Reducing Error / Increasing Efficiency: New Models for Nuclear Plant Outages

2011 SECOND WORKSHOP ON U.S. NUCLEAR POWER PLANT LIFE EXTENSION AND DEVELOPMENT

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Keith Moser
Innovation Manager
Exelon Corporation

Greg Weatherby
Human Factors/Operations Researcher
Idaho National Laboratory

Idaho National Laboratory

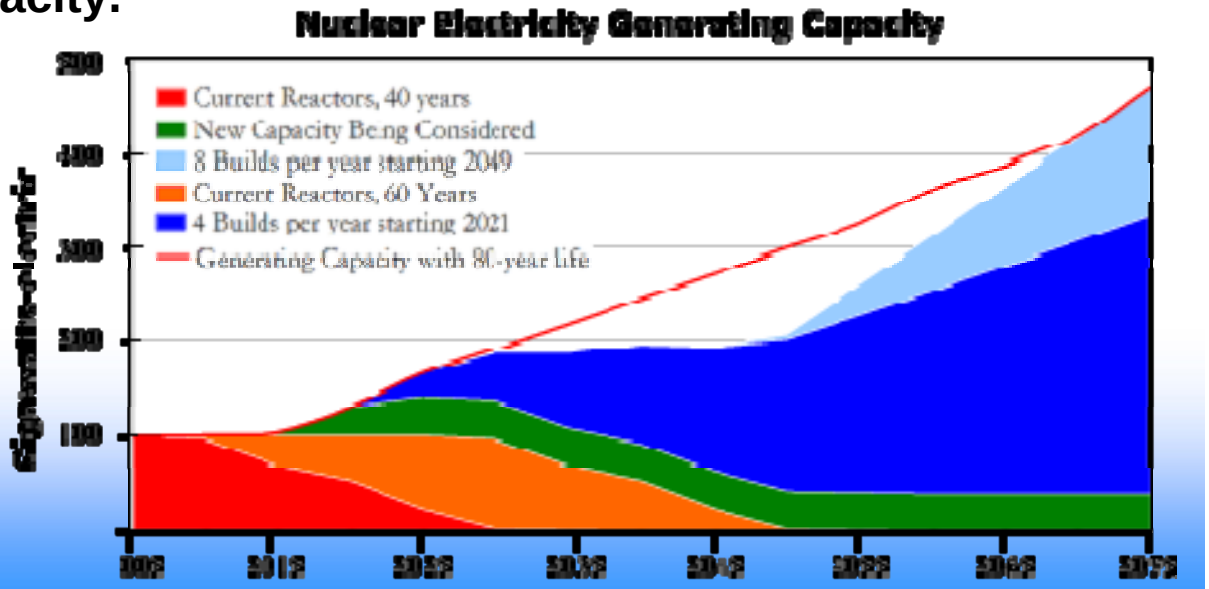
INL

Exelon Nuclear

The Need for Efficient and Sustainable Nuclear Power

- **The National Energy Policy Act of 2005 authorized the Nuclear Energy Systems Support Program supporting R&D activities addressing reliability, availability, productivity, component aging, safety, and security of existing nuclear power plants.**

- **Most currently operating nuclear power plants will begin reaching the end of their 60-year operating licenses. If these plants do not operate beyond 60 years, the total fraction of generated electrical energy from nuclear power will begin to decline - even with the addition of new nuclear generating capacity.**



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Light Water Reactor Sustainability Program (LWRS)

- **The Light Water Reactor Sustainability (LWRS) Program is a research and development (R&D) program sponsored by the Department of Energy (DOE), performed in close collaboration with industry R&D programs, to provide the technical foundations for licensing and managing the long-term, safe and economical operation of current nuclear power plants.**

- **One of the Pilot Programs is the rethinking of how Outage Control Centers and Work Execution Centers communicate with each other during refueling outages.**

- **Particularly in the areas of:**
  - **Safety**
  - **Schedule Adherence**
  - **Risk of Revenue loss**

