Exelon's PPC Lifecycle Strategy After 16 Years

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Goals & Objectives

Present an overview of the first 16 years of Exelon's PPC Long Term Asset Management (LTAM) strategy.

- Share successes and challenges, key lessons-learned, and adjustments and variations made to the strategy along the way
- Discuss how the strategy will continue to transform to meet the challenges our industry is facing now, and through plant decommissioning.

Exelon's PPC Replacement Plan

- Original PPC Replacement Plan Approved in 2002 to replace obsolete, legacy PPCs with a fleet-standard solution (Scientech R*Time)
- Existing PPCs were a mix of obsolete and unsupported platforms (Honeywell, Encore, GEPAC+, DS&S, etc…)
- PECO and Constellation had started PPC replacements with Scientech before the mergers in 2000 and 2013.

PPC Long-Term Asset Management (LTAM) Strategy

PPC Long Term Asset Management (LTAM) Strategy implemented in 2011 to address Continuous PPC Life-cycle Management by performing consistent and timely base system upgrades and server/hardware refreshes needed to maintain system reliability, compatibility for digital upgrades, and ongoing support of the fleet's Plant Process Computers.

- Continues PPC replacement plan and includes periodic refreshes through end of plant life
- Refresh hardware, O/S, and applications every 7 years
- Full system and DAS replacement every 21 years
- Plant Process Computer corporate strategic pool budget established in 2013 to support funding refresh projects needed to maintain reliability and support IAW PPC LTAM Strategy.
- Pool does not fund the full legacy PPC system replacements, such as those underway at Peach Bottom, NMP2 and Fitzpatrick. These are planned as independent strategic projects.
- At present, PPCs at all units are modern Scientech R*Time systems, except NMP2, PEA2&3 and Fitzpatrick.

PPC LTAM Strategy Status

Replacement Projects Completed:

- Ginna (2001)
- LaSalle (2003/2004)
- Oyster Creek (2004)
- Dresden (2005/2006)
- Clinton (2008)
- Quad Cities (2009/2010)
- Nine Mile Point 1 (2011/2012)
- Byron (2011/2012)
- Braidwood (2011/2012)
- TMI (2016)
- Limerick (2016/2017)

Refresh Projects Completed/Underway:

- LaSalle (2016)
- Oyster Creek (2016)
- Dresden (2017)
- Quad Cities (2018 - 2019)
- Ginna (2017 - 2019)
- Clinton (2018 – 2020)

Replacement Projects Underway/Planned:

- Nine Mile Point 2 (2015 – 2018)
- Peach Bottom (2017 – 2020)
- Fitzpatrick (2018 – 2020)

The Oyster Creek Challenge

- Per the LTAM strategy, Oyster Creek PPC refresh was planned for 2013
- Due to a unique set of economic conditions and changing environmental regulations facing the plant, ending operations in 2018 was determined to be the best option for the company, employees and shareholders
- Given these economic realities, the team was challenged to research and recommend lower-cost options to the planned full refresh (upgrade Hardware, Applications and OS)
- The Oyster Creek PPC is needed past 2018: Due to emergency plan commitments the system will need to be maintained until 2023 at a minimum, and possibly up to 10 or more years after shutdown based on OE from several decommissioning nuclear plants.

Oyster Creek Refresh Solution – Platform Virtualization

- Upgraded to current (supported) computer hardware
- Retained R*TIME version and software
- Retained operating system version
- No application code changes
- No new functionality

Pros:

- Much lower cost (less than half the cost of traditional refresh)
- Minimal Testing, Engineering and Validation
- Ability to easily re-host hardware for extended operation
- Maintain high availability to meet regulatory requirements
- Simplified Disaster Recovery

Cons:

- Reduced ability to add new functionality and features
- Limited/reduced support model for older software (Scientech, Microsoft)
- “First-of-a-kind” risks and unknowns

Advantages of Platform Virtualization for PPCs

Development and Testing

- System Portability
  - Replicate Development Environments between PBAPS and Idaho
  - Reduce configuration control issues by ensuring exact replica
- Easily reproduce OS level and above on any hardware that supports the virtualization platform
- Multiple Instances can be created for testing and development in tandem (Idaho, PBAPS, KSQ)

Disaster Recovery

- Simple backup methodology
- Virtual “Hardware” is just a configuration file

Separates Windows Operating System Environment (OSE) and Hardware

- Allows for simpler server hardware refresh
- Can isolate problems in Hardware vs Software

Challenges of Platform Virtualization for PPCs

Administrative

- Additional software knowledge / skillset

System Overhead

- Some resource overhead 1-10% (For management layer)
  - Testing in Idaho Falls in preparation for Peach Bottom design proved negligible impact with modern hardware

A Phased Approach to the Ginna Refresh

- SPING replacement in 2015 installed new, limited-use R*Time servers to allow interface to existing PPC (I/O Concentrator)
- Unique technical resources available at Ginna allowed for a phased migration of applications onto the new servers and cut-over of new DAS equipment will be staggered between 2017 and 2019
- After App Migration and Testing, the new PPC servers replaced the Legacy PPC as system of record
- Required negotiations with Scientech to upgrade R*Time licenses for PPC use and to determine an ongoing vendor support model for the system
- This approach reduced the Ginna refresh budget by nearly 60%

