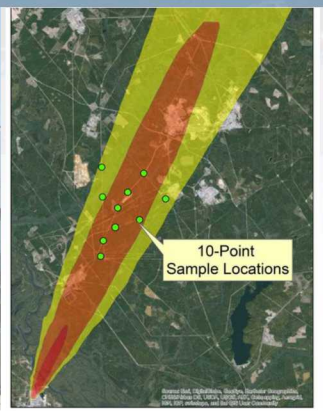
SAND2019-13045C

Federal Radiological Monitoring and Assessment Center (FRMAC) – Lessons Learned in Recent Events



2019

SAND2019-XXXX

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Overview

- Drills and Exercises
  - Mixed Fission Product Proficiency Test – *Special presentation later in workshop*
  - Cobalt Magnet 2019

- Real-world activities
  - Legacy site – wildfire causes public concern – RAP deployment
  - Indoor contamination incident – RAP/FAL deployment
  - Legacy nuclear site – routine monitoring "detection" and concerned citizen sampling – DOE-EM requests RAP deployment

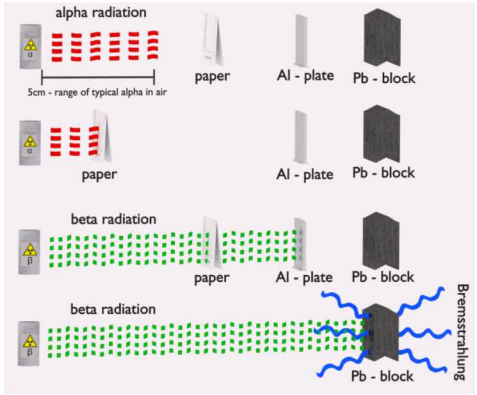
- Programmatic Lessons Learned
- Laboratory Lessons Learned

Cobalt Magnet 2019

Scenario

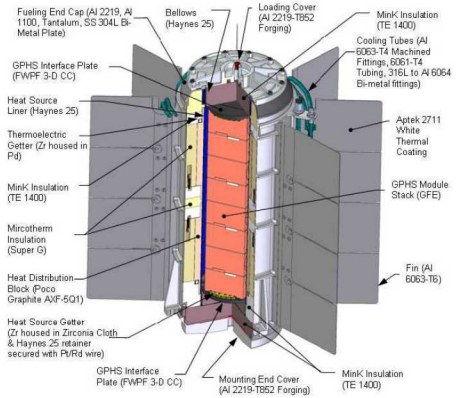
- NASA mission carrying a multi-mission radioisotope thermal electric generator (MMRTG) experiences anomaly

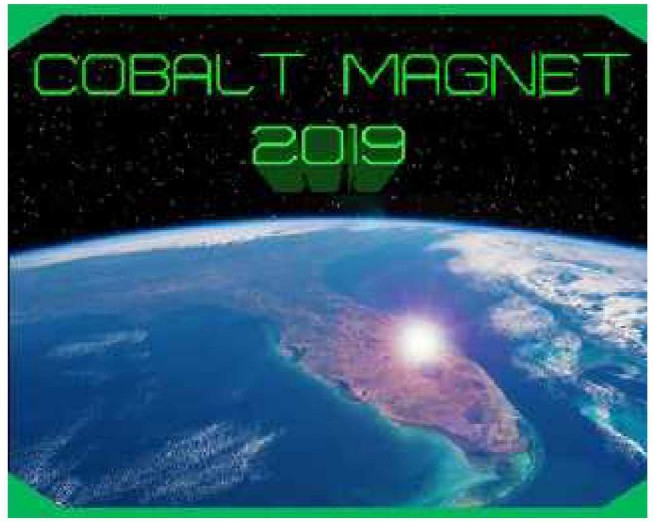
Challenges

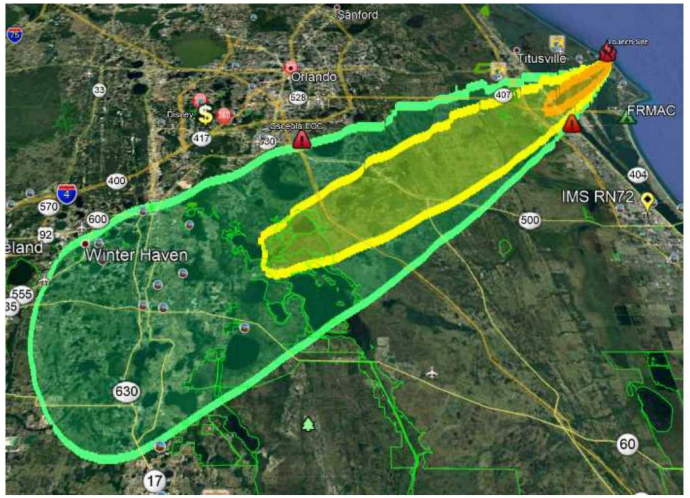


Why this scenario?