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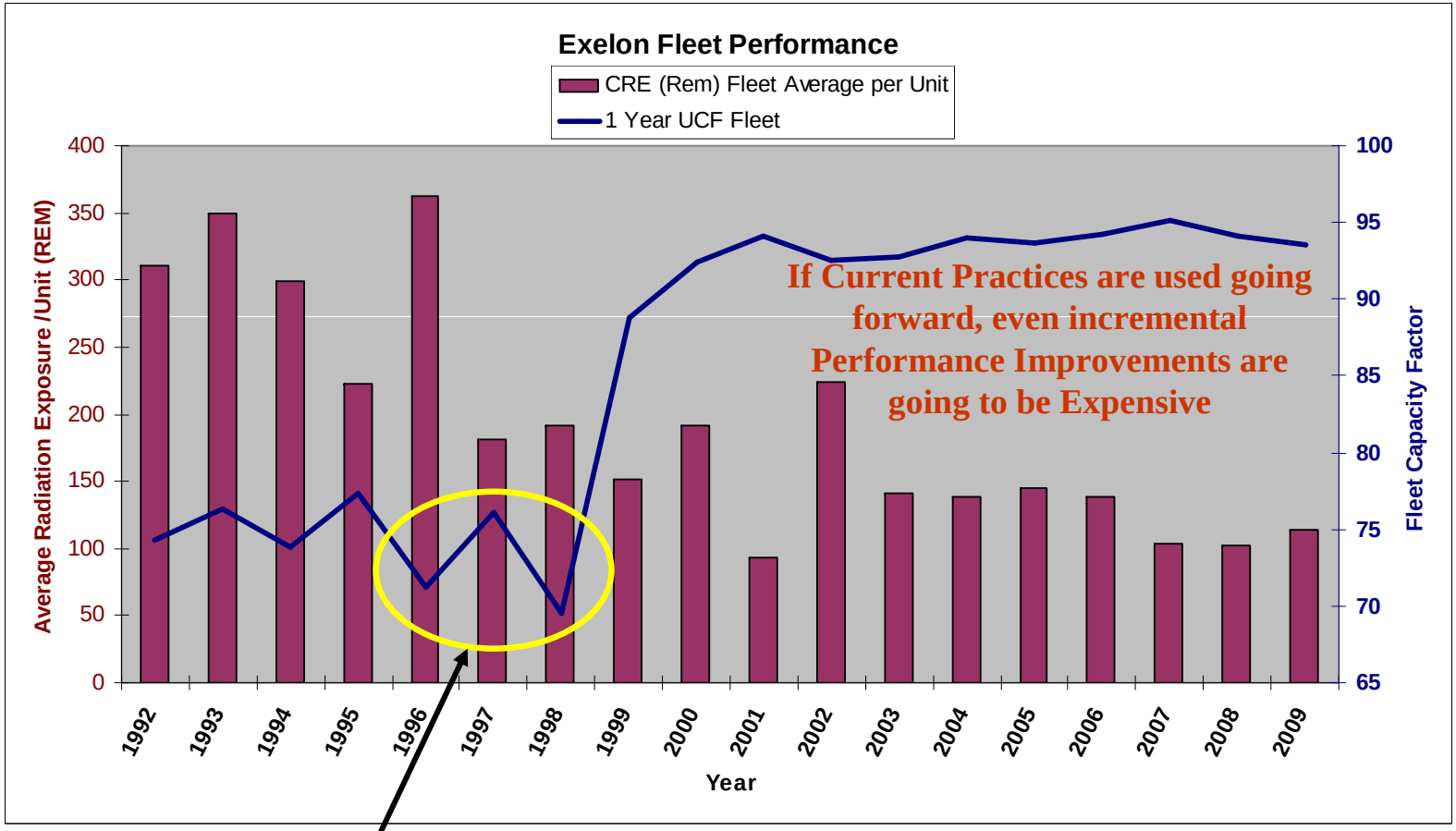
External Factors that Influenced Performance



