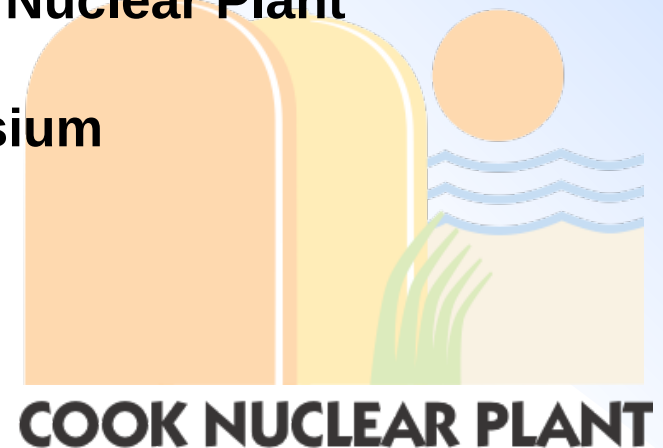




Innovation is Alive and Well in Radiation Protection CZT with Critical Surveys

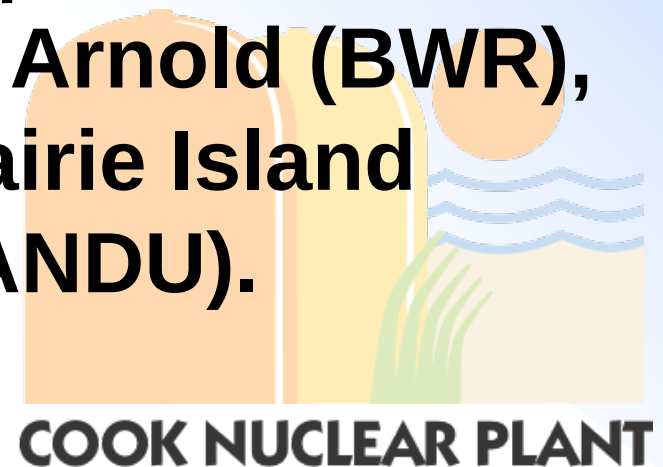
**Bob Hite - RP, Chemistry, Environmental Director
American Electric Power - Cook Nuclear Plant**

**ISOE European Symposium
April 9-11, 2014**



RP, Chem & Environmental Director

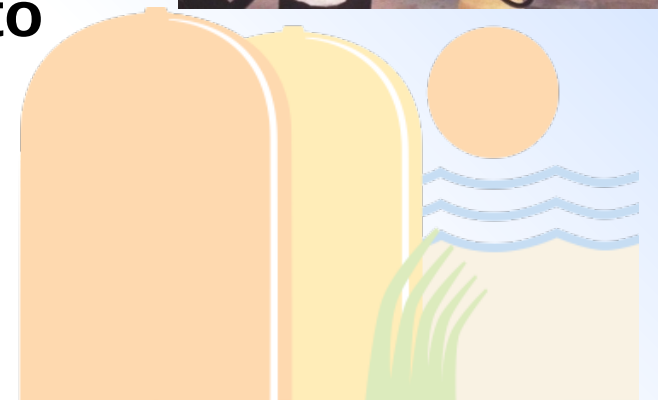
- **Arrived at Cook in fall 2011**
- **A rich and varied experience as RPM**
 - **first.....**
 - **Contract HP Technician**
 - **Health Physicist/1st-line Supervisor**
- **Previously RPM at Duane Arnold (BWR), Diablo Canyon (PWR), Prairie Island (PWR) & Bruce Power (CANDU).**



COOK NUCLEAR PLANT

Critical Surveys – A Concept

- **WHY??????**
 - 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



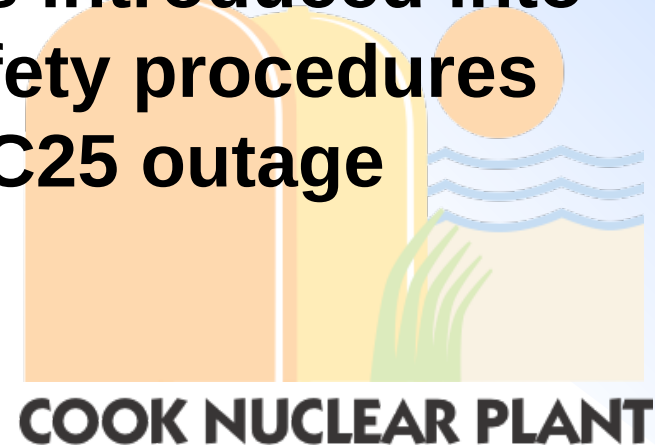
COOK NUCLEAR PLANT

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

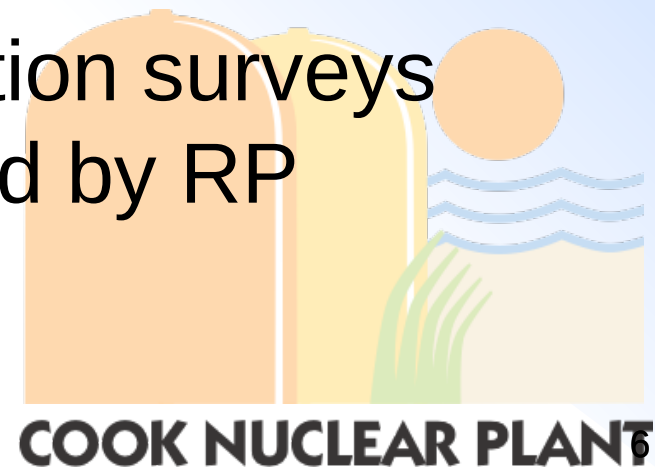
“a survey critical to plant radiological performance, industry or performance trending, or instrumental in the decision making process”



