DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof. Reference herein to any social initiative (including but not limited to Diversity, Equity, and Inclusion (DEI); Community Benefits Plans (CBP); Justice 40; etc.) is made by the Author independent of any current requirement by the United States Government and does not constitute or imply endorsement, recommendation, or support by the United States Government or any agency thereof.

FEDERAL RADIOLOGICAL

MONITORING AND ASSESSMENT CENTER

FRMAC LABORATORY ANALYSIS MANUAL

VOLUME 1, REVISION 0

Laboratory Analysis Division

July 2025

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550
Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC., a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA-0003525.
Approved for public release: further dissemination unlimited

FEDERAL RADIOLOGICAL MONITORING AND ASSESSMENT CENTER

Laboratory Analysis Manual

Volume 1, Revision 0

Laboratory Analysis Division

July 2025

APPROVED BY:

Sean Fournier
Laboratory Analysis Working Group Co-Chair
Sandia National Lab

James Burn
Laboratory Analysis Working Group Co-Chair
Environmental Protection Agency

Alvin Morris IV
Deputy Consequence Management Program Manager
U.S. Department of Energy, National Nuclear Security Administration

---

Jeffrey Kowalczik
Consequence Management Program Manager
U.S. Department of Energy, National Nuclear Security Administration

DISCLAIMER

AVAILABILITY

Available for sale to the public, in paper, from:

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
phone: 800.553.6847
fax: 703.605.6900
email: NTRLHelpDesk@ntis.gov
online ordering: https://ntrl.ntis.gov/NTRL/

Available electronically at http://www.osti.gov/bridge

Available for a processing fee to U.S. Department of Energy and its contractors, in paper, from:

U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062
phone: 865.576.8401
fax: 865.576.5728
email: reports@adonis.osti.gov

PUBLICATION HISTORY

Date	Pages Changed	Revision
September 2002 (Originally issued as Volume 1)	Original	Rev. 0
December 2013	Entire re-write	Rev 1
July 2025	Entire re-write and original manual split into two manuals	Vol 1, Rev 0

PREFACE

This manual is written for personnel who respond to a nuclear/radiological incident and will be called upon to provide support to ensure that samples receive appropriate laboratory analyses. Overall, this manual provides general guidance and some specific diagrams and forms. However, it is understood that site- and incident-specific operational decisions and procedures may need to be modified at the time of the incident. This manual is intended to provide guidance for laboratory analysis personnel without limiting FRMAC's ability to integrate the work with other partners and stakeholders. Some of the titles of management positions with the FRMAC have been changed in order to comply with the structure of the Incident Command System (ICS) under the National Incident Management System (NIMS).

ACKNOWLEDGEMENTS

The Federal Radiological Monitoring and Assessment Center (FRMAC) Laboratory Analysis Working Group and several additional individuals contributed their time and efforts in writing and/or reviewing this document. These individuals are recognized as follows:

FRMAC Laboratory Analysis Working Group Members and Reviewers

Name	Organization
Asellin, David	State of Michigan (CRCPD)
Brunner, Brennen	State of New Hampshire (CRCPD)
Button, Jon	USHHS, CDC
Corcoran, Robyn	USDA, APHIS
Eddy, Teresa	USDOE, SRS
Elkouz, Sandra	USEPA, RERT
Fournier, Sean	USDOE, NNSA, SNL
Gill, Jon	DHS, FEMA
Griggs, John	USEPA, OAR, ORIA, NAREL
Gwin, Jeremy	USDOE, NNSA, RSL
Howe, Michael	DHS, FEMA
Hunt, Brian	USDOE, NNSA, SNL
Juassi, Lynn	USDOE, NNSA, NNSS
Loesch, Elizabeth	USEPA
Lowe, Patty	USDOE, Y-12, RAP, Region 2
Mann, Jacqueline	USDOC, NIST
Mena, RaJah	USDOE, NNSA, RSL
Moore, Frank	USDOE, ANL, RAP, Region 5
Mosho, George	USDOE, ANL, RAP, Region 5
Morris, Alvin	USDOE, NNSA
Shanks, Sonoya	USDOE, NNSA, SNL
Stinson, Narvaez	DHS, FEMA
Stoliarova, Janise	DHS, FEMA
Wei, Cong	USHHS, FDA
Wierman, Kenneth	DHS, FEMA
Wilson, Lance	Illinois EMA
Yale, Ken	USEPA, OAR, ORIA
Zhichao, Lin	USHHS, FDA

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

AFRAT	Air Force Radiation Assistance Team
AAL	Analytical Action Level
ARF	Analysis Request Form
CMHT	Consequence Management Home Team
CMRT	Consequence Management Response Team
COSMOS	Consequence Management Operational System
DHS	Department of Homeland Security
DIL	Derived Intervention Level
DOE	Department of Energy
DOT	Department of Transportation
DQO	data quality objective
DRL	Derived Response Level
EDD	electronic data deliverable
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
FRMAC	Federal Radiological Monitoring and Assessment Center
H&S	health and safety
HPGe	high-purity germanium
IATA	International Air Transport Association
ICLN	Integrated Consortium of Laboratory Networks
ICS	Incident Command System
IDLH	immediately dangerous to life and health
MERL	Mobile Environmental Response Laboratory
MQO	measurement quality objective
NIMS	National Incident Management Systems
NNSA	National Nuclear Security Administration
NRF	National Response Framework
NRIA	Nuclear/Radiological Incident Annex
NRP	National Response Plan
ORAU	Oak Ridge Associated Universities
PAG	Protective Action Guideline
POC	Point of Contact
QA	quality assurance
QC	quality control
RAP	Radiological Assistance Program
RCO	Regional Coordinating Office (for the NNSA)
REAC/TS	Radiation Emergency Assistance Center/Training Site
RFI	Request for Information
SLTT	state/local/tribal/territorial governments

TTL	Technical Team Lead
USNRC	United States Nuclear Regulatory Commission

This page intentionally left blank

1. INTRODUCTION

1.1 FRMAC Overview and Mission

The Federal Radiological Monitoring and Assessment Center (FRMAC) is an operational center, available on request by the Department of Homeland Security (DHS) to respond to nuclear and radiological incidents as described in the National Response Framework (NRF). Under the Federal Interagency Operational Plan for Response and Recovery's Nuclear/Radiological Annex, the U.S. Department of Energy (DOE) has the responsibility to maintain the operational readiness of the FRMAC during the emergency phase of an event.

FRMAC is initially established and managed by the Nuclear Emergency Support Team (NEST) and serves as an interagency operations center with representatives from various federal, state, and local radiological response organizations. The purpose of the FRMAC is to assist state, local, tribal, and territorial governments (SLTT) in their mission to protect the health and well-being of their citizens with:

- Verified radiation measurements.
- Interpretations of radiation distributions based on Environmental Protection Agency (EPA), Food and Drug Administration (FDA), or local Protective Action Guidelines (PAGs).
- Characterization of overall radiological conditions.

Once a declaration to respond to a radiological emergency has been made, the National Nuclear Security Administration (NNSA) Headquarters will coordinate the response in consultation with the cognizant NNSA Regional Coordinating Office (RCO). Each of the eight RCOs maintain a 24-hour response capability for radiological emergencies that may occur in states served by its region.

When a FRMAC is established, it operates under the parameters of the Incident Command System (ICS), as defined in the National Incident Management Systems (NIMS) construct.

The Consequence Management Home Team (CMHT) will be activated immediately during normal business hours (Pacific Time Zone), and within two hours otherwise.

The Consequence Management Response Team (CMRT) is prepared for deployment within six hours after activation. Along with the assets, FRMAC provides an operational framework for coordinating of all federal off-site radiological monitoring and assessment activities during a response to a radiological emergency to support the coordinating agency and SLTT governments.

Potential radiological emergencies that fall within FRMAC vary widely in terms of the area affected, the nature of the contamination, and the scope of the government's response. Detonation of a nuclear device, accidental release of radiation from a nuclear power plant, and a terrorist threat are just a few of the many possible scenarios FRMAC must be prepared to address. Through all this, supporting the state, local, and tribal organizations in the protection of the public remains the primary goal of the federal response.

Within Consequence Management there are five divisions:

- Assessment

- Monitoring and Sampling
- Laboratory Analysis
- Health and Safety
- Support

This document will concern itself specifically with the processes and procedures for the FRMAC Laboratory Analysis.

The FRMAC Laboratory Analysis Manual is comprised of two volumes. Volume 1 provides general guidance and processes to establish a common operating environment for laboratory analysis personnel and other assets assisting in the laboratory response. Volume 2 contains the operational components of the sample control and Laboratory Analysis processes.

It is understood that site- and incident-specific operational decisions and procedural parameters will need to be established and documented at the time of and during an incident. It also is understood that Laboratory Analysis processes may be operating in an integrated or coordinated environment with other agencies and jurisdictions, including state or local assets. Volumes 1 and 2 are intended to provide guidance for stand-alone use without limiting FRMAC's ability to integrate work with other agencies, jurisdictions, and augmentation response assets.

1.1.1 FRMAC Laboratory Analysis Mission

The Nuclear/Radiological Incident Annex (NRIA) to the Federal Interagency Operational Plan for Response and Recovery (FIOP), addresses the response of federal agencies to incidents involving nuclear or radioactive material. The NRIA describes the DOE responsibility to provide the framework assigned in 44 CFR 351 through which participating federal agencies will coordinate their emergency radiological monitoring and assessment activities with those of state and local governments. DOE manages the FRMAC to coordinate those activities in the emergency phase.

In the event of a radiological incident (and when requested by DHS), the FRMAC will coordinate the federal, state, and local agencies that have various statutory responsibilities. The FRMAC is responsible for coordinating all federal emergency radiological monitoring, sampling, and assessment activities for the response.

When the FRMAC responds to a radiological/nuclear incident site, monitoring, sampling, and radioanalytical support will arrive from several different agencies. The respondents providing this support will have varying levels of training and experience with different monitoring, sampling, and radioanalytical equipment and procedures. Therefore, it is important that an acceptable, well-established set of processes are in place for an effective, integrated, coordinated response.

There are three general and basic phases to a response. Each of these phases has a different focus or purpose related to the FRMAC Assessment Division's need to be able to advise various decision makers (state, county, city, tribal, other governing agencies, etc.) on recommended actions. These response phases are referred to throughout this document and are informational and general in nature, often overlapping and can all be occurring at the same time.

1.1.1.1 Emergency/Early Phase

During the Early Phase of an incident, analytical data is urgently needed to establish protective actions. FRMAC response procedures are intended for use in the processing of relatively large numbers of samples in the shortest time possible. In the early stages of an incident, when the impact on the health and safety of the public is not well defined, the resources dedicated to quality assurance (QA) must be sufficient to assure that appropriate radioanalytical measurement quality objectives (MQOs) and thereby, assessment data quality objectives (DQOs) are met. In the Early Phase, the following apply:

- Decisions based on dose rates and generally relating to acute doses:
  - Whether to evacuate people or not?
  - Immediately dangerous to life and health (IDLH).
- Decisions may be based on quarantine levels.
- Higher result uncertainties or lower confidence limits can be tolerated.
- Time period is generally hours to days.

1.1.1.2 Intermediate Phase

The Intermediate Phase will require a greater degree of data assurance as more rigorous analytical methodologies are employed to support longer-term exposure risk evaluations. During this phase, the role of field measurement and mobile laboratory assets may decline if they are not able to meet the more rigorous MQOs needed to satisfy the assessment DQOs and support assessment decisions.

This phase is after the time-urgent response/emergency is over:

- Decisions transition from acute dose rate based to cumulative long term dose rates, regulatory, and monitoring based limits.
- Affected crops and livestock may be quarantined.
- Affected businesses, highways, freeways, airports, and waterways are closed.
- Affected crops and livestock may be unquarantined.
- Affected businesses, highways, freeways, airports and waterways re-opened.
- General operations begin to return to normal pre-event conditions.
- Transition from DOE control to EPA most likely to occur during this phase.
- Clearly not the emergency portion and clearly not the cleanup/recovery phase of the response.
- Time period lasts days to months.