The Burning Platform that Drove Exelon's Improved Performance - Deregulation

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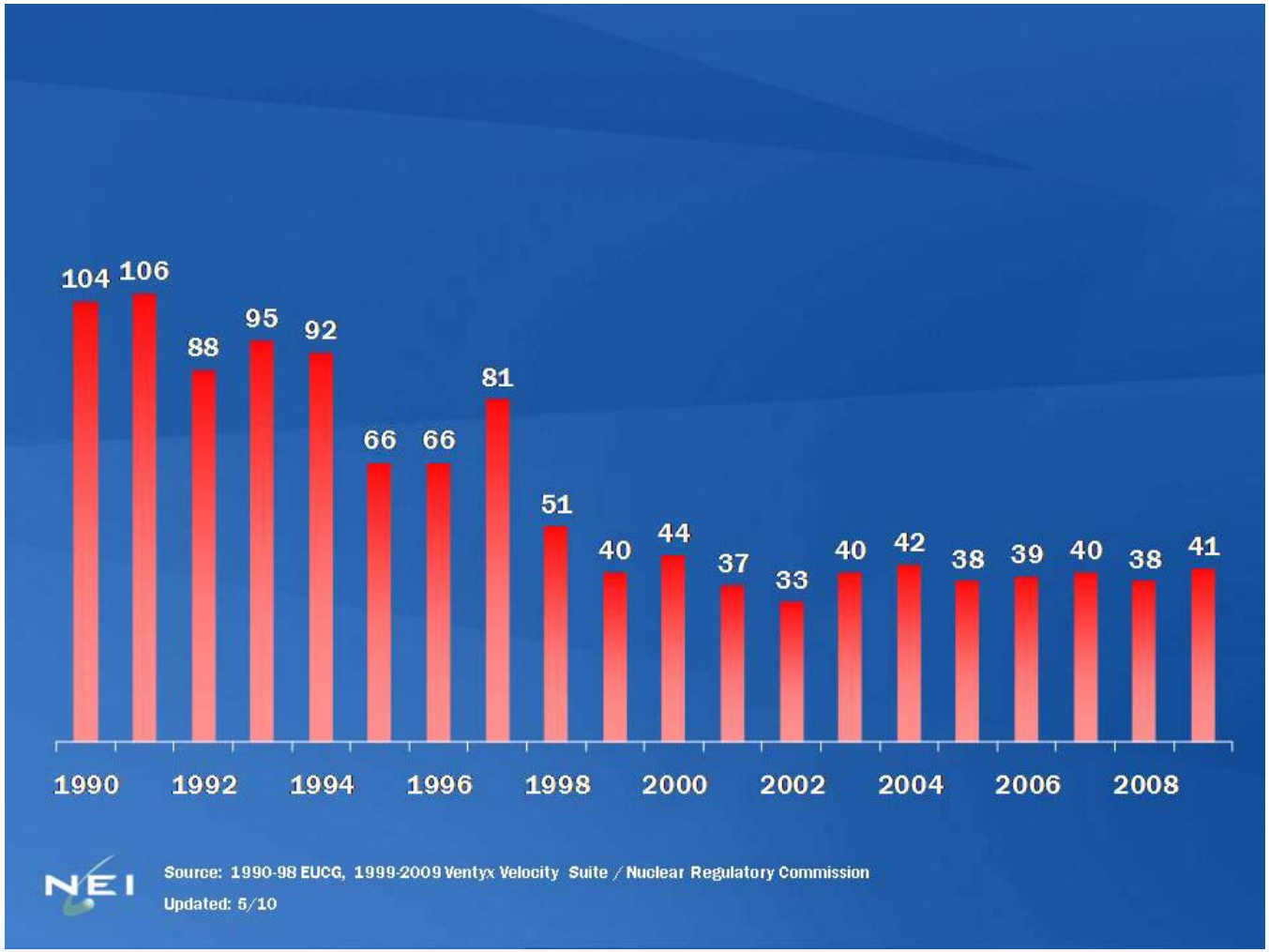
U.S. Nuclear Outage Average



