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Online I/O Upgrades

Comparison of
Peach Bottom & Oyster Creek

2010 R*TIME User's Conference

Clearwater, FL

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Introduction

- Peach Bottom Experience
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- Oyster Creek Experience
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  - Successes and Lessons

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Peach Bottom - Background

- Dual Unit Site (Peach Bottom 2 & 3)
- Separate Plant Monitoring System (PMS) for each unit
- PMS Implemented on VMS
- Applications implemented on SAIC-based system with custom modifications
- Multiplexer (same for Unit 2 and Unit 3)
  - Six IRCUs controlling a total of 23 chassis

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Reason to Upgrade – PB

- Increased unavailability of critical components needed to maintain the IRCU equipment in the VMS environment

- IRCUs were causing challenges to completing automatic failovers successfully

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Project Overview – PB

- Upgrade project initiated in 2007
- Hardware Scope
  - Removal of existing IRCU interface hardware
  - Install a total of 12 new universal chassis and 46 new RTP-2000M processors
  - Movement of existing 7400 series I/O cards from IRCU to the new 12 chassis

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Project Overview – PB (cont.)

- Software Scope
  - Implement a new software interface that interfaces to the RTP-2000M processors
  - Update the PMS data base with “new” tags to identify location within the I/O subsystem
  - Create new configurations for the RTP-2000M processors that map the “new” tags to field terminations
  - Provide new displays to view, monitor, and operate the new RTP-2000M processors

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Project Execution – PB

- Initial software work developed by contractor (CES) in their facility
  - Developed a simulator that allowed driving any values to and through the RTP-2000M processors
- Offline development environment available for prototyping and offline testing at Peach Bottom
- In-house developed Factory Acceptance Test procedures
  - Complete tag verification of RTP NetArrays projects
  - Complete verification of PMS database tags
  - Complete card edge to PMS testing for each I/O card type

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Project Execution – PB (cont.)

- Developed installation activities that ensured the following:
  - Redundant Class 1E inputs were not all taken out of service at the same time
  - Heat balance calculated value was maintained during the installation window
  - Ability to access both the new RTP-2000M and existing IRCU equipment
- Installation occurred over two month period
  - Operated in “mixed-mode” until all IRCUs replaced
  - Cutover occurred at rate of one to two IRCUs per week

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Peach Bottom Surprises

- "It's not supposed to do that……"
  - The interdependency of PMS application modules was underestimated when the initial database changes were made without a system restart.

- "It didn't work that way on the development system……"
  - Failover criteria for the "mixed-mode" environment precluded bringing an RTP-2000M online.

Peach Bottom Surprises (cont.)

- "What do you mean the surge card cables are too short……"
  - The new chassis resulted in a relative relocation of the option card slots by about ½ inch when compared to the IRCU chassis. This made the "just-long-enough" cables too short. Since there was a long lead time for new cables, the configuration projects were modified to allow the option cards to be moved to a different slot so that the cables would be long enough

- "That card wasn't on the prints – what's it used for……"
  - A power monitoring card installed on the Q-listed multipelxers was not listed because there were no external connections to the card. The PMS computer points assigned to the card were never used.

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Peach Bottom Successes

- The “mixed-mode” worked very well and provided an orderly and measured change from the IRCU to the RTP-2000M on a mux-by-mux basis.
  - This relieved pressure on the Maintenance installers to rush the physical installation!
- A utility was created and used to validate the RTP-2000M configuration projects based on the PMS online database.
  - This was successful in catching several errors during the offline testing!

Peach Bottom Successes (cont.)

- The installation Maintenance technicians were actively engaged and suggested several creative solutions to recover the overall design and maintain the schedule.

- The upgrade project was installed with no open test exceptions or open items.

