



How Low Can You Go?

Shannon Peterkin

Radiation Protection Manager
Susquehanna Steam Electric Station

Historical Background

- Two Unit BWR
- GE design (4/5)
 - 1420 Mwe post Extended Power Uprate
 - On line 1983/85 respectively
 - Extended license
 - Combined Refuel Floor
- Located outside of Berwick Pa on the Susquehanna River



A Story Of -

- Challenge
- Commitment
- Planning
- Execution
- Results
- Culture

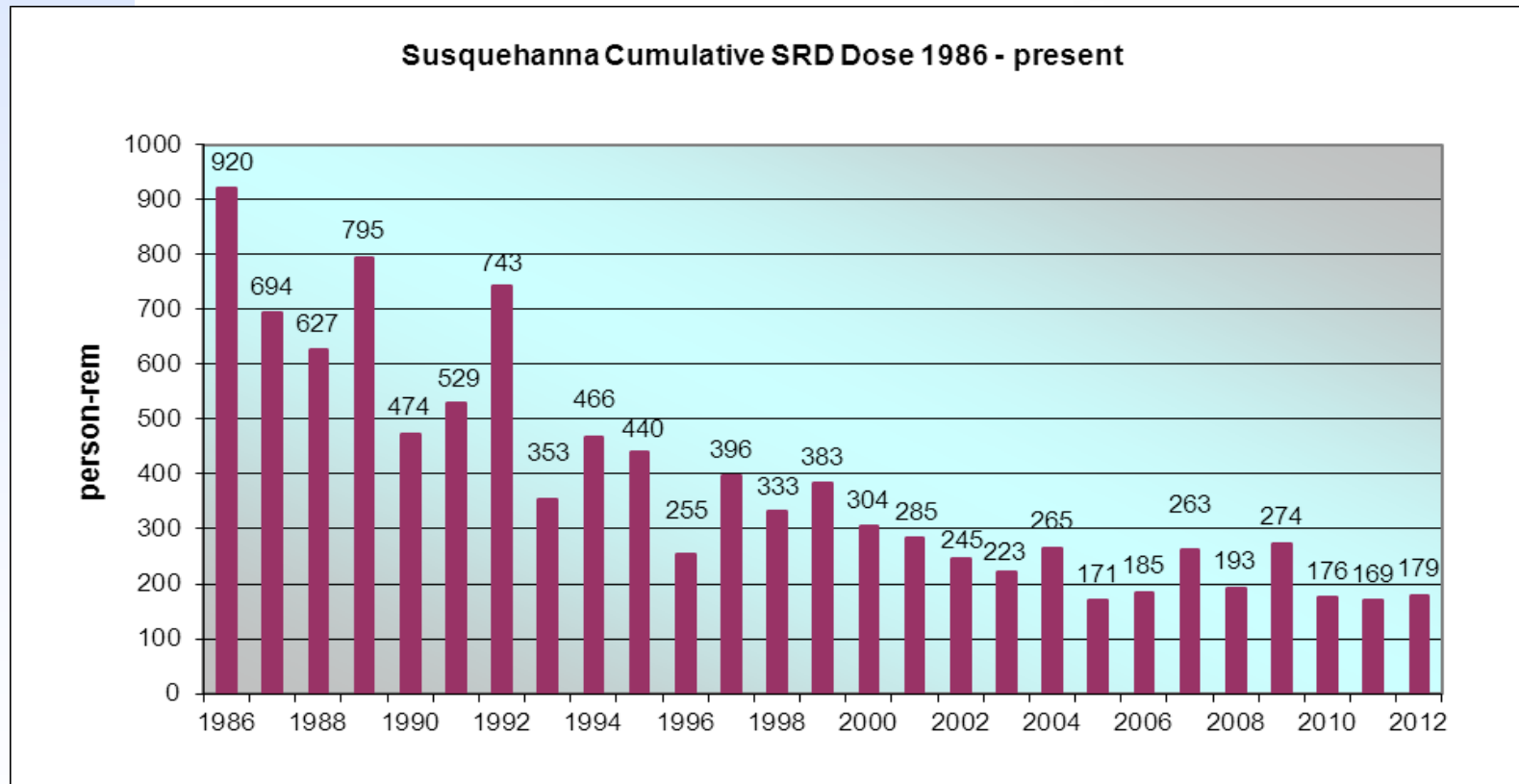


Challenges in the 1990s

- High insoluble iron levels in feedwater
- Hydrogen Water Chemistry for Mitigation of Stress Corrosion Cracking for Reactor Vessel Internals
- Overall Exposure Control Performance

