

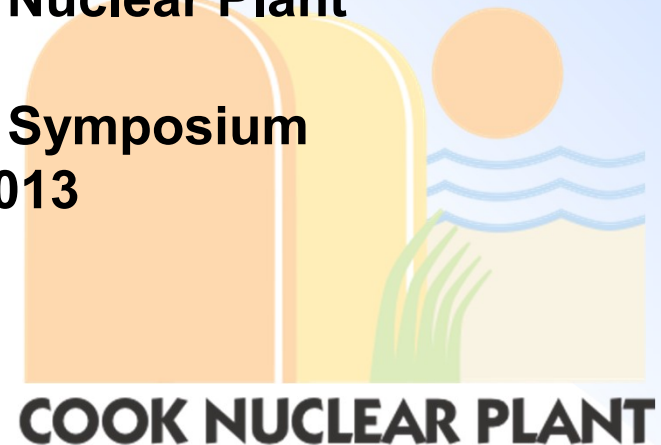


Cook Critical RP Survey Program

A New, Systematic Approach To Radiation Protection
Program Information Capture

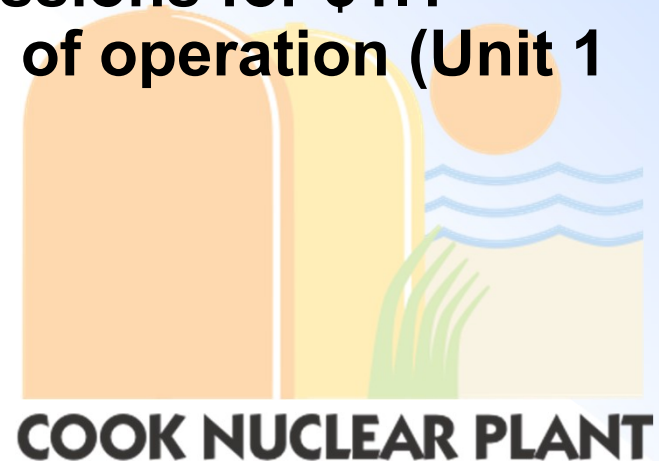
**Bob Hite - RP, Chemistry, Environmental Director
American Electric Power - Cook Nuclear Plant**

**2013 ISOE International ALARA Symposium
Tokyo, Japan, 27-29, 2013**



Cook Units 1 & 2 Background

- **Westinghouse PWR Ice Condensers**
- **Unit 1 Commenced Commercial Operation in 1975**
- **Unit 2 Commenced Commercial Operation in 1978**
- **Total Construction Costs were low: \$1.3 Billion USD**
- **Plant Life Cycle Management Project Approved by Indiana and Michigan Rate Commissions for \$1.1 Billion USD for 20 additional years of operation (Unit 1 to 2034 & Unit 2 to 2037)**



RP, Chem & Environmental Director Background

- Arrived at Cook in fall 2011
- Previously RPM at Duane Arnold (BWR), Diablo Canyon (PWR), Prairie Island (PWR) & Bruce Power (CANDU).
- Expertise in Alpha Hazard Awareness, RP software data analysis, radiochemistry & cellular health effects



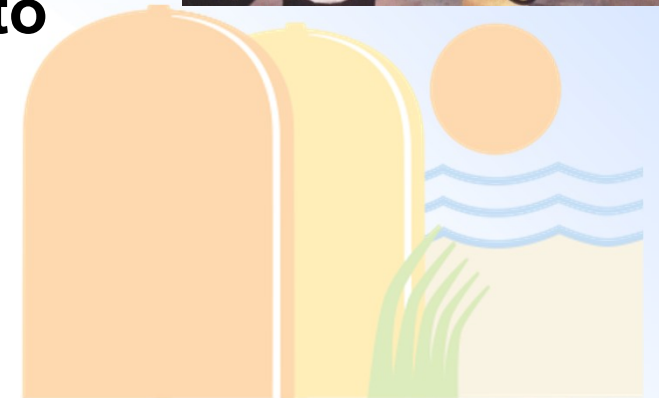
Cook Units Radiological Performance

- Achieved lowest US & French PWR 3-year rolling average based on WANO data in 2012
- Cook was fourth quartile US PWR in 2002
- Unit 1 achieved 514 days of continuous operation prior to spring 2013 refueling outage
- Unit 2 has logged 455 days of continuous operation at of August 1, 2013



Concept

- **The critical survey concept**
 - **Some important surveys during U2C20 were not obtained, OR**
 - **Were not of adequate quality**
 - **AND**
 - **There was not an opportunity to re-do the survey**
 - **AND**
 - **Was important in program evaluation or decision making**



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Concept

- **The concept is to specifically:**
 - Identify certain surveys as “critical”
 - Schedule the performance of the surveys with logic
 - Ensure surveys are completed the same shift
 - Enhance the level and timeliness of supervisory oversight over their conduct and timely review and approval



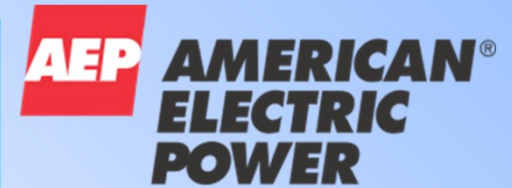
- **Concept was introduced into radiation safety procedures ahead of U1C25 outage**