- MARS 2020 Mission





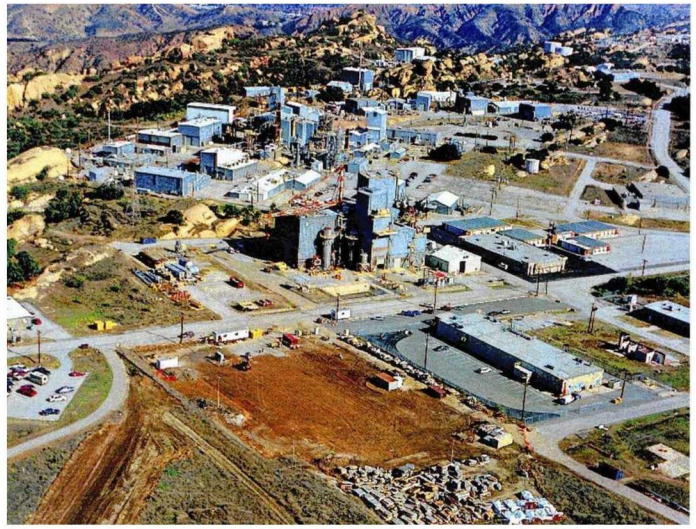


Cobalt Magnet 2019: Challenges

- Pure alpha source term makes field measurements difficult/unreliable and mobile detection platforms useless
- There is little-to-no field assay capability for gross alpha/beta on ground deposition or other environmental samples
  - Reliance on smears and air filter samples
  - Clear need for more rapid analysis capability at fixed labs
- Sample receipt hotline personnel approached by public
- Very difficult to estimate radiation quantities for shipment and laboratory acceptance criteria

Legacy testing site - wildfire

- Opened in 1948 to support multiple companies and agencies to test rocket technologies and eventually nuclear power research.
- Site chosen for its remote location (in 1947…)
  - Now, 150k people live within 5 miles of the site
- Several chemical contamination releases and nuclear accidents occurred at the site during its operation
- Laboratory no longer operational
  - Remediated for chemical and radiological contamination
  - Public is concerned about adequacy of cleanup efforts



Legacy testing site - wildfire

- Devastating fires burned the site and several surrounding neighborhoods
- Public concerned about the release of legacy chemical and radiological materials
- Several response assets deployed to support the state including the Radiological Assistance Program (RAP)
- RAP collected measurements, samples, and spectra of the ground at several locations

Legacy testing site – wildfire: Challenges

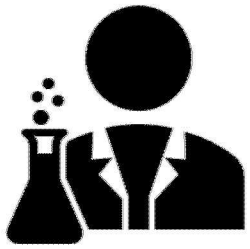
- Deployed field teams had trouble accessing sampling locations due to active wildfire
  - Field assets must maintain a close integration with the Incident Command to ensure the safety of responders
- No clear data quality objectives from the stakeholders
  - "Prove there is no radiation" is not an easy or reasonable objective
- Local/Regional lab capabilities were unknown
- Analyte of concern occurs in background due to global nuclear testing fallout
  - Difficult to explain positive detections to officials with no experience in radiological physics
- Difficulty finding and using historical radiation monitoring data for the site as a measurement of background

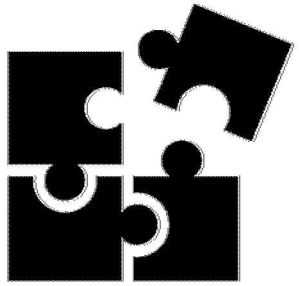
Indoor source breach - response

- State radiological emergency responders request the help of DOE to support the measurement and sampling campaigns.
- Goals:
  - Assess the extent of the contamination
  - Decontaminate affected areas
  - Recover the source material
  - Return the facility to normal operation

DOE Fly Away Lab was deployed to perform air sample and swipe screening for gross beta prior to shipment to fixed labs

