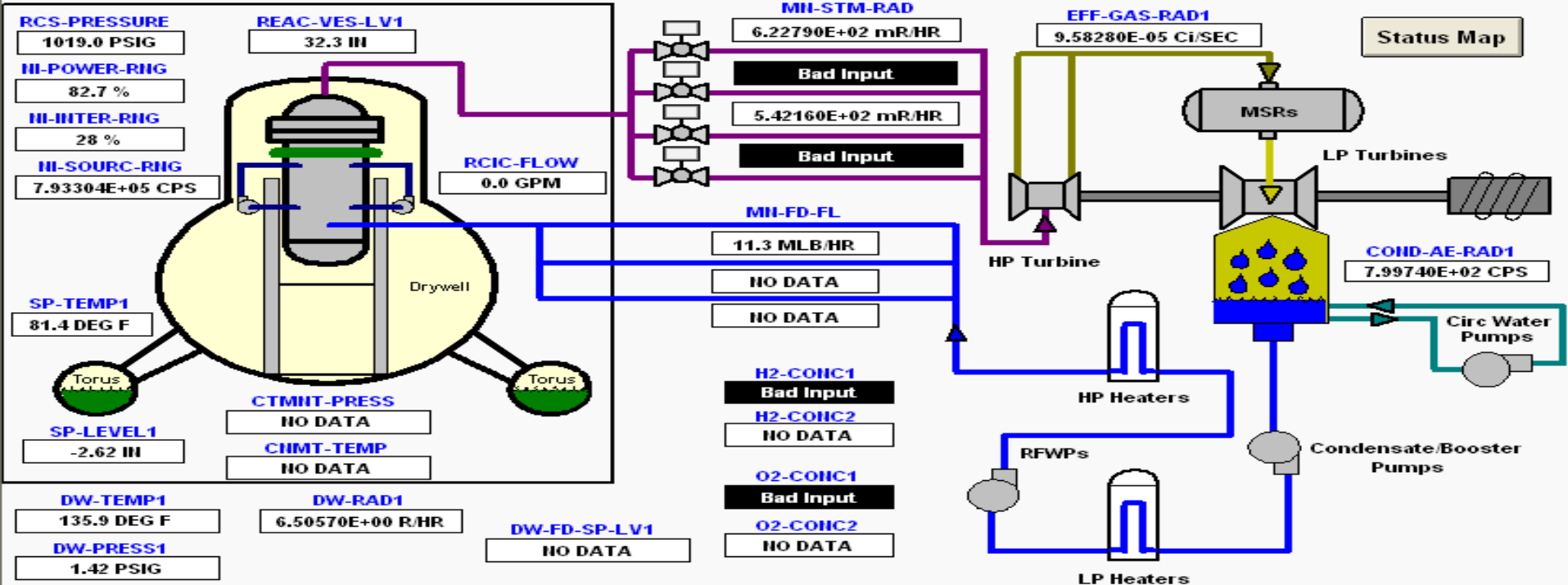
ADHOC

2/10/2010 8:43:14 AM

HQ TIME

SIMULATED

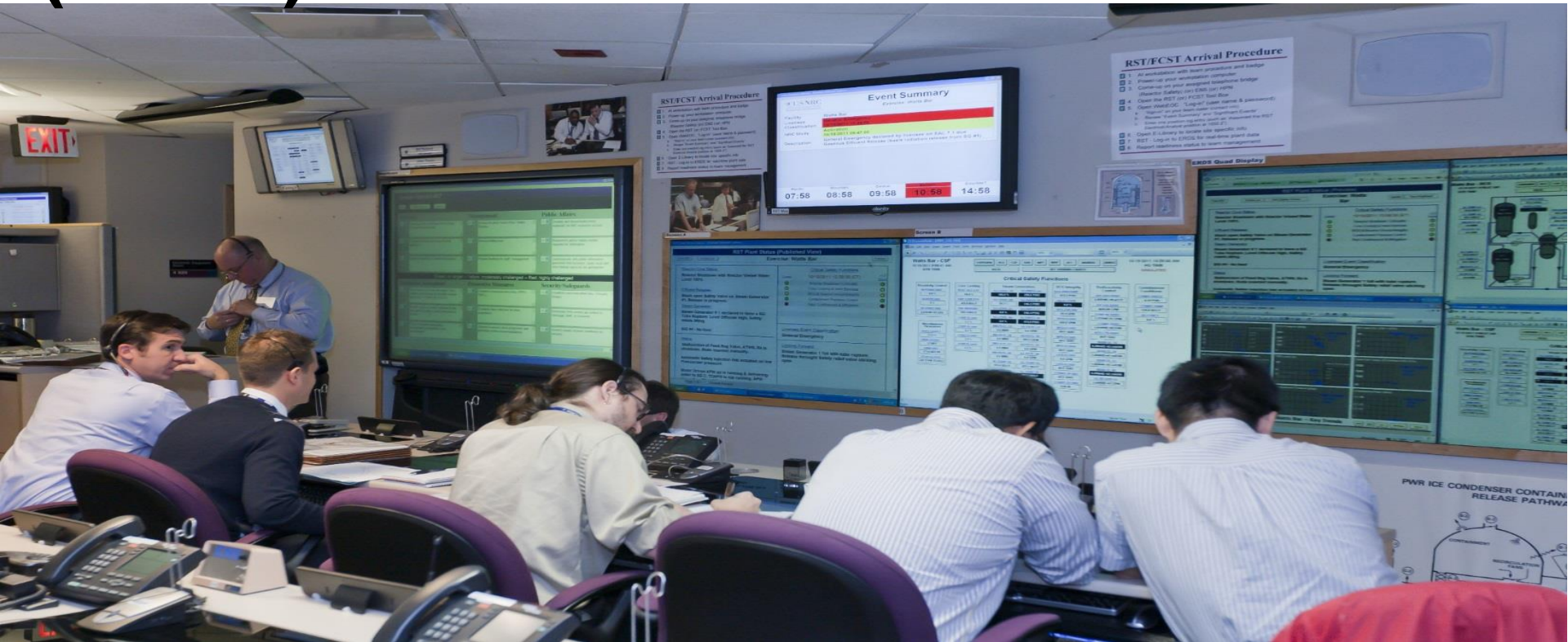
