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# Northern Lights 2016

## A FRMAC Laboratory Analysis Perspective

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*SAND Report XXXXXXXXX*

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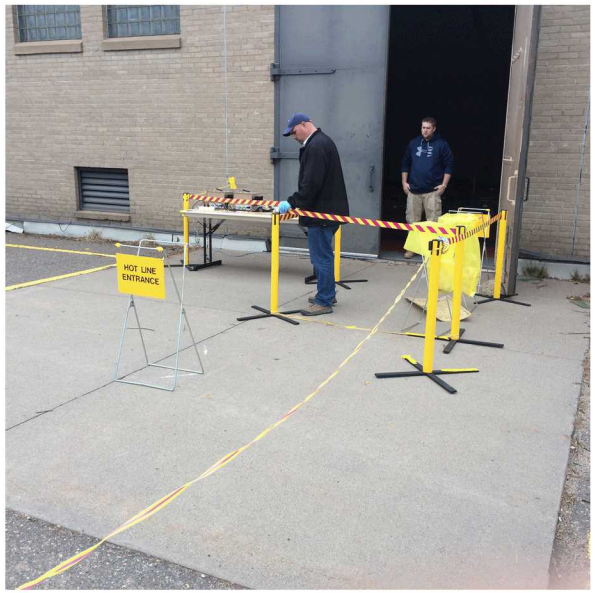
# Overview

- FRMAC Lab Analysis Mission Overview
- Northern Lights Objectives
- Northern Lights Successes
- Northern Lights Lessons Learned
  - Analytical Challenges
  - Operational Challenges
  - Data Reporting Challenges
  - Communications Challenges




# Federal Radiological Monitoring and Assessment Center (FRMAC)

- Multi-agency response effort including DOE, DOD, EPA, FDA, CDC, USDA.
- Mission: to assist with federal, state, tribal authorities with predictions, measurements, analysis and assessments related to radiological incidents
- Divisions of FRMAC
  - Sampling and Monitoring
  - Assessment
  - Health & Safety
  - Support
  - Liaison
  - Laboratory Analysis




REMOTE SENSING LABORATORY

Sandia National Laboratories

Lawrence Livermore National Laboratory

Los Alamos NATIONAL LABORATORY EST. 1943

# Laboratory Analysis Division Responsibilities

Mobile Labs

Local Fixed Labs

Analysis Needs Are Established

Collect sample/deliver to Hotline/Store Sample

Identify Laboratory

Prepare and ship sample

Receive and review laboratory results

Local Resources

Reachback

**NPDN** National Plant Diagnostic Network

**FERN** Food Emergency Response Network

**ELRN** Environmental LRN

**NAHLN** National Animal Health Laboratory Network

**RRLN** Radiological Response Laboratory Network

**LRN** Laboratory Response Network

ICLN Portal

**DLN** Department of Defense Lab Network

# Northern Lights 2016: Full-Scale Exercise

- Scenario: Nuclear Power Plant accident with significant radionuclide release
- Monticello Nuclear Generating Plant in Monticello, MN
- StartEx: t = +21 days post release
- Exercise Setup: 3 pre-start workshops and 4 days of exercise play
  - Onsite Play: Camp Ripley Training Center near Little Falls MN
- Objective: post-emergency phase leading to recovery phase and transition from DOE to EPA led FRMAC
  - Exercise end-to-end laboratory analysis function

