

2006 R\*Time Users Group Meeting

Prairie Island PPCS  
Replacement Project

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# Facility

- Prairie Island Nuclear Generating Plant (PINGP)
- Located in Welch, MN; SE of Twin Cities
- On the west bank of the Mississippi River
- Two-unit Westinghouse PWR
- Each unit is rated for 1,650 MWt
- Commercial Ops: Unit 1 - 1973, Unit 2 - 1974
- Owned by XCEL Energy (Minneapolis, MN)
- Operated by Nuclear Management Company (Hudson, WI)

# Overview of PPCS Project

- Entire PPCS for Unit 1, Unit 2 and Simulator replaced (HW, SW, HMI)
- Upgrade of DAS interface to PPCS
- Project justified through obsolescence and reliability
  - Failures caused entries into TRM LCO action statements, megawatt reduction, and additional operator logging
  - The reliability of the system put it on the sites top equipment issues list

# Project Timeline

- Data Concentrators replaced to address Y2K concerns - 1999
- Ill fated attempt at getting project approved - 2000
- Initial Specification Development - 2002
- Replacement Options Study – Fall 2002
- Final Specification Development – Spring 2003
- RFQ & Bid Evaluation – Summer 2003
- Project Approval Oct. 10th 2003, Contract Award in November
  - Final approval held pending additional dry cask storage
- Rush to order a majority of HW by end of 2003
- “Early Release” Turnover to Ops – February 4th, 2005
- U1, U2 & Sim FAT’s – Summer 2005
- Simulator Installation & SAT – July/August 2005
- Unit 1 Final Installation & SAT – December 5th - 15th, 2005
- Unit 2 Final Installation & SAT – January 11th - 18th, 2006
- Availability Test – March 4th - May 3rd, 2006

# Overview of Old PPCS

- Installed between 1985 and 1987
  - Vendor was SAIC (now DS&S), release 3
- Data Acquisition System (DAS)
  - CPI (now RTP) Dual IRCU's, 74xx series components
  - Single I/O landing in most cases, redundant signal beginning/ending at dual IRCU's
  - I/O from over 2500/2700 sensors through Remote Multiplexer Units (RMU) located throughout the facility
- Data Concentrators
  - Replaced in 1999 to resolve reliability, spare parts, and Year 2000 concerns, vendor DS&S
  - Redundant DEC Alpha 4000-5/533, OpenVMS V7.1

# Overview of Old PPCS – Continued

- Host Computers
  - Included all software for PMS, SPDS (SAS), NSSS, ERDS, etc.
  - Redundant Encore (Gould) 32/6780, MPX OS Release 3.4
- Simulator
  - Stimulated Unit 1
  - Simulated Unit 2, limited scope
- Display Equipment
  - Locations: Computer Room, Control Room, TSC, EOF, Backup EOF, Engineering Library, text only at other
  - Dedicated Satellite Display Stations (SDS)

# Special Interfaces

- Control Room
  - Single point plasma displays, three-pen analog recorders, LMM lights, some BOP/NSSS annunciators
- OSI PI
- NRC Emergency Response Data System (ERDS)
- Megawatt Meter Display units
- Substation Inputs (protocol converter necessary)
- River Water Temperature Inputs
- Radiological Dose Assessment Computer (RDAC)
- Unit-to-Unit Communication
- Computer Room UPS
  - Each unit has 2 trains of power

# Goals of the Project

- Greater system reliability/availability
  - Industry Standard Servers and Operating System
  - Windows 2003 Server, Windows XP workstations
    - NMC Business LAN standard
- Overall reduction in points of failure
- Address obsolescence issues
- Site wide access to PPCS displays
- Improved User Interface (point & click)
- Improved data archiving and retrieval
- Expandability
  - Support future plant digital upgrades



# Scope of Project

- Computer Room
  - All H/W & S/W replaced
  - Server Equipment:
    - New HP Servers in a Primary (w/Hot Backup) Configuration
    - Development System identical to units (H/W & S/W)
    - Plant Business LAN served by separate PSS servers
  - Network Equipment:
    - Redundant Cisco Switches
    - Redundant Nokia Firewalls to Plant Business LAN
    - HP NAS and Tape storage units
    - GPS Time Receiver
    - Existing RMU Fibers reused (re-terminated)
    - Existing Spare Fiber used for Control Room
    - Some Fiber to be installed for TSC and EOF
  - Redundant power to all components

# Scope of Project – Continued

- Data Acquisition
  - Forty (40) RMUs upgraded (21 – Unit 1; 19 – Unit 2):
    - Interface Replaced with RTP2000
      - Compatible with 74xx series cards
    - Other chassis and components upgraded as needed
  - Scope did NOT include:
    - Analog and digital cards
    - Chassis-external power supplies
- Control Room
- TSC, EOF, OSC and Backup EOF
- Simulator

