Real Time Information — Currency of the New Decade

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Emergency Response Data System (ERDS) Replacement for the U.S. Nuclear Regulatory Commission (NRC)

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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
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
ERDS Replacement

• Motivation
  – Antiquated system – 1985 vintage
  – Hardware support discontinued

• Needs
  – Short delivery timeframe
  – Limit impact on 104 nuclear power plants at 65 sites
  – Phase I existing modem connection with ERDS protocol
  – Phase II VPN connection secured by certificate

• Software vendor selection meets all NRC prerequisites and compliance standards

• Project Performance Corporation selected as prime contractor to provide a solution and architecture design
Project Performance Corporation (PPC)

- Management and IT consulting firm founded 18 years ago
- Headquartered in McLean, VA
- Germantown, MD office supports NRC
- Diverse business base
- Awarded CMMI Maturity Level 3 rating and ISO 9001:2008-registered
ERDS Background

- 1985 vintage
- Replacement parts very hard to find
- Many software limitations
- Need for modern technology that would be readily available
- Design only allowed a small number of plants to be connected at once via modem pool
Major Challenges

• State Regulators need connectivity
• Need similar interface for both NRC and State Regulators
• Users located at multiple facilities
• Verify that the data being sent is the same data that is being displayed – Need easier way to tell when a plant is disconnected.
High Availability Solution

• NRC stores and presents data from nuclear power plants for the purpose of review and analysis
  – All 104 NRC licensed commercial nuclear power plants can be displayed
• Provided two phase approach to modernize the hardware and software for NRC
• Install OSIsoft PI High Availability and redundancy using PI Collective and Interface
• Leverage OSIsoft nuclear expertise and best practices to design solution
• Build for the possibility of continuous data feeds from all plants
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)
Infrastructure Layout and Architecture
PI System Overview
PPC Application Development

• VBA code on ProcessBook displays
  – Form for interface control (via output tags)
  – Form for manual data entry
  – Form to display DPL metadata in PI Module Database
  – Form to display PAL metadata in PI Module Database

• Applications for maintenance and day-to-day operations
  – DPL workflow Automation
  – GUI wrapper for command line tool

• Use of many ProcessBook Multi-State Symbols
Design for ProcessBook Displays

- Displays designed to be as generic as possible but still show needed information for each nuclear power plant.
- Meetings with NRC staff determined that they needed to differentiate between “good” data quality and any quality other than “good”
- Standardized each data point to show black text with white background to show “good” data quality
- White text with black background to show “other than good” data quality

<table>
<thead>
<tr>
<th>Good Quality</th>
<th>Other Than Good Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 GPM</td>
<td>14.9 DEG F</td>
</tr>
</tbody>
</table>
Main Reasons for Application Coding

- Two different types of users
  - NRC Incident Response Staff
    - Local/WAN users
  - State Regulators
    - Have a Memorandum of Understanding
    - Have remote access to the NRC PI system
- More than just the data in the PI Point Database and PI Archive needs storing, retrieval, and display
User Authentication Solutions

- PI WebParts zone modifications within SharePoint
- Microsoft Active Directory Rights Management and group creations for each State end user
- Shared network folder for image delivery for ProcessBook users
- SharePoint folder permissions for displays and automatic document protection integrated with A.D. groups
- VeriSign digital certificates required for HTTPS connectivity to the website
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.
PI-SMT Security Groups

• Set up groups in PI-SMT that are based on particular nuclear power plant.
  – Easy to automate creating security groups.

• Assign PI Point datagroup and pointgroup to the above name. (Using PI-SMT Add-In) Setting dataaccess and pointaccess to: o:rw g:r w:

• Add users that are allowed to “see” that plant to the group in PI-SMT and voila! Security allows the users to “see” only the plants they are supposed to see. All others appear as “No Data.”
Security Groups SharePoint

- Matching the naming convention in the Share Point web site allowed us to extend this model and provide default Share Point error messages that read Access not allowed.
- PI Trust table set up for each user in user database.
- Microsoft Active Directory Rights Management and group creations for each State and user.
- SharePoint folder permissions for displays and automatic document protection integrated with A.D. groups.
- VeriSign Digital Certificates for supporting two-factor user authentication.
# Manual Data Entry