Critical Survey

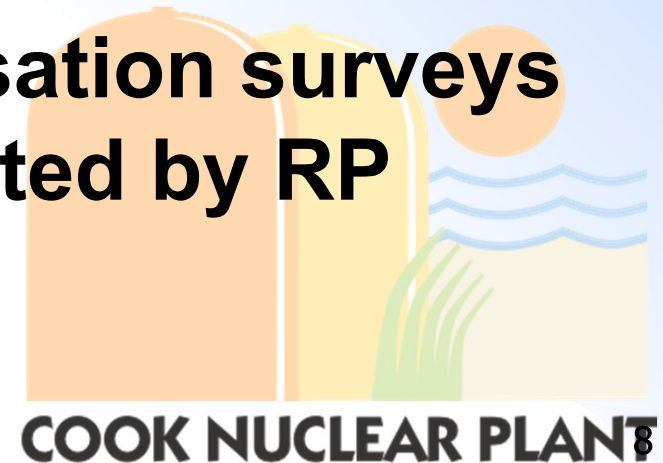
Defined by RP
Supervision as “a survey
critical to plant
radiological performance,
industry or performance
trending, or instrumental
in the decision making
process”.



Examples of Critical Surveys



- Initial steam generator bowl surveys
- EPRI standard radiation point surveys
- Containment entries at power surveys
- Before and after crud burst surveys
- Before and after refueling cavity decon
- Surveys for large dose estimates or risk
- Initial alpha characterisation surveys
- Any other survey selected by RP supervision



“Critical Survey” Requirements

- **Designated prior to performance to allow time for planning and discussion.**
- **Includes a pre job brief from RP supervisor to technician performing survey:**
 - **To include documentation (template), survey instruments and radiations to be measured.**
- **Survey to be completed by technician who has done survey before or briefed by technician or supervisor who has done it.**
- **Should be reviewed by supervision before work starts.**
- **Should be documented by technician by end of shift.**

Implementation in U1C25



- **15 critical surveys defined for the outage**
- **Critical survey packages, including templates prepared**
 - **Tried to identify best past survey examples, or create new diagrams or maps when required**
- **Spreadsheet to identify and track status of critical survey completion created**
 - **Discussed at daily turnover meeting**
 - **Identified supervisor responsible for each critical survey on upcoming shift**
- **Master binder maintained of all critical survey results as they were performed**



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Critical surveys in U1C25

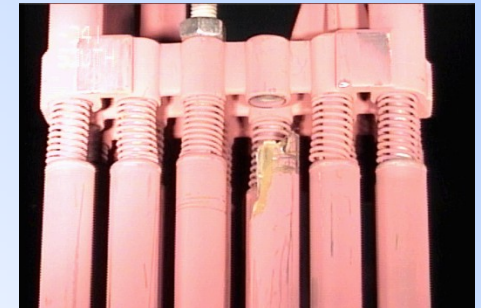


- Initial Entry Surveys
- Post crud burst, post shielding surveys
- EPRI survey points
- Steam generator bowl survey
- Regen heat exchanger work
- Reactor cavity pre and post drain down (especially after EDM work)
- RHR IM-350 valve (alpha)
- RCDDT waste drain valve (alpha)
- Pre transport surveys for LRSS bolt



Critical Surveys in U1C25

- **Used for alpha characterization surveys**
 - **Components that had not previously been characterized**
 - **Systems that had not been characterized**
 - **Items received from other facilities**



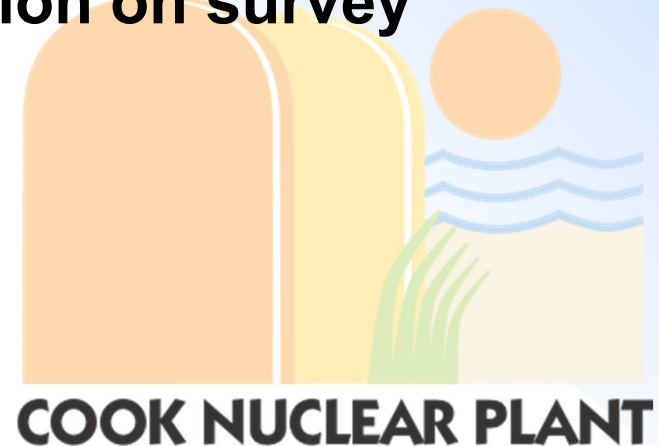
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Critical Surveys

Alpha Program Results



- **QRV-162**
 - **Three smears taken**
 - **Beta gamma levels 80 kdpm, 300 kdpm**
 - Counted on AC3 probe, background
 - Ratio 5000:1
 - Could have used 3030/proteon for first smear
 - (could have been more accurate if counted lower beta gamma wipes)
 - **Beta gamma level 25 kdpm**
 - Counted on 3030, background
 - **No air sample or label information on survey**



Critical Surveys

Alpha Program Results



- **1-WD-261 (at RCDDT)**
 - **One smear from valve body**
 - 29 dpm alpha, beta gamma to alpha ratio 990
 - **One smear following mild abrasion**
 - 71 dpm alpha, beta gamma to alpha ratio 544
 - **Note that levels increased when surface was abraded indicating historical contamination**
 - **Air sample and lapel very low**