Status Map



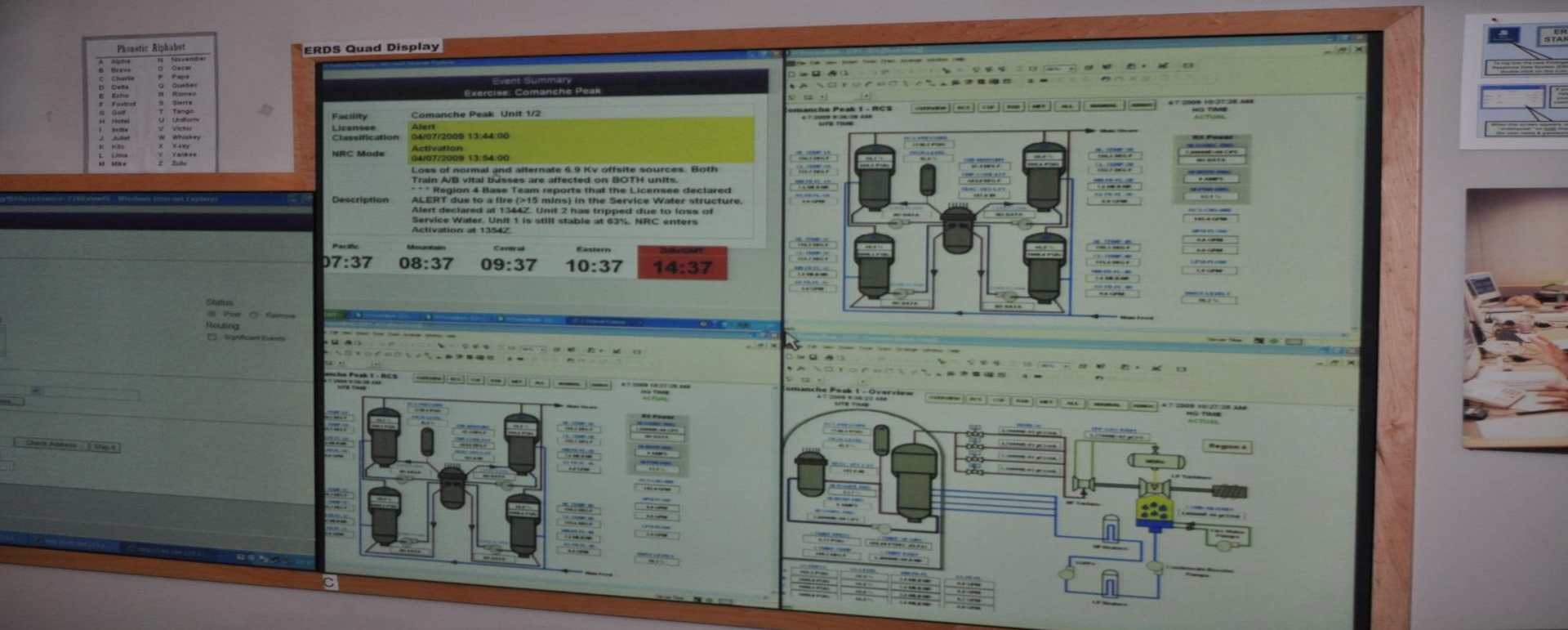
US NRC Incident Response Center (ERDS) – Millstone 2010 Drill



