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FEDERAL RADIOLOGICAL

MONITORING AND ASSESSMENT CENTER

FRMAC ASSESSMENT MANUAL

VOLUME 1

Assessment Division Operations

The Federal Manual for Assessing Environmental Data During a Radiological Emergency

May 2023

Prepared by
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FRMAC Assessment Manual

Volume 1

Assessment Division Operations

May 2023

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PREFACE

The Federal Radiological Monitoring and Assessment Center (FRMAC) Assessment Manual is the tool used to organize and guide activities of the FRMAC Assessment Division. The mission of the FRMAC Assessment Division in a radiological emergency is to interpret radiological data and predict worker and public doses. This information is used by Decision Makers to recommend protective actions in accordance with Protection Action Guides (PAGs) issued by government agencies. This manual integrates many health physics tools and techniques used to make these assessments.

The objectives of the FRMAC Assessment Manual are:

A. Document the assessment process.

   The manual defines Assessment Division operations and provides descriptions of organization, functions, and objectives.

B. Provide technical basis for assessments.

   The manual describes each assessment method in detail, provides references to scientific publications and guidance documents, and specifies the assumptions used.

C. Provide technical basis for the Turbo FRMAC software.

   The Turbo FRMAC software automates the calculations in the Assessment Manual, allowing for rapid computation of important dose assessment data. Turbo FRMAC uses the default input values established by the FRMAC Assessment Working Group (AWG). Assessment Scientists can modify these input values to accommodate incident-specific conditions.

D. Function as an orientation and training guide for Assessment Division members.

   The manual is used to train health physicists to use FRMAC assessment methods to evaluate environmental radiological conditions. It also describes the conduct of operations employed by FRMAC.

E. Provide Federal family consensus.

   The manual is based on the guidance issued by the U.S. Nuclear Regulatory Commission (NRC), U.S. Environmental Protection Agency (EPA), and U.S. the Food and Drug Administration (FDA) and on consensus standards, such as the International Commission on Radiation Protection (ICRP) and the National Council on Radiation Protection (NCRP). It was developed by the FRMAC AWG and has had broad review from multiple Federal agencies (NNSA, NRC, EPA, FDA, U.S. Department of Agriculture [USDA], and the Centers for Disease Control and Prevention [CDC]), state agencies, and other participants.

This manual:

1) Is intended for use by trained FRMAC Assessment Scientists. It is the basis for training FRMAC Assessment Scientists in standard FRMAC technical methods, and defines the standard technical methods used when responding to radiological incidents.

2) Represents the technical consensus of multiple federal agencies with expertise in and authority over aspects of radiological emergency response.
3) Defines methods to make many different radiological assessment calculations based on default assumptions agreed upon by the interagency FRMAC AWG as being most applicable to a wide variety of conditions. These default assumptions may or may not be appropriate for a specific incident.
4) Frequently uses the word "would" to define the result of the calculation, and it is important to be aware that this result is based on the established default assumptions. Should circumstances of the specific incident be different than the default assumptions, the predicted results may not reflect actual conditions. It is recommended that assessors obtain real-world data as soon as possible to validate the predictions made by the methods in this manual.
5) Is only intended to address the early and intermediate phases of a radiological incident. It does not address Late Phase issues, such as remediation.
6) Incorporates the EPA PAG Manual's Avoidable Dose concept.
7) Is not prescriptive. Situations may arise when the methods described in the Assessment Manual will not be sufficient, so the user may employ alternative methods or assumptions. Assessment Scientists must be sufficiently skilled in health physics to recognize when, which, and how alternative methods or assumptions may be employed. Possible alternatives may include dosimetry models, weathering factor, and resuspension factor.

The manual is organized as follows:

Volume 1 describes the roles and responsibilities of the Assessment Division during a response.

Volume 2 contains the scientific bases and technical methods for assessment calculations. These calculations are broken up into sections:

- Section 1 – Public Protection
- Section 2 – Worker Protection
- Section 3 – Ingestion Pathway
- Section 4 – Supplemental Methods

Volume 3 provides analyses for pre-assessed scenarios. These default scenarios include:

1. Nuclear power plant
2. Nuclear fuel fabrication
3. Nuclear fuel accident
4. Radiological dispersal device
5. Nuclear detonation
6. Nuclear weapon accident
7. Radioisotope thermoelectric generator accident

ACKNOWLEDGMENTS

Development of this revision of the FRMAC Assessment Manual, Volume 1 was a major undertaking to which many people contributed. The primary authors for this revision were Lainy Cochran and Kevin Hart (SNL). Editorial support was provided by Monica Bigney (SNL). Special recognition also goes to the members of the FRMAC Assessment Working Group for their work on this revision in developing radiological assessment guidance for the default scenarios of interest described in this volume.

