

**USNRC/PPL Susquehanna, LLC  
Regulatory Conference:  
Potential White Finding Regarding  
Radioactive Particles**

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**USNRC Region I Offices  
King of Prussia, PA  
March 1, 2001**



# Agenda

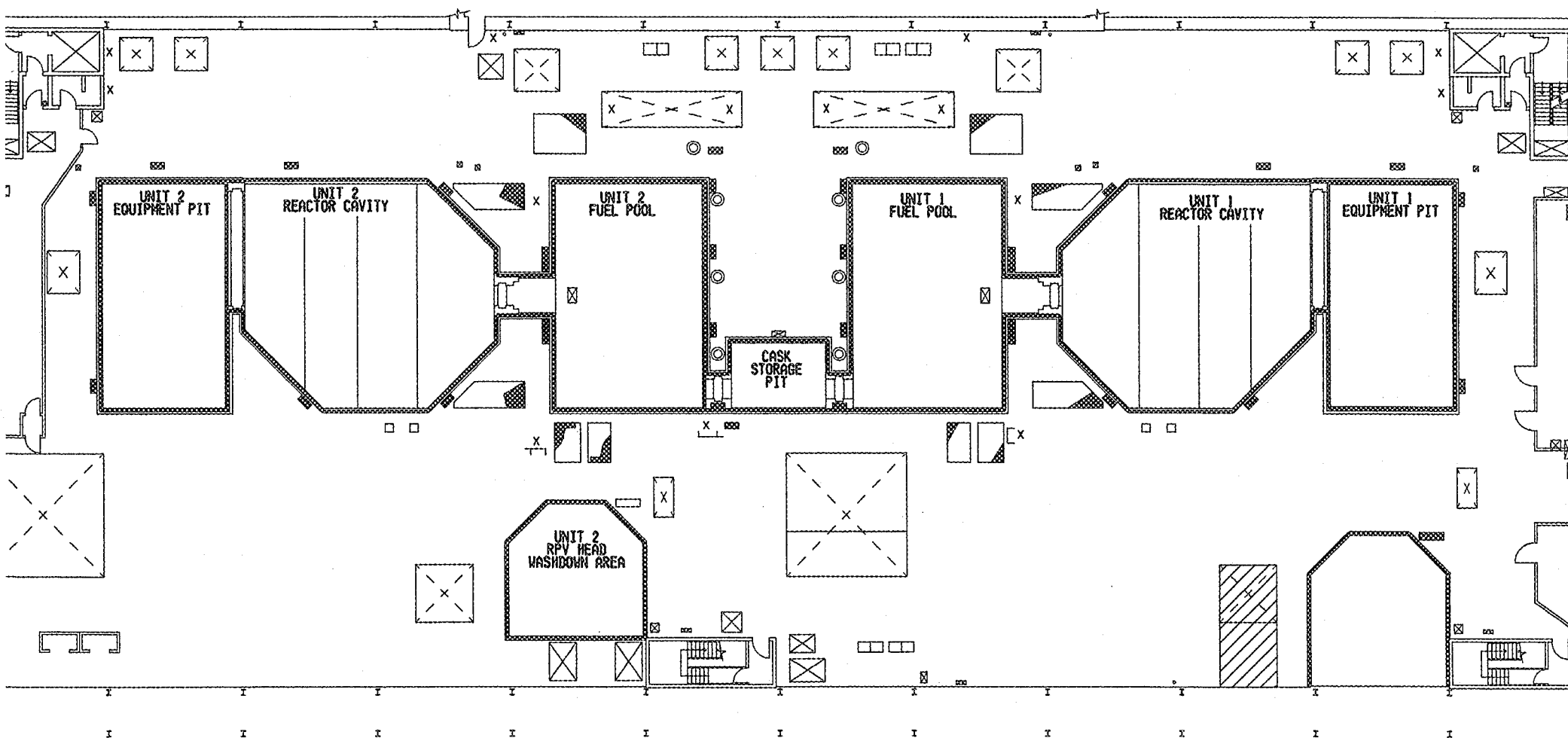
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- Introduction Bryce Shriver
- Background Duane Karchner
- Radiological Controls Myra McCarthy
- Root Causes &  
Corrective Actions Rich Anderson
- Conclusion Bryce Shriver