1.1.1.3 Late/Cleanup/Recovery Phase

Laboratories with larger capacity and greater capability will likely become the mainstay of the analytical effort as the incident evolves into the Recovery Phase. These laboratories may be geographically distant from the incident, which will increase sample management challenges. The relative role of field measurements, mobile laboratories, and off-site laboratories will depend on the radionuclides of concern for the specific incident. In the Recovery Phase, the following apply:

- More decisions based on regulatory requirements.

- Transition from DOE control to EPA most likely to have occurred but may occur during this phase.
- Monitoring of affected areas and long-term stewardship.
- Cleanup of affected areas.
- Return to pre-event conditions. Time period can last days to months to years.

2. LABORATORY ANALYSIS DIVISION

2.1 Conduct of Operations

The FRMAC mission is to coordinate and manage all federal radiological monitoring and assessment activities during a nuclear or radiological incident in support of state, local, and tribal governments, DHS, and the Coordinating Agency that has the primary authority for federal response. The Coordinating Agency is the federal agency that owns, has custody of, authorizes, regulates, or is otherwise designated responsibility for the nuclear/radioactive material, facility, or activity involved with the incident.

The FRMAC Laboratory Analysis Division is primarily responsible for the coordination and management of samples collected during the response.

In the early stages of an incident, when the impact on the health and safety of the public is not well-defined, the resources dedicated to the response must be sufficient to assure that appropriate radioanalytical objectives are met.

Analytical data are critical in the early event stage to characterize source term radionuclides and establish protective actions. FRMAC response procedures are intended to allow for processing relatively large numbers of samples in the shortest possible time. As the incident stabilizes, activities will change commensurate with evolving objectives, which are anticipated to become increasingly rigorous. Systematic planning is used to define the balance and compromise between precise analytical determinations and the timeliness for response activities and decisions.

As an incident progresses, a larger sample throughput will be required along with a greater degree of data quality assurance as more rigorous analytical methodologies are employed to support longer-term risk evaluations. After the initial phase, the role of field measurements and mobile laboratory assets may decline while the use of off-site analytical laboratories with greater capacity and enhanced capabilities will be required.

The relative role of field measurements, mobile laboratories, and off-site laboratories will depend on the radionuclides of concern for the specific incident and the requirements for that time frame of the response. The roles may also shift to support other critical needs to support shipment of large numbers of samples to off-site laboratories. Larger capacity laboratories with increased analytical capabilities from across the country will likely become the mainstay of the analytical effort as the incident evolves. These laboratories may be geographically distant from the incident. Specific laboratory analysis processes for coordinating sample analyses during FRMAC operations are discussed in Volume 2.

During the recovery phase of an incident, operational control of the FRMAC will transfer from DOE to the EPA. For additional information on operational transfer during the recovery phase, refer to *Guidance Document for the Transfer of Operational Control of the Federal Radiological Monitoring and Assessment Center (FRMAC) from the U.S. Department of Energy to the U.S. Environmental Protection Agency*, current version.

Figure 1 illustrates the organizational structure of a FRMAC and how the Laboratory Analysis Division fits into the overall FRMAC organization.

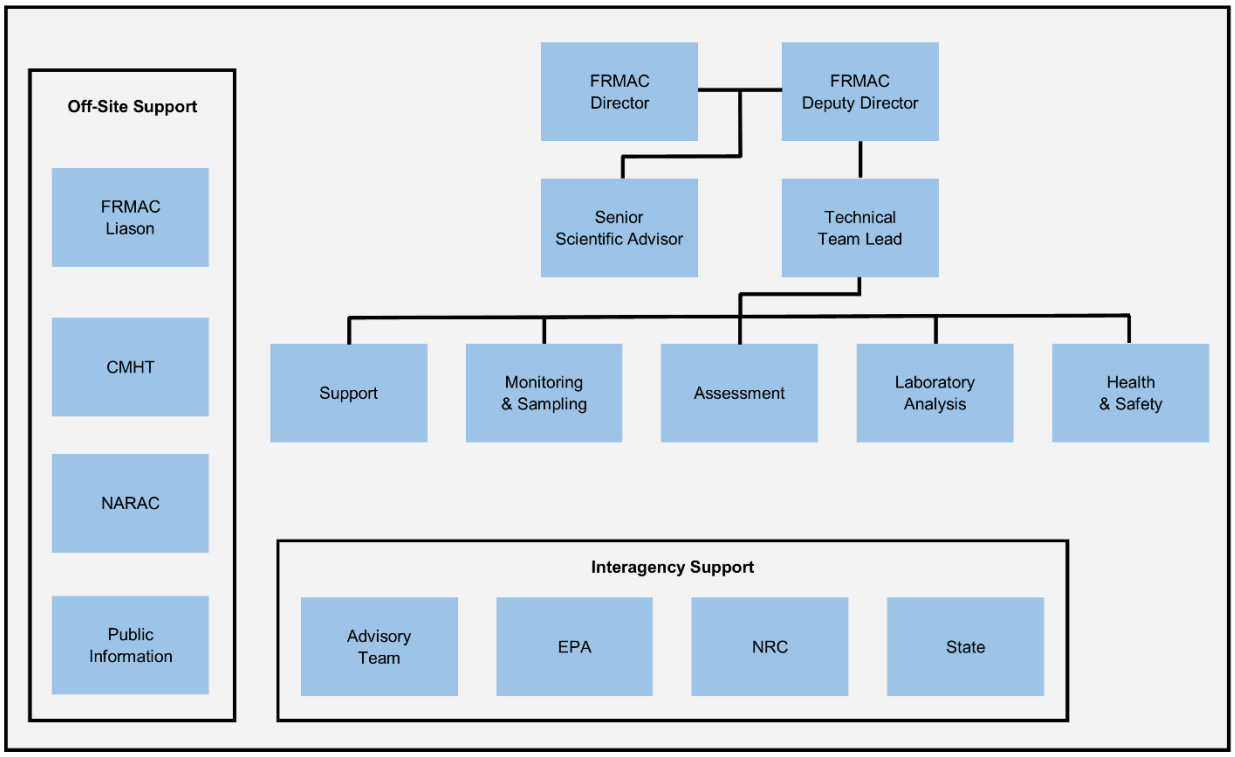

Figure 1. **FRMAC Structure**

Figure 2 shows the structure of the Laboratory Analysis positions. The organizational structure depicted in Figure 2 is used to identify key roles defined in Laboratory Analysis processes. In Figure 2, the red colored boxes indicate the activities of the Consequence Management Home Team that are performed remotely to support the deployed laboratory analysis assets. Complete FRMAC organizational charts are available in the *FRMAC Operations Manual*. The Laboratory Analysis positions will be staffed with personnel to carry out the following:

- Sampling and analysis planning.
- Laboratory stand-up and coordination.
- Sample control, including receipt, handling, storage, tracking, and shipping.
- Radiological analysis data review, quality control, and entry into the current operational database.
- Development of laboratory analysis situational awareness reporting and technical data products at the request of the FRMAC Technical Team Lead (TTL).

Although these functions may initially be filled by DOE/NNSA personnel, responders from the various participating agencies will be used to assist in handling the large number of samples expected to be collected from a nuclear/radiological incident. Although DOE will eventually turn over the primary operations of the event/incident response to EPA in the late phase of the response, the EPA is deployed at the beginning of the event/incident to help ensure a smooth transition of operations in later phases.

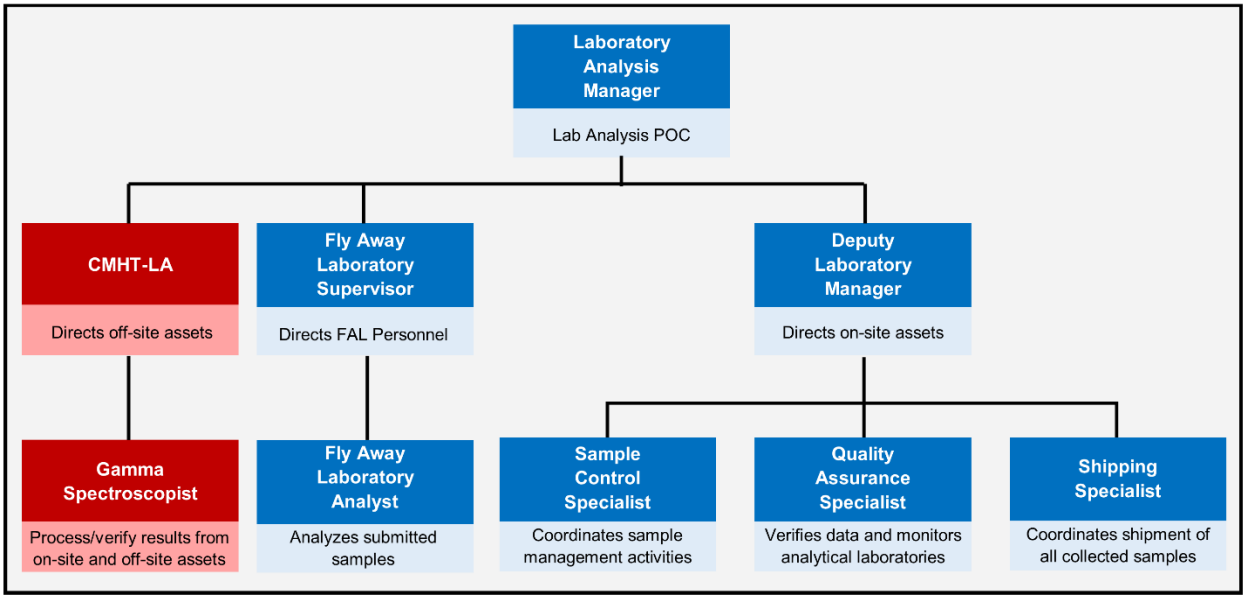

Figure 2. **FRMAC Laboratory Analysis Position Structure**

2.2 Assets

The laboratory resources that support the FRMAC may be composed of a variety of federal, state, other government, local and commercial assets that are requested to respond to an incident. State or local mobile laboratory resources may arrive first on scene and coordinate with the federal assets as they arrive.

2.2.1 Fly Away Laboratory

DOE provides a mobile fly-away laboratory for on-site limited rapid analysis capability, assistance with shipping and other FRMAC support, as well as the ability to analyze high-activity samples.

2.2.2 Other Resources

Other federal resources may also be deployed to support a radiological event. Integration of these varied resources is key to the success of the laboratory analysis mission.

- CMHT assets will be drawn upon to support the response. The CMHT has representation from each FRMAC division and will manage federal requests and provide any required assistance to the field teams.
- Augmentation personnel/assets will be drawn in to support the response. These individuals will be task qualified by trained FRMAC personnel to provide support in Laboratory Analysis tasks/areas as needed.
- The Integrated Consortium of Laboratory Networks (ICLN) is headed by DHS. The ICLN network consists of networks from federal agencies and can be used to assist in determining available analytical laboratories for analysis.
- The Air Force Radiation Assistance Team (AFRAT) has mobile laboratory capability and has a primary mission to provide health and safety (H&S) support to the military

responders. However, mission priorities can be modified at the discretion of the commanding officer.

- The Radiation Emergency Assistance Center/Training Site (REAC/TS) is a world-renowned, DOE asset and a leader in emergency medical response to radiological/nuclear incidents. REAC/TS provides emergency response and subject matter expertise on the medical management of radiation incidents for NNSA's Office of Counterterrorism and Counterproliferation. REAC/TS is located at the Oak Ridge Institute for Science and Education in Tennessee and is operated for DOE by Oak Ridge Associated Universities (ORAU). REAC/TS can provide a resource for identifying analytical capabilities.
- State and local assets may also bring mobile laboratories to the response. Upon arrival, these laboratories will integrate with the FRMAC Laboratory Analysis processes.
- Radiological Assistance Program (RAP) teams are located throughout the U.S. and have responders with limited radiological analysis equipment that may be used to respond to a radiological incident.
- Chemical, Biological, Radiological, and Nuclear Defense (CBRN) Responder (also known as Rad Responder) is an online and mobile computer application and database that facilitates sample control and management through a laboratory portal.
- DOE Radiation Triage is a reach-back capability that has expertise in nuclear engineering, physics, chemistry, and chemical engineering. This capability assists in radiation spectral analysis for verification of initial gamma spectroscopy measurements.