Indoor source breach - Challenges

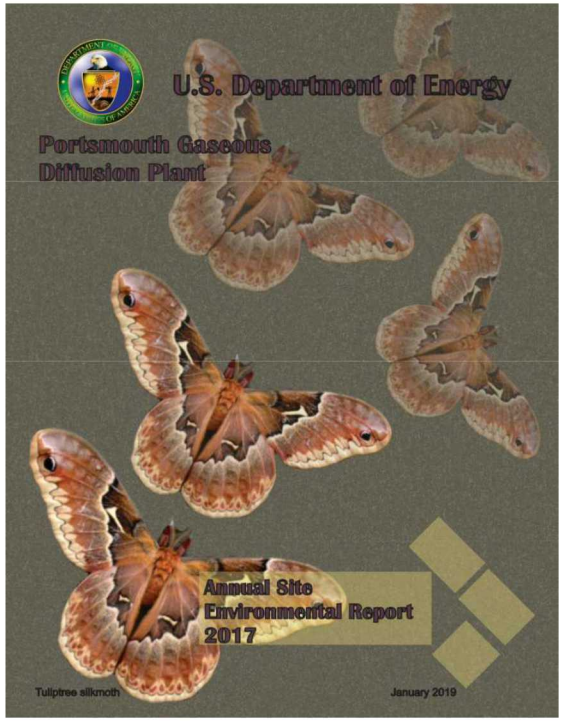




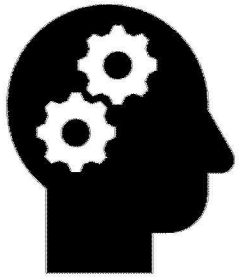
- Contamination was easily detected by field instruments but still 1000s of confirmatory samples needed analysis, even in this small event. Labs had trouble keeping up with the flow of samples while maintaining their routine operations for other customers
- Sample collection and packaging processes were not robust enough to meet laboratory standards
  - Some samples were packaged together in the same bag
  - Limited or no information on where/when sample was collected
  - Samples torn or damaged
- Responding laboratories had to qualify data based on the state of the samples they received
  - This information had to be communicated back to data users in an easy-to-understand way so that data was not overused
- Performing a verification or validation of the data with little knowledge or control over the process was difficult
  - Incorporating data into existing electronic systems proved difficult

Legacy nuclear facility – concerned citizen sampling

- DOE works to clean up and monitor legacy and active sites through the Office of Environmental Management (EM)
- Routine environmental monitoring data is published annually in an Annual Site Environmental Report (ASER)
- Sometimes, false-positive detections below the regulatory limits will be reported
- In some areas of the country, concerned citizens perform sampling and analysis through pro-bono organizations
- Recently, a request was made to DOE to investigate claims made by concerned citizens near an active DOE EM site, RAP was called in to investigate by collecting measurements and samples of a public building

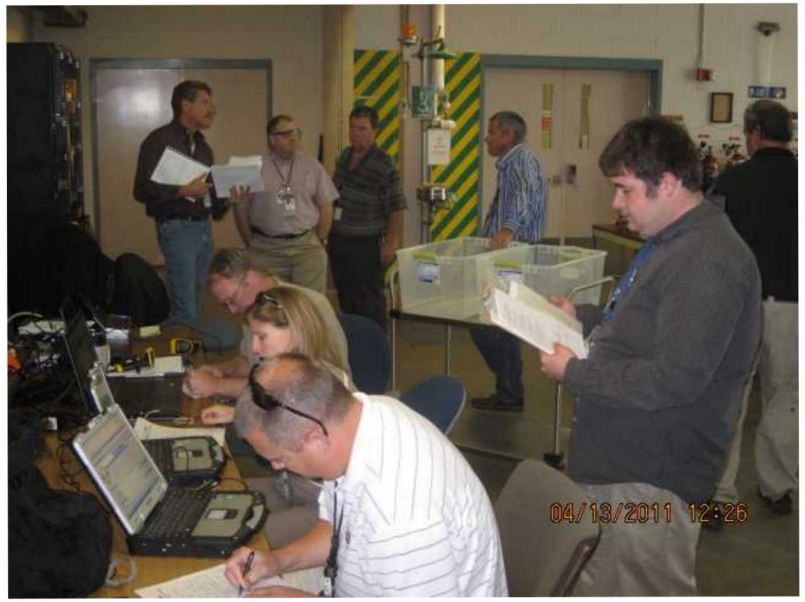


Legacy nuclear facility – concerned citizen sampling - challenges



- Though careful measurement and sampling plans were coordinated in an expedited way, citizen groups felt left out of the discussion
- Analytes of concern included NORM isotopes which can easily be detected in dirt/dust and are even present in sampling media
  - Field teams equipped with health and safety sampling and monitoring equipment did not have the sampling media used for trace isotope detection (i.e. ghost wipes)
- Some samples were sent for quantitative forensic analysis by ICP-MS and others were sent for health and safety-focused gross alpha/beta analysis with follow-up alpha spectroscopy
  - The Pro-Bono assay of the citizen samples were reported as isotope ratios only and no limits of detection were reported
- Health and Safety –focused sampling and analysis was performed quantitatively and the citizen analysis did not have this level of rigor to compare
- Standard federal government protocols were seen as concealment or suppression by some members of the public
- Lack of understanding around basic concepts of radiation and health physics made it difficult to explain background and NORM to the public