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

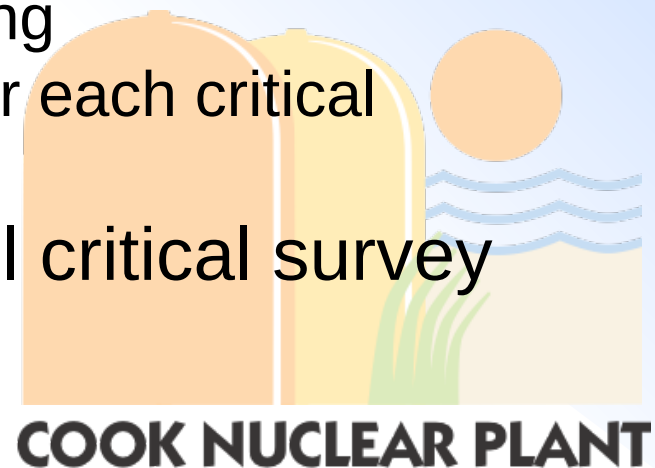


“Critical Survey” Requirements

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

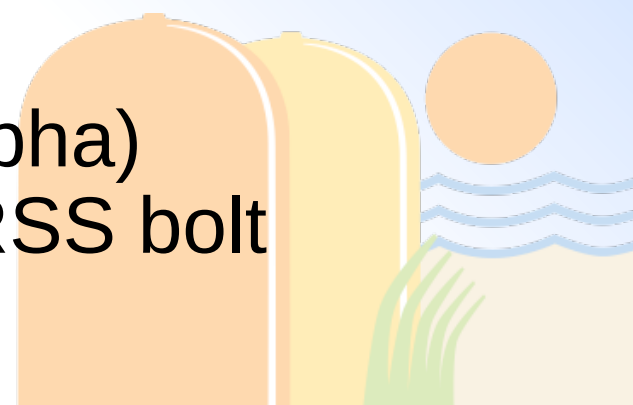
Implementation in U1C25

- 15 critical surveys defined for the outage
- Critical survey packages
 - Included prepared templates
 - 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 shiftly turnover meeting
 - Identified supervisor responsible for each critical survey on upcoming shift
- Master binder maintained with all critical survey results as they were performed



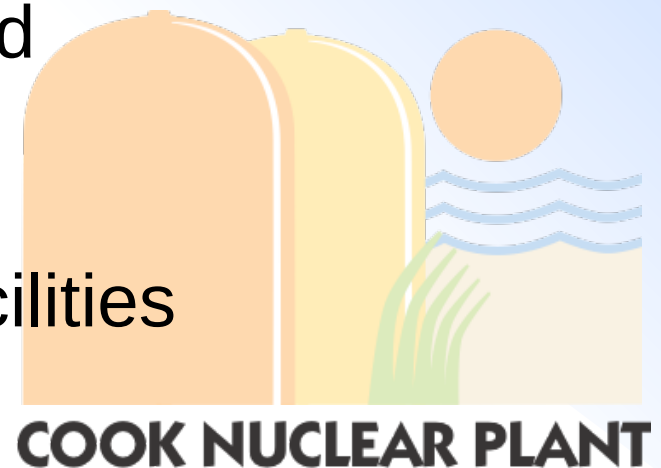
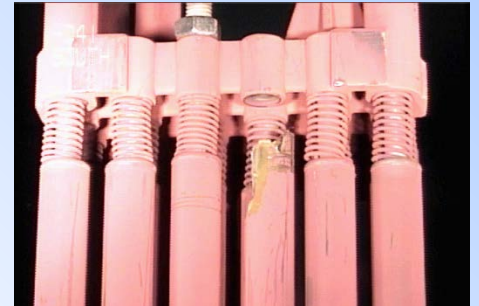
Critical surveys in U1C25

- 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
 - This was part of the genesis of the concept
 - Components that had not previously been characterized
 - Systems that had not been characterized
- Items received from other facilities

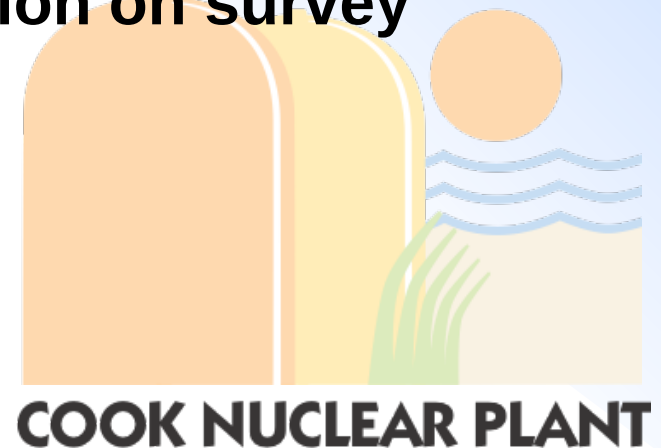


Critical Surveys

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/protean for first smear
 - (could have been more accurate if counted lower beta gamma wipes)
 - **Beta gamma level - 25 Kdpm/smear**
 - Counted on 3030, background
 - **No air sample or label information on survey**