2.3 Laboratory Analysis Operations Overview

When the FRMAC responds to a radiological/nuclear incident, the laboratory analysis mission will be to facilitate the analysis of samples and assure the measurement quality of the data is appropriate to the data quality objectives required. Such data and actions include the following:

- Analytical results from air filters collected near the incident scene will dictate respiratory protection requirements for responders and provide a measure of airborne concentrations to which the public may be exposed.
- Analytical results from soil and surface samples (swipes) will provide a measure of surface deposition and are used to determine protective action recommendations and on-site health and safety controls.
- Alpha and gamma spectroscopy of early samples provides the quantity and limited identification of each radionuclide present (mixed or multiple sources).
- Liquid scintillation analysis indicates if there is tritium or other low-energy radionuclides present.

The Consequence Management Operational System (COSMOS) is a web-based tool providing a standardized approach to prioritizing and tracking RFIs (requests for information) received by the FRMAC during a response. COSMOS enables effective management of RFIs by tracking them through workflows and linking the technical data used to address each RFI. It is also designed with the flexibility to adjust priorities as a response progresses and communicate updated prioritization immediately to all CMRT and CMHT personnel.

The FRMAC Laboratory Analysis Manager, as well as other staff, will need to attend frequent meetings with the FRMAC TTL and FRMAC division leadership to define sampling plans and coordinate and prioritize activities.

Figure 3 provides an overall description of the FRMAC Laboratory Analysis Process. For additional FRMAC Laboratory Analysis Division operations, see FRMAC Laboratory Analysis Manual, Vol. 2.

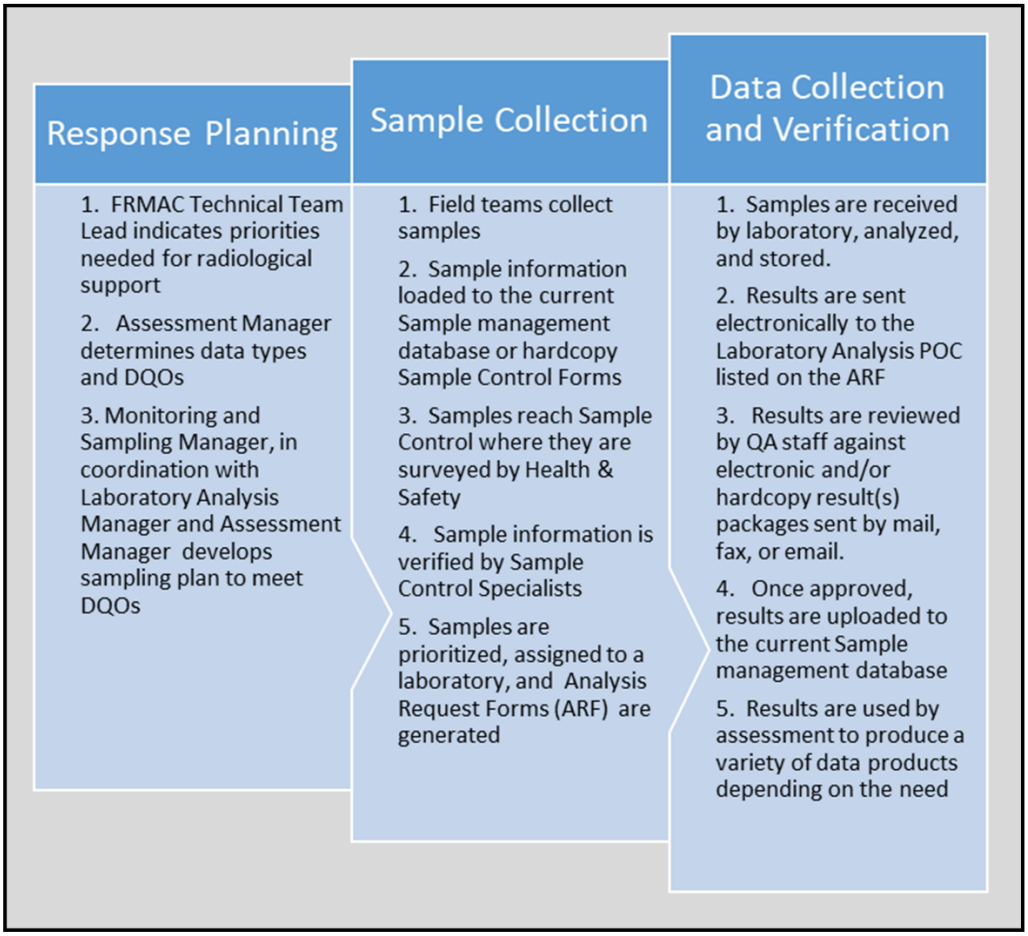

Figure 3. **Overview of FRMAC Laboratory Analysis Process**

3. POSITION ROLES AND RESPONSIBILITIES

Below are high-level descriptions of each major operational position within the Laboratory Analysis Division. Training requirements for each position are listed in Appendix A, and detailed position descriptions can be found in Appendix B.

3.1 Laboratory Analysis Manager

The Laboratory Analysis Manager maintains close coordination with the CMHT Laboratory Manager and Deputy Laboratory Analysis Manager(s). The Laboratory Analysis Manager communicates and interfaces with the FRMAC TTL and the other FRMAC Division managers to ensure that the Laboratory Analysis Division is appropriately resourced and that the necessary information and priorities are received from, and provided to, the other FRMAC organizations. The Laboratory Analysis Manager also works with the Assessment Manager and Monitoring Manager to ensure that samples collected (and the analyses requested) will enable the Assessment Scientist to make the necessary decisions and meet the intent of the defined DQOs. The Laboratory Analysis Manager will also ensure that MQOs sufficient to achieve the DQOs are established and keep Assessment division advised of the quality of the data.

3.2 Deputy Laboratory Analysis Manager

The FRMAC Deputy Laboratory Analysis Manager primarily directs all on-site laboratory analytical activities and maintains close coordination with on-site mobile laboratories, Laboratory Analysis Manager, CMHT Laboratory Manager, Sample Control, Quality Assurance, and Shipping Specialists providing support to the FRMAC. The Deputy Laboratory Analysis Manager acts as the point of contact for queries regarding the status of on-site sample analyses, on-site laboratories, and will communicate MQOs to the on-site laboratories, receive laboratories' feedback on their ability to achieve the MQOs, and ensure that the laboratory data is received and reviewed for accuracy and quality.

3.3 Sample Control Specialist

The FRMAC Sample Control Specialist is responsible for receiving, inspecting, logging, storing, and handling samples that have been submitted to the Hotline, and screened by H&S personnel. After confirming that the minimum data recording requirements from the sample control forms have been met and entered into the current Sample management database, they place the samples in storage where the samples are prepared for delivery to the laboratories for analysis. Once an Analysis Request Form (ARF) has been created, and the sample numbers and analyses have been added to the form, the samples are prepared for delivery or shipping to the analysis laboratories. The Sample Control Specialist works closely with the Deputy Laboratory Analysis Manager, the Quality Assurance Specialist, and the Shipping Specialist. If required, additional support staff will be recruited, and task qualified by a trained Sample Control Specialist to perform specific sample control activities.

3.4 Quality Assurance Specialist

The Quality Assurance Specialist is primarily responsible for verifying that the FRMAC receives what was expected from the analysis laboratories, reviewing/verifying/validating analytical data results, entering results into the current Sample management database, and coordinating the collection of QA samples with the Monitoring Manager and the designated monitoring staff. The Quality Assurance Specialist (QAS) may also inject quality control (QC) samples into the

sample analysis stream, report results from QC samples, investigate the causes of unusual quality assurance results, and bring unusual results to the attention of the Analysis Laboratory and to the FRMAC Laboratory Analysis Manger(s), CMHT Lab Analysis Manager(s), and Deputy Laboratory Analysis Manager(s). If required, additional support staff will be recruited, and task qualified by a trained Quality Assurance Specialist to perform specific QA activities.

3.5 Shipping Specialist

The FRMAC Shipping Specialist is responsible for packaging of samples and arranging delivery to either the on-site mobile laboratories or off-site fixed laboratories. The Shipping Specialist is responsible for ensuring the shipments meet required transportation regulations. The Shipping Specialist is specifically required to certify any shipment that will be transported under Department of Transportation (DOT) and/or International Air Transport Association (IATA) shipment regulations. The decision to determine if a shipment is regulated will be made on available data, or data generated by an on-site mobile laboratory's analysis. The Shipping Specialist works closely with the Sample Control Specialists and Deputy Laboratory Analysis Manager. Since regulators have wide interpretations on what specific training is required to certify an individual as a "qualified shipper," it is up to the individual responders' originating (base) organization to define what they consider to be a "qualified/certified hazardous material shipper" for their organization. If required, additional staff will be recruited to support Shipping Specialist activities.

3.6 Fly Away Laboratory Supervisor

The Fly Away Laboratory (FAL) Supervisor coordinates workload and priorities for the FAL with the Laboratory Analysis Manager and the Deputy Laboratory Analysis Manager. Communicates priorities and reviews data produced by FAL Analysts.

3.7 Fly Away Laboratory Analysts

The FAL Analysts operate their assigned equipment and perform instrument setup, function and QC checks and record analytical results as appropriate.

3.8 Consequence Management Home Team Laboratory Manager

The CMHT functions as a virtual extension of the FRMAC. The CMHT Laboratory Manager functions as the FRMAC contact for laboratory information until deployed Laboratory Analysis capability arrives on-site and becomes functional. When the FRMAC on-site laboratory resources are operational, the CMHT will support the field assets as requested. The CMHT Laboratory Manager is primarily responsible for gathering available operational information to understand the developing needs for laboratory support, activating the off-site laboratories, and communicating their analytical capability and capacity to the Laboratory Analysis Manager and Deputy Laboratory Analysis Manager(s). The CMHT Laboratory Manager acts as the point of contact for queries regarding the status of sample analyses, will communicate MQOs to the analysis laboratories, receive analysis laboratories feedback on their ability to achieve the MQOs, and ensure that the laboratory data is received and reviewed for accuracy and quality. The CMHT Laboratory Manager recruits reach-back assets and home team support as necessary to accept/review/validate the data provided by the analysis laboratories (or additional tasks as needed) and ensures that this information is properly reviewed and entered in the operational

database. The CMHT Laboratory Manager may be called upon to develop technical products to assist in interpreting radioanalytical data.

3.9 Consequence Management Home Team Gamma Spectroscopist

The Gamma Spectroscopist is responsible for the analysis, review, validation, and interpretation of gamma spectrometry results submitted to the FRMAC from in-situ measurements, on-site mobile laboratory measurements, and off-site fixed laboratory measurements. The FRMAC Gamma Spectroscopist will also coordinate with DOE Radiological Triage and work with analytical laboratories to ensure that nuclide libraries are properly set up. The CMHT Gamma Spectroscopist will be the reviewer and perform verification and interpretation of gamma spectrometry results as needed and upload results into the current sample management database. This position may also be called upon to troubleshoot FRMAC gamma spectrometry hardware and software as it relates to interpretation of results and run full analyses on selected raw spectral data using commercial software packages.

4. LABORATORY ANALYSIS PROCESSES

4.1 Process Overview and Interdivisional Connections

The CMHT Laboratory and Deputy Laboratory Analysis Managers support the CMHT Assessment and Monitoring Managers with development of the initial DQOs for sampling and analysis to support the incident response. Once the decision has been made to collect samples, and the radionuclides of interest for each matrix has been determined, the MQOs for each analysis must be determined to support the DQOs for the decisions that will be made. These discussions and identified issues are communicated with field elements for review and implementation.

4.2 Establishing Data Quality Objectives during an Emergency Response

4.2.1 Data Quality Objectives Process

At the end of the initial directed planning process, the project planning team will have established its priority of concerns, the definition of the problem, the decision(s) or outcome to address the posed problem, the inputs and boundaries to the decision(s), and the tolerable decision error rates. The team should also come to agreement on decision rules that incorporate all this information into a logic statement about what must be done to obtain the desired answer.

The DQO process, as stated in *Guidance on Systematic Planning Using the Data Quality Objectives Process EPA QA/G-4,* is used to "determine the type, quantity, and quality of data needed to reach defensible decisions or make credible estimates" and "used to establish performance and acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of the study" or to set the intended goals to be met for the samples being collected. DQOs are designed or created to answer the questions, "For what purpose was this sample collected?" and "What purpose do these results serve?"