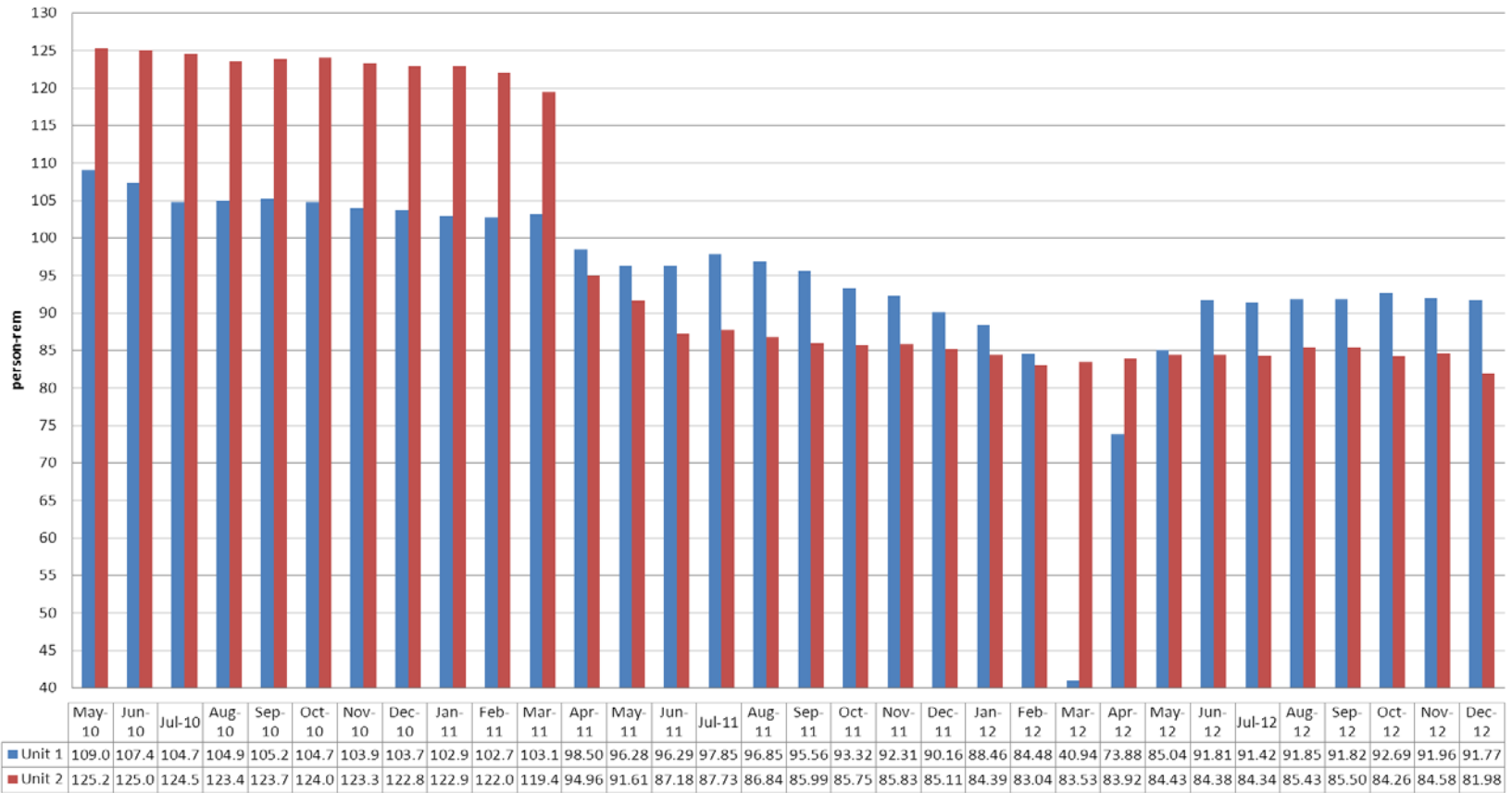


Team Susquehanna Exposure Review



2011-12, A Cycle in Review

Susq 1 & 2 Cumulative Radiation Exposure
INPO 2 Year-Rolling Average



Commitment Starts with Vision

- Be top quartile across a broad set of relevant measures
- Maintain excellent reactor water chemistry control
- Aggressively implement source-term and other dose reduction initiatives
- Culture, Culture, and Culture



Vision Transitioned to Expectations

- Develop strategic goals
- Base it on Industry Experience and Projections
- Address outage and operational periods
- Recognize implementation will require several years



The Plan....

- Source Term Reduction Projects
 - Stellite Reduction
 - Process improvements
- Work Practice Evaluations
- Technology Growth
- Implement Extended Power Uprate