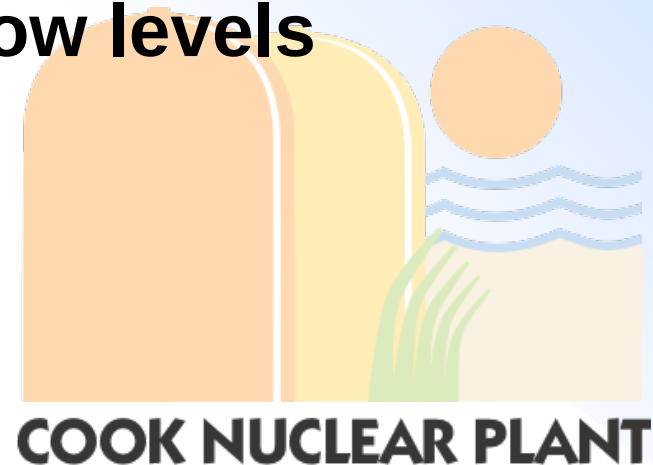


Critical Surveys

Alpha Program Results



- **1-WD-261 (at RCDT)**
 - 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 levels

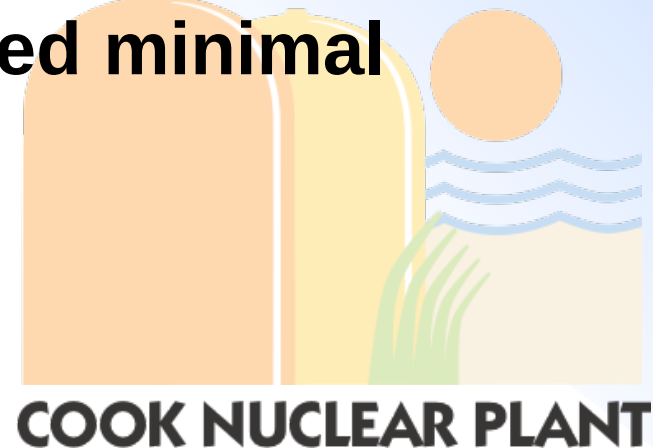


Critical Surveys

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

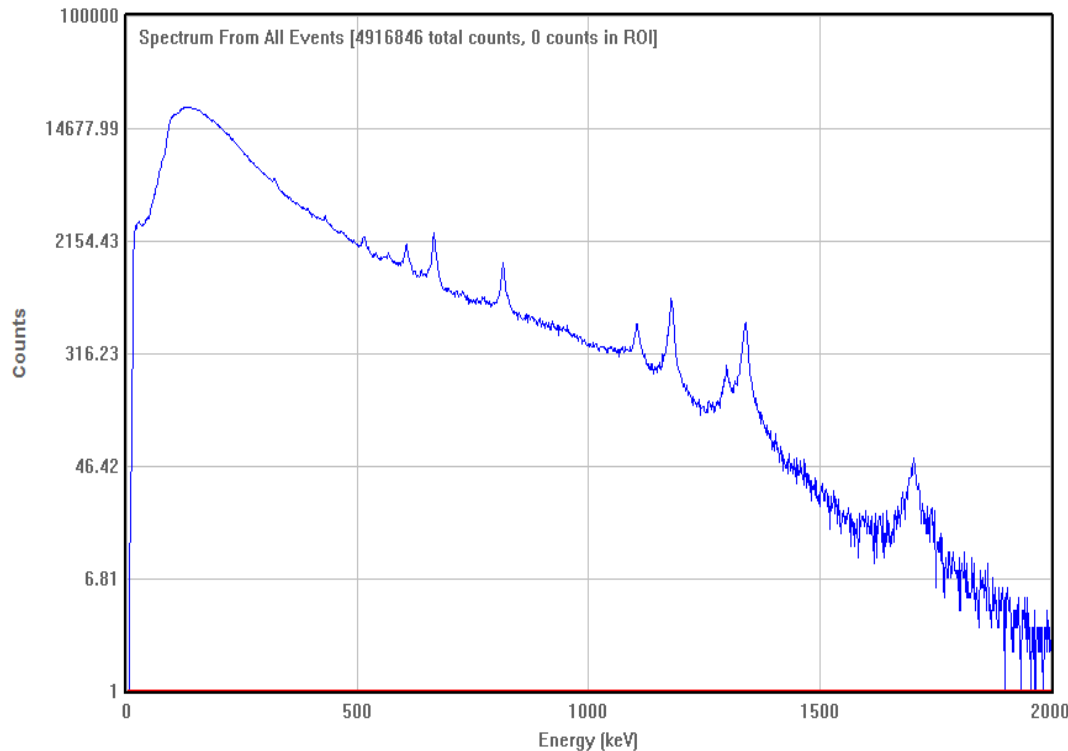
Alpha Program Results



- **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 justified the need for the enhanced alpha monitoring program**