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Acknowledgment is given to those who participated in development of previous versions of the manual because this revision was built upon those efforts.

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ACRONYMS AND ABBREVIATIONS

AAL	Analytical Action Level
AMS	Aerial Measuring System
ANL	Argonne National Laboratory
API	Application Programming Interface
ARF	Analysis Request Form
ARG	Accident Response Group
AVID	Advanced Visualization of Data
CDC	Centers for Disease Control and Prevention
CM	Consequence Management
CMHT	Consequence Management Home Team
CMRT	Consequence Management Response Team
COP	Common Operating Picture
COSMOS	Consequence Management Operational System
cpm	counts per minute
DAR	Data Analysis Repository
DCFPAK	Dose Coefficient File Package
DFM	Digital Field Monitoring
DIL	Derived Intervention Level
DOE	Department of Energy
DQO	Data Quality Objective
DRL	Derived Response Level
ECAM	Environmental Continuous Air Monitor
EDD	Electronic Data Deliverable
EOC	Emergency Operations Center
ECN	Emergency Communications Network
EPA	Environmental Protection Agency
FRMAC	Federal Radiological Monitoring and Assessment Center
FHTL	Federal Home Team Leader
FIL	FRMAC Intervention Level

FTL	Federal Team Leader
GIS	Geographic Information System
GPS	Global Positioning System
IC	Incident Command
ICS	Incident Command System
IL	Intervention Level
JFO	Joint Field Office
JTOT	Joint Technical Operations Team
LANL	Los Alamos National Laboratory
L_C	Critical Level
LLNL	Lawrence Livermore National Laboratory
MACS	Multi-Agency Coordination System
NARAC	National Atmospheric Release Advisory Center
NIMS	National Incident Management System
NIT	Nuclear Incident Team
NNSA	National Nuclear Security Administration
NRC	Nuclear Regulatory Commission
NST	National Search Team
OGT	Operational Guidelines Task Group
PAG	Protective Action Guide
PAR	Protective Action Recommendation
PNNL	Pacific Northwest National Laboratory
QA	Quality Assurance
QC	Quality Control
RAMP	Radiation Protection Computer Code Analysis and Maintenance Program
RAP	Radiological Assistance Program
RASCAL	Radiological Assessment System for Consequence Analysis
REAC/TS	Radiation Emergency Assistance Center/Training Site
RESRAD	Residual Radiation
RFI	Request for Information

RSL	Remote Sensing Laboratory
SHIRE	Secure Hosting Infrastructure for the Radiological Emergency Response Enterprise
SLTT	State, Local, Tribal, Territorial
SNL	Sandia National Laboratories
SRNL	Savannah River National Laboratory
SRS	Savannah River Site
THTL	Technical Home Team Leader
TTL	Technical Team Leader
UC	Unified Command
USDA	U.S. Department of Agriculture
VoIP	Voice Over Internet Protocol
VSP	Visual Sampling Plan

1. INTRODUCTION

In the event of a major radiological incident or accident, the Federal Radiological Monitoring and Assessment Center (FRMAC) will coordinate the federal agencies that have various statutory responsibilities and/or capabilities for responding to such incidents (Ref. FRMAC10). The FRMAC is responsible for coordinating all environmental radiological monitoring, sampling, and assessment activities for the response. For less severe radiological incidents, elements of the Department of Energy (DOE) Consequence Management (CM) program, such as the CM Response Team (CMRT) or CM Home Team (CMHT) may be activated to provide similar support activities to regional or local response assets.

This manual describes the roles and responsibilities of the Assessment Division of the FRMAC during a response to a radiological incident. Every effort will be made in this manual in accordance with the *Implementation of the National Incident Management System (NIMS)/Incident Command System (ICS) in the Federal Radiological Monitoring and Assessment Center (FRMAC) – Emergency Phase (Ref. RSL07)* to use terminology consistent with the National Incident Management System (NIMS) for Incident Command System (ICS) organizations, planning processes, and leadership positions (Ref. FEMA17). This manual also applies to smaller scale CM responses that may involve the CMRT or CMHT elements without the formation of a FRMAC. It details the concept of operations for the Assessment Division, including common tasks performed by the Division. This manual also describes the organizational structure of the Assessment Division and roles of the personnel within the Division.