# Overview of 2000 Fuel Pool Cleanout Project

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- Overview of SSES Refueling Floor
- Principal Locations of Project Work
- Cleanout of Unit 1 and 2 Fuel Pools



FLOOR PLAN - ELEV. 818'-1"

# Fuel Pool Cleanout Project Scope

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## 1991

- 98 CR BLADES
- 72 LPRM STRINGS
- 4 IRM STRINGS
- 9 TIPS/ 4 EX-CORE
- 100 FILTERS

## 2000

- 136 CR BLADES
- 75 LPRM STRINGS
- 10 IRM STRINGS
- 5 TIPS
- 84 FILTERS

2000: ~40% Scope Increase

# Lessons Learned From 1991

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- Use of remote cameras
- Remote dose monitoring
- Use of shield walls for crane operator
- Cask pit gates open
- ALARA Results
  - 1991: 23.2 person-rem
  - 2000: 14 person-rem

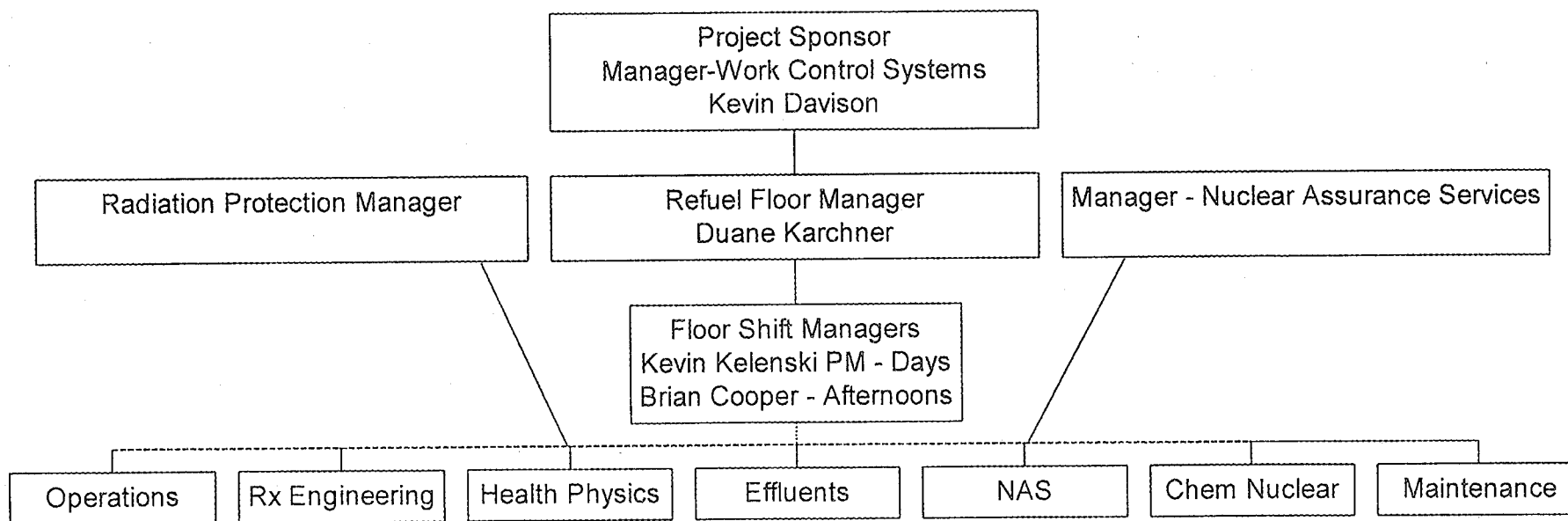
# 2000 Project Planning

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- Detailed project planning began in March 2000
- 2000 Project Plan included lessons learned
- Project plan and procedures were reviewed for personnel and radiation safety issues by:
  - Station ALARA Committee
  - Plant Operations Review Committee
  - Project kick-off meetings