The DQOs are translated into MQOs. These MQOs define the accuracy needed, or the amount of uncertainty or confidence in a result that will be tolerated in order to support defensible decisions or credible result estimates. The MQOs are basically the uncertainty or tolerance allowed for the analysis method(s).

The Assessment Division uses FRMAC data provided to CBRN Responder to advise various decision makers (state, county, city, tribal, other governing agencies, etc.) on recommended actions. These recommended actions may be based on PAGs, various action levels (embargo, quarantine, etc.), regulatory limits, or monitoring requirements. All of these action levels, regulatory limits, and monitoring levels are translated into Requested Detection Limits/Required Reporting Limits for the Analysis Laboratory.

Samples are collected and analyses are requested to answer various questions from the Assessment Division. These questions are related to the phase of the response and change often during the response.

4.2.2 Summary of Protective Action Guides

As part of the DQO process, the team will utilize a PAG, which is the projected dose to an individual from a release of radioactive material at which a specific protective action to reduce or avoid that dose is recommended. There are numerical PAGs associated with the Early and

Intermediate Phases of a nuclear/radiological release incident. PAGs are communicated in the form of a projected dose (rem/mSv) from exposure over a specified time period. Depending on the radionuclides involved in the incident, this dose/exposure needs to be converted into concentration units appropriate for the media/matrix to be collected as a sample.

FRMAC uses PAGS established by federal agencies (DHS, EPA, FDA) to perform evaluations of radiological conditions.

4.2.3 Derived Response and Intervention Levels

The Assessment Division calculates Derived Response Levels (DRL) and Derived Intervention Levels (DIL) appropriate for the samples to be collected. These quantities are then used to determine the Analytical Action Level (AAL) and the critical level (Lc) for each analyte, matrix, and analysis method, in collaboration with the Laboratory Analysis Division. The Laboratory Analysis Division Manager is responsible for advising and informing the other FRMAC Divisions on sample size requirements and approximate analysis times based on the AALs and Lc that have been determined for each sample type. For samples requiring large sample sizes and/or very long analysis times to reach desired AALs/Lc, the Assessment Division Manager, Laboratory Analysis Division Manager, and Monitoring Division Manager will need to balance collection time/volume of the sample, counting time, and detection limits to determine mutually acceptable sample sizes and analysis times to achieve a reasonable and acceptable compromise on the AALs and Lc.

4.2.4 Analytical Action Levels

AAL is the primary MQO to convert a DQO to a value that instructs laboratories to apply an appropriate set of sample preparation, processing, and counting conditions to provide an analytical result of sufficient sensitivity (detection limit). AALs are typically communicated as a posteriori Minimum Detectable Concentration or Lc test.

4.3 Laboratory Selection Methods and Procedures

The process of selecting a laboratory to perform analysis of a particular matrix/analyte pair to meet a particular MQO is a complicated and subjective process that is detailed in Volume 2. The biggest hurdle in this process is the communication of an organization's capability, capacity, and competence to personnel in the CMHT laboratory analysis section. Early in an event, submitting appropriate samples to available on-site mobile laboratory(s) or laboratories in close proximity to the event, will be a priority to facilitate timeliness of results.

4.3.1 Laboratory Selection Priorities

Priority of selection for a laboratory will be to those that are listed as a Laboratory type in the CBRN Responder organization database. Laboratory type organizations have access to the CBRN Responder laboratory portal for electronic analytical result reporting. There may be radioanalytical organizations in the vicinity of the incident (local fixed or responding mobile laboratories) that can be added to the CBRN Responder organization database, but those organizations cannot be considered until they are integrated into CBRN Responder.

4.3.2 Laboratory Evaluation and Selection

Initial consideration of potential radioanalytical laboratory support will focus on the organization's capability, capacity, and competence. The appropriateness of an organization to

provide radioanalytical support will also depend on the current phase of the response, which in turn drives the DQOs and thus the MQOs for each analysis. The following should be considered when evaluating a laboratory:

- The analyses needed.
- The sample matrices.
- The required MQOs.
- The anticipated sample contamination levels and the laboratory's experience in handling these types of samples.
- Timeliness of results and sample capacity.

In the evaluation and selection process, the decision should be based on capability, capacity, and competence, as outlined in the following:

- The capability of a radioanalytical organization to support a response is primarily determined by the presence of established analytical procedures for the analyte/matrix combination of interest. This establishes that the organization has the basic technical resources to perform this analysis. There are further considerations before selection, but this is the first evaluation hurdle.
- The capacity of the organization to perform the analysis is driven by many factors. The initial capacity consideration is the quantity of appropriate detectors/instruments needed to perform the desired analysis. Ancillary capacity considerations can include: the number of personnel, amount of analytical bench/hood space available, radioactive material license/permit limits and current inventory, reagents and standards inventory as well as stockpiles of consumable analytical supplies.
- The competence of the organization will also affect the confidence in their reported data. Indicators of competence can include: a quality assurance program, the qualification/training/experience of personnel, organization certifications, audits, and its participation in Performance Evaluation sample analysis programs.

4.4 Laboratory Analysis Data Quality Assurance

At each stage of the data production process, there needs to be an assurance of the quality of the data. To support defensible decisions and credible result estimates, data needs to be of a known and documented quality.

Lab Analysis Data Quality Assurance begins at Sample Receipt/Hotline and continues through the process of transferring samples to the Analysis Laboratories, and then ends with the return and upload of the result data into CBRN Responder (or current FRMAC database).

Data Quality Assurance is:

- Commensurate to, and a graded approach to, the phase of the response.
- Based on the resources available.
- Based on the need for QA/QC in the process.
- A verification or collection of verifications that lead to validation.
- Verification that the results supplied by the Analysis Laboratory meet the intentions of the DQOs.

- Ensuring that the analysis requested is an accurate representation of Assessment's expectations/DQOs and that these expectations are accurately and thoroughly translated/understood by the Analysis Laboratory.
- Ensuring that negotiations occur between the Analysis Laboratory and Assessment and resolutions (new DQOs are established) are put in place when the Analysis Laboratory cannot reasonably meet Assessment's original DQOs.
- Ensuring that maximum sample count times are transmitted to the Analysis Laboratories for time-based decision needs.
- Ensuring results are complete and that FRMAC received what was requested.
- Verification and validation of Analysis Laboratory results supplied to CBRN Responder (or current FRMAC database).
- Validation of the processes that generate the data in CBRN Responder (or current FRMAC database).
- Generating DQOs for QC samples (may be blanks, spiked samples, duplicates, split samples, blind QC, double blind QC, etc.) that may be injected at any point in the process to verify accuracy, test for contamination, laboratory comparison, or other QA function.
  - Monitoring injected QC results.
  - Taking necessary actions for out-of-tolerance conditions.
- Qualifying Analysis Laboratory data as necessary.
- Attaching the Analysis Laboratory's Case Narrative to CBRN Responder (or current FRMAC database).
- Ensuring results from any other sources outside the FRMAC processes described in this document (data from other agencies, databases, studies, journals, historical records, etc.) are scrutinized similarly to the FRMAC processes, that the data are qualified and annotated as necessary, date and times are in proper format, and GPS coordinates get translated to the correct datum.

Laboratory Analysis personnel QA (review, qualify, correct, annotate) their data/processes so that Assessment will have the most accurate data to base their recommendations to the Decision Makers on (the state, local, and tribal governments) so that they, in turn, can make the decisions that "protect the health and well-being of their citizens" and therefore, the purpose of FRMAC, "to assist the states, local and tribal governments in their mission to protect the health and well-being of their citizens," will be fulfilled.

4.4.1 Data Package Overview

Data packages may be paper copy, electronic, or a combination of both depending on the specific laboratory's capability.

4.4.2 Quality Control Samples

QC samples are often viewed as the analysis laboratory's internal QC but should not be limited to that. Quality control should be a graded approach based on the phase of the response, resources available, need for QA in the process, etc. This would be most likely after the emergency phase when DQOs are tightening up for later phase decisions.

QC samples can be:

- Blank samples inserted into the process.
- Duplicate and split samples.
- Analysis laboratory internal QC samples.
- Part of performance testing samples and programs.

4.5 Sample Control Stations

A key responsibility of FRMAC Laboratory Analysis section is to establish a location and process to conduct sample control operations. This ensures samples collected in the field can be efficiently processed through analytical laboratories and the results can be provided for FRMAC data products to support the response effort.

A dedicated sample processing area with personnel who are trained to work with radiological materials will perform sample screening, splitting, packaging, and shipping.

The FRMAC Laboratory Analysis Division will be physically set up nearby but likely outside of the actual FRMAC in a convenient location where:

- Communication lines can easily be run and proximity to the hotline where potentially externally contaminated samples are received and managed.
- Adequate space for a hotline and contamination control station.
- Shelter (tent) for sample control operations.
- A staging area and storage area.
- An acceptable area to locate the mobile and fly-away laboratories.
- Access to the CBRN Responder and the internet.
- Phone or radio communications with the FRMAC and responding laboratories can be established.

The FRMAC sample control process is conducted by establishing two main stations which may or may not be placed in the same general location.

4.5.1 Sample Receipt Area

The first station is the sample receipt area within the hotline which is staffed by, at a minimum, one Deputy Lab Analysis Manager, two Sample Control Specialists, and one radiological control staff assigned by the FRMAC H&S Manager. This station is where field team personnel, equipment, and samples will come to be radiologically screened out of the affected region. Specific details for the health and safety work performed at the hotline can be found in the current *FRMAC Health and Safety Manual*.

Depending on incident-specific situations and sampling decision, there may be a need to establish forward-staged sample receipt locations, from which samples are brought back to a central sample control area.

4.5.2 Sample Control Area

The second station established by FRMAC Laboratory Analysis is Sample Control. Sample Control is staffed by at least one Deputy Lab Analysis Manager (which may be shared with the

hotline if stations are co-located), one Sample Control Specialist, one Shipping Specialist, and one Quality Assurance Specialist. Within the sample control station, FRMAC Lab Analysis staff work as a team to organize, store, and prepare samples for shipment to both on-site and off-site laboratories. The QAS works with on-site laboratories to establish analytical requirements and review data packages as they become available.

The co-location of these two stations can optimize operations by eliminating the need to courier samples from the hotline to Sample Control, but this may not be possible due to the need to keep staff away from the affected region. In the case where the sample receipt hotline and Sample Control are not co-located, a courier must be tasked with moving samples between the two stations and there must be at least one staff tasked by the FRMAC H&S Manager to perform safety and radiological control work, as well as one Deputy Lab Analysis Manager at each location.

4.6 Sample Control Process

The sample control process encompasses the identification of samples, their physical location at any given time, their state in the sample control process, and the individuals in custody of the sample at any given time (including the transfer of custody). The FRMAC sample control process follows these general steps:

1. Based on a pre-defined sampling plan negotiated amongst the FRMAC leadership associated with an RFI, the sample is collected and given a unique identification number and metadata that correlate it to a specific location and moment in time, then notated in COSMOS.
2. The samples are handed off by the collector to either a courier or directly to the hotline, where samples are screened for contamination and dose rate, and verified that the metadata is complete and accurate.
3. If the hotline and Sample Control are not co-located, samples must be transported between the two stations.
4. Once at Sample Control, samples are stored in a secure location that is organized effectively to ensure samples are easily retrievable.
5. Samples are batched under an analysis request and packaged for DOT-compliant shipment. Sealed packages are screened, and shipping paperwork is prepared that characterizes the materials inside the container to an adequate level.
6. Samples are shipped or hand-carried to laboratories where they are analyzed.
7. Upon completion, the samples and/or unused portions may stay at the laboratory for storage, be shipped back to the FRMAC location, or be disposed of, pending instruction from the Lab Analysis Manager. Returned samples or their portions may cycle through this process again as needed. Samples that are disposed of end their lifecycle here.

This chain of custody is maintained throughout the sample storage, packaging, shipping, laboratory analysis, return, and/or disposal process. Chain of custody documentation should include, at a minimum, the names of the individuals or organizations in custody of a sample and the date at which transfers occur.