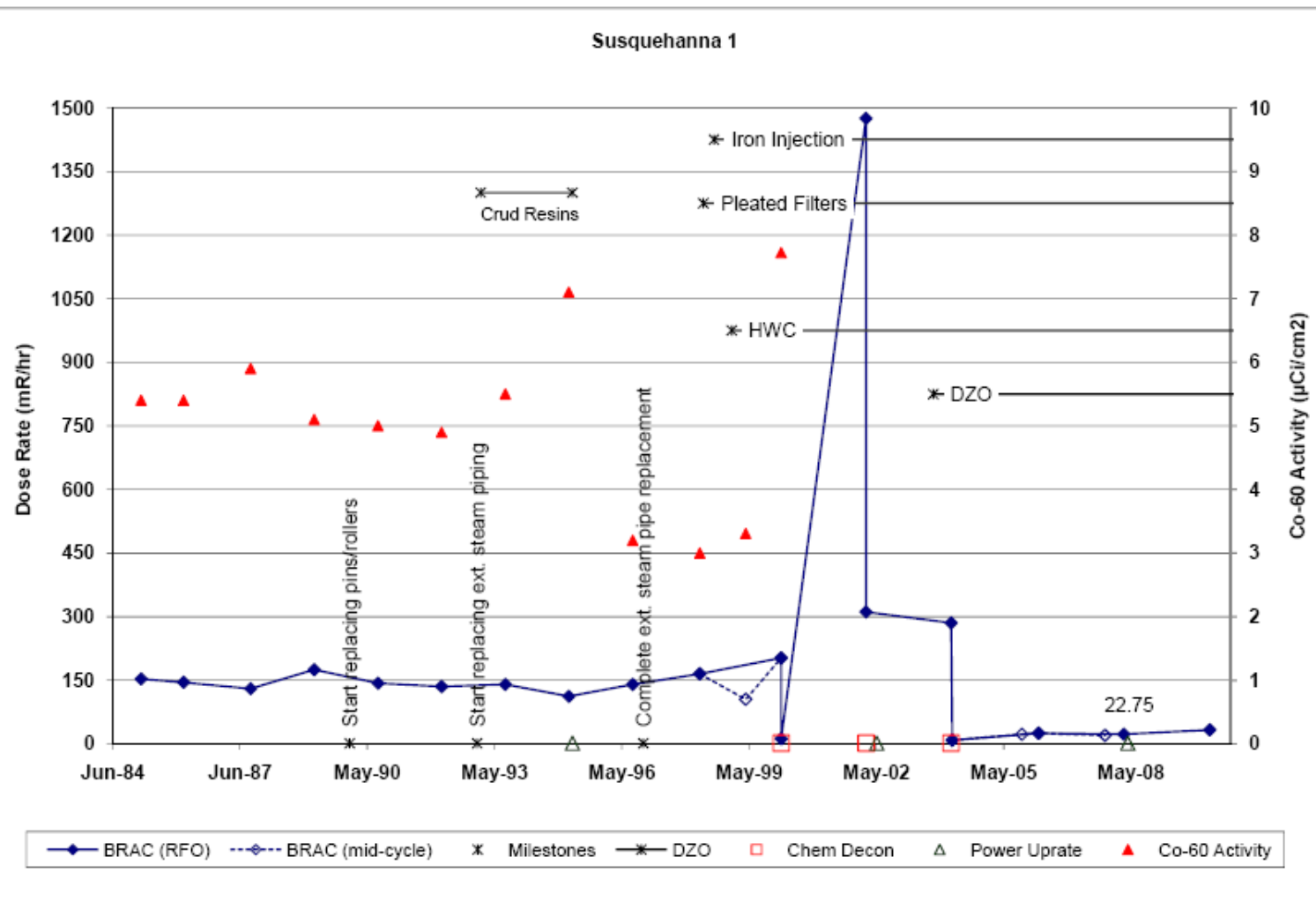


Attack of the Source Term

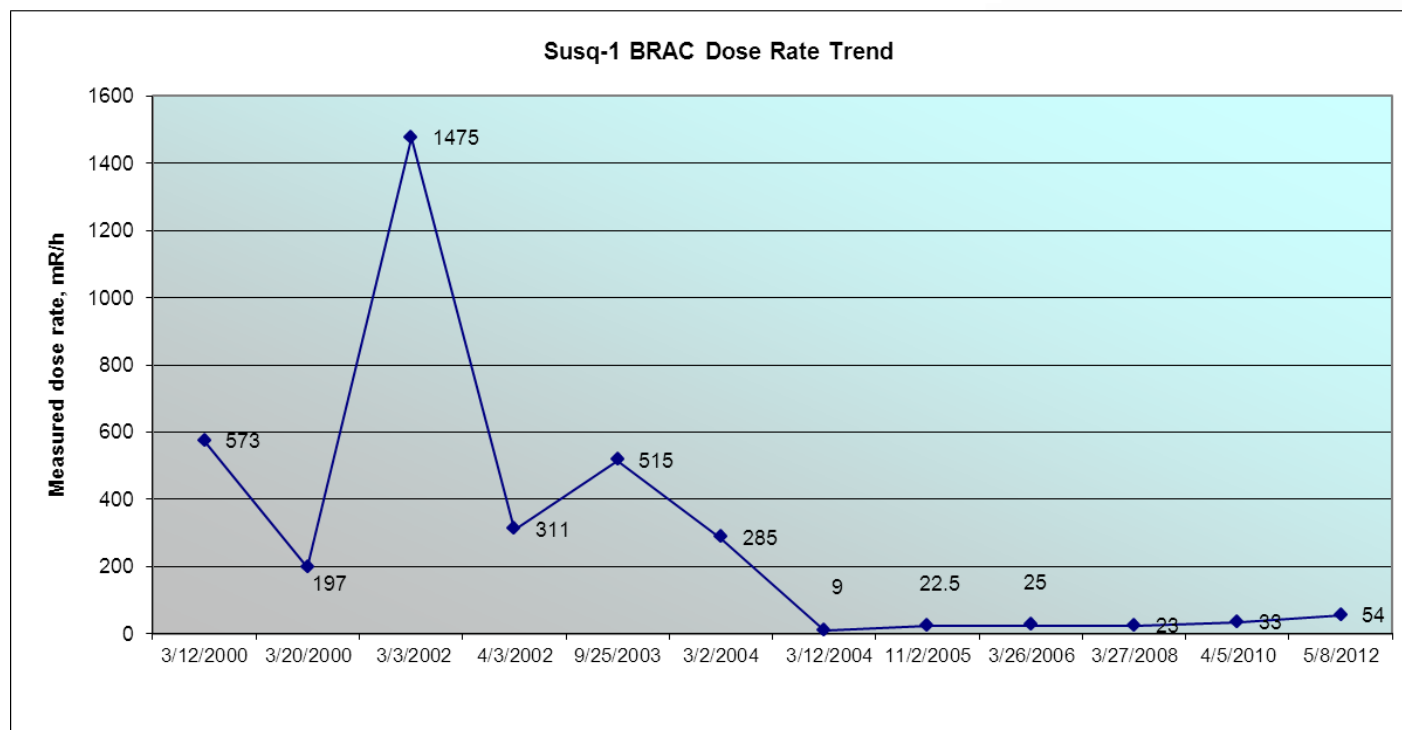
Initiatives	Unit 1	Unit 2
Condensate Filtration System	5/98	6/99
Feed water Iron Injection	8/98	7/99
Hydrogen Water Injection	2/99	8/99
Chemical Decontamination 1	3/00	3/01
Chemical Decontamination 2	3/02	N/A
Depleted Zinc Injection	10/03	12/02
Chemical Decontamination 3	3/04	3/03
RWCU Septa Replacements	12/10	12/12
Noble Metal Chemistry	2014	2015