## GENERIC BWR - Manual Data Entry

### STRING TAGS
- ENTER TAG DESCRIPTION (AND UNITS)
- ENTER TAG DESCRIPTION (AND UNITS)
- ENTER TAG DESCRIPTION (AND UNITS)
- ENTER TAG DESCRIPTION (AND UNITS)
- ENTER TAG DESCRIPTION (AND UNITS)
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- ENTER TAG DESCRIPTION (AND UNITS)
- ENTER TAG DESCRIPTION (AND UNITS)
- ENTER TAG DESCRIPTION (AND UNITS)

### VALUE TAGS
- No Data
- No Data
- No Data
- No Data
- No Data
- No Data
- No Data
- No Data
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- No Data
- No Data
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- No Data
- No Data
- No Data

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### Manual Data Entry Display

**Insert the Description (with units) and Value**

If necessary, enter the date and time.

```plaintext
<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>REACTOR VESSEL LEVEL (%)</td>
<td>100</td>
</tr>
<tr>
<td>ENTER TAG DESCRIPTION (AND UNITS)</td>
<td>NO DATA</td>
</tr>
<tr>
<td>ENTER TAG DESCRIPTION (AND UNITS)</td>
<td>NO DATA</td>
</tr>
<tr>
<td>ENTER TAG DESCRIPTION (AND UNITS)</td>
<td>NO DATA</td>
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<td>ENTER TAG DESCRIPTION (AND UNITS)</td>
<td>NO DATA</td>
</tr>
<tr>
<td>ENTER TAG DESCRIPTION (AND UNITS)</td>
<td>NO DATA</td>
</tr>
</tbody>
</table>

**Enter Site Date/Time**

DD/MM/YYYY HH:MM (SS optional) (24 Hour Time)

- **Use Current Time**
- **Enter SITE Date/Time** MM/DD/YYYY

**Update**
**Updated Manual Entry**

**STRING TAGS**

<table>
<thead>
<tr>
<th>Tag Description</th>
<th>Value Tags</th>
</tr>
</thead>
<tbody>
<tr>
<td>REACTOR VESSEL LEVEL (%)</td>
<td>100</td>
</tr>
<tr>
<td>ENTER TAG DESCRIPTION</td>
<td>No Data</td>
</tr>
<tr>
<td>ENTER TAG DESCRIPTION</td>
<td>No Data</td>
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<td>ENTER TAG DESCRIPTION</td>
<td>No Data</td>
</tr>
<tr>
<td>ENTER TAG DESCRIPTION</td>
<td>No Data</td>
</tr>
</tbody>
</table>

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## Generic BWR – “ALL” Display

<table>
<thead>
<tr>
<th>Generic BWR - ALL</th>
<th>Overview</th>
<th>CSF</th>
<th>RAD</th>
<th>MET</th>
<th>ALL</th>
<th>Manual</th>
<th>Adhoc</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO_ERDS</td>
<td>NO_ERDS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site Time</td>
<td>NO_ERDS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **COND_AE_RAD1**: NO_ERDS
- **CR_SPRAY_FL1**: NO_ERDS
- **CR_SPRAY_FL2**: NO_ERDS
- **CST_LEVEL1**: NO_ERDS
- **DW_PRESS1**: NO_ERDS
- **DW_RAD1**: NO_ERDS
- **DW_RAD2**: NO_ERDS
- **DW_TEMP1**: NO_ERDS
- **EFF_GAS_RAD1**: NO_ERDS
- **H2_CONC1**: NO_ERDS
- **HPCI_FLOW**: NO_ERDS
- **LPCI_FLOW**: NO_ERDS
- **LPCI_FLOW2**: NO_ERDS
- **MAIN_F0_FLOW1**: NO_ERDS
- **MN_STM_RAD1**: NO_ERDS
- **MN_STM_RAD2**: NO_ERDS
- **MN_STM_RAD3**: NO_ERDS
- **MN_STM_RAD4**: NO_ERDS
- **NI_INTER_RNG**: NO_ERDS
- **NI_POWER_RNG**: NO_ERDS
- **NI_SOURC_RNG**: NO_ERDS

- **O2_CONC**: NO_ERDS
- **RCIC_FLOW1**: NO_ERDS
- **RC5_PRESSURE**: NO_ERDS
- **REAC_VES_LV1**: NO_ERDS
- **REAL_SIM**: NO_ERDS
- **SP_LEVEL1**: NO_ERDS
- **SP_TEMP1**: NO_ERDS
- **STAB_CLASS1**: NO_ERDS
- **STAB_CLASS2**: NO_ERDS
- **STAB_CLASS3**: NO_ERDS
- **WIND_DIR1**: NO_ERDS