# “Early Release” System

- Backup parallel system for TRM LCO relief
- Turned over to Ops ~1 year prior to final release
- Same Scientech R\*Time display and subsystem environment as final release
- Field data received “raw” from Data Concentrators
- Key TRM LCO applications & database converted
- Workstation put in control room
  - ... and select personal Business LAN locations
- Delayed final installation a few months
- Implementation proved to be invaluable
  - Resulted in less TRM LCO entries and earlier operator familiarization with the new system

# Miscellaneous

- PPCS cutover from old to new system performed while units online!
- 25 site-specific applications were developed
  - Most based on old functionality, some new functionality added
- Over 125 displays per unit on old system, over 350 on new
  - Retained similar look/layout
  - Graphics kept simplistic to keep focus on system data/status
- Periodic logs/reports retained
  - Reduced number automatically sent to printer; retained on disk
- Documents – 117 total
  - SRS/SDD – 25, combined (highly recommend)
  - FAT & SAT – 37 each
  - Other - 18
- Scientech PMAX balance of plant performance monitoring software package installed on separate server

# Historic Data Archival

- PPCS Servers
  - Server based storage, 410 GBytes
  - Field Inputs: 50 and 100 millisecond
  - All Points: 1 second, 1 minute, 1 hour
- PSS Servers
  - NAS based storage, 1640 GBytes
  - All Points: 1 and 5 second, 1 minute, 1 hour
  - System Monitor: 1 minute
    - Network management using SNMP and SNMP based tools

# Project Team

- IT Computer Engineering
  - Primarily PPCS, utilized Security Computer personnel
- Design Engineer
- Operator
- Project Manager
- Simulator Engineer & Test Coordinator
- Planning/Scheduling
- Project Sponsor
- Procedures
- Various Test Personnel for SAT

# Project Status

- Completed
  - Simulator, Unit 1 & Unit 2 Replacement PPCS
  - Availability Test
  - Connectivity to Business LAN
  - OSI PI Connectivity
  - Scientech PMAX package installation
  - Training
  - Old equipment removal
  - Removal of PPCS from site Top Equipment Issues List !

# Project Status – Continued

- In Progress
  - Closure of TER's: > 280 initiated, majority are closed
  - PPCS procedure updates
  - Slow/poor PPCS network connection to Training
  - Resolve RTP2000 noise for low mv signals (high gain)
  - Potential changes looming due to Cyber Security
  - Project Follow-on Enhancements
  - Process to improve control of plant Computer Room equipment
- Always Present
  - Resource issues
    - Attempting to support other site projects interfacing to new system



# New system potential being realized

- Site staff just loves their Business LAN access!
- Projects
  - I/C Network (ICNet)
  - Project Enhancements
    - Aux Bldg PLC, Water Treatment, NSSS/BOP Interface, Paperless Recorders, Archival Conversion
  - Caldon LEFM
  - Amertap/Toprogge (Condenser Tube Cleaning System)
  - Turbine EHC & Yokagawa Recorders
  - State of MN EOC connectivity
  - CL Pump Full Flow Testing
  - Changes due to standard EAL implementation
  - Very good long term, but...
    - Untimely; distracted focus; should've delayed support of these more than we did (during project implementation)

# Comments and Lessons Learned

- Two events during installation, one on each unit
  - Unit 1 – Bank D Rod Withdrawal Hi Limit annunciator; Isolation of Letdown
  - Unit 2 – Bank D Rod Withdrawal Hi Limit annunciator; Bank D rods moved in one step
  - Control Room Foxboro racks RIL and RSC contain very sensitive and old components
  - Work stoppage with both events
    - Immediate interviews and assessments, upper management involvement, with CAP's resulting in lots of untimely paperwork
  - Required changes to work package and pre-job brief
    - RMU point list assessment, review of cabinets by Ops, manual action/alignment of systems with risk, card edge inspection, etc.
  - Challenge Review Board
    - For Unit 1 work restart and Unit 2 start

# Comments and LL – Continued

- RTP
  - RTP2000 noise for low mv signals (high gain)
  - Were required by RTP to work through Sciencetech to get support from RTP
  - Slow repair turn around and very long order lead time
    - Obtain non-NEQ chassis from Ginna for Unit 2 install
    - No contingency for NEQ chassis failure on Unit 2
- Scheduling/Planning:
  - WO package planning always behind
    - Large packages and they were started too late
  - Scheduling not pleased with how last minute everything was
  - Review of PM's & SP's for each week PPCS was OOS
    - Had a rather large impact on schedulers (Ops & procedure group too)

# Comments and LL – Continued

- Plant Procedures
  - Started too late, not enough support initially
  - Writers need to know navigation of new system
- PPCS Procedures
  - No time to focus on this prior to installation
  - This hurt us post Availability Test
- Emergency Planning
  - Involved with ERDS, SPDS, ERO and Emergency Preparedness Program Assessment
  - Awareness of their role not immediately recognized
- Regulatory Compliance
  - NRC notifications and updates
  - Correspondence with resident inspectors
  - No one initially understood all necessary communication