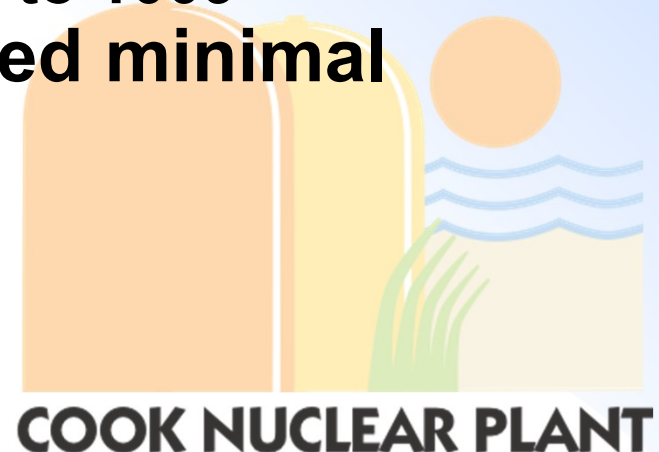


Critical Surveys

Alpha Program Results



- **RHR valve, 1-IMO-350**
 - **Five smears taken and monitored using AC3 probe - Contamination ranged from 100-220 cpm (526-800 dpm alpha)**
 - **Smears of smears taken from two of these**
 - **Activity 344 dpm and 237 dpm alpha on these**
 - Equates to 3323 and 761 dpm on first smear
 - **Beta gamma ratios from 361 to 1009**
 - **Air sample and lapel showed minimal activity**



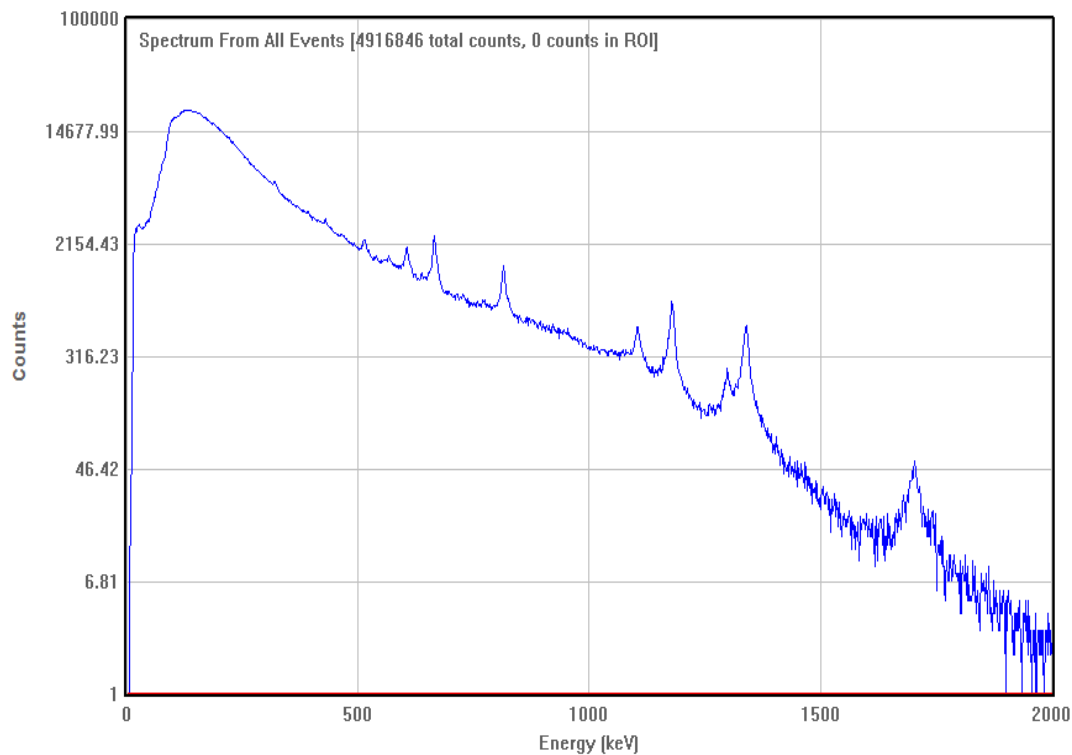
Critical Surveys Alpha Program Results



- **CZT was used throughout the plant and identified a large amount of Cs-137 in beta gamma contamination**
 - **This confirms that alpha emitters very likely to be present in these areas/in the plant**
- **Further justifies the need for the enhanced alpha monitoring program**