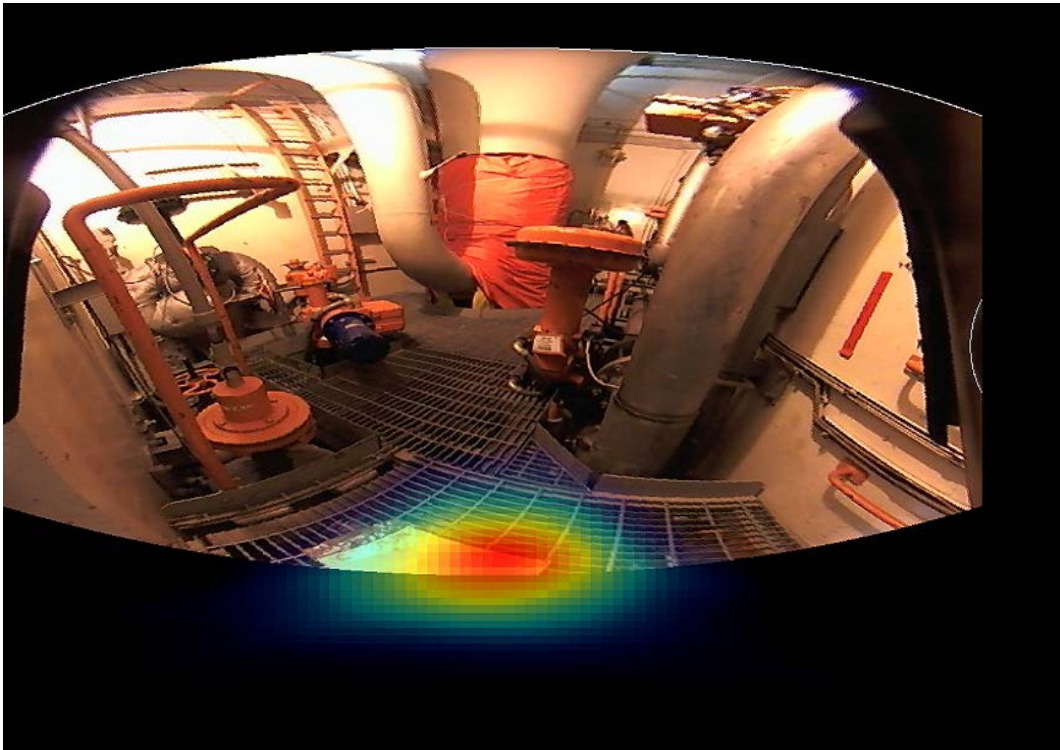


U1 E RHR Hx Mid-Outage



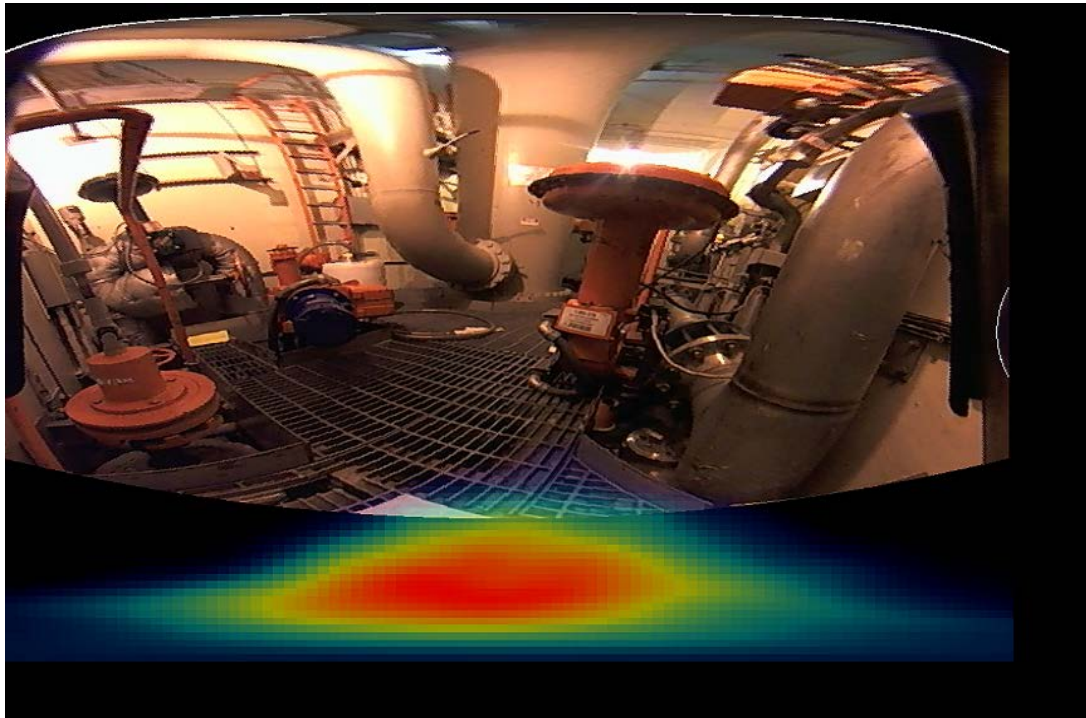
- **Measurement info: 04-02-2013 13:38:03 (22.2 min) U1 E RHR Hx**
- **Isotopes: Co-58, Fe-59, Co-60, Sb-124, Cs-137**
- **Trace amounts of: Cr-51, Nb-95, Zr-95**

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

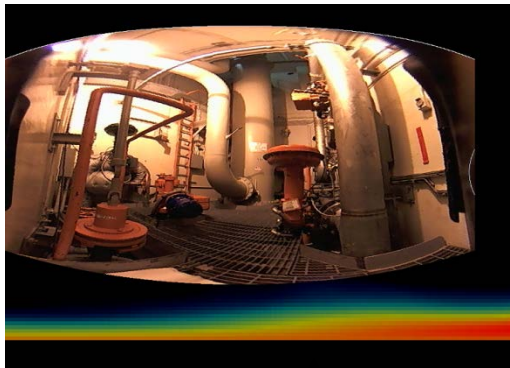


- Measurement info: 05-16-2013 12:36:55 (16.5 min) U1 E RHR Hx GA
- Selected Isotopes in Post-Processed Imaging: **Cs-137**