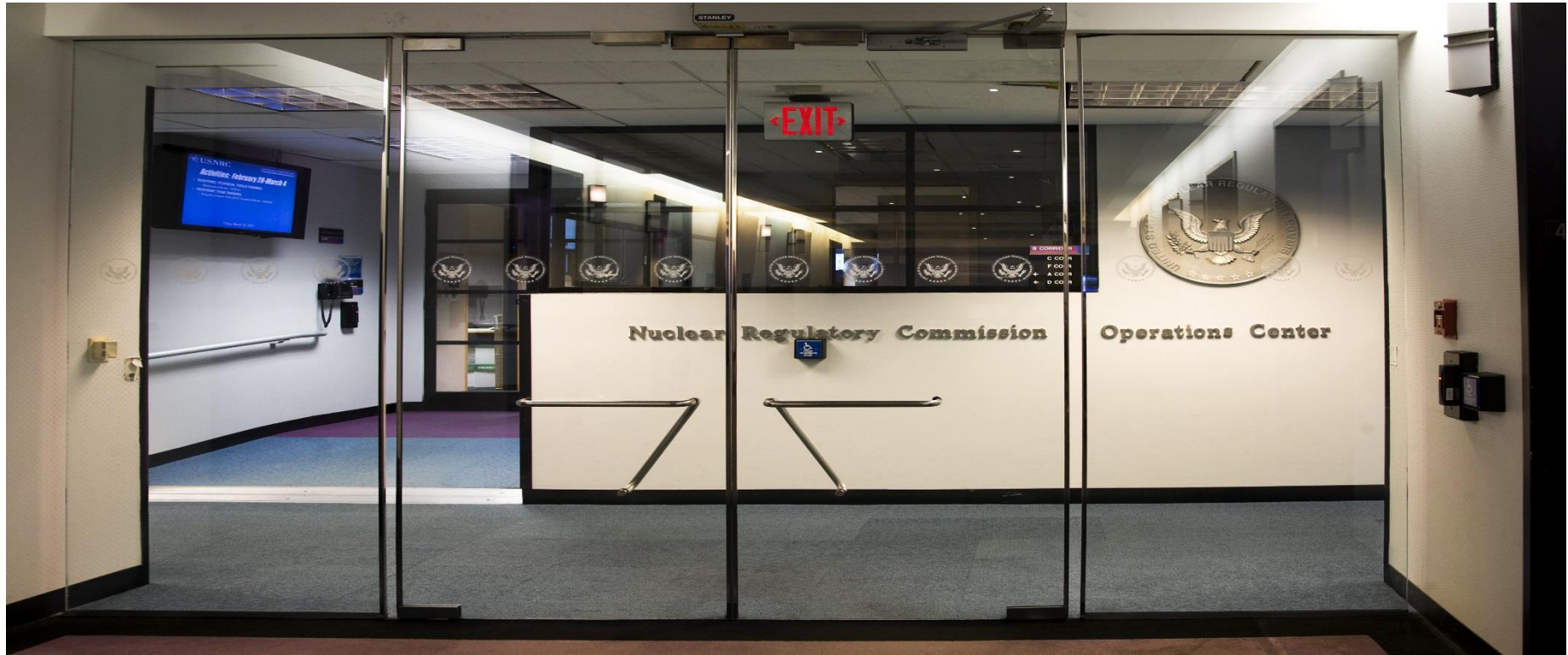
US NRC Incident Response Center (ERDS) – Watts Bar 2011 Drill