- **WIND_DIR2**: NO_ERDS
- **WIND_DIR3**: NO_ERDS
- **WIND_SPEED1**: NO_ERDS
- **WIND_SPEED2**: NO_ERDS
- **WIND_SPEED3**: NO_ERDS

**1/19/2010 2:53:36 PM**

**Actual**
ProcessBook Additional Information

• Needed the ability to display metadata for every transmitted data point.
• “ALL” display shows every transmitted data point.
• Custom code behind the form links to Module Database whenever blue text is double clicked to display metadata (stored in the PI Module Database) in a user form.
# Additional Info in Module Database

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERDS_PARM</td>
<td>WIND_SPEED1</td>
</tr>
<tr>
<td>CSF_CAT</td>
<td>MET</td>
</tr>
<tr>
<td>ERDS_DESC</td>
<td>WIND SPEED - UPPER LEVEL</td>
</tr>
<tr>
<td>FAIL_MODE</td>
<td>LOW</td>
</tr>
<tr>
<td>INST_MAX</td>
<td>50</td>
</tr>
<tr>
<td>INST_MIN</td>
<td>0</td>
</tr>
<tr>
<td>NUM_INPUT</td>
<td>1</td>
</tr>
<tr>
<td>POINT_ID</td>
<td>WSPEED</td>
</tr>
<tr>
<td>POINT_TYPE</td>
<td>A</td>
</tr>
<tr>
<td>PROC_DESC</td>
<td>N/A</td>
</tr>
<tr>
<td>PWR_OUT_OF</td>
<td>N/A</td>
</tr>
<tr>
<td>PWR_OUT_ON</td>
<td>N/A</td>
</tr>
<tr>
<td>REF_LEG</td>
<td>N/A</td>
</tr>
<tr>
<td>REF_NOTES</td>
<td>N/A</td>
</tr>
<tr>
<td>SET_INFO</td>
<td>NO ALARMS</td>
</tr>
<tr>
<td>SITE_DESC</td>
<td>AVERAGE WIND SPEED (25 MIN AVG)</td>
</tr>
<tr>
<td>SGNR_FLAG</td>
<td>S</td>
</tr>
<tr>
<td>SGNR_LOC</td>
<td>AT THE 100 METER LEVEL OF THE MET TOWER</td>
</tr>
<tr>
<td>SYS_DESC</td>
<td></td>
</tr>
<tr>
<td>TEMP_COMP</td>
<td>N</td>
</tr>
<tr>
<td>UNITS_CONV</td>
<td>N/A</td>
</tr>
<tr>
<td>UNITS_TAG</td>
<td>M/SEC</td>
</tr>
<tr>
<td>ZERO_REF</td>
<td>N/A</td>
</tr>
</tbody>
</table>

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Real Time Information — Currency of the New Decade
ProcessBook Interface Control

• PPC provided a ProcessBook display that controls each nuclear power plant’s connection to the system
ProcessBook Interface Control

- Needed the ability to control connections to the system
  - Mechanism to determine each plant’s interface connection – The interface number.
  - Ability to terminate existing plant’s connection at any time.
  - Ability to Deny, Suspend and Resume connections in Manual Mode.

- OSIsoft provided the UniInt based interface for the ERDS protocol
ProcessBook Interface Control

- Transmitting Data

Double click on interface number to bring up control form.
ProcessBook Interface Control

- Uses custom VBA code to terminate connections
PI Plant Simulator/Run Simulator

- OSIsoft created the PI Plant Simulator
  - “simulate” transmission from a nuclear power plant
  - command line application with no GUI
- PPC created a GUI wrapper for the command line application
  - allow users a simple way to run the simulator
    - training with a generic plant
    - specific plant using previously transmitted data.
Run Simulator

The image shows a window for running a simulator. The window contains fields for specifying the plant type, port, file, IP/node address, and command line arguments. The fields are filled with the following information:

- **Plant:** GENERIC BWR
- **Port:** 6401
- **Replay:** 5
- **Interval:** 5000
- **File:** C:sample1.txt
- **IP/Node Address:** LT-4838
- **Modify Time:**
- **Dial Modem:** unchecked
- **Cmd Line:**