# Field Exercise Dilemmas for Laboratories

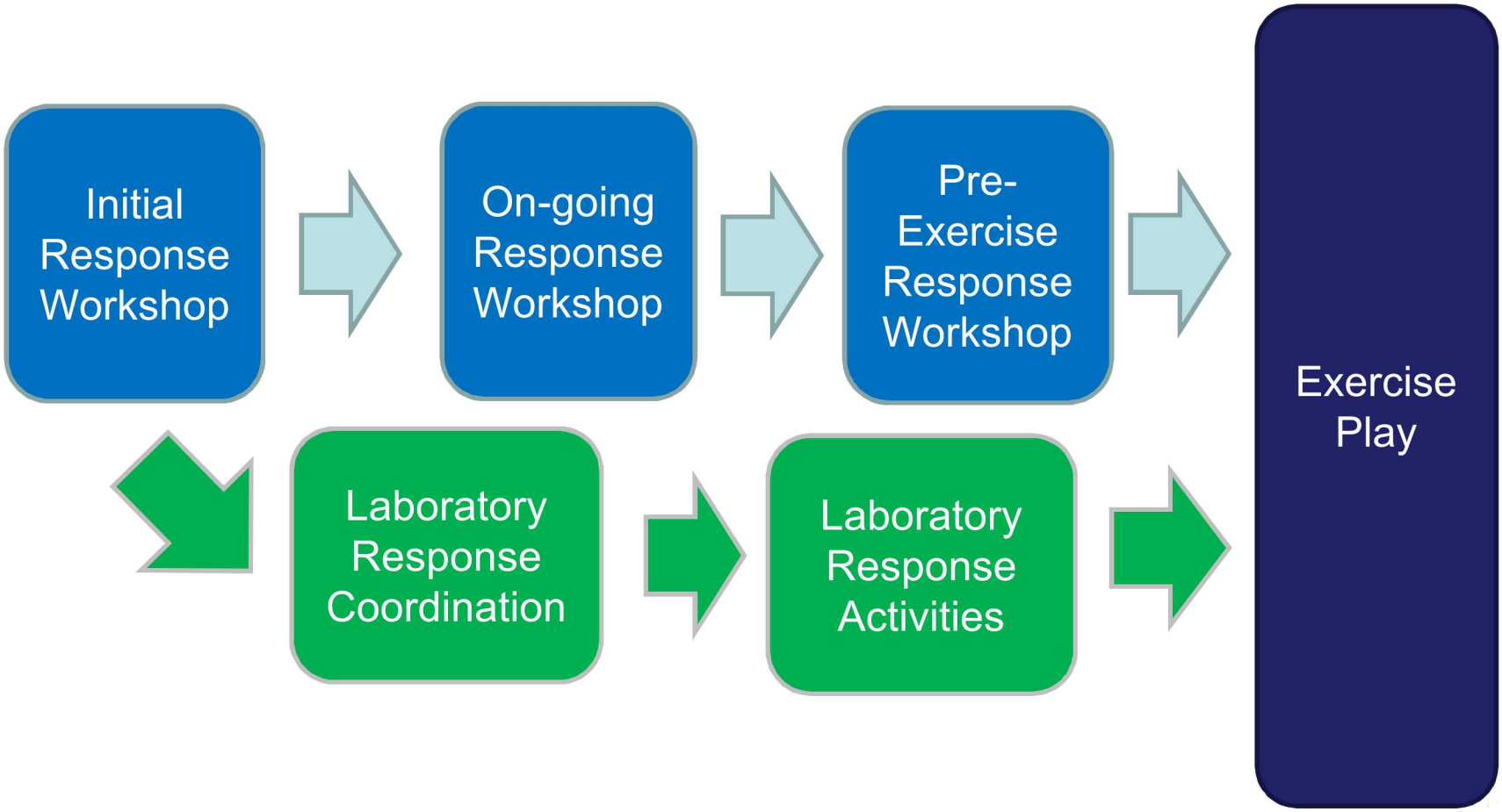
Not enough time to analyze samples

No radioactivity in samples

How to incorporate off-site labs?

Northern Lights scenario provided opportunity to incorporate off-site lab analysis using “more realistic” samples.