U1 E RHR Time-lapse

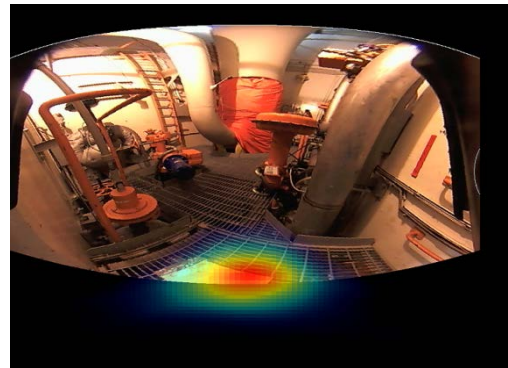
Cs-137

Pre-Outage

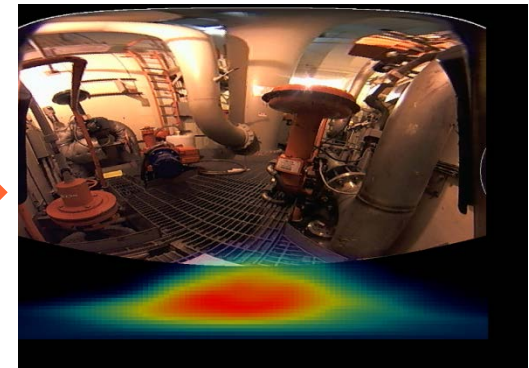


Beneath
Detector

Mid-Outage



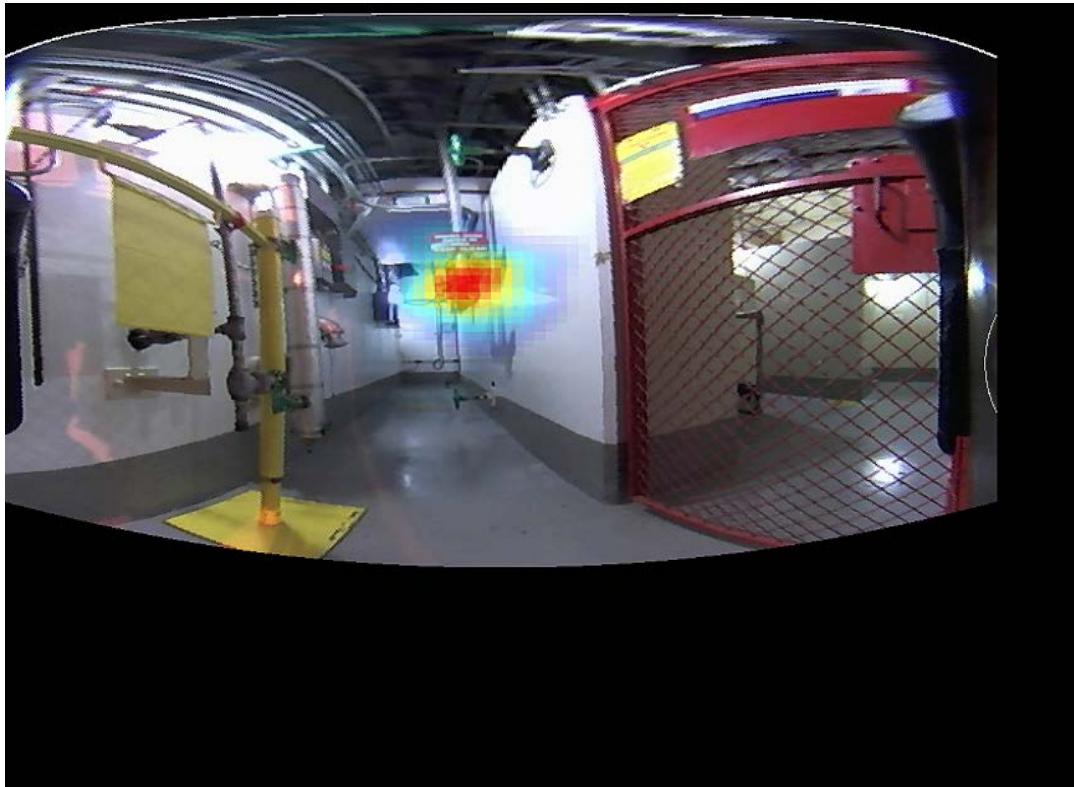
Post-Outage



587' AUX BUILDING RADIATION AREA (RA)

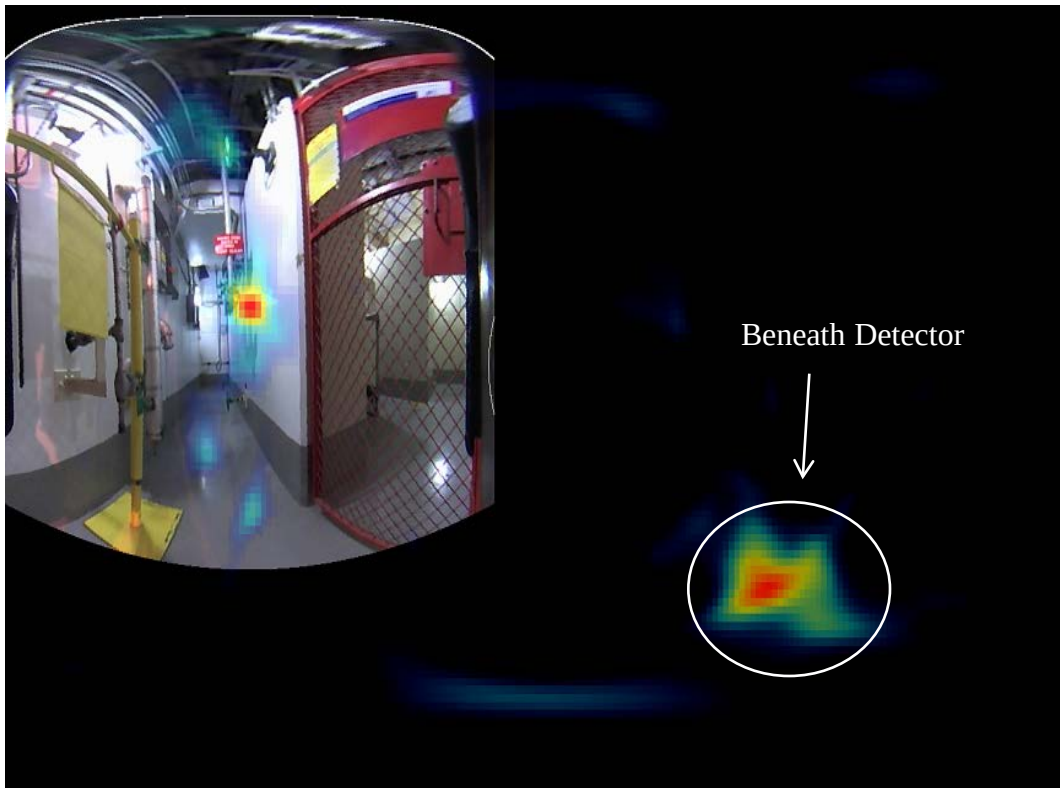
Image of the hallway next to north waste evaporator filter/pump room. It is the only RA on the 587' level that is not located in a room. Current hot spot is 60 mR/hr contact and 5 mR/hr at 30 cm. Cobalt-60 is concentrated on valve 12-WD-322 in the waste disposal system. Cesium-137 is embedded in the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