This information should be stored in a way that is retrievable as part of a data package for a given set of samples. Specific processes and logistical requirements for conducting the FRMAC sample control process are provided in Figure 4 below describing the sample/data lifecycle.

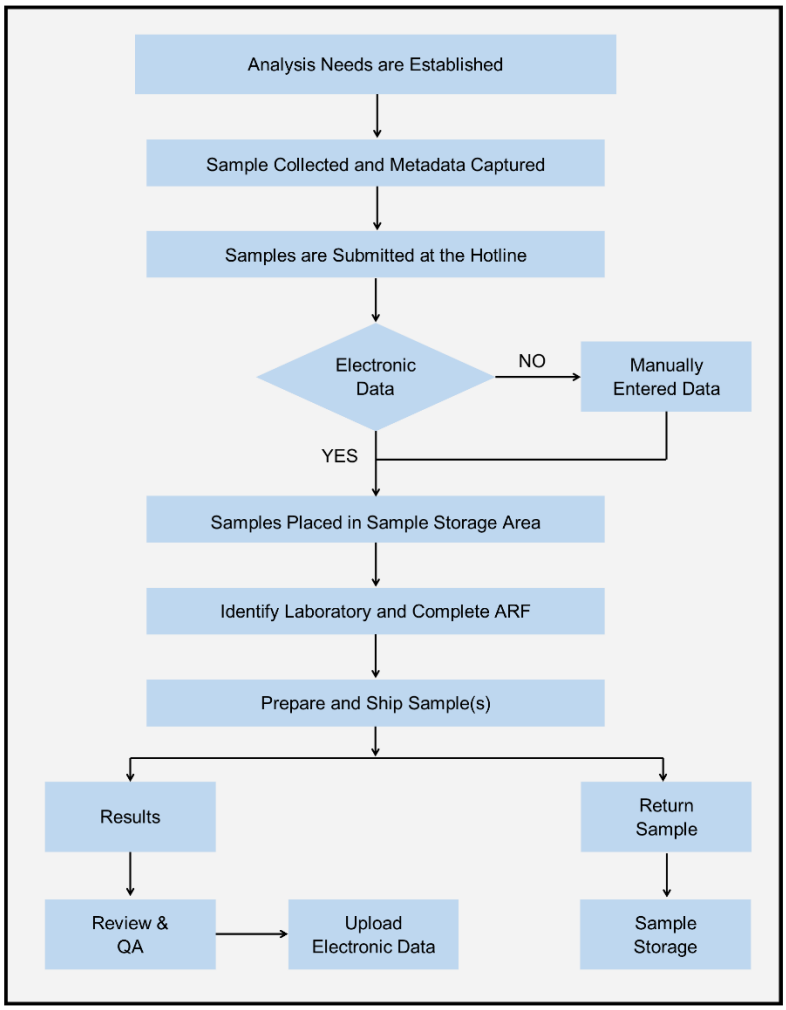

Figure 4. **Laboratory Analysis Process Flow Diagram**

4.7 Laboratory Data Processing and Review

Samples are grouped together for a single laboratory by use of an ARF. Through the ARF, laboratories are instructed to perform analysis according to the instructions and measurement quality objectives and are asked to provide both hardcopy (scanned reports) and electronic results in a format compatible with the database used by FRMAC. On-site and mobile laboratories should submit the electronic data deliverable (EDD) and paper copies of the analysis results to the field deployed FRMAC QAS. Off-site laboratories should use the CBRN Responder Laboratory Portal when available or email the EDD and scanned report to the CMHT.

Laboratory Analysis QAS verify the electronic data prior to loading and processing the data in the database. If electronic results are provided ahead of hardcopy reports, care must be taken to ensure the electronic records are correct, since many laboratories may be:

- More experienced with producing hardcopy results (instrument or Laboratory Information Management System printouts) as opposed to electronic deliverables.
- Relatively inexperienced with the FRMAC EDD format and data value expectations.
- Generating the EDD by manual data entry, which under schedule demands, can increase the likelihood of errors.

In all phases of a response, data quality processes are commensurate with the need to make decisions on data of known quality. Quality assurance rigor applied during the early phase will generally be less stringent than later phases. This is because the need for timely data outweighs the need for highly accurate and precise measurements. Laboratory gross analyses (gamma, alpha, and beta) and higher detection limits may support decisions to evacuate or shelter-in-place, whereas later decisions will demand isotopic analyses at lower detection limits to make decisions on whether to remediate or condemn property, quarantine crops, etc.

However, regardless of the phase of response, data integrity is vital. Therefore, three types of safeguards are utilized:

- The first safeguard is the sample chain of custody established at sample collection/creation and carried through analysis to sample archive/disposal.
- The second safeguard is the adherence to an established QC process that ensures sample analysis is done with a level of quality that takes into consideration the initial RFI, which drives the need for sampling and analysis.
- The third safeguard is the construction and maintenance of an accessible yet secure electronic database to track samples, manage analysis requests, and store sample result information that can be easily queried by the user of the data.

Specific processes and procedures for conducting data processing and review are provided in the FRMAC Laboratory Analysis Manual Vol. 2.

4.8 In-Situ Spectrum Analysis

During events where radionuclides are released that have a significant gamma signature that can be measured by HPGe detectors, field teams may employ the use of in-situ gamma spectroscopy to quantify these radionuclides deposited on the ground. Raw instrument spectra from the field are uploaded to the electronic data collection system.

Data users cannot use these raw spectral files nor rely on the on-board software to yield quantitative areal activity values for the radionuclides that are detected. The conversion of these spectra is the work of the CMHT Gamma Spectroscopist. This position works under the direction of the CMHT Laboratory Analysis Manager and processes these spectra into quantitative results that are uploaded to the electronic data repository. Specific processes and procedures for processing and reporting in-situ gamma spectroscopy data are given in the FRMAC Laboratory Analysis Manual Vol. 2.

4.9 Recordkeeping Requirements

The FRMAC is responsible for maintaining all records generated during the response until the records can be turned over to the Coordinating Agency. During the DOE-led portion of the response, the primary recordkeeping system for samples and laboratory analysis data will be the CBRN Responder database. This database will be used to store all sample and laboratory data

collected, along with the metadata and ancillary records generated through the collection of the data. All FRMAC products, reports, and supporting documents will be transferred and maintained by document control. The recommended minimum recordkeeping requirements for laboratory analysis information during the DOE-led portion of the response include:

- All data should be recorded or transcribed into an electronic database, such as CBRN Responder. The database should be cloud-based or mirrored to at least one additional location to minimize the risk of data loss.
- In the event paper records are needed, and in the absence of functioning electronic means, daily paper records are deposited at the FRMAC for scanning or transcription into electronic records.
- Any data received in an electronic format outside of the primary electronic database should be uploaded to the database. Also, the original electronic data file should be uploaded to the primary database as an attachment to the data or to an equivalent electronic data archive.
- All data originally received as a hard-copy record should be scanned or transcribed to the electronic database(s). The hard-copy record should be protected until it can be scanned and archived into the electronic database or equivalent data archive. Documents can be temporarily protected from loss or damage by maintaining two copies in separate locations, storing the original in a fire-resistant container, or an equivalent method until it can be electronically archived.

By the recovery phase of an event, EPA will assume a management role and will establish recordkeeping protocols to meet their requirements. As part of the transition to the recovery phase, recordkeeping requirements for the FRMAC will be finalized and documented. As part of the DOE to EPA transition, a team will evaluate the primary database and other pertinent records to determine what data meets recovery phase requirements. In the event termination phase, all FRMAC documents will be transferred to the Coordinating Agency for appropriate storage. EPA will establish the recordkeeping requirements and assume the responsibility of the records as part of the transition process during the recovery phase. Records not transitioned to EPA will be archived by DOE according to FRMAC guidance.

5. REFERENCES

U.S. Department of Energy, National Nuclear Security Administration, *FRMAC Health and Safety Manual,* March 2012.

U.S. Department of Energy, National Nuclear Security Administration, *FRMAC Operations Manual,* May 2010.

U.S. Department of Energy, National Nuclear Security Administration, *FRMAC Sampling and Monitoring Manual, Vol. 2,* January 2021.

Guidance Document for the Transfer of Operational Control of the Federal Radiological Monitoring and Assessment Center (FRMAC) from the U.S. Department of Energy to the U.S. Environmental Protection Agency, Version 2, September 28, 2009.

Guidance on Systematic Planning Using the Data Quality Objectives Process EPA QA/G-4.

Appendix A. LABORATORY ANALYSIS TRAINING REQUIREMENTS

Table A-1 describes the laboratory analysis training requirements for the major operational positions listed in Section 3.

Table A-1. Laboratory Analysis Training Requirements

Training	Frequency	Laboratory and Deputy Manager	CMHT	QA Specialist	Sample Control Specialist	Shipping Specialist	Gamma Spectroscopist
CM Drill or equivalent	3 years	X	X	X	X	X	X
CM/FRMAC Major Exercise	1 time	X					
ICS 100: Introduction to ICS	1 time	X	X	X	X	X	X
ICS 200: ICS for Single Resources and Initial Action Incidents	1 time	X	X	X	X	X	X
IS 700: NIMS	1 time	X	X	X	X	X	X
IS 800.b: National Response Framework (NRF), Introduction	1 time	X	X				X
Rad Worker I	Current			X	X	X	
LA 100: Sample Control Training or equivalent	3 years	X	X	X	X	X	
LA 200: Laboratory Operations Training or equivalent	3 years	X	X	X			
LA 300: Laboratory Manager Training or equivalent	3 years	X	X				
GA 100: Gamma Spectroscopist Training	3 years						X
Advanced Hazardous Materials Shipper Certification	Current					X	

Appendix B. DETAILED POSITION DESCRIPTIONS

B.1. Laboratory Analysis Manager

Field Deployable	Yes
Receives Direction From	Technical Team Lead, FRMAC Director
Works With	CMHT Assets, Monitoring Manager, Assessment Manager, Health and Safety Manager
Provides Direction To	Deputy Laboratory Analysis Manager, Shipping Specialist, Quality Assurance Specialist
Skills, Knowledge, and Experience	Maintain a general working knowledge and understanding of FRMAC missions, capabilities, objectives, and procedures. Maintain detailed knowledge, expertise, and proficiency with the FRMAC Laboratory Analysis Manual and current Sample management database. Maintain working knowledge and experience in radioanalytical laboratory operations, including deriving MQOs (AALs) from DQOs (e.g.; EPA PAGs, FDA Intervention Levels, DRLs), laboratory QA systems and QC processes, methods, and data reporting. Successful completion of all training identified in Asset Readiness and Management System (ARMS). Authorized for deployment. Minimum of 3 years of experience working within a radioanalytical laboratory or managing radioanalytical analyses.
Physical Demands and Requirements	Able to adapt and work in possibly austere/rugged/uncomfortable/harsh living and/or travel conditions. Able to work long hours in possibly stressful, urgent situations. Able to adapt and work in extreme temperature and weather conditions.

Phase: Pre-Deployment
Function: Maintain qualification(s) for position Function: Qualified to respond/deploy Function: Communicate with CMHT concerning deployment Function: Ensure Operational Logistics • Communicates with CMHT Laboratory Manager any anomalies and requirements.
Phase: Deployment
Function: Operational Logistics • Reports to Technical Team Lead upon arrival. • Communicates with the Technical Team Lead to ensure that the Laboratory Analysis Unit is appropriately resourced. • Ensures that necessary information is received from and coordinates with other FRMAC Division Managers. • Works with CMHT Laboratory Manager to identify and activate off-site, as well as on-site radiological analytical laboratories. • Communicates with on-scene laboratory analysis assets. • Maintains close coordination with the Deputy Laboratory Manager, the Quality Assurance Specialist, and the CMHT Laboratory Manager. • Coordinate sample identification, tracking, and laboratory use with other State or local agencies involved in the event. • Addresses Non-Conformances if the Deputy Manager is unavailable.