Additional Challenges and Lessons Learned

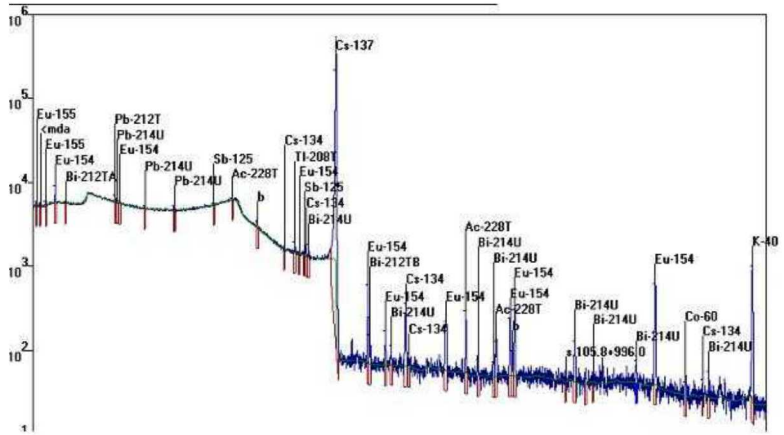


Operational Challenges for Off-Site Labs

- Volatile species of radionuclides in realistic sample media
  - Labs may need special equipment and permits to handle off-gassing during sample processing
- Standard operating procedures (SOPs) may not be flexible enough to meet the DQOs of an emergency response which may include uncommon sample matrices—ag products, livestock, ground deposition samples
- Potential Solutions:
  - Develop a special "Emergency SOP" with some flexibility
  - Develop the capability to model samples for rapid gamma spectroscopy These are not challenges but rather solutions.
- USDA permits may be required to process some sample types

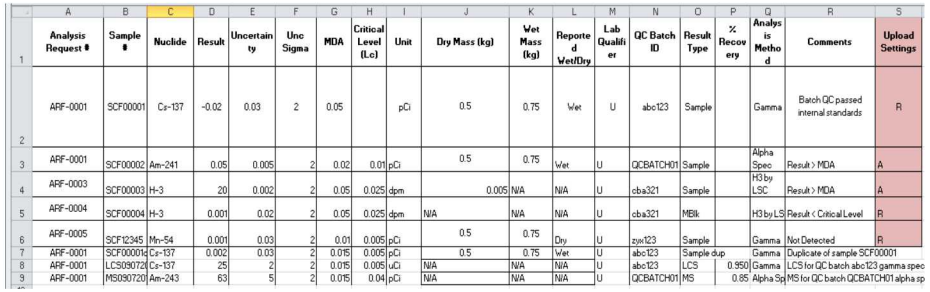
Analytical Challenges

- The most likely nuclear emergency scenarios may involve very complex source terms
- Sr-89/90 analysis methods are challenging and need some improvement to meet turn-around-time and sensitivity requirements
- Requested critical level (Lc) values may be unachievable
- Limited lab experience with fresh fission product samples that have complex gamma spectra
- Insufficient calibrated geometries for gamma spec and/or no modeling capabilities to provide quantitative results

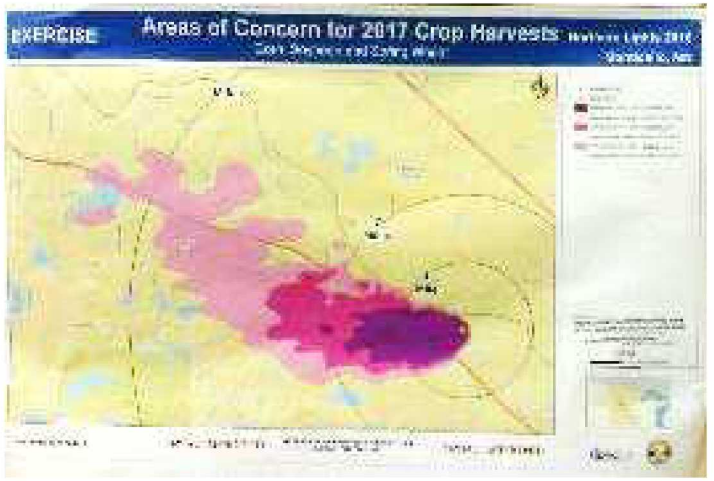


Data Reporting Challenges

- Many labs need flexibility for reporting non-detected radionuclides
- What does a Level I and Level IV data package look like?
- Unclear what records must be uploaded to FRMAC Web Portal
  - Better software design in the works to help with this issue
  - Transition to RadRepsonder