```
"C:\PIPLANTSIMULATOR.EXE" /replay=5 /modifytime=1 /TZOffset=1 /interval=5000 /sport=6401 /plantfile="C:\sample1.txt" /tsaddress=LT-4838
```
Data Point Library (DPL) Workflow

• Licensees use DPL file to communicate to NRC metadata about the real-time data.
• Each DPL entry has information that is stored in the PI Point Database and the PI Module Database. Whenever this information changes, it is necessary to change it BOTH places so the information matches.
• Whenever a specific data point changes (PI TAG), All the ProcessBook displays that contain that point must be changed.
• PPC developed a PI SDK application to automate
  – updating the PI Point Database
  – updating the PI Module Database
  – updating the ProcessBook displays
DPL Maintenance
DPL Maintenance Functionality

- Creates Full/Partial DPL Listing (in Excel)
  - DPL file format defined by NRC regulation
- Compare PI configuration to DPL
  - Verify all DPL entries are in the PI Point Database
  - Verify that all points in the PI Point Database have DPL entries
- Create “Preset Data” files useful in testing the ProcessBook displays
DPL Maintenance Functionality (cont)

• Create “import” spreadsheet from corrected full DPL listing for use in the PI-SMT add in in Excel.
  – DPL Import - Used to create/modify the full PI Module Database DPL section that populates items for the “ALL” display.
  – PI TAG Import - For creating/modifying the PI Point database.
  – PAL_IMPORT - used to create/modify the Plant Attribute Library (PAL) section of the Module Database.

• Create an exact copy of a plant’s PI displays and log files with a new three character designation to make a training plant
  – Useful for training on a plant without affecting actual data
  – Eliminates the need for an additional PI Server for training
Modify Multi-State Symbol

• Modifies the Multi-State Symbol on all displays of the selected plant -
  – Change Unknown quality to look like good quality

  Good Quality
  0.0 GPM

  Other Than Good Quality
  14.9 DEG F

  – Change the Multi-State Symbol based on previously saved defaults
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.
Results (continued)

• **Availability** – System is designed to be available 24x7. OSIsoft has assisted with maintaining the system operation as close as possible.

• **Ease of Maintenance** –
  - Both the PI Point Database and the PI Module Database are updated at the same time keeping all configuration data synchronized.
  - By using the plant name as the security group, additional plants can be easily added.
  - Adding a plant can be automated.
  - System Maintenance is only performed once. No chance of erroneous information.
Tangible Benefits

• Retired aging hardware
  – Very expensive parts, hard to find.
• New technology applied
  – Existing ERDS protocol
  – Low impact on nuclear power plants
  – Same DPL file format
  – Seamless transfer to new system
• System allows more plants connected
• Remote Access
  – Very limited before
  – Now in place for many users
More Tangible Benefits

• Ability to show PI points configured but not defined by DPL file to be in the data stream
• Maintenance of PI Module Database and PI Point Database cut in half
Intangible Benefits

• Many more simultaneous user connections
• More secure ERDS connection
  – Phase II TCP/IP vs. Phase I modem
• DPL Workflow Automation
  – PI SDK Application
  • Update the PI Point Database
  • Update the PI Module Database
  • Update ProcessBook displays if necessary
• System is very easy to use despite being customized for 104 nuclear power plants.
Future Plans – Next Steps

• Complete Phase II Implementation for all nuclear power plants
• Reduce the number of displays (AF)
• Incorporate DataLink into system
• UPGRADE ProcessBook!
• Evolution of NRC towards receiving continuous data feeds
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Thank you