- Addresses action items assigned to Laboratory Analysis in the Action tracker application (e.g., COSMOS APPLICATION).
- Works with H&S personnel to ensure the hotline has personnel for performing contamination surveys.
- Attends meetings representing Laboratory Analysis.
- Communicates analytical capabilities to other FRMAC managers.
- Confirms internet access and required resources at laboratory analysis location.
- Monitors status of all laboratories.
- Participates as a team member with Assessment, Monitoring, and Sampling in developing a Sampling Plan to indicate the number, locations, and types of samples to be collected to meet the DQOs as defined by Assessment.
- Communicates to the Deputy Laboratory Analysis Manager the priorities from the Technical Team Lead and Assessment.
- Determines which laboratories to use during the response, and ensure they are selected for the Event in the current Sample management database.
- Coordinates with CMHT Laboratory Manager for the preparation of situational reports.
- Coordinates with Assessment, Monitoring, Sampling and CMHT to determine the nuclide mixture (nuclides of interest/analyses to request), ensures that these mixtures are entered into current Sample management database, and the priority of the sample results.

Function: Receive and Inspect Samples

- Communicates sample priorities from Assessment and Sampling Plan.
- Ensures that the data review criteria are established.
- If applicable or as necessary, ensures blind sample materials are available.
- Resolves with Assessment and/or Monitoring and Sampling any sample issues (mass, volume, integrity, etc.) that may adversely affect achieving the established MQOs.

Function: Prepare Samples

- If applicable or as necessary, directs Quality Control Specialist on the collection or preparation of the QC materials.

Function: Distribute Samples

- Ensures the quantity of samples and/or the sample size collected is adequate to meet detection limit requirements in a reasonable amount of time.
- Monitors the sample load for each laboratory for situational reports.
- Acts as the point of contact for the Technical Team Lead and Assessment on queries regarding the status of a sample being analyzed by the laboratories.

Function: Receive Sample Results from Laboratories

- Evaluates performance of laboratories providing analytical support to the response.
- Monitors sample loading and actual turnaround times of results for the analysis laboratories providing support to the response.

Function: Sample Retention and Disposal

- Coordinates sample disposition.
- Communicates sample retention and disposal requirements to the Deputy Manager and CMHT Laboratory Analysis Manager and to EPA.
- Retains returned samples until written authorization for disposal is received by the disposition authority to the FRMAC Director or Technical Team Lead.

Phase: Post-Deployment

Function: Continue with Deployment activities, if required

Function: Execute Transition Plan

- Assists in the development of a Transition to EPA Plan.

B.2. Deputy Laboratory Analysis Manager

Field Deployable	Yes
Receives Direction From	CMHT Laboratory Manager, Laboratory Analysis Manager
Works With	Sample Control Specialist, Shipping Specialist, CMHT Laboratory Manager, Quality Assurance Specialist, on-site mobile laboratories
Provides Direction To	Sample Control Specialist, Quality Assurance Specialist, Shipping Specialist, on-site augmentation personnel
Skills, Knowledge, and Experience	Maintain a general working knowledge and understanding of FRMAC missions, capabilities, objectives, and procedures. Maintain detailed knowledge, expertise, and proficiency with the FRMAC Laboratory Analysis Manual, current sample management database, and action tracker application. Maintain expert working knowledge and experience in radioanalytical methods, laboratory operations, laboratory QA/QC, and environmental radiochemistry. Demonstrated knowledge and experience in laboratory and environmental radiochemistry. Working knowledge and experience with DQOs, analytical methods, minimum detectable activity (MDA) calculations, and quality assurance procedures. Working knowledge and experience with DRLs, AALs, EPA PAGs, and FDA DILs. Successful completion of all training identified in Asset Readiness and Management System (ARMS). Authorized for deployment. Minimum of 3 years of experience working within a radioanalytical laboratory or managing radioanalytical analyses. Experience working as Sample Control Specialist, Shipping Specialist, and Quality Assurance Specialist.
Physical Demands and Requirements	Possibly, only austere living conditions will be available. Work can require long hours and stressful, urgent situations. Potential exposure to extreme temperature and weather conditions can be encountered.

Phase: Pre-Deployment
Function: Maintain qualification(s) for position Function: Qualified to respond/deploy Function: Communicate with CMHT concerning deployment Function: Ensure Operational Logistics • Communicates with Laboratory Analysis Manager any anomalies or additional requirements
Phase: Deployment
Function: Operational Logistics • Reports to FRMAC Laboratory Analysis Manager upon arrival. • Communicates with Laboratory Analysis Manager to ensure that the Laboratory Analysis Unit is appropriately resourced. • Supports the Laboratory Analysis Manager and serves in that capacity, as needed. • Works with CMHT Laboratory Manager to identify and activate off-site analytical laboratories. • Communicates with on-scene laboratory analysis assets. • Manages sample control and receipt personnel to assure that samples are surveyed for contamination and appropriate paperwork is prepared.

- Evaluates the analytical capabilities of the on-site laboratories and identifies what analyses can be performed.
- Aids in the determination of the locations for the mobile laboratory assets.
- Ensures that the laboratories receiving the samples can reach the required detection limits.
- Monitor number of samples and analysis types to maximize throughput and minimize turnaround time commensurate with MQOs. Track the sample load to the on-site laboratories.
- Communicate expected turnaround time for results from the on-site laboratories and communicate analytical priorities to the on-site laboratories based on requirements.
- Maintains close coordination with the Quality Assurance Specialist, the Shipping Specialist, Sample Control Specialist, and the CMHT Lab Manager.
- Coordinates locations for on-site mobile laboratory assets and communicates FRMAC expectations.
- Addresses Non-Conformances.
- Assists Laboratory Analysis Manager in addressing action items assigned to Laboratory Analysis.
- Ensures Health and Safety has staffed the hotline with personnel for performing contamination surveys.
- Communicates analytical capabilities to the Laboratory Analysis Manager.
- Confirms internet access at laboratory analysis location.
- Monitors status of all laboratories.
- Communicates to the Laboratory Analysis Team the priorities from the Laboratory Analysis Manager.
- Posts a Point-of-Contact board in the Sample Control tent and updates as needed.
- Determines which laboratories to use during the response, and ensure they are selected for the Event in the current sample management database.

Function: Receive and Inspect Samples

- Communicates sample priorities from the Laboratory Analysis Manager and selects laboratories to ship samples.
- Ensures that the data review criteria are established and implemented.
- Resolves any sample issues (mass, volume, integrity, etc.) that may adversely affect achieving the established MQOs.

Function: Prepare Samples

- If applicable, directs Quality Control Specialist on the preparation of the performance testing (PT)/QC samples.
- Communicates required quantity of sample collected to sample control personnel.

Function: Distribute Samples

- Monitors the sample load for each on-site laboratory.

Function: Receive Sample Results from Laboratories

- Ensure that the analysis results are forwarded to the QA specialist for verification, distribution, recording, and retention.
- Ensures the data are appropriately reviewed, qualified, loaded into current sample management database so that Assessment is aware that the data are available.
- Evaluates performance of laboratories providing analytical support to the response.

Function: Sample Retention and Disposal

- Manages and coordinates on-site sample disposition locations.

Phase: Post-Deployment

Function: Continue with Deployment activities, if required

Function: Execute Transition Plan

- If needed, assists in the development of a Transition Plan.

B.3. Consequence Management Home Team Laboratory Manager

Field Deployable	No
Receives Direction From	Technical Team Lead, Laboratory Analysis Manager
Works With	Laboratory Manager, CMHT Personnel, Gamma Spectroscopist, Deputy Laboratory Manager
Provides Direction To	Gamma Spectroscopist, off-site analytical laboratories, CMHT augmentation personnel
Skills, Knowledge, and Experience	Maintain a general working knowledge and understanding of FRMAC missions, capabilities, objectives, and procedures. Maintain detailed knowledge, expertise, and proficiency with the FRMAC Laboratory Analysis Manual and current sample management database. Maintain working knowledge and experience in radioanalytical laboratory operations, including deriving MQOs (AALs) from DQOs (e.g.; EPA PAGs, FDA Intervention Levels, DRLs), laboratory QA systems and QC processes, methods, and data reporting. Successful completion of all training identified in Asset Readiness and Management System (ARMS). Minimum of 3 years of experience working within a radioanalytical laboratory or managing radioanalytical analyses.
Physical Demands and Requirements	Able to work long hours in possibly stressful, urgent situations

Phase: Pre-Deployment
Function: Maintain qualification(s) for position Function: Qualified to respond/deploy to CMHT location Function: Communicate with CMHT concerning activation Function: Ensure Operational Logistics • Communicates with Laboratory Analysis Manager any anomalies or additional requirements.
Phase: Activation
Function: Operational Logistics • Reports to CMHT and Laboratory Manager upon arrival to CMHT location. • Ensures that necessary information is received from and coordinates with Laboratory Managers. • Works with Laboratory Analysis Manager to identify and activate off-site analytical laboratories. • Communicates with on-scene laboratory analysis assets. • Activates Gamma Spectroscopist Support as needed. • Maintains close coordination with Laboratory Manager and Deputy Laboratory Manager, and Gamma Spectroscopist. • Addresses Non-Conformances if the Deputy Manager or Laboratory Analysis Manager is unavailable. • Addresses CMHT related action items assigned to Laboratory Analysis in action tracker application. • Attends meetings representing CMHT Laboratory Analysis. • Communicates off-site analytical capabilities to other FRMAC managers. • Finds resources and responds to requests from field operations. • Monitors status of off-site laboratories. • Determines which laboratories to use during the response, and ensure they are selected for the Event in the current sample management database. • Coordinates with Laboratory Analysis Manager for the preparation of situational reports and requested technical products.

Function: Samples • Communicates sample priorities to the off-site laboratories. • Ensures that the data review criteria are established and implemented. • Monitors the sample load for each laboratory for situational reports. • Acts as the point of contact for queries regarding the status of a sample being analyzed by an off-site laboratory. Function: Receive Sample Results from Laboratories • Ensures the off-site data are appropriately reviewed, qualified, and loaded into the current sample management database so that Assessment is aware that the data are available. • Evaluates performance of off-site laboratories providing analytical support to the response. • Coordinate sample identification, tracking, and laboratory use with other state or local agencies involved in the event. Function: Sample Retention and Disposal • Communicates sample retention and disposal requirements to the off-site laboratories.
Phase: Post-Deployment (Recovery)
Function: Continue with Deployment activities, if required Function: Execute Transition Plan • Assists in the development of a Transition Plan

B.4. Quality Assurance Specialist

Field Deployable	Yes
Duties and Responsibilities	Compiles and reports results from QA samples sent to the on-site laboratories and brings unusual results to the attention of the Laboratory Analysis Manager. Establishes the QC data evaluation criteria and associated sample data qualification. Works with the supporting laboratories to investigate performance concerns. Coordinates with Deputy Laboratory Analysis Manager to investigate causes of unusual quality assurance results. Ensures that the reports received from the off-site laboratories are reviewed for accuracy and reasonableness and resolve data quality issues. Ensures that analytical data results are verified and uploaded into the current sample management database.
Receives Direction From	Laboratory Analysis Manager, Deputy Laboratory Analysis Manager, CMHT Laboratory Manager
Works With	Sample Control Specialist, Shipping Specialist, Gamma Spectroscopist, CMHT Laboratory Manager
Provides Direction To	Augmentation personnel
Skills, Knowledge, and Experience	Maintain a general working knowledge and understanding of FRMAC missions, capabilities, objectives, and procedures. Maintain detailed knowledge, expertise, and proficiency with the FRMAC Laboratory Analysis Manual and the current sample management database. Maintain expert working knowledge and experience in radioanalytical methods, laboratory operations, laboratory QA/QC, and environmental radiochemistry. Demonstrated knowledge and experience in laboratory and environmental radiochemistry. Working knowledge and experience with DQOs, analytical methods, minimum detectable activity (MDA) calculations, and quality assurance procedures.

	Successful completion of all training identified in Asset Readiness and Management System (ARMS). Authorized for deployment. Minimum of 1 year experience reviewing radioanalytical data. Familiar with radioanalytical Quality Assurance/Quality control systems and processes.
Physical Demands and Requirements	Able to adapt and work in austere living conditions. Able to work long hours in possibly stressful, urgent situations. Able to adapt and work in extreme temperature and weather conditions.