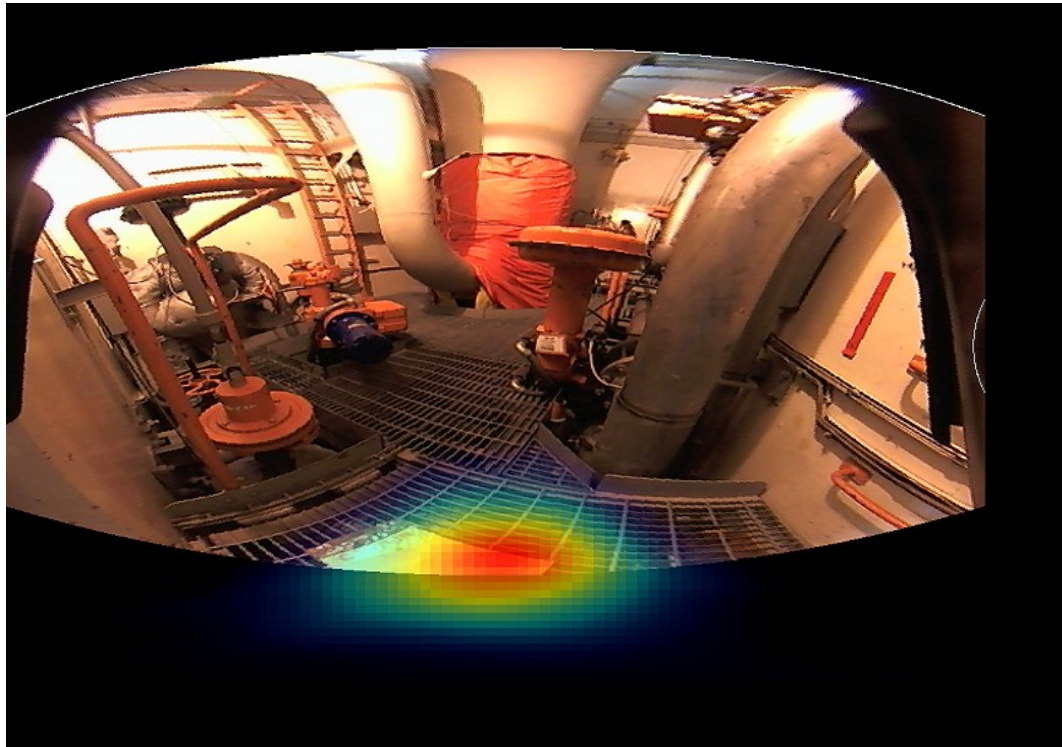


U1 E RHR Hx Mid-Outage



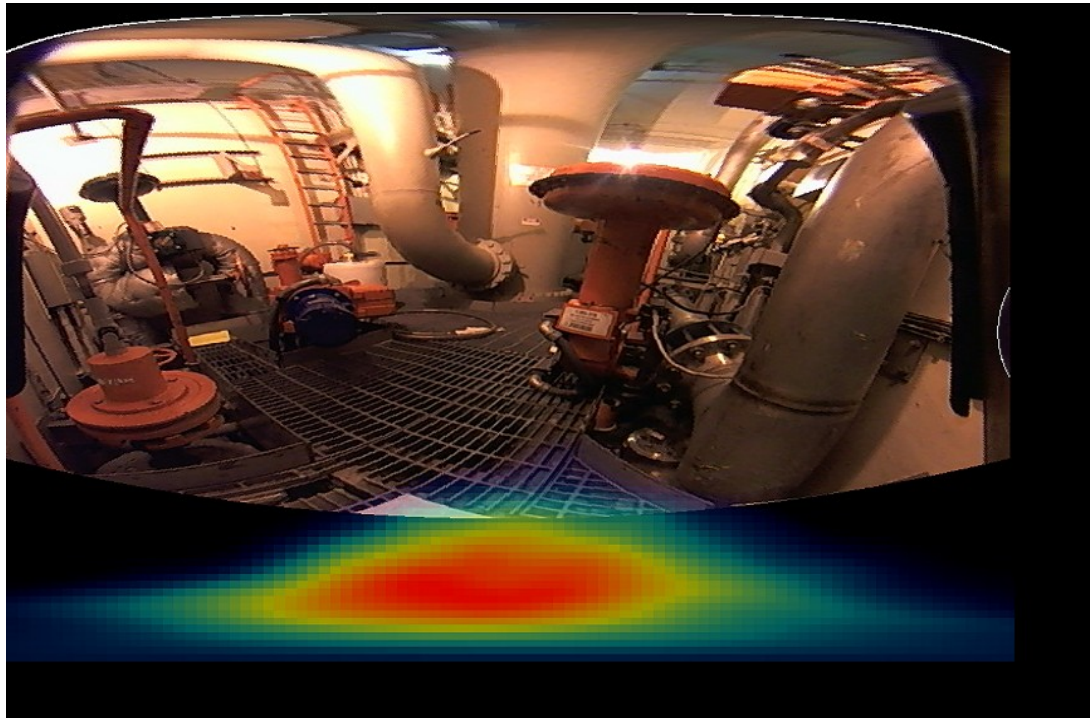
- **Measurement info: 04-02-2013 13:38:03 (22.2 min) U1 E RHR Hx**
- **Isotopes: Co-58, Fe-59, Co-60, Sb-124, Cs-137**
- **Trace amounts of: Cr-51, Nb-95, Zr-95**

U1 E RHR Hx Mid-Outage



- **Measurement info: 04-02-2013 13:38:03 (22.2 min) U1 E RHR Hx**
- **Selected Isotopes in Post-Processed Imaging: Cs-137**

U1 E RHR Hx Post-Outage

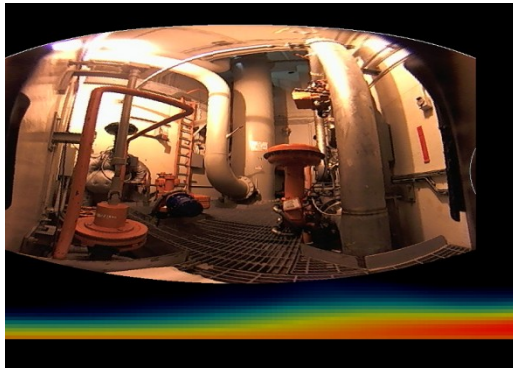


- Measurement info: 05-16-2013 12:36:55 (16.5 min) U1 E RHR Hx GA
- Selected Isotopes in Post-Processed Imaging: Cs-137