# Northern Lights Exercise Design



# Laboratory Participation

- 6 DOE/NAMP Labs
  - SRS, SNL, INL, ORISE, WIPP, *LLNL*
- EPA NAREL (ERLN)
- Food Emergency Response Network (FERN) through the ICLN
  - WEAC, MD DoH, NY DoH, TX DoH, WA PHL, WI PHL
- State of Minnesota Public Health Lab
- FRMAC Fly-Away Lab (onsite mobile lab during exercise)

# “Realistic” Sample Development

- HEU irradiation
- Samples shipped to 13 labs 3 weeks later
  - Aligned nuclide decay with post-accident time line
- Water, Soil, Air Filter, Vegetation (Coffee Grounds)
- 75 Spiked Samples
  - 0.0128 μCi or 0.1 μCi
- 135 Blank Samples

Eckert & Ziegler Analytics

# Lab Analysis Exercise Timeline

- **Aug. 18, 2016** – Initial Response Workshop (t = +2 to +7d)
  - Development of Data Quality Objectives (DQOs), sampling plans and activated participating labs.
- **Sept. 29 2016** – Ongoing Response Workshop (t = +14 days)
  - Development of Analysis Requests for labs
  - Gamma spec and Sr-89/90 analyses on 4 different matrices
- **Sept. 30-Oct 17** – Off-site labs received test samples and performed requested analyses.
  - ICLN portal used to coordinate FRMAC analysis requests.
- **Oct. 17 2016** – Offsite labs report results directly to FRMAC or through ICLN Coordinating Office
- **Oct. 17 – 20** – Start of On-site Exercise Play
  - Sample collection, mobile lab analysis, shipping and validation of lab results

# Exercise Metrics

| Laboratory | Gamma Analyses | Sr-89/90 Analyses | # completed |
|---|---|---|---|
| Idaho National Laboratory | 20 | 6 | 20 |
| Savannah River Nuclear Solutions | 20 | 6 | 26 |
| ORISE/AEAV | 20 | 6 | 26 |
| Sandia National Laboratories | 20 | | 20 |
| WIPP | 20 | | 20 |
| *LLNL Radiochemistry group* | *0* | *2* | *2* |
| MN State Public Health lab | 38 | 10 | 48 |
| EPA NAREL | 20 | 4 | 24 |
| Texas DoH | 3 | | 3 (qualitative) |
| Washington PHL | 3 | | 3 |
| Maryland DoH | 3 | | 3 (qualitative) |
| WEAC | 3 | | 3 |
| Wisconsin PHL | 3 | | 3 (qualitative) |
| New York DoH | 3 | | 3 |

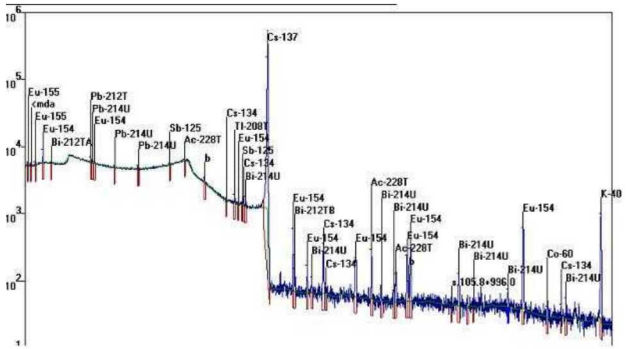
# NL16 Successes

- Design and delivery of 210 test samples (75 spiked with fresh fission products) in 4 matrices to 14 off-site labs
- Completion of non-routine and complex radiochemical analyses
  - Successfully re-directed samples across country
  - Analysis completed by SRNL during Hurricane Matthew
  - Interpretation of complex gamma data (FRMAC Gamma Spectroscopist)
  - On-site gamma spec modeling requests fulfilled for special samples
- Incorporation of FRMAC CM Home Team Lab Manager
  - Coordination of off-site analyses and communication with the various laboratory networks through ICLN portal
  - Handled special technical requests

# NL16 Lessons Learned

## Analytical Challenges

- The most likely nuclear emergency scenarios may involve very complex source terms
- Sr-89/90 analysis methods did not meet exercise DQOs
- 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