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Oyster Creek - Background

- Single Unit Site
- 2004 - PPC upgraded to R*TIME version 11.9
  - Upgrade maintained existing IRCUs via a VME / PCI card interface
- PPC implemented on Windows-based servers (Windows Server 2000)
- Multiplexer
  - Two IRCUs controlling a total of eight chassis

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Reason to Upgrade – OC

- Address intermittent failures of the VME/PCI configuration that caused inputs to “flat-line” with no error indications

- Move the site to standard (versus custom) network-based equipment that is less obsolete and robust in performance

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Project Overview - OC

- Upgrade project initiated in 2008

- Hardware Scope
  - Removal of existing IRCUs, IRCU chassis, and expansion chassis
  - Install a total of eight new universal chassis each containing an RTP-2000M processor
  - Movement of the existing 7400 series I/O cards to the new chassis

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Project Overview – OC (cont.)

- Software Scope
  - DAS software modifications to interface with the new RTP-2000M processors
  - Update the R*TIME data base with “new” tags to identify location within the I/O subsystem
  - Create new configurations for the RTP-2000M processors that map the “new” tags to field terminations
  - Provide new displays to view, monitor, and operate the new RTP-2000M processors

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Project Execution - OC

- Initial software work developed by Scientech in their Cromwell facility
  - A hardware chassis with the different types of I/O cards was provided to Scientech for their development work
- Offline development environment was built and used for offline testing at Oyster Creek
  - All eight new chassis were staged along with two existing RTP-2000 chassis providing an exact configuration as the production environment

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Project Execution – OC (cont.)

- In-house developed Factory Acceptance Test procedures
  - Complete tag verification of RTP NetArrays projects
  - Complete verification of PMS database tags
  - Complete card edge to PMS testing for each I/O card type
- Installation activities developed
  - Using the development system, installation steps were verified multiple times
- Communications to key stakeholders (T-4 Days)
  - Final meeting held with key stakeholders to address outstanding concerns and questions

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Project Execution – OC (cont.)

- Equipment Staging (T-3 Days)
  - Equipment used for FAT testing relocated to installation site
- Installation occurred within a single day
  - System taken OOS at 0600 for software work
    - Operations made NRC notifications for SPDS / ERDS
  - Hardware work started at 0800 after software work completed
  - Two teams (both IT & Maintenance) worked in parallel to install and test the new chassis
  - System returned to service by 2300

Oyster Creek Surprises

- "Now serving number……"
  - The work management system indicated that required project equipment had been ORDERED, however the equipment really had not been ordered. Follow-up with Procurement was needed to ensure the equipment order was actually placed. This resulted in a slight delay to setting up the equipment for test.

- "Dude, where's my power…..?"
  - An unexpected AC power problem was discovered in the installation location one week before the cutover date. The lesson is that there is a need to inspect and test all critical work performed by other departments.

Oyster Creek Surprises (cont.)

- "Uh-oh…why aren't the SOE points working on this chassis but are working on the other……?"
  - Removal of unused SOE cards resulted in the inadvertent removal of an "undocumented" card modification that placed voltage on the chassis back plane. Removal of this "feature" caused delays in installation and temporary interim measures to compensate for the undocumented feature.

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Oyster Creek Successes

- Several dry runs of the FAT tests resulted in the actual FAT running smoothly
- Installation steps were able to be practiced on the Development system which improved the execution of the production system installation
- The Development test equipment was able to be configured closely to the plant production environment. This helped reduce the number of “surprises”

Oyster Creek Successes (cont.)

- Close interaction with personnel assigned to perform the actual field work allowed for more robust work order instructions

- Interaction with Operations ahead of time allowed alignment with the work details and the time period the system would be out of service, including making required notifications.

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Summary / Conclusions

- Make the decision early and ensure all stakeholders are aligned with the decision
- Communicate important milestones and activities with key stakeholders
- Ensure offline testing is thorough to avoid “surprises”
- Develop contingency plans for production installation
  - Discuss contingencies with key stakeholders *before* installation
  - Have a viable “back-out” plan available

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Acknowledgement

Thanks are extended to Mike Johnson, Exelon Nuclear Real Time Analyst, and Dave Hinrichs (now with Scientech) for their contributions to this presentation.

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Comments / Questions