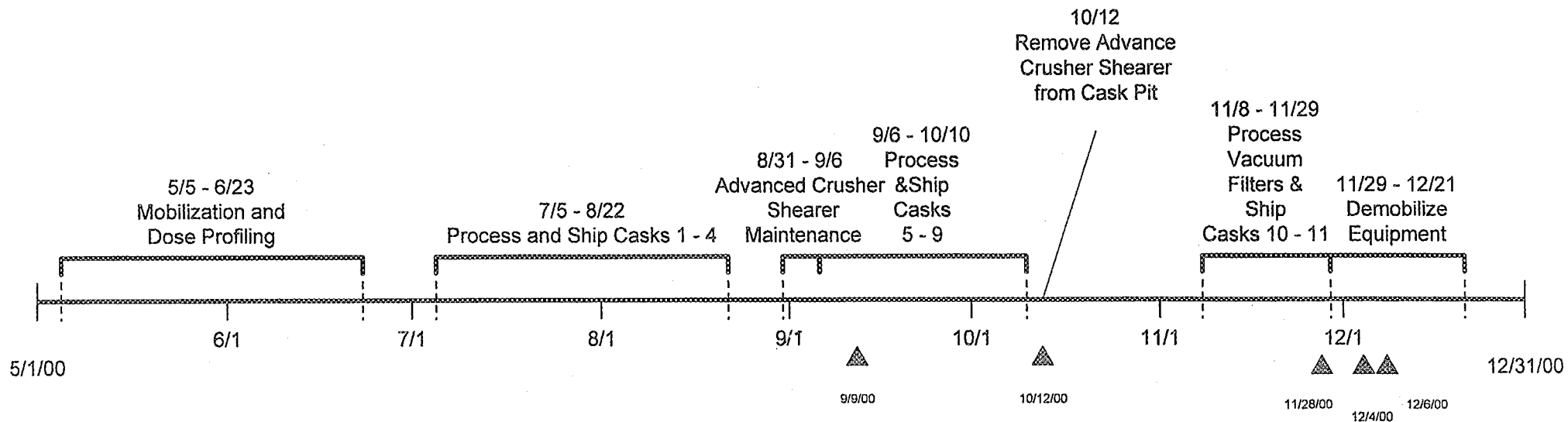
# Fuel Pool Cleanout Project 2000

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# 2000 FUEL POOL CLEANOUT PROJECT TIMELINE



▲ Significant particle (as identified in NRC report)

# Radiological Controls on Refuel Floor

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- Initial Controls
- Timeline of Events
- Assessment of Significance

# Initial Radiological Controls

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- Based on internal experience and industry guidelines
  - Job specific Radiation Work Permits (RWPs)
    - Constant Health Physics coverage when withdrawing items from the water
    - Rinse of items pulled from water
    - Establish radioactive particle control zones
    - Monitor workers for radioactive particles every 4 hours and when exiting control zone
    - Survey equipment for radioactive particles when exiting control zone

# Timeline of Events

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- 6/12 - Project begins
- 9/09 - Radioactive particle detected on worker's forearm when exiting refuel floor
  - 12 Rem SDE
  - Protective Actions
    - Revised RWP to require immediate frisks of personnel after removing equipment from the pool
    - Required hoods and plastic aprons when handling equipment that had been in pool

# Timeline of Events

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- 10/12 - Identified a highly radioactive particle during movement of crusher-shearer.
- Immediate Response:
  - STOP WORK** - evacuated local area and refueling floor
    - shielded particle
    - treated entire refuel floor as radioactive particle control zone and high radiation area
- Subsequent Actions
  - initiated root cause event review team
  - assembled recovery team
  - additional surveys
    - determined particle dose rate of 800 Rem/hour

# Timeline of Events

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- Corrective Actions from Root Cause Analysis
  - RWPs revised to require enhanced radioactive particle controls
  - Initiated radioactive particle tracking process
  - Enhanced management oversight
  - More detailed evolution planning
- 11/28 - 220 Rem/hour particle found on cask on refuel floor (no dose)
- 12/04 - 200 Rem/hour particle found in crusher-shearer tent (no dose)