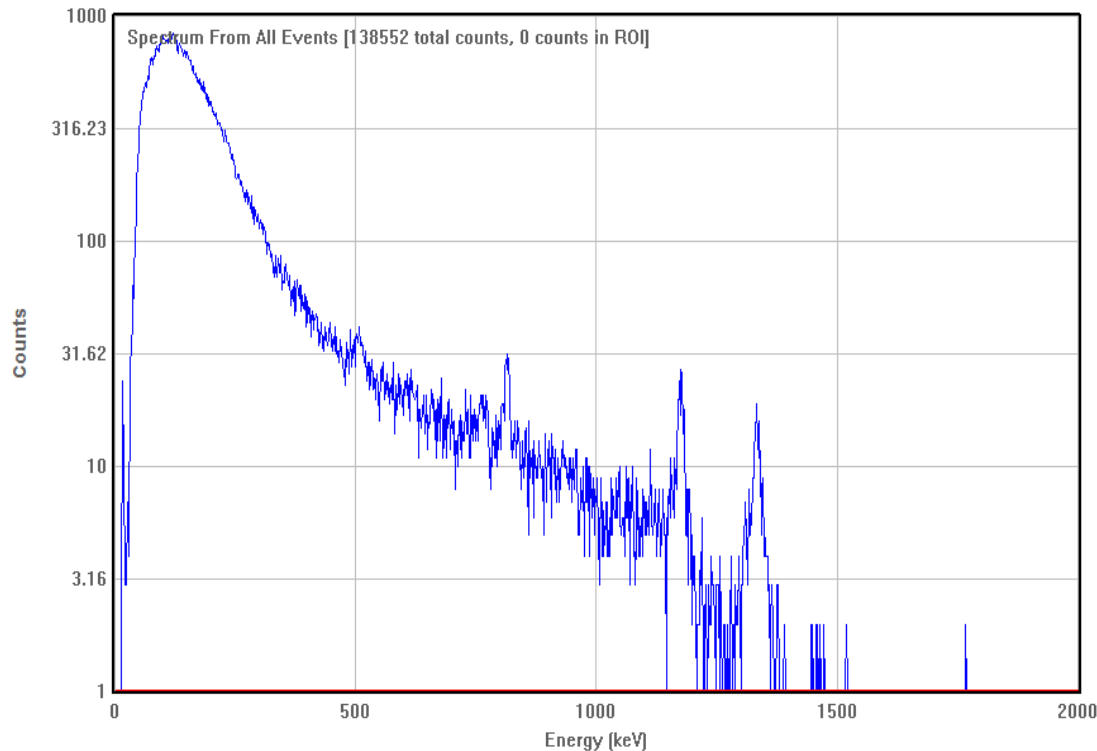


- Measurement info: 06-03-2013 13:40:32
(11.6 min) N. Waste Evaporator Feed/Filter Pump Room
- Selected Isotopes in Post-Processed Imaging: **Cs-137**