1.1. Overview of the Consequence Management Response and Home Team

DOE's CMRT and CMHT have the mission to support the federal, state, local tribal, and territorial (SLTT) organizations to assess and evaluate the impact on people and the environment of radiological material accidentally or intentionally released into the environment. The CMRT provides personnel and resources to each of the subordinate organizations that make up the deployed FRMAC (Figure 1). The CMHT reports to the FRMAC Director as indicated in Figure 1, but CMHT personnel work directly with their deployed counterparts in the CMRT. Depending on the incident, CMRT resources may be consolidated within an onsite/offsite FRMAC or distributed among Unified Command (UC), a Joint Field Office (JFO) if established, or other Multi-Agency Coordination System (MACS) entities. The CMRT provides resources for environmental radiological monitoring and sampling followed by data aggregation, robust quality control, dose assessments, evaluation relative to various government guidance, and presentation for decision makers. The CMRT works closely with the CMHT which parallels the CMRT in structure.

As with the CMRT, the CMHT mission is to assist federal, state, tribal, and local decision makers in collecting and interpreting data in order to provide for public safety and minimize the social and economic impacts of a nuclear/radiological incident. CMHT support includes collecting and analyzing data, evaluating hazards, providing event information and data products to protective action decision makers. The Remote Sensing Laboratory (RSL) serves as the headquarters for CMHT. The CMHT establishes a bridge line for decision makers, scientists, state authorities, and other assets to discuss the situation and any available data before CMRT

has set up the FRMAC, or in the event a FRMAC is not requested. The CMHT will continue to support the event for as long as necessary. The CMHT serves as an extension of the deployed CMRT with nodes located at Sandia National Laboratories (SNL), RSL, Los Alamos National laboratory (LANL), Lawrence Livermore National Laboratory (LLNL), National Atmospheric Release Advisory Center (NARAC), Savannah River Site (SRS). CMRT Assessment Division functions and organization structure is mirrored in the CMHT to provide depth and minimize the number of personnel deployed to the field.

CMRT organization, resources, and positions are briefly described below (Figure 1).

1.1.1. CMRT and CMHT Leadership

The FRMAC Director and CMRT Technical Team Leader (TTL) and Federal Home Team Leader (FHTL) and CMHT Technical Home Team Leader (THTL) provide support to the primary authority or UC group and ensures objectives related to radiological response are identified and met efficiently.

1.1.2. Assessment Division

The Assessment Division Manager reviews, assesses, and reports data to partners in accordance with accepted guidelines. The Assessment Division provides dose assessment, Geographic Information System (GIS) support, data management, and through the NARAC, atmospheric dispersion modeling in coordination with the CMHT.

1.1.3. Monitoring and Sampling Division

The Monitoring Division Manager in coordination with the Operations Section Chief and with input from the FRMAC Division Managers creates execution plans for environmental surveys and sampling needed to meet incident objectives (Ref. FRMAC19). Using the execution plan, the Monitoring Division Manager creates daily field team instructions and coordinates taskings for the Aerial Measuring System (AMS) with the AMS Mission Manager.

1.1.4. Health and Safety Division

The Health and Safety Division Manager supports the UC Safety Officer in managing and monitoring the health and welfare of deployed staff.

Radiological Emergency Assistance Center/Training Site (REAC/TS) staff provide subject matter expertise on the medical management of radiation incidents.

1.1.5. Laboratory Analysis Division

The Laboratory Analysis Division Manager is responsible for coordinating all Laboratory Analysis operations in the field. This includes sample receipt from monitoring and sampling teams, sample control and storage, shipment of samples to appropriate laboratories for analysis, securing contracts or agreements with appropriate laboratories, communicating analysis capabilities and capacities across FRMAC organizations, receipt of radioanalytical results from all laboratories, review/verification/validation of all radioanalytical results, ensuring results are uploaded electronically and available in the prescribed software information management system

(e.g. CBRNResponder or other system, and maintaining all electronic and paper analytical reports received during an incident.

1.1.6. Support Section

The Support Division Manager ensures the availability of communications, provides CMRT specific logistical support through supply and service, and maintains document control.

1.1.7. Liaisons

The CMRT provides various Liaisons to responding organizations and various SLTT agencies.