# Timeline of Events

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- 12/6 - Radioactive particle found on worker's protective shoe cover during radioactive particle frisk
  - 17 Rem SDE
- Protective Actions
  - STOP WORK** : Terminated all high-risk evolutions
    - Initiated comprehensive re-evaluation of events
    - Conducted benchmarking phone survey
    - INPO assist visit
    - Remote imaging of refuel floor
    - Communicated to workers

# Significance of Events

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- Actual: No regulatory limits were exceeded.
  - 9/9/00 - 12 Rem SDE
  - 12/6/00 - 17 Rem SDE
- Potential: Highly radioactive particles identified during the 2000 fuel pool cleanout project could have resulted in significant doses.



# Root Causes

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- Lack of sensitivity by radiological protection and station management to radiation risks posed by radioactive particles
- Radiological controls did not adequately mitigate the risks associated with radioactive particles
  - in the pool
  - on the refueling floor
- Insufficient management and independent oversight of high risk project evolutions

# Station Sensitivity to Radioactive Particle Risk

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- Contributing factors:
  - Treatment of events as accepted occurrences
  - General perception that controls were adequate
  - Industry documentation that characterizes these events as skin dose concerns
  - Station focus on dose and dose limits rather than near misses or adverse trends
  - Inconsistent tracking of radioactive particle events

# Effectiveness of Controls

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- Contributing factors:
  - Inadequate review of peer experience
  - Unfamiliarity with geometry of equipment
  - In-pool and refuel floor particle control efforts were not state-of-the-art
  - RWPs did not provide strict requirements for particle control
  - No project-specific goal for particles
  - Perception that more strict controls could result in unproductive dose

# Management and Independent Oversight

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- Contributing factors
  - No regularly scheduled update meetings with senior management
  - Daily management meetings did not consistently report on the project
  - Reports to management focused on successes rather than challenges
  - Minimal management presence on refuel floor
  - Missed opportunities for use of independent oversight

# Corrective Actions

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- Established a defense-in-depth approach to control of radioactive particles
  - Enhanced site sensitivity to radiation risks
  - Established better control of particles at source
  - Implemented enhanced radiological monitoring
  - Improved management oversight of high risk evolutions
  - Improvements to independent oversight

# Corrective Actions

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- Enhanced sensitivity to radioactive particle issues
  - Developed communication plan
  - Revised procedures to highlight potential risk
  - Better use of corrective action program
  - Engage industry in evaluation of risk
  - Incorporate lessons learned into Training

# Corrective Actions

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- Established better control of particles at the source
  - Use of operating experience/benchmarking/self-assessment
  - Identification of potentially affected systems
  - Developed a particle pre-job checklist
  - Evaluate other sources of Co-60
  - Chemical decon of fuel pool cooling systems
  - Evaluating equipment wash-down/vacuuming techniques

# Corrective Actions

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- Implemented enhanced radiological monitoring
  - Evaluated health physics survey techniques
  - More frequent cleaning of refueling floor
  - Initiated use of remote survey tools
  - Evaluate use of telemetry and area radiation monitors



# Corrective Actions

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- Improved management oversight of high risk evolutions
  - Improving work standards for radiation area work
  - Incorporation of radiation protection considerations into work plans
  - Increase management presence in the plant
  - Radiation protection management
  - Two refuel floor supervisor positions created

# Corrective Actions

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- Improvements to independent oversight
  - Revise nuclear assurance oversight activities to specifically include radioactive particle controls
  - Improve line organization response to findings and recommendations

# Summary of Present Status

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- Station sensitivity to risks posed by radioactive particles has increased
- Radiological controls have been enhanced and reflect SSES and industry experience
- Radiological management has been improved - further changes are ongoing

# Conclusion

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- Worker safety is our priority
- Actual events did not result in dose in excess of regulatory limits
- We recognize our controls were inadequate
- Station Response has been broad and comprehensive