650' AUXILIARY BUILDING

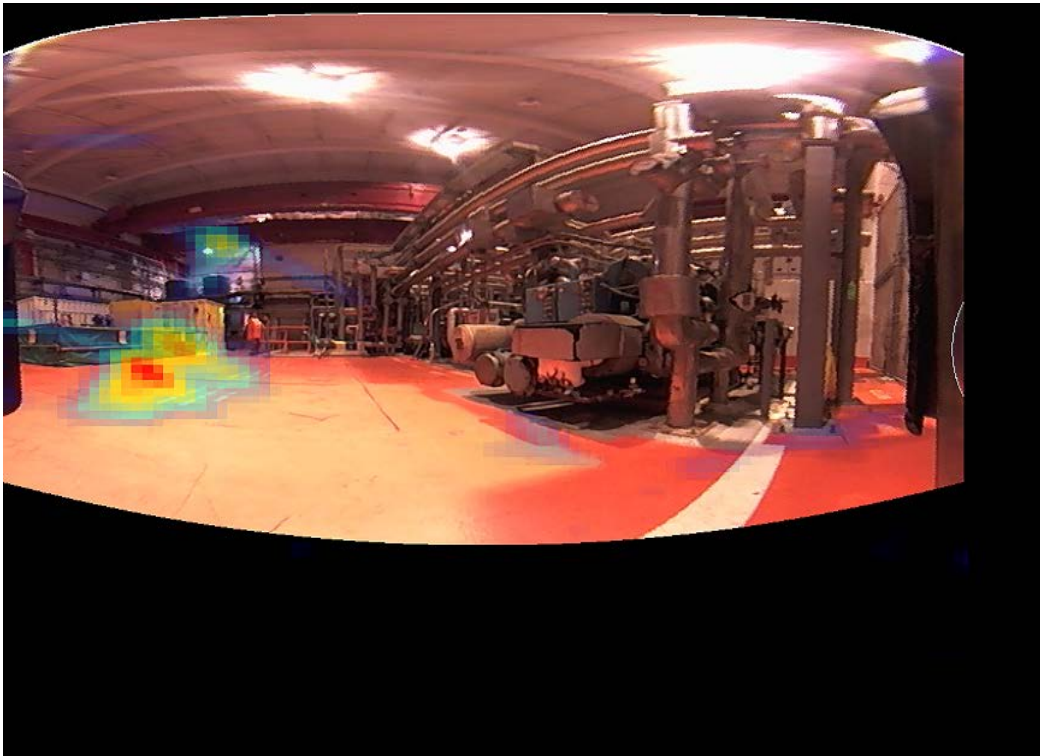
120,000 ccpm personnel contamination occurred in a “clean areas” on the 650’ aux building. This measurement located areas for follow-up smears by RP technicians. Two 2,000 ccpm particles and one 140,000 ccpm particle were found and removed.

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

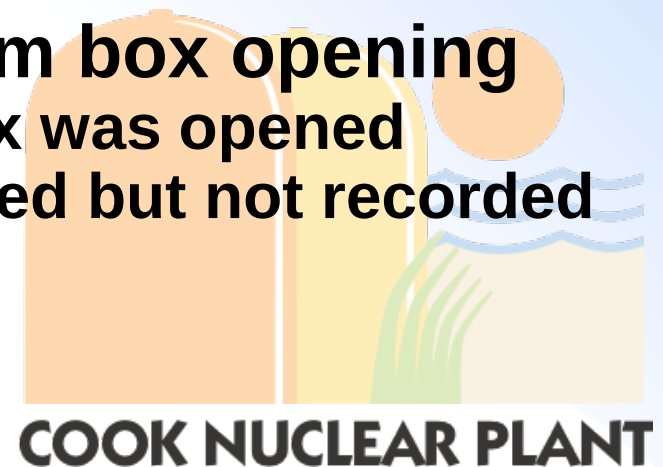
- Increased overall quality of survey data
- Increased oversight over the performance of important surveys
 - They were done by right person at right time in the right way
- QA over dose rate surveys used to verify appropriateness of dose estimates
 - Used good survey data to lower dose estimate in one 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



COOK NUCLEAR PLANT

Lessons Learned



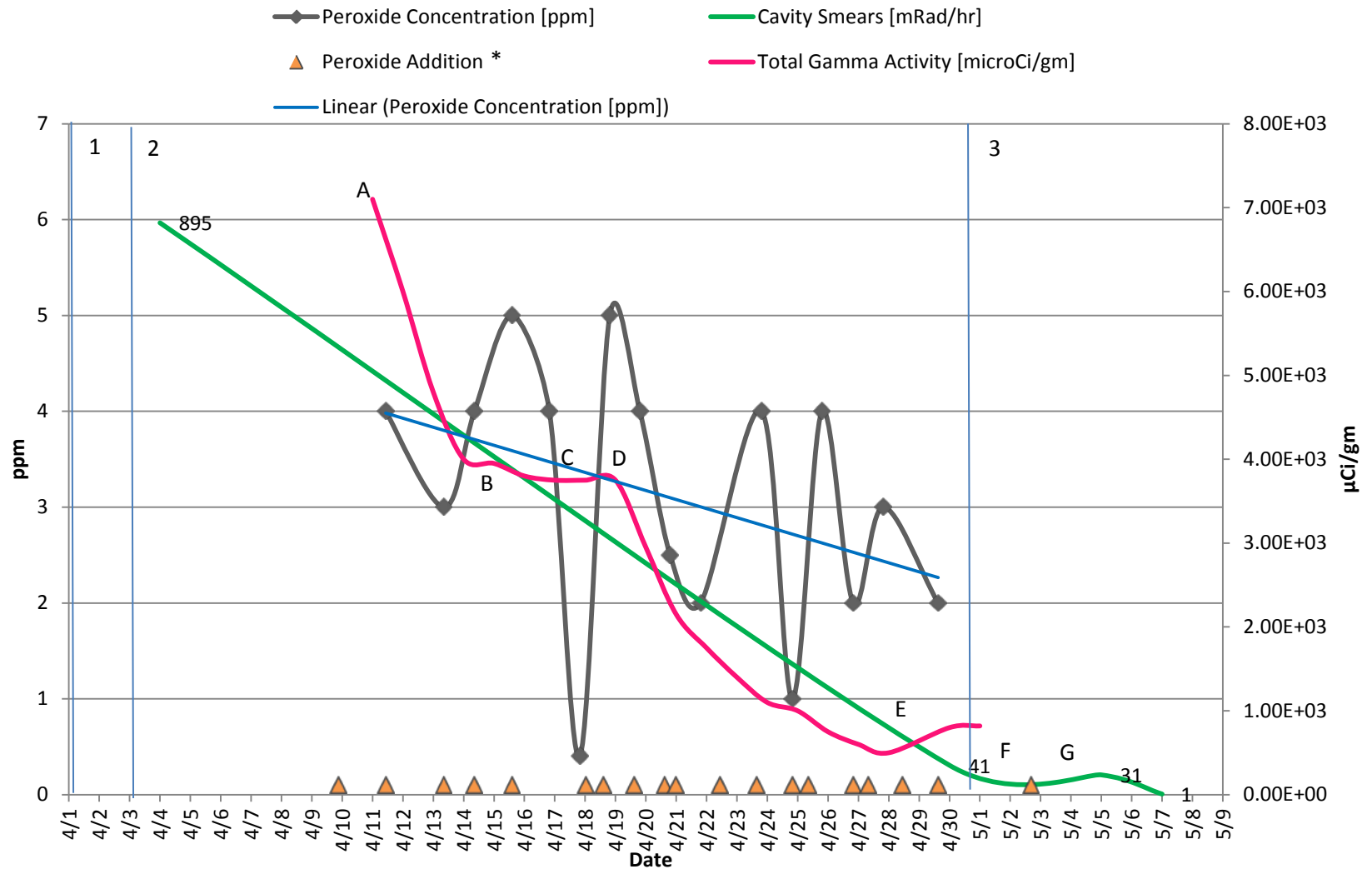
- **Recording precisely how alpha monitoring was performed improves accuracy of the alpha data and provides additional information:**
 - Smear of a smear in the RHR-IM-350 valve identified 344 dpm alpha, which was recorded on the survey as 344 dpm, but actually was 3323 dpm alpha if ratio back to first 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**