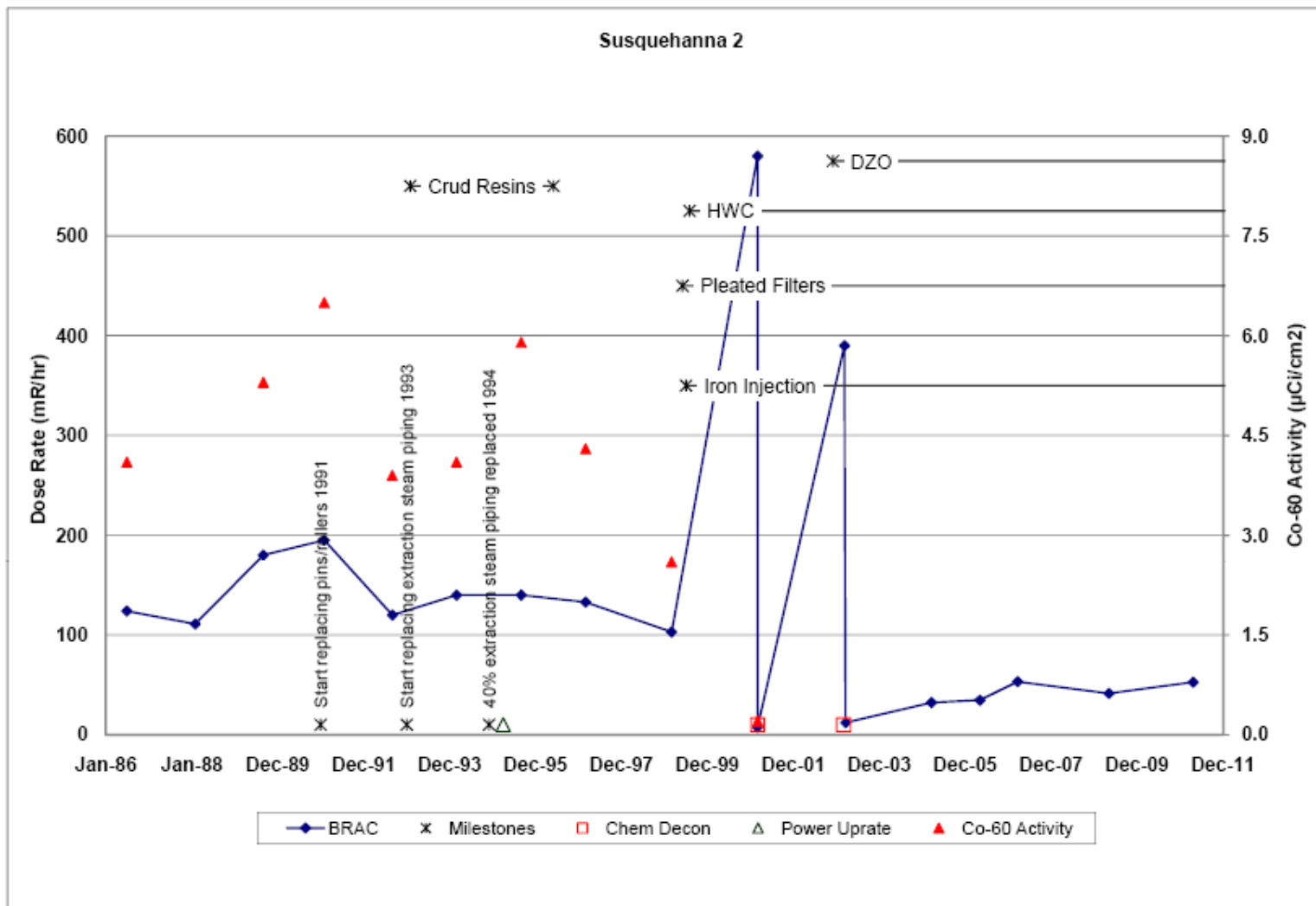
SSES U1 Average BRAC