U1 E RHR Time-lapse

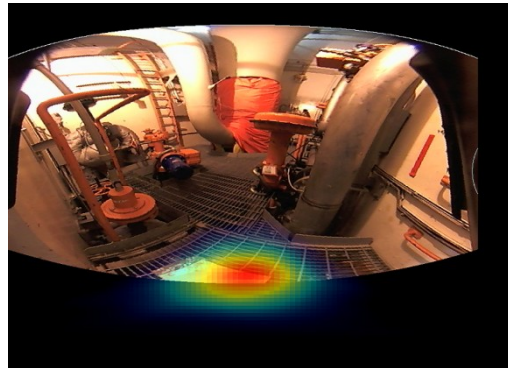
Cs-137

Pre-Outage

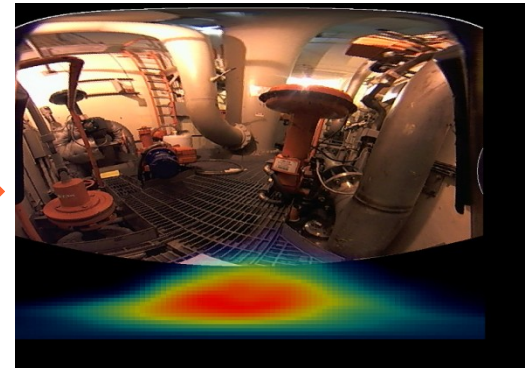


Beneath
Detector

Mid-



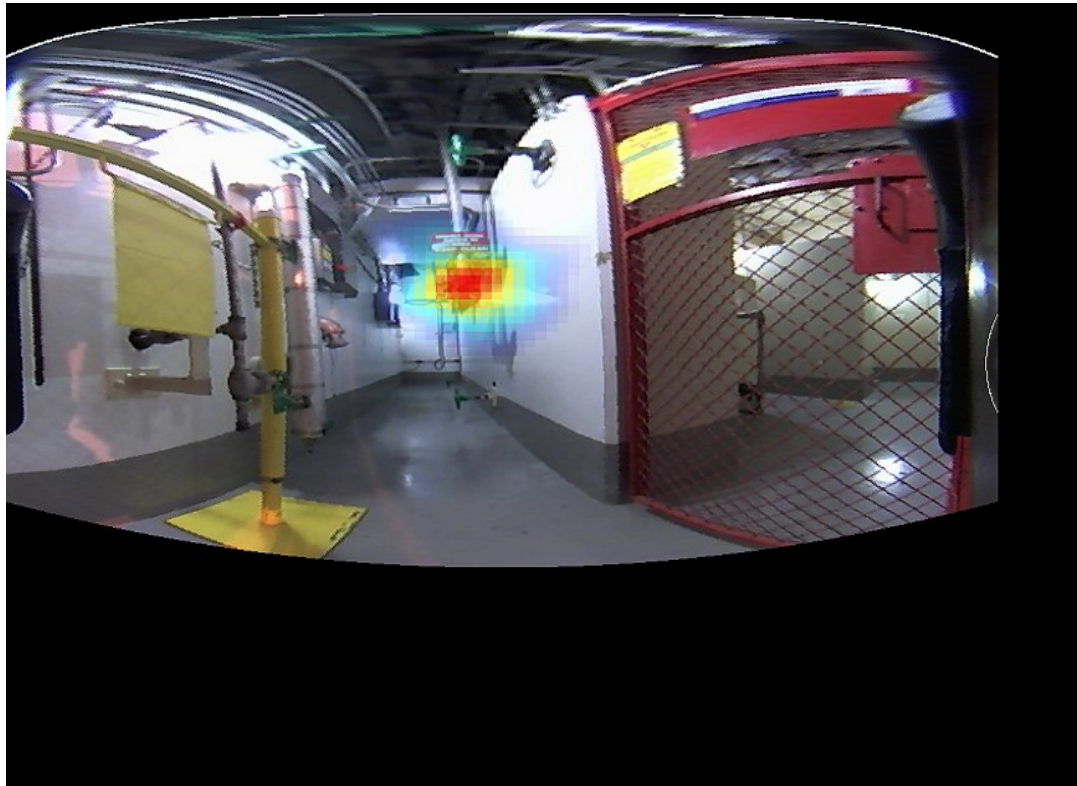
Post-



587' AUX BUILDING RADIATION AREA (RA)

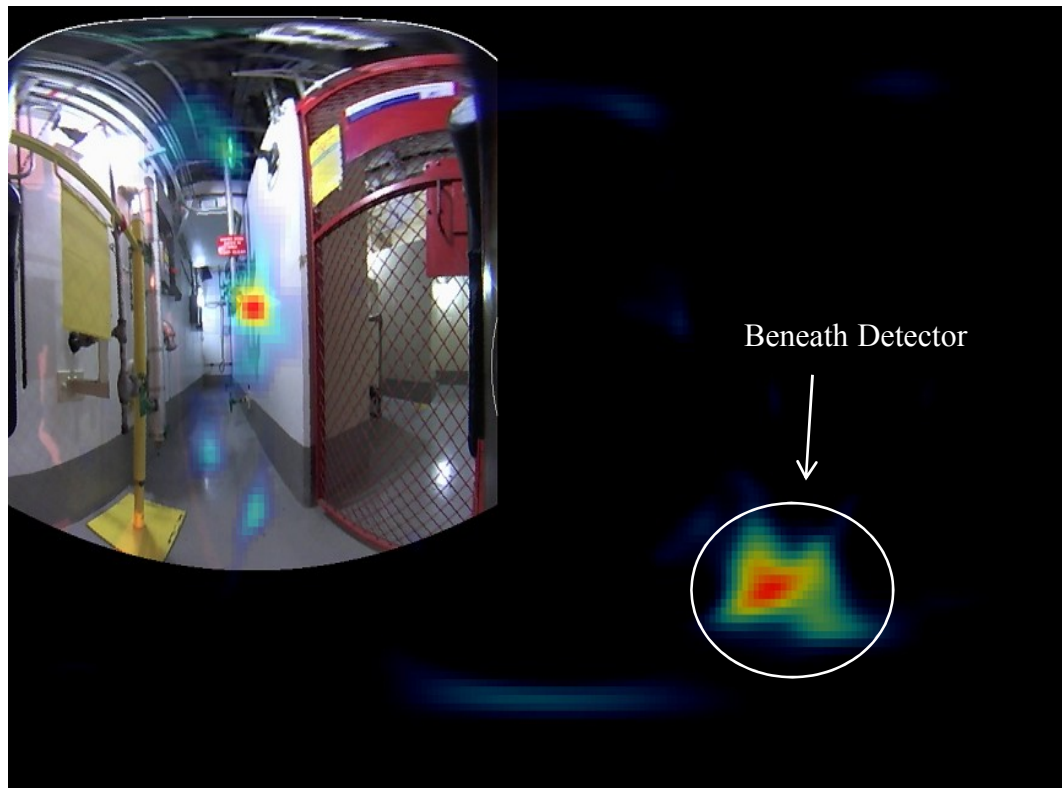
Image of the hallway next to north waste evaporator filter/pump room. It is the only RA on the 587' level that is not located in a room. Current hot spot is 60 mR/hr contact and 5 mR/hr at 30 cm. Cobalt-60 is concentrated on valve 12-WD-322 in the waste disposal system. Cesium-137 is embedded in the floor, walls and piping.