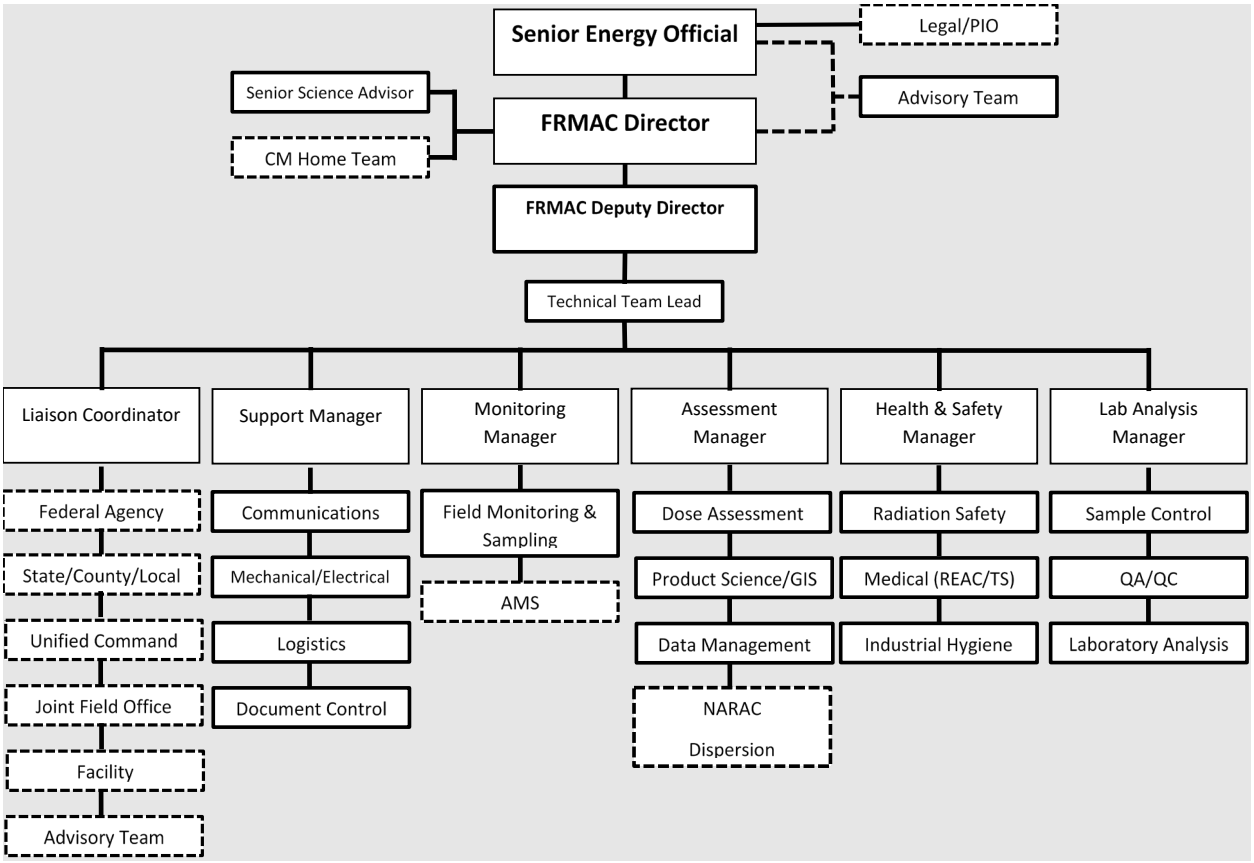

Figure 1. FRMAC Organization without use of NIMS/ICS Terminology

1.2. Role of the Assessment Division in a CM Response

The Assessment Division supports the technical needs of government response organizations and augments their technical capabilities. It serves as the integrating point for all radiological data collected by responders. It also facilitates a uniform and consistent analysis of that data. As such, it is intended to be the single point for dissemination of data and analyses for the federal response.

The Assessment Division's broad-based staff is the key to achieving the FRMAC's objectives. The staff is drawn from multiple agencies and has a variety of skills. The staff includes health physicists, data analysts, cartographers, modelers, meteorologists, and computer scientists. These professionals facilitate the analysis, interpretation, presentation, and preservation of incident-specific radiological data.

These individuals are primarily drawn from the National Nuclear Security Administration (NNSA) and the Environmental Protection Agency (EPA). However, staff also includes members from the Nuclear Regulatory Commission (NRC), US Department of Agriculture (USDA), Food and Drug Administration (FDA), Centers for Disease Control and Prevention (CDC), and other federal agencies. SLTT scientific specialists are also invited to participate.