# Comments and LL – Continued

- ERDS
  - Consider timing of NRC notification for DPL update and change of hardware/software
  - Unit 1 Installation
    - Connectivity issues to NRC ERDS due to baud rate setting, not identified during Simulator test
    - NRC system was down for maintenance while testing Unit 1
- Project Schedule Changes
  - Simulator installation date moved
    - Due to change of initial/requal NRC licensed Ops exams
  - Year-end Schedule Compression for plant installation
    - Forced to compress schedule for year-end budgetary purposes
    - Quite a bit of pressure was put on project team to keep on schedule. We successfully met the challenge, but it took its toll
  - Passport Project
    - Rollout schedule forced a change to our schedule

# Comments and LL A– Continued

- Time & Schedule Pressure
  - Constant, and then very high during installation when PPCS is OOS
  - The same site people that tell us to push back on time/schedule pressure were the worst offenders
  - Unrealistic site expectations for the workload and size of project team staff
- Business LAN Rollout of PPCS
  - Time consuming to develop Marimba push-out package
  - Site pushed hard to get this out right when we were trying to focus on Unit 2 RMU cutover installation
- PMAX Installation
  - There appeared to be little communication between Scientech R\*Time and PMAX personnel
  - Project team and site engineer not kept up on status

# Comments and LL – Continued

- **Factory Staging of Equipment**
  - Be present for staging of the new equipment at factory
  - Consider involvement with some of the initial software installs
  - These would've been good preparation for site installation
- **Network Architecture**
  - This is an area we were weak on and relied on Scientech
  - Our lack of expertise hindered us throughout the project
  - Gain knowledge prior to assembling specification document
  - Scientech struggled a little with network setup & tuning
- **Cyber Security**
  - NEI 04-04 was in its infancy when we first began this project
  - We still should have done better at understanding all aspects
  - Cyber security needs to be incorporated into Scientech baseline product and addressed in their proposal responses

# Comments and LL – Continued

- SRS/SDD, FAT & SAT Reviews
  - Very time consuming for the staff, and an area we underestimated
  - You get out what you put in, so we put in all we could
    - Reduces TER's and change orders
    - OE from Kewaunee and Scientech
- Simulator
  - More complicated than plant PPCS
  - Address the Simulator special requirements thoroughly in SRS/SDD
  - Don't assume Scientech understands your needs in this area for application response to Sim unique functions
  - Simulator engineer involved in various SRS/SDD reviews as necessary, and owned the Simulator Interface procedures



# Comments and LL – Continued

- Training
  - Boot Camp
    - Good value received for making more informed decisions
  - Ops Staff and Instructors
    - Great results by having training for the Ops staff prepared for and presented by someone on their own staff and by the same person assigned to support the project
    - Improved Ops buy-in of final product
- Operator on Project Team
  - This is a must! We didn't do this soon enough
  - Fulltime support needed (could've used two)
  - This was a huge help to the project team
  - Ops go-to person for Q&A and requests
  - Very effective at buy-in from Ops of final product

# Comments and LL – Continued

- Project Team Staffing Issues
  - Loss of two PPCS personnel during project
    - Hardware Technician
    - Engineer performing Project Manager & Technical Liaison roles
  - Change of Design Engineer early on
  - Recognizing need for planner, additional Design Engineering support, Project Manager, and procedure personnel
  - Project Team had to periodically justify retaining assigned fulltime Operator
  - Change of Project Sponsor
    - Loss of initial upper management project sponsor
    - The new sponsor was initially the Ops Manager, and he later became the Plant Manager. Having this person behind the project was great
  - Simulator Test Coordinator changed after implementation
  - Loss of two Sciencetech personnel late in project to support other projects

# Comments and LL – Continued

- Other Distractions
  - Passport Rollout Project
    - Attendance of required training had an impact on an already compressed PPCS implementation schedule
    - Freeze and unfamiliarity of new system caused project delays
  - IT Reorganization
    - Transferred from Site to Fleet, and then back to Site again
    - Untimely disruption and concern for some on the project team
    - Transition of Simulator Support personnel from IT to fleet Training
  - Fleet Project Process Change
    - We were one of the first projects to begin wading through new fleet Integrated Planning Project Approval Process
    - This was cumbersome as the process wasn't clear or well understood

# Comments and LL – Continued

- Scientech
  - Personnel were always available and had good knowledge of their system
  - Easy to work and communicate with
  - They were flexible on many small scope changes throughout most of the project
    - Occasionally we had to convince them that a requested change wasn't an enhancement, but rather the way we thought the product should function (or was expected to function)
  - Was open to suggestions on enhancing the base R\*Time system (benefits all customers)
  - Needs to ensure consistent use of programming standards by all personnel
    - Different programming styles with .ini file usage and HMI interaction
    - Especially noticeable between the different Scientech offices

# Comments and LL – Continued

- Scientech - Continued
  - R\*Time Data Viewer
    - Displays don't always downsize well
    - e.g., from 1280x1024 to 1024x768
  - Logs & Reports
    - We had (have) a number of issues getting these to function as expected
  - Facilities Move
    - The impact to the project schedule was barely noticeable (we expected worse)
  - Lived up to our expectations; we never regretted choosing them as our PPCS implementation vendor

# Prairie Island PPCS Project

- Questions?