587' Aux RA



- **Measurement info: 06-03-2013 13:40:32 (11.6 min) N. Waste Evaporator Feed/Filter Pump Room**
- **Selected Isotopes in Post-Processed Imaging: Co-60**

587' Aux RA

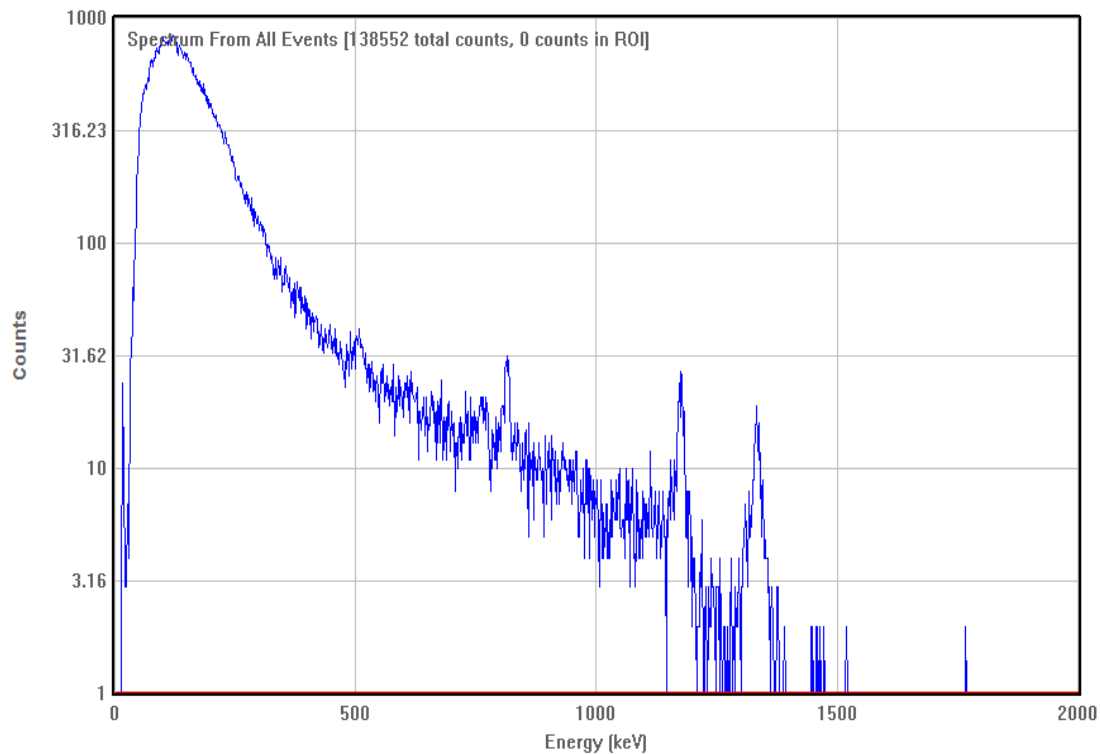


- **Measurement info: 06-03-2013 13:40:32 (11.6 min) N. Waste Evaporator Feed/Filter Pump Room**
- **Selected Isotopes in Post-Processed Imaging: Cs-137**

650' AUXILIARY BUILDING

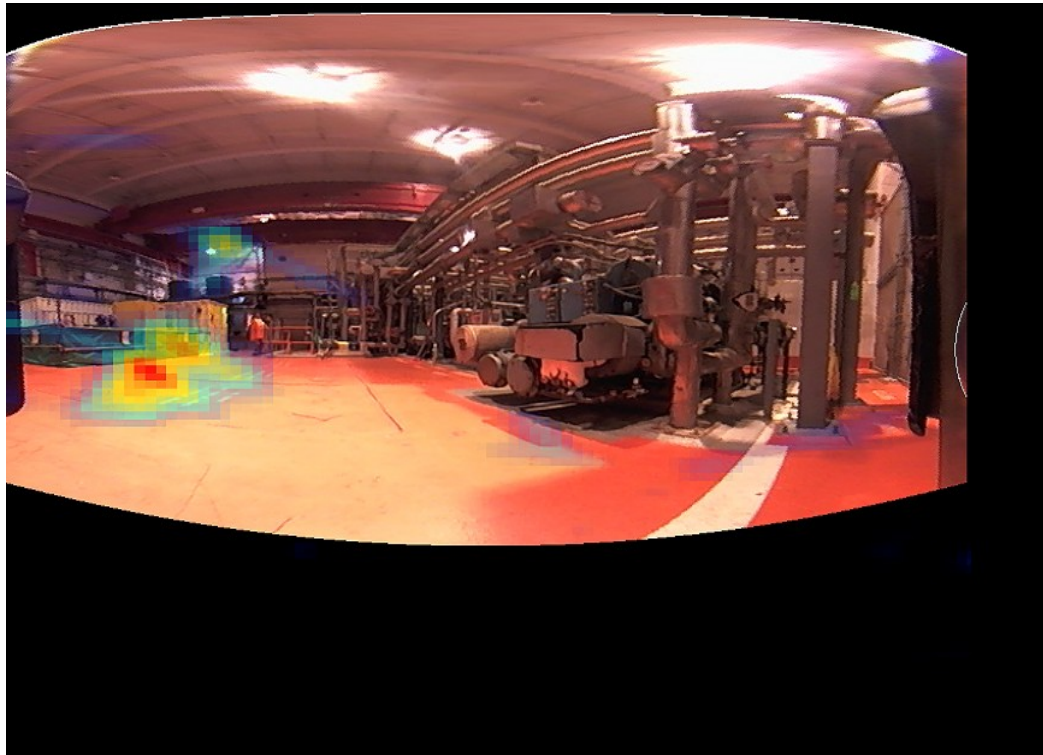
120,000 ccpm personnel contamination occurred in a “clean areas” on the 650’ aux building. This measurement located areas for follow-up smears by RP technicians. Two 2,000 ccpm particles and one 140,000 ccpm particle were found and removed.