	Analysis Request	Sample	Nuclide	Result	Uncertainty	Unc Sigma	MDA	Critical Level (Lc)	Unit	Dry Mass (kg)	Wet Mass (kg)	Reported Wet/Dry	Lab Qualifier	QC Batch ID	Result Type	% Recovery	Analysis Method	Comments	Upload Settings
2	ARF-0001	SCF00001	Cs-137	-0.02	0.03	2	0.05		pCi	0.5	0.75	Wet	U	abc123	Sample		Gamma	Batch QC passed internal standards	R
3	ARF-0001	SCF00002	Am-241	0.05	0.005	2	0.02	0.01	pCi	0.5	0.75	Wet	U	QCBATCH01	Sample		Alpha Spec	Result > MDA	A
4	ARF-0003	SCF00003	H-3	20	0.002	2	0.05	0.025	dpm	0.005	N/A	N/A	U	cba321	Sample		H3 by LSC	Result > MDA	A
5	ARF-0004	SCF00004	H-3	0.001	0.02	2	0.05	0.025	dpm	N/A	N/A	N/A	U	cba321	MBlk		H3 by LS	Result < Critical Level	R
6	ARF-0005	SCF12345	Mn-54	0.001	0.03	2	0.01	0.005	pCi	0.5	0.75	Dry	U	zyxc123	Sample		Gamma	Not Detected	R
7	ARF-0001	SCF00014	Cs-137	0.002	0.03	2	0.05	0.005	pCi	0.5	0.75	Wet	U	abc123	Sample dup		Gamma	Duplicate of sample SCF00001	
8	ARF-0001	LCS09072	Cs-137	25	2	2	0.05	0.005	uCi	N/A	N/A	N/A	U	abc123	LCS	0.950	Gamma	LCS for QC batch abc123 gamma spec	
9	ARF-0001	MS090720	Am-243	63	5	2	0.05	0.04	pCi	N/A	N/A	N/A	U	QCBATCH01	MS	0.85	Alpha Sp	MS for QC batch QCBATCH01 alpha sp	



Communication Challenges

- Communication channels between FRMAC Lab Management, lab network coordinators and off-site labs not always clear
- Off-site labs sometimes feel "out-of-the-loop"
- Lack of sample and analysis planning prior to sample collection leads to misunderstanding and misuse of data
- Little experience with an EPA-led FRMAC after the transition from emergency to recovery operations

Programmatic Lessons Learned

- FRMAC needs an electronic system to log indoor survey and sampling data
  - Currently being worked on in RadResponder
- FRMAC needs an ability to tap into additional reliable and rapid gross alpha, gross beta, and gamma spectroscopy methods and capacity
  - The primary need is for speed, not low uncertainty.
  - Many of the consequence management action limits will be quite large compared to what labs are used to
- FRMAC needs an ability to quickly retrieve information related to an area's radiological background and better methods to compare lab data to this background and communicate with the stakeholders
  - This will help us answer the difficult question of "Is there any radiation/contamination here?"
- When high sensitivity, low background methods are required/requested, more specialized sampling media will be needed (i.e. ghostwipes)
- Traditional radiation protection "sticky back" smears are good for direct counting but if digestion is needed, this matrix is very difficult for the lab to work with
  - Using paper or glass fiber filters for smears are more easily processed

Analytical Laboratory Lessons Learned

- Be prepared to receive radiological material
  - Know your lab's limits, and inform FRMAC before we ship samples
- Be prepared to change staff schedules to work longer shifts and/or split shifts for 24 hr operations
- Automate data reporting into an electronic format as much as possible
  - Hand calculations and data entry are very error-prone
- Document all questionable sample packaging/documentation and include in the data package
  - Don't be afraid to pause and ask questions
- Reach out to FRMAC for data reporting formats ahead of time
- FRMAC will be happy to send information and work with your lab to prepare.

Contact Us!

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Questions?