Phase: Pre-Deployment
Function: Maintain qualification(s) for position Function: Qualified to respond/deploy to CMHT location Function: Communicate with CMHT concerning activation Function: Deployment • Report to and receive assignment from Laboratory Analysis Manager or Deputy Laboratory Analysis Manager upon arrival.
Phase: Activation
Function: Operational Logistics • Coordinate and communicate with the Laboratory Analysis Manager, CMHT Laboratory Manager, and Deputy Laboratory Analysis Manager to discuss quality control and quality assurance activities. • Communicate resource requirements and needs to the Deputy Laboratory Analysis Manager. • If possible, consider providing PT samples to laboratories (on and off-site) to provide the opportunity for the lab to exercise their processes, gather data indicating performance, and to address issues prior to receiving actual field samples. Function: Receive and Inspect Samples • Support the Laboratory Analysis Manager, CMHT Laboratory Manager, and Deputy Laboratory Analysis Manager in determining resolution of quality affecting issues. • Monitor sample receipt and control activities to resolve quality issues, as needed, and determine whether systemic issues are occurring. • If applicable, ensure PT samples are logged into the current sample management database. • Monitor performance testing of selected laboratories. Function: Prepare Samples • If applicable, ensure QC samples have been injected. • Communicate on-site laboratory performance and issues to the Deputy Laboratory Analysis Manager, CMHT Laboratory Manager, and Laboratory Analysis Manager. • Ensure PT samples are added to the ARF as needed. Function: Distribute Samples • If applicable, manage QA/QC sample distribution as agreed to with the Deputy Laboratory Analysis Manager, Laboratory Analysis Manager, and CMHT Laboratory Manager. • Support resolving Non-Conformances. • Manage the PT sample distribution. • Determines the frequency of splits. • Determines the laboratory QC on field samples. • Verify that the laboratories receiving the samples can reach the detection limits required for assessment decisions. • Verify that the quantity of sample collected is adequate to meet detection limit requirements in a reasonable count time. • Verify all paperwork associated with the samples are attached.

- Verify samples are directed to the appropriate laboratory.
- Monitor sample numbers and analysis types for samples sent to the on-site laboratories to maximize production and minimize turnaround time commensurate with the DQOs.
- Track the sample load to the on-site laboratories.
- Ensure the on-site laboratories receiving the samples can reach the detection limits required for assessment decisions.
- Validate the samples are submitted to the on-site laboratories.
- Act as the point of contact for queries regarding the status of a sample being analyzed by the on-site laboratories.

Function: Receive Sample Results from Laboratories

- Communicates data package requirements to on-site laboratories as needed.
- Ensures that the laboratory data are reviewed.
- Monitors on-site laboratory performance.
- Provides information for situation reports as needed.
- Distribute the data to the appropriate personnel for review.
- Monitor QA/QC results and communicate with the Laboratory Analysis Manager, CMHT Laboratory Manager, and Deputy Laboratory Analysis Manager, as needed.
- Resolve data quality issues with the on-site laboratories.
- Ensure data are uploaded, qualified, and status updated in the current sample management database.
- Ensure that completed laboratory data packages are retained.

Function: Receive Sample Results from Laboratories

- Communicates data package requirements to on-site laboratories as needed.
- Ensures that the laboratory data are reviewed.
- Monitors on-site laboratory performance.
- Provides information for sit rep reports as needed.
- Distribute the data to the appropriate personnel for review.
- Monitor QA/QC results and communicate with the Laboratory Analysis Manager, CMHT Laboratory Manager, and Deputy Laboratory Analysis Manager, as needed.
- Resolve data quality issues with the on-site laboratories.
- Ensure data are uploaded, qualified, and status updated in the current sample management database.
- Ensure laboratory data packages complete are retained.

Function: Sample Retention and Disposal

- Advise the Laboratory Analysis Manager, CMHT Laboratory Manager, and Deputy Laboratory Manager if data quality issues associated with samples pending disposal have been resolved.

Phase: Late (Recovery)

Function: Assist in the creation of the Transition / Close-out Plan

- Support the Laboratory Analysis Manager in developing the plan, as requested.

B.5. Sample Control Specialist

Field Deployable	Yes
Duties and Responsibilities	Perform sample management activities and support shipping activities. Work with Field Teams to ensure required information is obtained for analyses being submitted at sample control. Ensure that sample control is adequately resourced, staffed and surveyed for contamination. Ensure accuracy of paperwork for accepted samples are properly logged into the current sample management database. Ensure samples are stored properly and in a way that they are easily retrievable. Prepare Analysis Request Forms (ARFs) at the direction of the Laboratory Analysis Manager, CMHT Laboratory Analysis Manager, or Deputy Laboratory Analysis Manager. Manage samples returned from on-site laboratories or shipped back from off-site laboratories. Assist the shipping specialist in delivering sample packages to on-site laboratories or couriers.
Receives Direction From	Laboratory Analysis Manager, Deputy Laboratory Analysis Manager, CMHT Laboratory Manager, Quality Assurance Specialist
Works With	Quality Assurance Specialist, Shipping Specialist, Deputy Laboratory Analysis Manager, CMHT Laboratory Manager, Monitoring, and Sampling teams
Provides Direction To	Augmentation personnel
Skills, Knowledge, and Experience	Maintain a general working knowledge and understanding of FRMAC missions, capabilities, objectives, and procedures. Maintain detailed knowledge, expertise, and proficiency with the FRMAC Laboratory Analysis Manual, and current sample management database. Successful completion of all training identified in Asset Readiness and Management System (ARMS). Authorized for deployment. Qualified by home organization to handle radioactive material with the potential for external contamination.
Physical Demands and Requirements	Able to adapt and work in austere living conditions. Able to work long hours in possibly stressful, urgent situations. Able to adapt and work in extreme temperature and weather conditions.

Phase: Pre-Deployment
Function: Maintain qualification(s) for position. Function: Qualified to respond/deploy. Function: Communicate with CMHT concerning deployment. Function: Ensure Operational Logistics. • Communicates with Deputy Lab Manager any anomalies or additional requirements
Phase: Deployment
Function: Deployment Readiness • Reports and receives assignment from Laboratory Analysis Manager or Deputy Laboratory Analysis Manager upon arrival. • Assists with Sample Receiving hotline, sample control area, and sample storage set-up. • Verifies equipment and supplies are accounted for and are operational.

Function: Receive and Inspect Samples

- Validate all samples have been screened by Health and Safety hotline personnel for external contamination and abnormally high radiation dose rates.
- Review sample control forms to ensure information is complete and resolve any discrepancies with the Field Team.
- Login QA samples collected by Field Teams.
- Verify the chain of custody documentation is complete.
- Ensure information is complete and documented in the current sample management database or on the Sample Control Form (SCF), and any discrepancies are addressed or noted on a Non-Conformance Form.
- Sign chain of custody documentation.
- Determine what additional data must be obtained and entered to complete requirements specified in the current sample management database and on the SCF.
- Check the security seal on the original sample container to be sure it is intact.
- Generate a Non-Conformance form if issues can't be immediately resolved.
- Note any discrepancies on the SCF or Receipt Form.
- Weigh the sample (exceptions are air filters and swipes).
- Record the weight in grams on the SCF, current sample management database and/or receipt forms.
- Place samples in designated storage location.
- Initiate analysis requests to laboratories.
- Remains cognizant of contamination control procedures during all sample control and handling activities.
- Update sample status in current sample management database.

Function: Prepare Samples

- Repackage sample, if needed.
- Split or combine samples, if needed.
- Check sample priorities and paperwork.
- Segregate samples by activity priority, media, collection location, or any other pertinent parameter.
- Store samples until ready for transport to the designated laboratory.
- Prepare Analysis Request Form (ARF) as directed by the Deputy Laboratory Analysis Manager.
- Supports QA sample preparation login activities as specified by the QA Specialist.
- Adds PT samples to the ARF as directed by the QA Specialist.

Function: Distribute Samples

- Assists in transport of samples to the on-site labs.
- Assists in packaging samples for shipments to off-site laboratories.
- Updates sample status in current sample management database after shipment of samples to laboratories.

Function: Receive Sample Results from Laboratories

- Updates sample result status.
- Assists with uploading data current sample management database.
- Assists with data verification.
- Assists in hard copy file data management.

Function: Sample Retention and Disposal

- Stores samples, as directed.
- Assists in sample disposition, as directed.
- Files custody documents with other sample records.

Phase: Post-Deployment (Recovery)

Function: Continue with Deployment activities, if required.

Function: Execute Transition Plan • Supports transition sample control activities to the EPA per the Transition Plan. Function: Sample Retention and Disposal • Supports transition sample custody to the EPA per the Transition Plan. Function: Equipment Redistribution • Supports transition sample control equipment per the Transition Plan. Function: Records Collection • Supports transition sample control records per the Transition Plan. Function: Miscellaneous Close-Out Activities • Assist the Laboratory Analysis Manager as directed.

B.6. Shipping Specialist

Field Deployable	Yes
Duties and Responsibilities	Remain cognizant of contamination control procedures during all sample control and handling activities. Prepares paperwork and ships samples to on- and off-site analytical laboratories. Ensures PT sample shipments are done in accordance with requirements.
Receives Direction From	Laboratory Analysis Manager, Deputy Laboratory Analysis Manager
Works With	Sample Control Specialist, Quality Assurance Specialist
Provides Direction To	Augmentation personnel
Skills, Knowledge, and Experience	Maintain a general working knowledge and understanding of FRMAC missions, capabilities, objectives, and procedures. Maintain expertise, proficiency, and familiarity with all applicable DOT and IATA. regulations relating to shipment of hazardous materials by air and ground. Successful completion of all training identified in Asset Readiness and Management System (ARMS). Authorized for deployment. Experience handling radiological samples. Qualified radioactive material shipper based on home location requirements.
Physical Demands and Requirements	Able to adapt and work in austere living conditions. Able to work long hours in possibly stressful, urgent situations. Able to adapt and work in extreme temperature and weather conditions.

Phase: Pre-Deployment
Function: Pre-Deployment • Communicate with CMHT concerning deployment.
Phase: Deployment
Function: Deployment • Report to and receive assignment from Laboratory Analysis Manager or Deputy Laboratory Analysis Manager upon arrival. Function: Operational Logistics • Ensure appropriate packaging, shipping containers, and supplies are available. • Gain an operational awareness of shipping options for that location. • Determine import/export requirements.

Function: Receive Samples (No Taskings) Function: Inspect Samples (No Taskings) Function: Prepare Samples • Works closely with Sample Control Specialist and Deputy Laboratory Analysis Manager. • Retrieve sample from Sample Storage area. • Visually inspect each sample container for indication of leaks or defects in the sample container and ensure tamper seals are properly adhered to samples. • If an issue is identified, do not allow the sample to be shipped until the issue is resolved. If no problem is found, complete the ARF paperwork. • Package samples for shipping. • Remain cognizant of contamination control procedures during all sample control and handling activities. Function: Distribute Samples • Ensure the ARF shipping information is updated in current sample management database. • Coordinate shipment of samples. • Generate formal transportation documents, as required. • Track shipments and confirm receipt. • Resolve shipping issues with the carrier or the laboratory, when needed. Function: Receive Sample Results from Laboratories (No Taskings) Function: Sample Retention and Disposal • Track the return shipments and update current sample management database.
Phase: Late (Recovery)
Function: Assist in the creation of the Transition / Close-out Plan • Support the Laboratory Analysis Manager and Deputy Laboratory Analysis Manager in developing the plan, as requested. Function: Miscellaneous Close-Out Activities • Assist the Laboratory Analysis Manager, as directed.