650' Aux Building



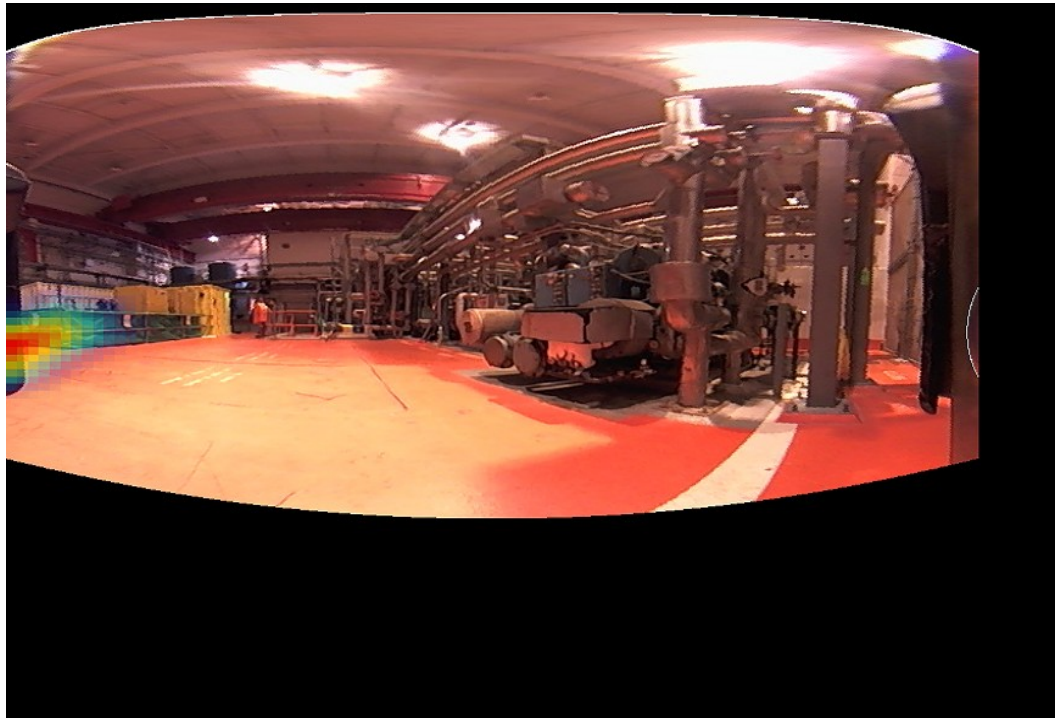
- **Measurement info: 05-20-2013 15:24:09 (30.5 min) 650' Elevation O/S Vital Area**
- **Isotopes: Co-58, Co-60**
- **Trace Amounts of: Nb-95**

650' Aux Building



- **Measurement info: 05-20-2013 15:24:09
(30.5 min) 650'
Elevation O/S Vital
Area**
- **Selected Isotopes in
Post-Processed
Imaging: Co-58**

650' Aux Building



- **Measurement info: 05-20-2013 15:24:09
(30.5 min) 650'
Elevation O/S Vital
Area**
- **Selected Isotopes in
Post-Processed
Imaging: Co-60**

Critical Surveys Results

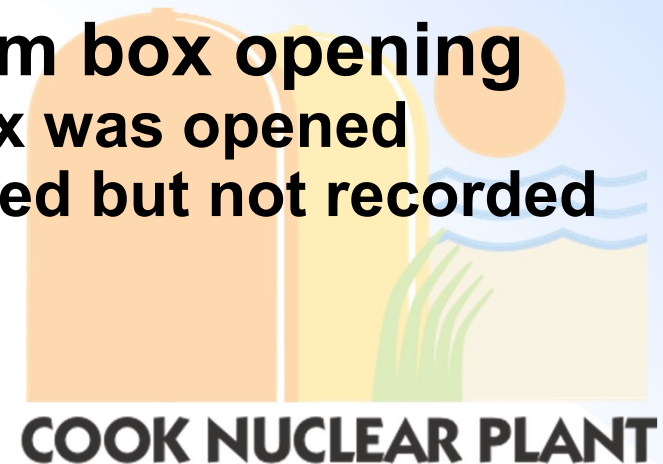
- Increased overall quality of survey data
- Increased oversight over the performance of important surveys
 - They were done by right person at right time in the right way
- QA over dose rate surveys used to verify appropriateness of dose estimates
 - Used good survey data to lower dose estimate in one case
- Improved confidence in alpha monitoring data collected
- Demonstrated effectiveness of new process for cavity water clean up
- Feedback from supervisors and technicians very positive