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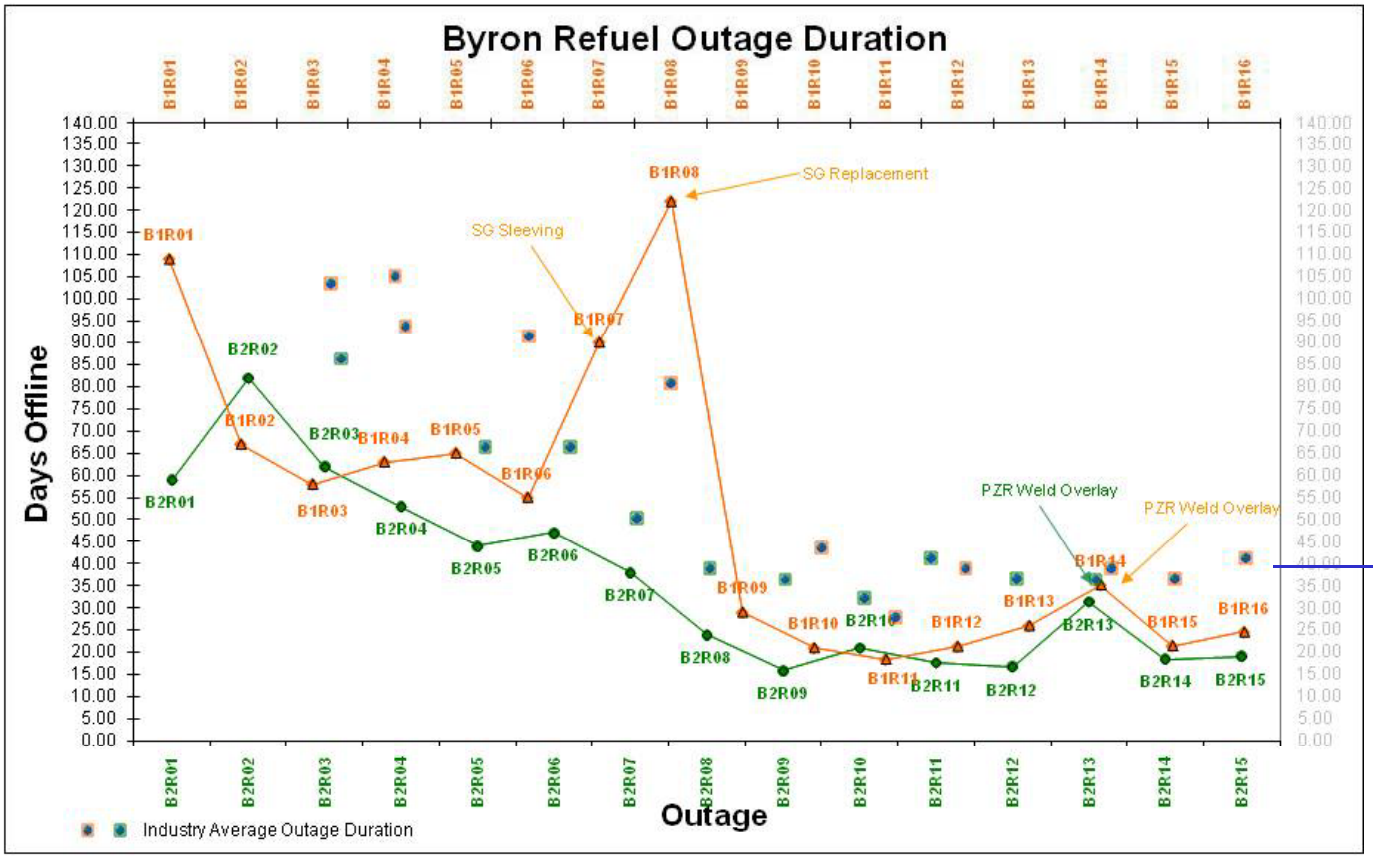
Exelon Outage Average (Byron)