The primary role of the Assessment Division is to review and analyze the models and data available to develop an understanding of the radiological environment and communicate that understanding to the responders and SLTT officials so that they can take appropriate and defensible actions to protect the public following a radiological incident. Three standing actions are assigned to the Assessment Division to support this role:

- Characterize the radiological release to develop and evolve the Common Operating Picture (COP),
- Maintain maps and other products to support the situational awareness of the radiological environment for all responders, and
- Develop and maintain products to support protective action recommendations (PARs).

The Assessment Division is also responsible for leading the response to requests for information (RFIs) from Incident Command/Unified Command (IC/UC), stakeholders, and other agencies. The Assessment Division may also be tasked to provide Subject Matter Experts to respond to specific RFIs or provide assistance to Liaisons or federal leadership in explaining key technical aspects of the data or models in the COP. A COP provides a single identical display of relevant information shared by more than one organization and facilitates collaborative planning. Additionally, the Assessment Division will provide technical information to response organizations which do not rise to the level of formal RFIs.

1.3. Assessment Division Objectives

The primary objective of the Assessment Division is to interpret radiological conditions and provide guidance to responsible government authorities. All radiological predictions and measurements are evaluated in terms of the Protective Action Guides (PAGs), which are the criteria for making decisions such as evacuation, sheltering, relocation, and food embargo (Ref. EPA17). Generally, PAGs are used to control health risks by placing restrictions on the radiological dose received via the primary dose pathways.

The Assessment Division of the CMRT works closely with the responsible government authorities to tailor assessment data products for the incident. The Assessment Division also works closely with the Federal Advisory Team for Environment, Food, and Health. The Advisory Team includes representatives from those federal agencies that have specific statutory

responsibilities for public health. The Advisory Team may provide incident-specific guidance including adjustments to Assessment Division assumptions, parameters, and methodology. The Advisory Team uses Assessment Division interpretations to develop their advice and review the application of PAGs.

The Assessment Division does not make PARs. SLTT response organizations are responsible for developing and implementing PARs. The Coordinating Agency, the utility (if applicable), and the Advisory Team support the development of PARs.

The Assessment Division remains a key function during all phases of an incident and will continue to support incident response when the management of FRMAC transfers to EPA during the Intermediate/Late Phase.

2. ASSESSMENT DIVISION ORGANIZATION AND POSITIONS

The Assessment Division is made up of Dose Assessment and Product Science/GIS. NARAC performs dispersion modeling and meteorology (Figure 2) as a part of the CMHT. The FRMAC Operations Manual (Ref. FRMAC10) has a detailed discussion on how the CMRT is integrated within the ICS. Note that all, some or none of the Assessment Division may deploy as part of the CMRT. As the field footprint of the Assessment Division becomes smaller, the load on the CMHT Assessment Division becomes larger.

Depending on the type and scope of an incident, some or all of these functions can be performed by the CMHT. It is paramount that the Assessment Division Manager, if deployed, work closely with the CMHT Assessment Division Manager to identify RFI handling, NARAC coordination, data management, data assessment, dose assessment, and assessment product development and handling procedures.