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Critical Survey Results

- **When choice made NOT to do a critical survey, then noticed drop in standards:**
 - **Reactor pit**
 - Routine survey was relied upon
 - Two dose rate alarms found, and discovered routine survey was not comprehensive enough
 - Implementation of the critical survey concept in this area may have prevented this event
 - **Steam generator nozzle dam box opening**
 - Could not prepare before box was opened
 - Alpha surveys were conducted but not recorded



Lessons Learned



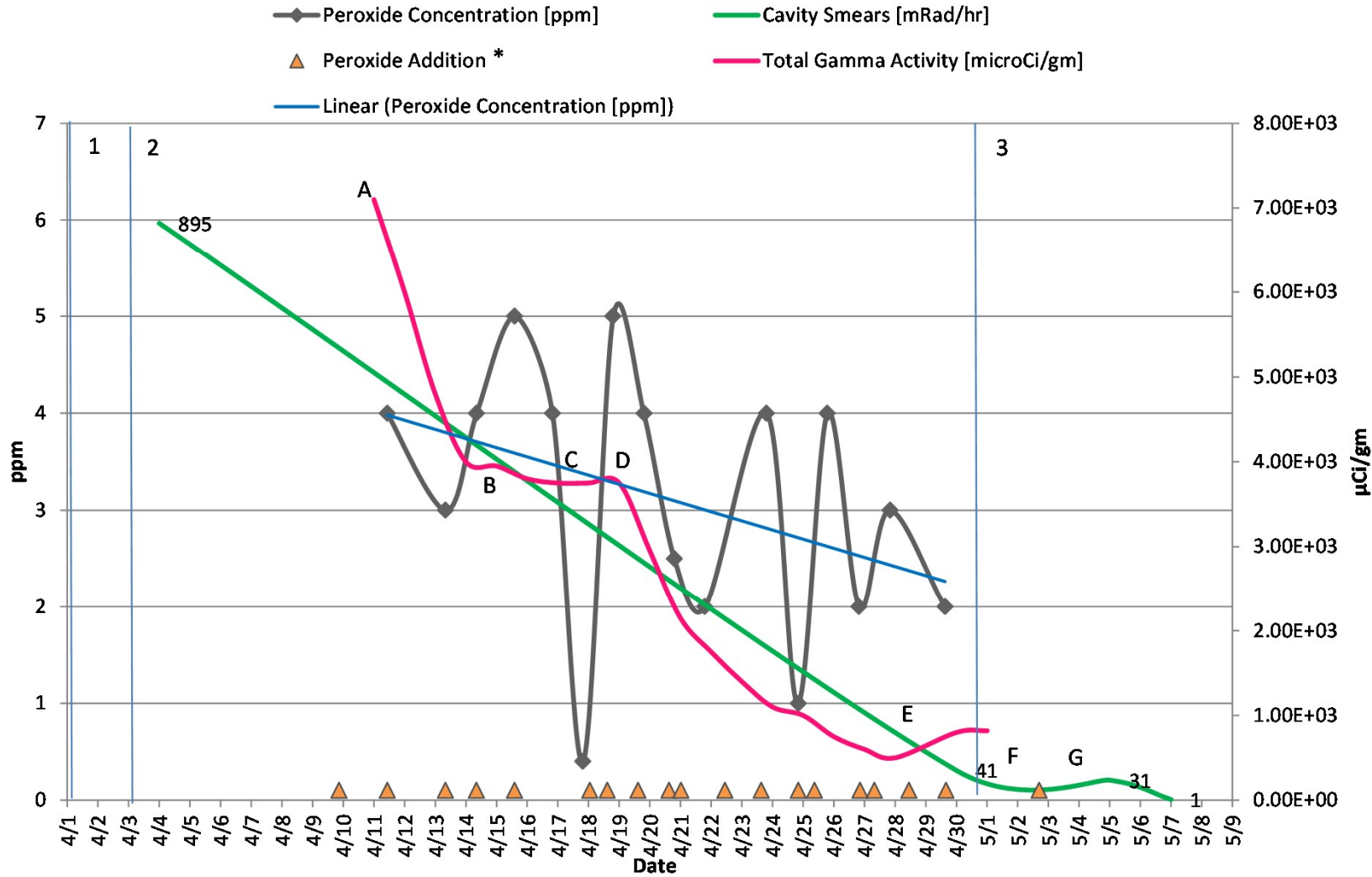
- **Recording precisely how alpha monitoring was performed improves accuracy of the alpha data and provides additional information:**
 - **Smear of a smear in the RHR-IM-350 valve identified 344 dpm alpha, which was recorded on the survey as 344 dpm, but actually was 3323 dpm alpha if ratio back to first smear**
 - **Abrasive smear of RCDT waste valve showed alpha activity increased by 2.5 times and ratio decreased by a factor of two from surface smear**
- **Both issues were picked up from review of the “critical survey” performed for job coverage**

Lessons Learned

- **Reactor cavity clean using peroxide addition and recirculation of cavity water through the spent fuel pool demineralizer using PRC-01 resin was effective**
- **See Graph**



Total Gamma Activity - Reactor Cavity/Refuel Canal 1



Conclusions



- **Critical survey concept is a useful tool to increase the oversight and therefore quality of survey data obtained**
- **Focus on survey quality for critical surveys will impact quality of all surveys as errors are identified and survey quality is improved**
- **Critical survey concept will continue to be used and refined further at Cook**