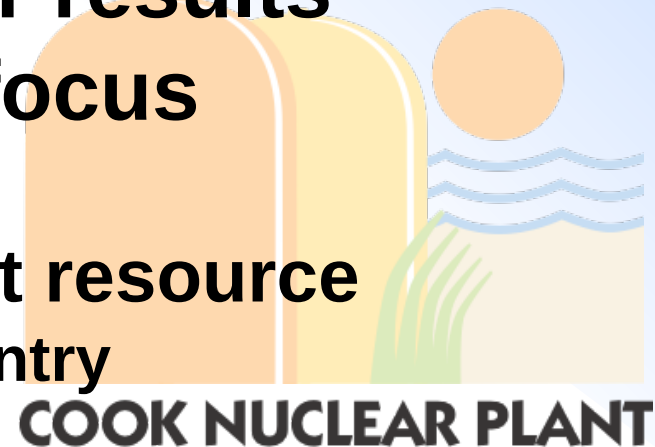


Total Gamma Activity - Reactor Cavity/Refuel Canal 1



The NEXT Outage with Critical Surveys

- **Had more time to plan and build packages**
- **Supervisors were more attuned**
 - **Use continuing training to review previous outage results**
- **Technicians understood program**
- **Better performance, better results**
- **Supervisors are now the focus**
 - **Missed some reviews**
 - **Didn't always send the best resource**
 - **Had a dose alarm on initial entry**

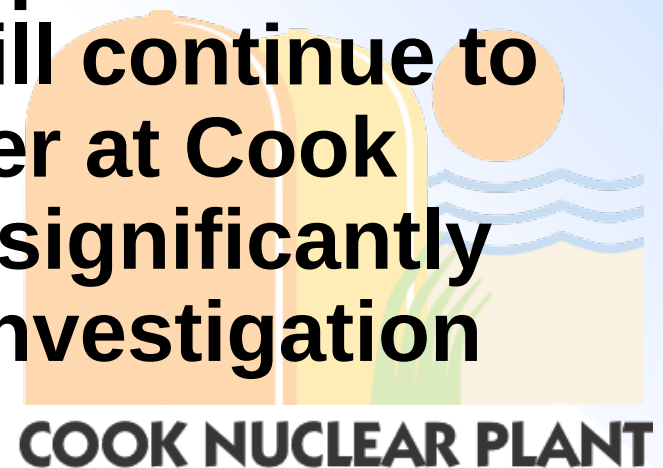


COOK NUCLEAR PLANT

Conclusions

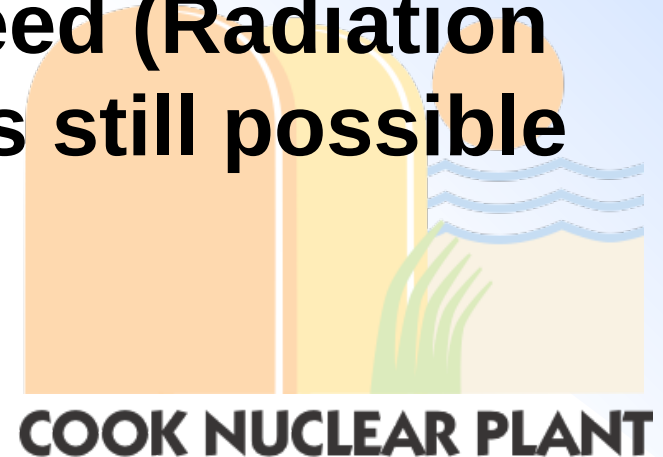


- **Critical survey concept is a useful tool to increase the oversight and therefore quality of survey data obtained**
- **Focus on survey quality for critical surveys will impact quality of all surveys as errors are identified and survey quality continues to be improved**
- **Critical survey concept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



Conclusions

- **The Critical Survey concept was a new, formalized process to a very old requirement**
- **The CZT was an entirely new detection capability that significantly enhanced the survey and characterization programs**
- **For an old, established need (Radiation Protection) – Innovation is still possible and is happening!**



- **Thank you for your time**