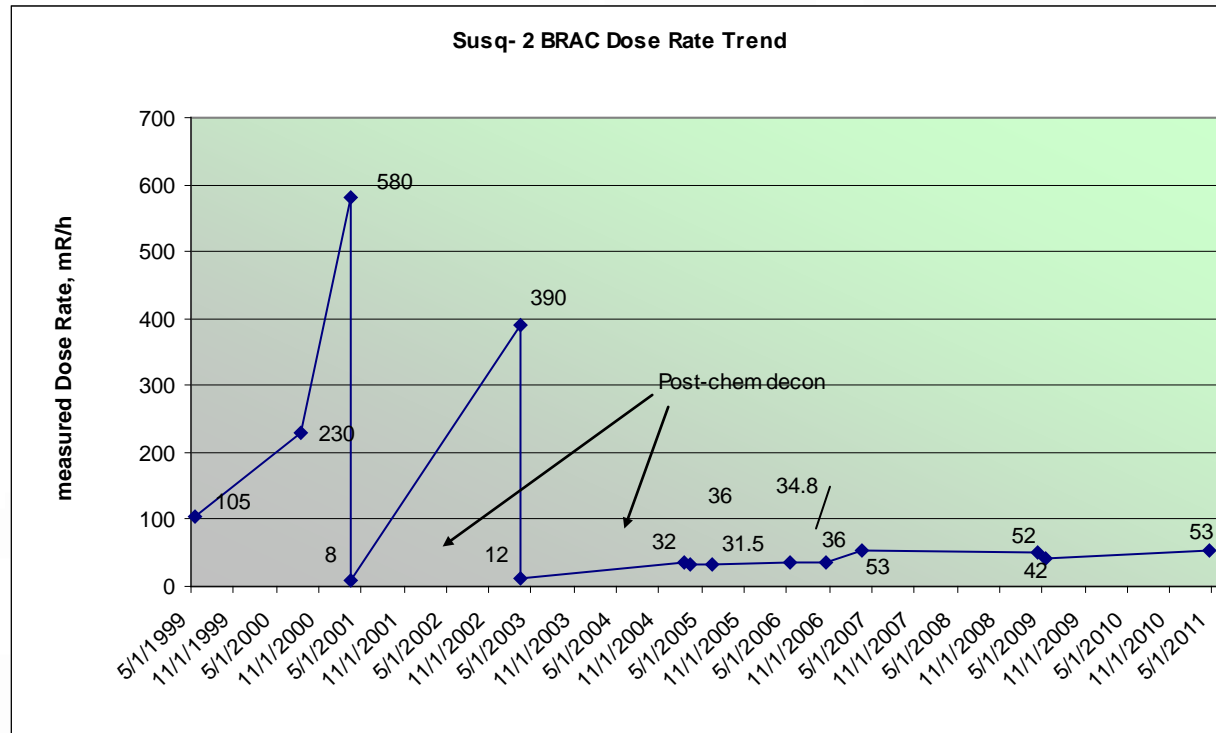
Historical BRAC Dose Rates – Susq Unit 1