B.7. CMHT Gamma Spectroscopist

Field Deployable	No
Duties and Responsibilities	Maintain a general working knowledge and understanding of FRMAC missions, capabilities, objectives, and procedures. Review, validate, and interpret gamma-ray spectrometry results from in-situ and laboratory measurement systems. Perform full quantitative analyses on raw spectral data, as needed. Maintain fundamental knowledge of gamma-ray analysis and interpretation of gamma-ray spectrometric data. Assist on-site and off-site laboratories with configuration of gamma spectrometry systems for use on FRMAC Samples. This includes but is not limited to development of event-specific libraries and analysis settings to be used by the laboratories. Develop modeled or empirical efficiency calibrations for use on field and laboratory detection systems, as needed. Troubleshoot hardware and software issues relevant to interpretation and review of gamma-ray spectrometry results. Call upon Triage or other CM resources for aid in interpreting overly complex spectra.
Receives Direction From	CMHT Laboratory Manager, Laboratory Analysis Manager, Technical Team Leader

Works With	Fly Away Laboratory Supervisor, Assessment Manager, Field Team Manager, Deputy Laboratory Analysis Manager, Quality Control Specialist, Triage Scientists, or other applicable CM personnel/assets
Provides Direction To	On-site laboratories, off-site laboratories
Skills, Knowledge, and Experience (Required)	Knowledge and experience in gamma-ray spectrometry including: • Proficiency in analysis of HPGe gamma ray spectra, including modeling of sample geometries, using commercial software and non-commercial software applications, and identifying common spectral features. • Understanding of radioactive transient and secular equilibrium including ability to perform decay and ingrowth corrections/calculations. • Understanding of nuclide decay chains including the U-238, U-235, and Th-232 decay series. • Understanding of in-situ gamma spectroscopy methodologies and concepts. • Understanding of detector resolution (including typical values for common gamma spectrometers), detector efficiency (intrinsic and absolute), solid angle, and detector resolution and efficiency calibration methods. • Understanding and application of general counting statistics concepts including proficiency in performing detection limit and general propagation of error calculations. • Understanding of fission product yields and typical nuclear reactor inventories. • Understanding of routine performance check measurements and associated control charts used to verify proper detector system operation. • Understanding of random/chance coincidence and true/cascade coincidence. • Understanding of dead time and pileup rejection. • Understanding of shielding effects on spectra. • Understanding of the general quantitative effect on gamma ray spectra results when non-standard counting geometries are used. Familiarity with HPGe gamma spectrometers used in FRMAC operations. Maintain a general working knowledge and understanding of FRMAC missions, capabilities, objectives, and procedures including a familiarity with FRMAC field operations. Successful completion of all training identified in Asset Readiness and Management System (ARMS).
Required Education and Experience	Bachelor's degree in engineering/chemistry/physics/physical sciences or, as demonstrated and approved by the CMHT Laboratory Manager or Laboratory Analysis Manager, sufficient experience and/or training in gamma spectroscopy or related science. 2 years of experience involving analysis of HPGe gamma-ray spectra

Phase: Pre-Deployment
Function: Maintain qualification(s) for position Function: Qualified to respond to CMHT location Function: Communicate with CMHT concerning deployment Function: Ensure Operational Logistics • Communicates with CMHT Laboratory Manager any anomalies and requirements.
Phase: Deployment
Function: Operational Logistics • Reports to CMHT Laboratory Manager and Technical Team Lead upon arrival. • Ensures that necessary information is received from and coordinates with other Division Managers.

- Maintains close coordination with the CMHT Laboratory Manager and Laboratory Analysis Manager.
- Addresses action items assigned to Laboratory Analysis pertaining to gamma spectroscopy in action tracker application.
- Attends meetings and prepares reports as requested.
- Communicates analytical capabilities to other FRMAC managers, as requested.
- Confirms internet access and required resources at home team location.
- May be asked to participate as a team member with Assessment and Monitoring in developing a Sampling Plan to indicate the number, locations, and types of samples to be collected to meet the DQOs as defined by Assessment.
- Coordinates with CMHT Laboratory Manager for the preparation of situational reports.

Function: Receive and Inspect Samples

- Ensures that the gamma library criteria are established and communicated to supporting laboratories.

Function: Prepare Samples (no taskings)

Function: Distribute Samples (no taskings)

Function: Receive Sample Results from Laboratories

- Ensures the gamma data are appropriately reviewed, qualified, and loaded into the current sample management database so that Assessment is aware that the data are available.
- Evaluates performance of laboratories providing analytical support to the response.
- Performs quantitative analysis on spectra collected in the field from in-situ gamma spectroscopy equipment and uploads data into the current sample management database.

Function: Sample Retention and Disposal (no taskings)

Phase: Post-Deployment (Recovery)

Function: Continue with Deployment activities, if required

Function: Execute Transition Plan

- Assists in the development of a Transition Plan as requested.

Appendix C. MODEL SCOPE OF WORK FOR SUPPORTING RADIOLOGICAL LABORATORIES

C.1. General Information and Expectations

When the FRMAC responds to a nuclear/radioactive event, samples will be collected and sent for analysis. The results from these samples will serve various purposes throughout the response. These results may support recommeded actions based on Protective Action Guidelines (PAGs), various action levels (embargo, quarantine, etc.), regulatory limits (Safe Driniking Water Act, cleanup limits, etc.), or monitoring requirements. The samples collected (and results for those samples) are relative to how the data will be used, somewhat relative to the phase (Emergency/Early vs. Intermediate vs. Recovery/Cleanup/Long Term Monitoring) of the response, are often time based for decisions, and the requirements change often during the response.

All of the action levels, regulatory limits, monitoring levels and Measurement Quality Objectives (MQO's) encountered for the samples, are translated into Requested Detection Limits/Required Reporting Limits and listed on the sample Analyis Request Form (ARF) for the Analysis Laboratory.

C.2. Standard to the Industry practices

It is expected that the existing established radiological Analysis Laboratories will:

- Have a mature and robust quality program in place.
- Have necessary procedures in place to appropriately handle and process samples with radioactive components or the potential for radioactive components.
- Use standards that are traceable to National Institute of Standards and Technology (NIST) or equivalent.
- Have adequate facilities and storage areas to handle radioactive samples.
- Have appropriate licenses, permits, certifications, and accreditations common to the industry.
- Have common industry processes and procedures based on recognized standards (ASTM, MARLAP, MARSIM, ISO 17025, TNI Standard, Standard Methods, DoD/DOE QSM, etc.)
- Participate in radiological Performance Testing programs.

C.3. Points of Contact

The FRMAC POC for the Analysis Laboratory data may change frequently due to shift changes, personnel assignments, general progression of the event, and change in the event response administrative control from DOE to EPA. Typical FRMAC positions that may interact with the Analysis Laboratory are the Consequence Management Home Team (CMHT), Laboratory Analysis Manager, Deputy Lab Analysis Manager, Quality Assurance (QA) Specialist, Shipping Specialist, and others as assigned. Changing of POCs will require a coordinated effort between FRMAC and the Analysis Laboratory.

C.4. Sample Types and Subtypes to be expected

- Air

  - Cartridge
  - Filter
  - Impactor
- Ground Deposition (defined by volume or weight, surface area, depth, area and depth units)
- Soil
- Swipes
- Water
  - Ground/Well
  - Other
  - Surface
  - Tap Water

C.5. Radioactive Materials License and Limitations

The Analysis Laboratory must have/hold a Radioactive Materials License issued by the USNRC, or issued by an Agreement State, or have/hold an NRC Exemption from Licensing of Radioactive Materials and provide a copy to FRMAC Laboratory Analysis.

Whereas the details of the Radioactive Materials License/ Exemption are unique to the Analysis Laboratory, it is imperative that the restrictions, limitations, special handling, permissions, pre-approval for acceptance, etc., must be made known to the FRMAC prior to shipping of any samples.

C.6. Requested Detection Limits/Required Reporting Limits

Results will often be used for decisions related to protective actions that are time dependent. In some of these cases (time dependent), a general count time may be requested/established rather than meet, or count to, the Requested Detection Limits/Required Reporting Limits. These details will be stipulated on the ARF and/or in correspondence with the laboratory POC.

Requested Detection Limits/Required Reporting Limits will vary depending upon the purpose the results are used for. Decisions involving whether to evacuate people or not or Immediately Dangerous to Life and Health (IDLH) can often be made with short sample count times and higher result uncertainties. Lower confidence limits (<<95%) can be tolerated and less QC is required (Early/Emergency Phase). These results will have a “Do it Right Now” short turnaround time.

Decisions involving quarantining and lifting of the quarantine, and closures and openings, often require lower detection limits and less uncertainty than Early Phase samples, but still do not require results at 95% confidence interval. These samples will have a normal to expedited Turnaround Time.

Decisions involving regulatory compliance, meeting cleanup standards and long-term monitoring require results at the 95% confidence interval as well as rigorous QA/QC. These samples predominately appear in the late or recovery phase of the response, and perhaps the intermediate phase as well. These samples will, most often, have a normal or typical to the industry Turnaround Time.

Sample Requested Detection Limits/Required Reporting Limits will be set according to the decisions being made/purpose of the results. By default, these Requested Detection Limits/Required Reporting Limits will be stated on the ARF at the 95% confidence level regardless of the purpose or decision being made on the results.

In some cases, the Analysis Laboratory will not be able to reasonably meet the Requested Detection Limits/Required Reporting Limits or meet the Requested Detection Limits/Required Reporting Limits in the space of time requested for results. The Requested Detection Limits/Required Reporting Limits are generally set to achieve results with a 95% confidence interval at 1 sigma uncertainty. The actual accuracy needed, or the amount of uncertainty, or confidence, in a result that will be tolerated in order to support defensible decisions or credible result estimates may be less depending upon the purpose the data is intended for. Therefore, if the Analysis Laboratory cannot meet the Requested Detection Limits/Required Reporting Limits, it is expected that the Analysis Laboratory immediately state what they can't do, state what they can do, recommend alternatives, and expect changes to the Analysis Request.

It is a best practice for results (if they can be reasonably produced) to meet or exceed the stated expectations.

C.7. Turnaround Times

Turnaround times will be stated on the ARF. The Turnaround Time begins when the laboratory receives the sample and ends when the final results have been submitted.

The laboratory must immediately notify the FRMAC POC if the Turnaround Times cannot be met due to unforeseen circumstances or other reasons such as: too many rush or priority samples to complete with the available resources, lab impacted by closure or quarantine, holidays, etc.

C.8. Reporting Results

Results can be reported via:

- Entry into an Excel Template provided by CBRN Responder that is uploaded to the FRMAC Laboratory Portal and FRMAC POC notified.
- Electronic message to the FRMAC POC.
- Entry into an Excel Template provided by CBRN Responder and directly uploaded into CBRN Responder where allowed.
- Hardcopy to the FRMAC POC.

Results of each sample delivery group or ARF should be reported together at the same time.

Corrected results, updated results, or amendments to results should be made promptly with the FRMAC POC notified. The corrected/updated/amended results should include the reason/case narrative explaining the changes.

C.9. Reporting Units

All results should be reported in activity per sample except as stipulated in the ARF.

C.10. Case Narrative

A case narrative shall be supplied with the results that:

- Explains or qualifies any anomalies or problems or biases with the samples or results.
- Explains or qualifies any out of tolerance conditions or known biases of the laboratory's internal QC.
- Explains anything that affects the accuracy of the data.
- Explains anything that limits the credibility or reliability of the data, or affects interpretation of results.

C.11. Confidentiality of Results

Results shall remain confidential and shall not be released/transmitted to any third party without the written consent or authorization of FRMAC.

C.12. Laboratory Sample Loads and Time Urgent Results

Primarily during the early to intermediate phase of the response, amongst/in addition to the regular samples, there will be samples that are time urgent to support decisions for evacuation, quarantine, and other decisions. The number of time urgent FRMAC samples may be limited/regulated/prioritized to the Analysis Laboratory. This is to ensure the most quick and efficient means of getting time urgent results (ASAP, 1–3 day turnaround) back to the FRMAC. It is imperative that the Analysis Laboratory communicate their ability to provide time urgent results on a case-by-case basis prior to these samples being sent to the Analysis Laboratory. Many Analysis Laboratories will be participating. It is not the desire of FRMAC to overload or overwhelm any particular laboratory with samples at any time during the response and especially not impede the time urgent results.

In some cases, sample count times/analysis times may be dictated by FRMAC to meet the time urgent data request.

C.13. Sample and Results Retention

The Analysis Laboratory shall store samples and the remaining portions of an analyzed sample until directed by FRMAC to either:

- Return samples and unused fractions to FRMAC, or
- Dispose of Sample and Residuals

C.14. FRMAC QA/QC

The FRMAC may inject/insert additional QA/QC samples to assess and/or monitor any portion of the results creation/ laboratory analysis process. These QA/QC samples may be obvious, single blind, double blind, be part of Performance Testing programs, round robins, etc.

C.15. Analysis Laboratory QA/QC

Each analysis batch (defined by the Analysis Laboratory) of samples shall contain at least 1 blank and one Laboratory Control Sample.