# NL16 Lessons Learned

## Operational Challenges for Off-Site Labs

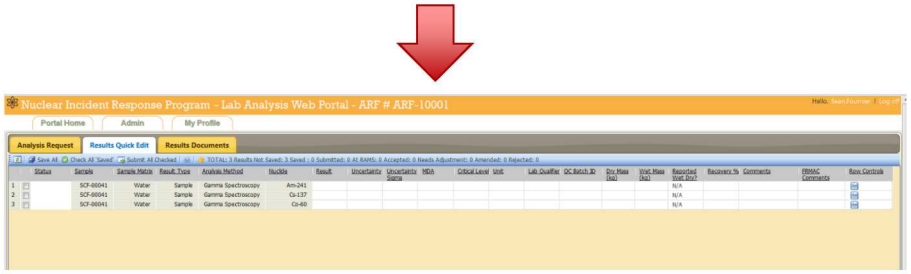
- Volatile species of radionuclides in realistic sample media
  - Labs may need special equipment and permits to handle off-gassing during sample processing
- Standard operating procedures (SOPs) may not be flexible enough to meet the DQOs of an emergency response
  - Uncommon sample matrices—ag products, livestock, ground deposition samples
- USDA permits may be required to process some sample types

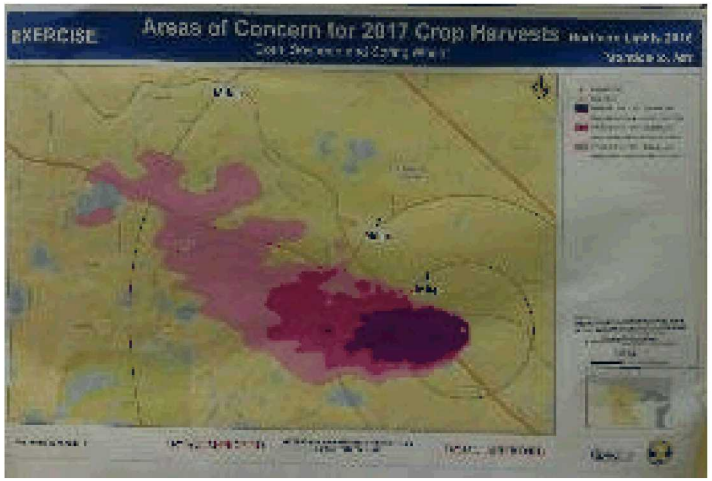
# NL16 Lessons Learned

## Data Reporting Challenges

- 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
- Time consuming analytical results verification process

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |
| 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 |
| 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 |
| ARF-0005 | SCF12345 | Mn-54 | 0.001 | 0.03 | 2 | 0.01 | 0.005 | pCi | 0.5 | 0.75 | Dry | U | zyx123 | Sample | | Gamma | Not Detected | R |
| ARF-0001 | SCF00001 | Cs-137 | 0.002 | 0.03 | 2 | 0.015 | 0.005 | pCi | 0.5 | 0.75 | Wet | U | abc123 | Sample dup | | Gamma | Duplicate of sample SCF00001 | |
| ARF-0001 | LCS090720 | Cs-137 | 25 | 2 | 2 | 0.015 | 0.005 | uCi | N/A | N/A | N/A | U | abc123 | LCS | 0.950 | Gamma | LCS for QC batch abc123 gamma spec | |
| ARF-0001 | MS090720 | Am-243 | 63 | 5 | 2 | 0.015 | 0.04 | pCi | N/A | N/A | N/A | U | QCBATCH01 | MS | 0.85 | Alpha Sp | MS for QC batch QCBATCH01 alpha sp | |



# NL16 Lessons Learned

## Communication Challenges

- Communication channels between FRMAC Lab Management, ICLN 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
- Little experience with an EPA-led FRMAC


# Acknowledgements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  - Argonne National Laboratory

# Questions and Comments