SSES U2 Average BRAC



Historical BRAC Dose Rates – Susq Unit 2



Parallel Activities....

- Remote audio, video, and teledosimetry
- Virtual tours
- Robotics
- Steam Affected Area Exposure Rate modeling
- Risk-based ISI
- Work management improvements
- Utilize tungsten shielding
- Permanent shielding
- Flushes
- Elemental Cobalt Sampling Program



Attack the Giant First

- Drywell Coordination
 - ISI Teams (insulation, weld preps, scaffolding)
 - MSRV coordination
- Equipment Reliability (a gift that keeps on giving)
 - Specialized Valve Program
 - CRDs, replaced with low stellite
 - HCU Changeouts
 - Drytube flushing and vacuuming
- Contractor Partnership for Coordination
 - Planning involvement



Goliath Continued.

- Strategic Shielding for Outages
- Drywell Flushes
 - Recirc drains around Recirc pumps
 - RHR bypass valves
 - RWCU Bottom Head Drain Flushes
 - Core Spray Sensing Lines
- RHR Flushes (After Use)
 - Coordinated Pump flushes with Suppression Pool
- Post Outage Cavity Let Down Flushes through a Con Demin Vessel



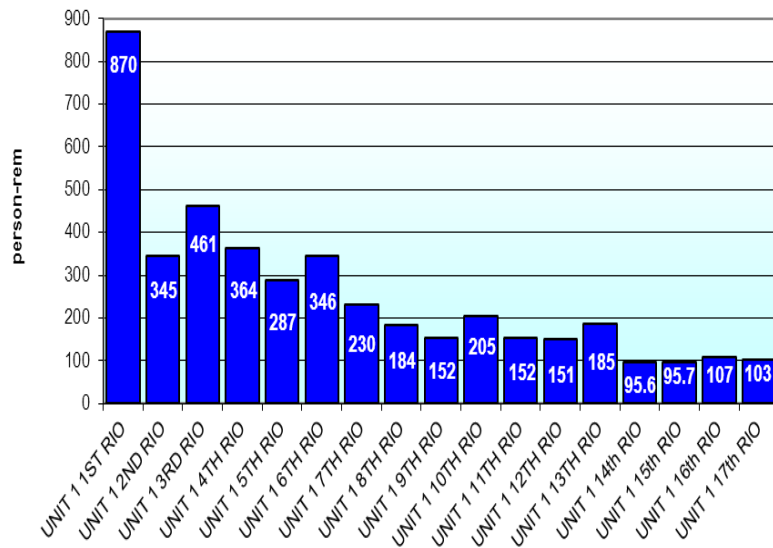
Keep Attacking...