Delivering the Nuclear Promise: One-time and Sustained Savings

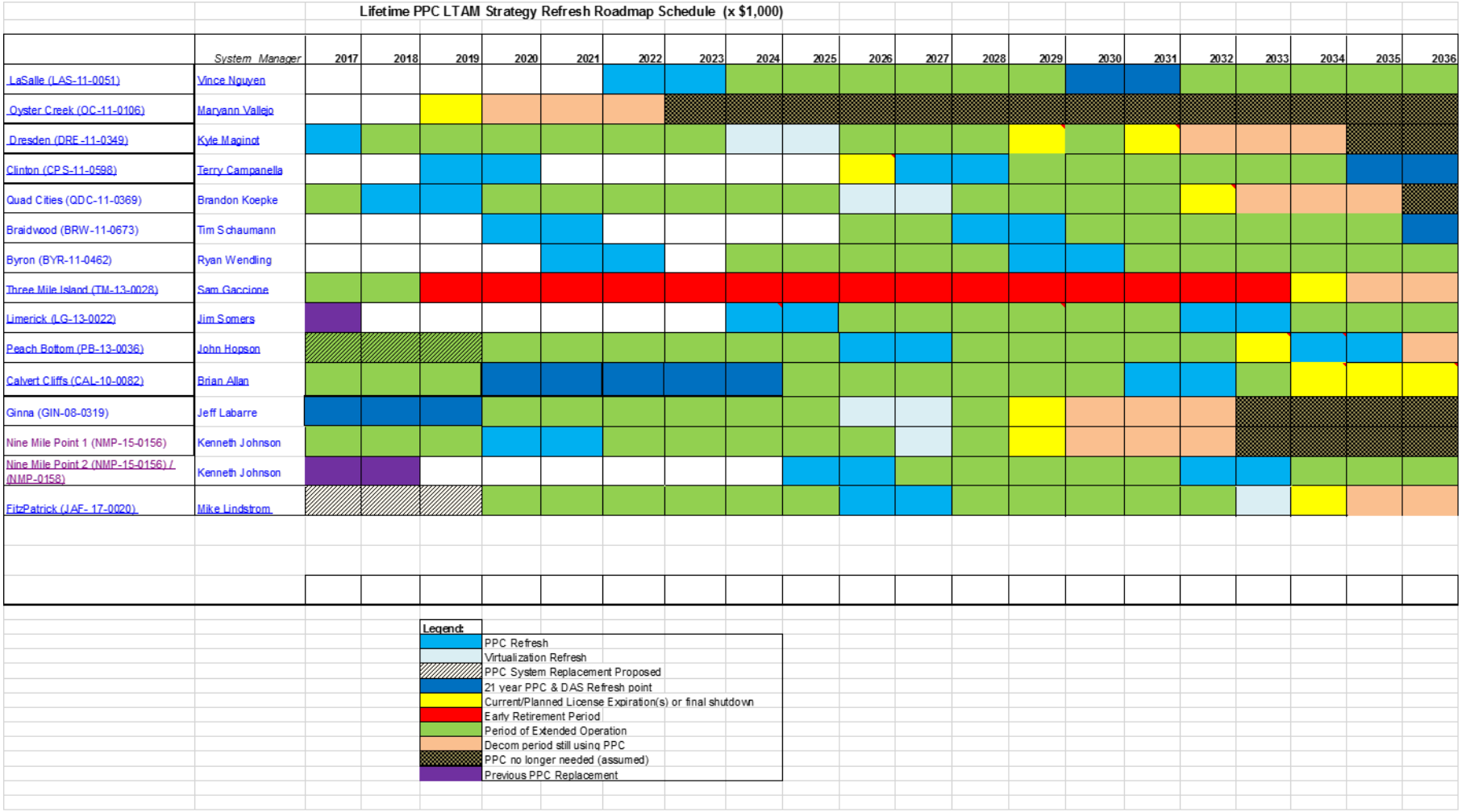
- Successful implementation of PPC Platform Virtualization at Oyster Creek led to several updates to the LTAM strategy
  - Platform virtualization is now the selected refresh approach for plants with scheduled refreshes within 5 years of decommissioning; this resulted in large AMP budget reduction
  - Virtualization will be evaluated as a potential approach during the initiation phase for all future refreshes and replacements.
  - The Peach Bottom PPC Replacement Project will deliver the first Scientech configured and supported virtual PPC.

- Ginna's in-house, phased refresh approach represents a unique savings opportunity, but sets a precedent for innovative thinking in planning for future refreshes across the fleet.

Exelon's PPC LTAM Strategy – A Living Document and Template

- Funding for PPC Refresh projects is managed in a Corporate Strategic Pool
  - Refreshes budgeted through end-of-life for each plant
  - Simplifies project prioritization and approvals
- LTAM strategies are reviewed and revised annually
  - Each site participates in review cycle to raise specific issues, add enhancements
- Refresh schedule "Roadmap" and associated site-specific project issues/budget forecasts adjusted as needed to match current conditions
  - Requests from leadership to normalize/levelize spend year-to-year
  - M&A activities and potential plant retirements
- PPC LTAM Strategy used as a template for the Plant Security Computer System (PSCS) Strategy

PPC Refresh "Roadmap"



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Questions?

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