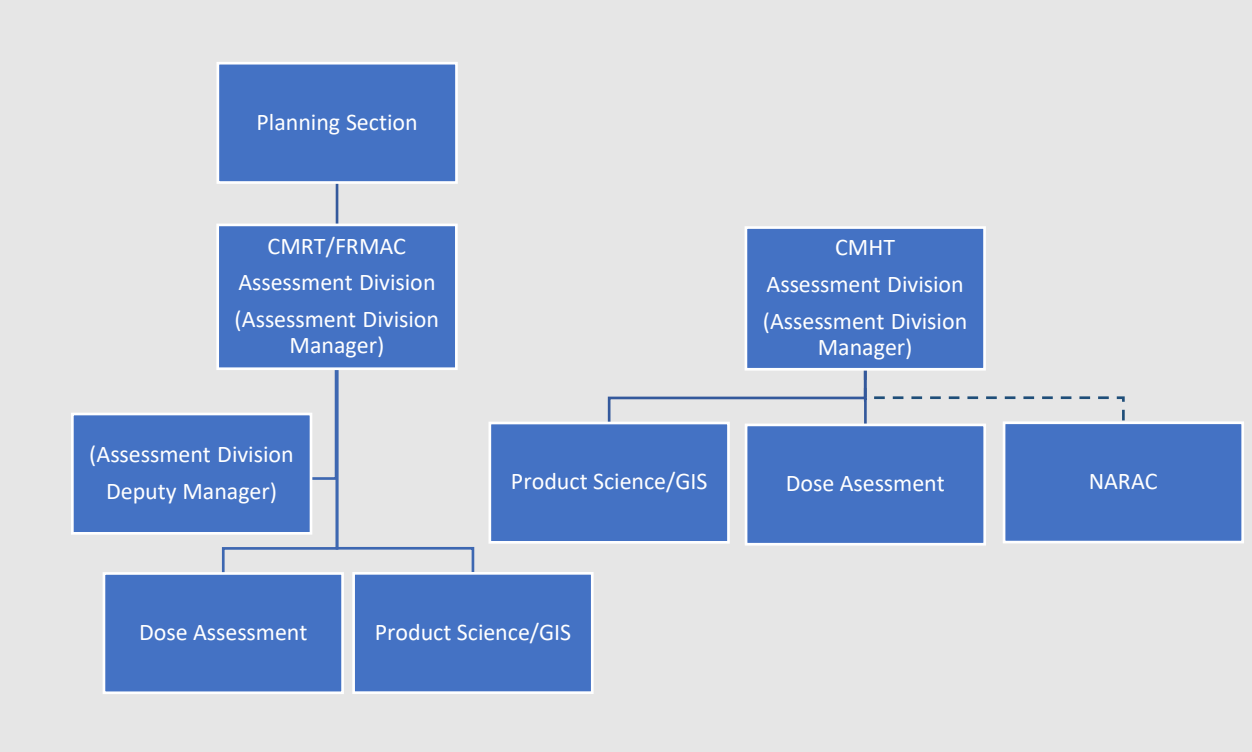

Figure 2. Assessment Organization within ICS

2.1. Assessment Division Organization

The CMRT Assessment Division deploys with an Assessment Manager and Deputy. The CMHT Assessment Division is also established with an Assessment Division Manager. While data management is not an organization within the Assessment Division, CMHT is predominately responsible for leading data quality assessment activities. The CMHT Assessment Manager

should designate one of the Assessment or Product Scientists in the CMHT as the lead for data quality assessment.

2.1.1. Dose Assessment

Dose Assessment is responsible for public protection, ingestion, drinking water, and worker protection calculations. For a large-scale event, Dose Assessment within the CMRT is staffed with at least two qualified Assessment Scientists. Qualification requirements are maintained in NNSA's Asset Management Readiness System. Dose Assessment within the CMHT is staffed four qualified Assessment Scientists for the day shift and two for the night shift. These personnel can also be augmented by qualified Assessment Scientists from other agencies and NNSA teams.

2.1.2. Product Science/GIS

Product Science/GIS is responsible for maintaining the COP for the FRMAC and SLTT stakeholders. For a large-scale event, CMRT Product Science is staffed with at least one qualified Product Scientist and GIS Specialist for day and at least one Product Scientist and GIS Specialist for night. CMHT Product Science is also staffed with at least two Product Scientists and two GIS Specialists for each shift. staffed with two qualified Product Scientists for day and two for the night shift.

2.1.3. NARAC

During a CM response, NARAC becomes part of the CMHT. NARAC Scientists work with the Product Scientists to identify which data sets have been approved for use to update the NARAC models and source term estimates. Additionally, NARAC works with the Assessment Division Manager to identify needed support to answer RFIs.

2.2. Position Descriptions and Responsibilities

The FRMAC position titles do not correlate with ICS position titles. Specific leadership titles may change when the CMRT is integrated into the ICS.

2.2.1. Assessment Division Manager

2.2.1.1. Roles and Responsibilities

Assessment Division Managers are senior Assessment personnel responsible for managing the activities of the Assessment Division and assisting the TTL in prioritizing RFIs. Assessment Division Managers may also be called upon to provide technical briefings to partner agencies. The Assessment Division Manager within the CMHT may be responsible for some or all of the below activities in coordination with the CMRT Assessment Division Manager.