Current Industry Average

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Drivers For More Efficient Outages

- **Exelon and other nuclear utilities use paper processes and analog technology to control work management.**
- **Competition from natural gas, renewables and the economic downturn limit the investment that nuclear power utilities can invest in modernization.**
- **Outage Cost (Time, People, Error)**
- **Enhanced safety in outages and plant operations**
- **Improved Human Performance**
- **Reduced Radiation Exposure**
- **Useful Technologies exist that are not being deployed to enhance performance**

"Real-Time Truth" *

- A survey of Outage managers from around the country revealed that of all the things they need, they need "Real-Time Truth"

- Real Time Truth is:

  - Accurate, information in real time concerning plant status and configuration,
  - Dependable information concerning the status of maintenance and upgrade progress at the work package level,
  - Timely notice of emerging issues,
  - Knowing the location of and having ability to contact key people
  - Predictable dose information on the workforce

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* Attributed to Jim Brower, SONGS

Strategies

- **Team with INL, Exelon, EPRI, Halden Research Reactor (Norway), and equipment/technology suppliers to produce a cutting edge OCC.**

- **Using Human Factors, Human Performance, Six-Sigma techniques, and outage experience, determine what information is needed to perform an efficient outage. (What, When, How evaluation)**

- **Use a phased approach to develop a base technology/display, then refine and upgrade the system as new capabilities and technologies are needed.**
  - **Phase One:** **Information Gathering and Prototype Development, Deploy working prototype Outage Control Center and Work Execution Center**
  - **Phase Two:** **Develop and Pilot Electronic Work Processes**
  - **Phase Three:** **Develop and Pilot Wireless Rad Monitoring System**
  - **Phase Four:** **Develop and Pilot Communication and Tracking**
  - **Phase Five:** **Develop Emergency Operating Capabilities for TSC**

What is Possible?

- OCC (Collaborative Work Area)
  - Large-scale Touch Screen Technology Fast, Natural Means of interfacing)
  - 3D modeling, feeds, and real-time proximity/locating of personnel
  - Emerging issue management (Mobile / reconfigurable work stations, Real-time feeds)
  - Shift-change statusing / preparation

- OCC / Field Interface
  - Remote Hand Held Tools for Electronic Procedure Use
    - Exact job status (% complete v. predicted or reported)
    - Staging of QA / Safety personnel at procedure hold points
    - Predictable time estimation for job completion (“on-deck” teams)
    - Visual reference for workers / management (Remote Team Problem Solving)
    - Bar-code scanning for tools, calibration, training
  - Real-time Dosimetry (Personnel dose / dose remaining)
  - FME Tracking (Visual Verification)
- Other Capabilities
  - Integrated with Warehouse / Supply Chain functions
  - Lessons Learned /training for task development, critiques, and task modification.

Where Are We Going From Here?

- Currently gathering information from Exelon Outage managers and processes.
  - INL Staff to participate in the Byron Refueling Outage
- Installing a state-of-the-art OCC layout at Byron Station.
  - 2 Smart Board in the OCC
  - 4 Hitachi Star Boards OCC
  - 1 Smart Board in the WEC
  - 1 Smart Board in the Refueling Floor War Room
  - 1 Smart Board in the Engineering War Room
  - Bridget Software to tie them all together
- Reviewing technologies and “best-practice” processes from partners and other sources worldwide.
- OCC/WEC prototype up and running (with limited capabilities) at INL and Byron by March 8, 2011.
- Additional Phases of work to be worked through 2013

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Phase 1 Smart Boards

SMART Board™ 6052i
interactive display

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Example SOM Overview Board

Example WEC/OCC Communication Tool