US NRC Incident Response Center (ERDS) – Comanche Peak



US NRC Operations Center





Rick Hasselberg – The Pi Guy



Process Book Displays



Maps?



US NRC ERDS Status

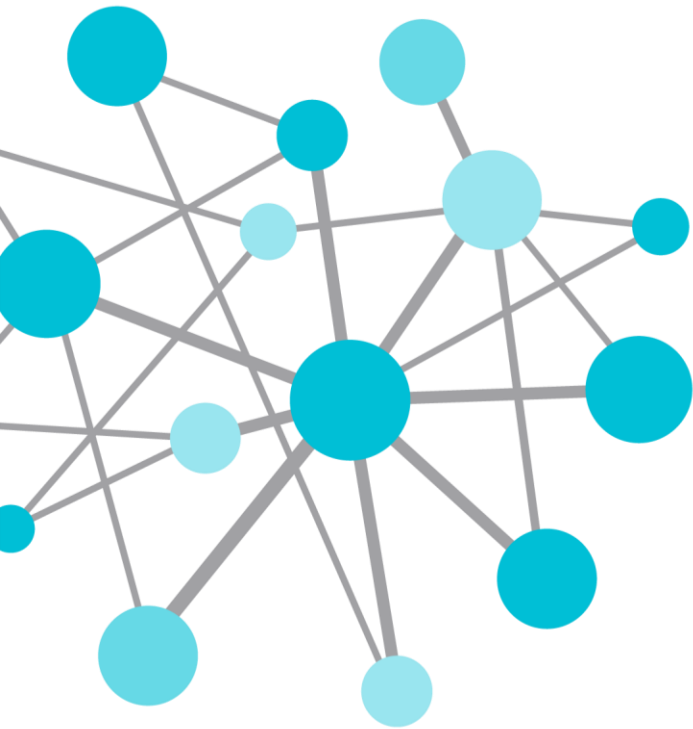
- ERDS PI System technologies upgraded to latest (most secure) versions
- As of end of 2012, 100% of US reactors connected to ERDS via secure VPN
- As of end of 2013, 50% of US reactors providing data to ERDS 24x7
- Increasing the number of data streams being provided is being considered
- Integrating real-time reactor data with weather, plume and other geo-special data (ESRI) is being considered
- Actively pursuing both Canadian (CNSC) and Japanese (NRA) ERDS-like initiatives

Key Takeaways

- Sharing knowledge and best practices with partners and customers is key to our success
- Real-time data infrastructure is required to meet any objective to create real-time shared, situational awareness
- Real-time data can be securely replicated from industrial control system networks or critical assets (exposing the data to various user groups; while enabling network protection)
- OSIsoft partners with some of those most knowledgeable and experienced application providers, cyber infrastructure providers and system integrators in the real-time space
- OSIsoft's continued investment in software security and cybersecurity provides significant advantages and enables safe, reliable and efficient operations
- Unidirectional Security Gateways/Data Didoes is an accepted method to meet US NRC nuclear cybersecurity requirements for network protection (high assurance, one way deterministic data flow)...and may be applicable in other situations requiring network protection
- Integration of time and space with the PI Integrator for ESRI ArcGIS will be game changing for the EP space

“The greater danger for most of us is not that our aim is too high and we miss it, but that it is too low and we reach it.” Michelangelo

Real-time shared, situational awareness is doable, today...and will only get easier and more effective with geospatial integration.



THANK
YOU

Brought to you by  **OSI**soft.



Chris Crosby



- Principle - US Federal; Global Nuclear and Renewable Energy
- ccrosby@osisoft.com