2.2.1.2. Activities

1. Function as an expert with respect to radiological dose assessment, radiation-related health effects and environmental impact, PAGs, mitigation processes, and consequence management activities
2. Work with the TTL, THTL, and/or CMHT Assessment Division Manager to prioritize RFIs and manage Assessment Division resources

3. Coordinate with the Monitoring Division Manager and Laboratory Analysis Division Manager to establish the priority of monitoring efforts, as well as the types and quantities of samples/measurements to be collected (i.e., Data Quality Objective (DQO) development)
4. Ensure the development, technical integrity, and scientific defensibility of all CM summarized and assessed data to support revising NARAC dispersion models and products
5. Manage allocation of assessment division personnel to complete tasks assigned to the Division. Manage allocation of tasks between CMRT and CMHT Assessment teams.
6. Provide technical expertise, planning, and resource information for the mitigation and recovery process
7. Provide dose mitigation options with predictions of effectiveness to minimize dose
8. Responsible for the completion of data summarization and dose assessment-related duties, activities, and documentation required to bring the deployment to closure and to redeploy
9. Interact with SLTT assessors to identify dose pathways of concern, assumptions used in dose calculations, and priority locations requiring assessment
10. Coordinate with the Advisory Team

2.2.2. Assessment Division Deputy Manager

2.2.2.1. Roles and Responsibilities

Assessment Division Deputy Manager, a qualified Assessment Division Manager, when present, is responsible for coordinating the efforts of Assessment Division personnel, ensuring RFIs have been assigned to individual Assessment Division personnel, and assisting the Assessment Division Manager in running the Assessment Division.

2.2.2.2. Activities

1. Work with the CMHT Assessment Division Manager to assign RFIs to individual members of the Division, both deployed and in the CMHT
2. Ensure tasks are completed in priority order and in time to advise needed recommendations for decision makers
3. Assist the Assessment Division Manager in running the Division
4. Supervise Assessment Division personnel and support them in completing assigned tasks.

2.2.3. Assessment Scientist

2.2.3.1. Roles and Responsibilities

Assessment Scientists are experts on health effects and environmental impacts resulting from exposure to ionizing radiation and provide a radiological dose assessment expertise to aid with interpretation of radiological data to support protective action decision making. Assessment Scientists possess a detailed understanding of EPA and FDA PAGs and FRMAC Assessment methods (Ref. FRMAC23) to quickly project the resulting radiological impact from modeled or measured data.

2.2.3.2. Activities

1. Provide radiological dose assessment expertise and understanding of potential impact on human health and the environment
2. Provide detailed understanding of EPA and FDA PAGs and FRMAC Assessment methods
3. Perform FRMAC Assessment method calculations according to FRMAC Assessment Manual, Volume 2 (Ref. FRMAC23)
4. Work with NARAC to ensure consistent source term and health physics assumptions
5. Review NARAC model output
6. Work with Product Scientist to identify appropriate data sets to use in assessment calculations
7. Incorporate data into Assessment Division calculations
8. Support Health and Safety by supplying turn-back limits for worker protection
9. Interact with SLTT assessors to identify dose pathways of concern, assumptions used in dose calculations, and priority locations requiring assessment
10. Work with Monitoring and Sampling Deputy Supervisor or Field Team Leader to investigate potentially anomalous data as part of data integration review
11. Interact with SLTT assessors to incorporate data they may have collected; include their areas of concern in monitoring and sampling, or laboratory analysis plans
12. Assist SLTT teams with data quality review of SLTT-collected data if needed
13. Assist Field Team Supervisor (Lead) with data quality review as needed
14. Conduct data integration review
15. Work with NARAC to prepare data sets and evaluate data integration with dispersion models

2.2.4. Product Scientist

2.2.4.1. Roles and Responsibilities

Product Scientists supporting Product Science/GIS are primarily responsible for performing the data integration review of all data collected by the FRMAC to develop, maintain, and evolve the COP and for communicating the COP to decision makers to support public protection action decisions. Product Scientists also support the Assessment Division as secondary reviewers for products, reports, and calculations generated by the Division, as well as any other Assessment Division-related tasks assigned by the Assessment Division Manager.

2.2.4.2. Activities

1. Provide radiological dose assessment expertise and understanding of potential impact on human health and the environment
2. Work with the Assessment Scientist to identify appropriate calculations to incorporate into map products
3. Work with NARAC to generate models and contours to support the development of map products
4. Work with GIS Specialist to create map products
5. Interact with SLTT assessors to identify dose pathways of concern, assumptions used in dose calculations, and priority locations requiring assessment
6. Design appropriate map products
7. Revise/edit map products