- Work coordination based on system parameters
 - Work coordination with divisional system work
 - Non impacting system work completed prior to system draining
 - LPRM changeouts prior to CRD Mech changeouts
 - Lowers effective dose rates

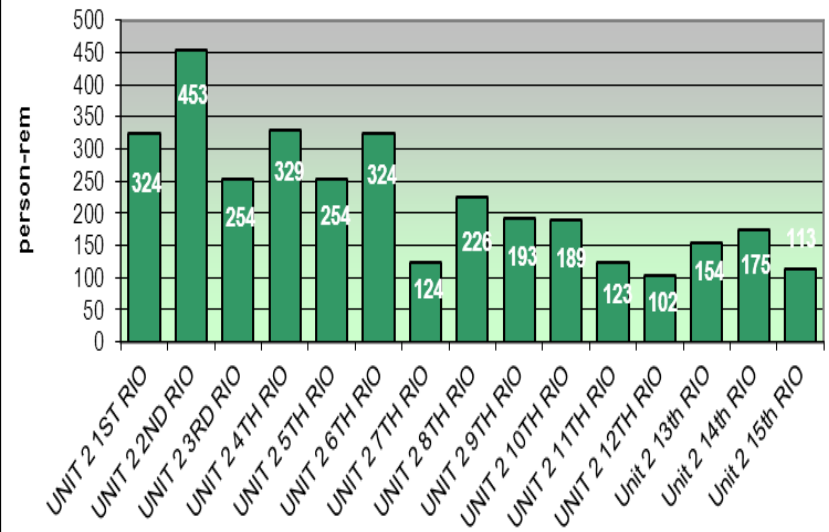


Refuel Exposure Results

Susquehanna Unit 1 Historical Outage Dose



Susquehanna Unit 2 Historical Outage Dose



Flexibility

- “I have always found that plans are useless, but planning is indispensable” (Gen. Eisenhower)
 - Recent Plant Challenges with multiple shutdowns
 - Waterbox Cleaning (8 Person-Rem savings)
 - Plant Security Modification (1 Person-Rem savings)
 - Fuel Pool Heat Exchanger (1 Person-Rem savings)



Practice

- Culture: cultivated behavior; totality of a person's learned, accumulated experience which is socially transmitted



Extended Power Up-rate

- Extended power up-rate (EPU): 2008 – 2011
 - Approximately 95 person-rem (both units)
- Key EPU activities (dose includes both units):
 - Additional condensate filtration (CFS) vessel
 - 3.7 person-rem
 - Additional condensate demineralizer vessel
 - 14.6 person-rem



Extended Power Uprate

- Key activities, cont.:
 - EPU related scaffold support – 8.2 person-rem
 - Condensate Pump Replacements
 - High pressure Turbine replacement – 1.4 person-rem
 - Integrated Control System for reactor feed pump speed control – 7.1 person-rem
 - Steam Dryer Replacement – 40 person-rem
 - Upgraded 4 RWCU filter demineralizers – 2.2 person-rem



EPU Dose Mitigating Activities

- Plant Modification Engagement
- Remote cutting of steam dryers
- Remote handling of steam dryers during transport
- Use of Lessons Learned
- Engaged work groups
- Installed additional shielding
- Utilized mock-ups
- Removed URC for extra Con Demin
(Performed flushes of ultrasonic resin cleaners (URC) prior to removal)
- Permanent shielding High Traffic Areas



Summit

- Coordinated chemistry modifications chemical decontaminations
- Condensate filtration system with iron addition
- Continuous Learning.
- The Co-60(s)/RCS Zn(s) ratio for moderate HWC plants
 - Maintaining the ratio is important.
 - Maintaining FW and RCS Zn (s) at desired levels.
- Maintaining hydrogen injection levels for a reducing environment and low electro chemical potential



Summit, continued

- Results: Top quartile/decile plant - collective radiation exposure
- Result: INPO strengths – utilization of lessons learned
- Recognition:
 - Techniques Susquehanna used were not especially unusual,
 - Sustainability



Stay Focused, It's almost over!!

- Recognition: Importance of planning the work and working a plan
- Recognition: One team, one commitment