8. Deliver or post finalized products to CMweb for SLTT partners
9. Incorporate SLTT protective action decisions into map products
10. Work with Monitoring and Sampling Deputy Supervisor or Field Team Leader to investigate potentially anomalous data as part of data integration review
11. Interact with SLTT assessors to incorporate data they may have collected; include their areas of concern in monitoring and sampling, or laboratory analysis plans
12. Assist SLTT teams with data quality review of SLTT-collected data if needed
13. Assist Field Team Supervisor (Lead) with data quality review as needed
14. Conduct data integration review
15. Work with NARAC to prepare data sets and evaluate data integration with dispersion models
16. Work with GIS Specialist to perform spatial analysis and review of data as integration review

2.2.5. Geographic Information System Specialist

2.2.5.1. Roles and Responsibilities

GIS Specialists are primarily responsible for developing and maintaining the geospatial data and visualizations used by the FRMAC and for producing map-based assessment products. GIS Specialists are also responsible for supporting the geospatial data integration review of data, and for collating geospatial data and data layers from local, regional, and national databases. The GIS Specialist will also serve as the primary point of contact for GIS Specialists from SLTT and other federal agencies to share GIS data for the event.

2.2.5.2. Activities

1. Curate base map layers, such as locations of shelters, fire stations, farms, etc., for use in producing decision making support and situational awareness products
2. Work with the Product Scientist to create map products
3. Maintain situational awareness map products on the GIS portal
4. Revise/edit map products
5. Coordinate with SLTT and other Federal Agency GIS Specialists to share geospatial data and products across response
6. Work with the Product Scientist performing data integration review to support geospatial analysis of data

3. ASSESSMENT DIVISION INTERACTIONS

The Assessment Division interacts with organizations within and outside of UC and the MACS. It is important that the Assessment Division clearly identify all interfaces with the UC organization both associated with and not directly associated with the FRMAC, Liaisons to SLTT agencies, and other entities as needed.

3.1. Primary Interactions within FRMAC for the Assessment Division

The Assessment Division takes direction from both the CMRT chain of command as well as from the UC or MACS leadership. Tasks or requests will be managed through an RFI process in order of priority given by the TTL and/or THTL. Each organization within the FRMAC gives and receives input or products to or from the Assessment Division.

3.1.1. Monitoring and Sampling Division

3.1.1.1. Data Collection

The Assessment Division provides input to the Monitoring and Sampling Division on the monitoring strategy including numbers and types of measurements and samples, sampling locations and spacing, and aerial surveys using AMS. The Assessment Division in coordination with the Laboratory Analysis Division provides input on sampling volume and count times necessary to meet DQOs.

3.1.1.2. Data Quality Assessment

The Assessment Division conducts the data integration review of all data collected during a response. This review compares the data against the COP of the release to determine if the current model of the release most accurately represents the data. Prior to this review, the Monitoring and Sampling Division is responsible for performing the data quality review to ensure that the units are representative of the instrument used, the location of the measurement is correct, and that the instrument specifics (probe area, efficiency, etc.) are available to allow the data to be analyzed.

3.1.2. Laboratory Analysis Division

3.1.2.1. Data Quality Objective Development

The Assessment Division calculates Derived Response Levels (DRL) and Intervention Levels (IL) appropriate for the samples to be collected. These quantities are then used to determine the Analytical Action Levels (AAL) and Critical Levels (L_C) for each 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 L_C that have been determined for each sample type. For samples requiring large sample sizes and/or very long analysis times to reach desired AALs/L_C, 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 and achieve a reasonable and acceptable compromise on the AALs and L_C.

3.1.2.2. Data Quality Assessment

The laboratory sample results are reviewed for quality by the Quality Assurance / Quality Control (QA/QC) Specialists within the Laboratory Analysis Division. This review is performed as part of the data receipt process and occurs prior to any results being entered into CBRNResponder or other designated data repository. This review precedes the Assessment Division integration review of all data collected during a response.

3.1.3. Health and Safety Division

The Assessment Division calculates instrument-specific turn-back limits (integrated dose, dose rate, and/or contamination based) to establish worker protection guidelines, in coordination with the Health and Safety Division.

3.1.4. Consequence Management Home Team

The CMRT Assessment Division Manager and their subordinate personnel coordinate planning and assessment with their counterparts within the CMHT through the respective team leads. Specifically, the CMHT supports the following activities:

3.1.4.1. Planning

The CMHT can be staffed with the same resources as the CMRT Assessment Division. The CMRT Assessment Division Manager will work with the CMHT Assessment Division Manager on division of labor for mission planning for field teams and AMS including development of DQOs, AAL calculations, and execution planning.

3.1.4.2. Dose Assessment

The CMHT can work to answer RFIs and review or calculate DRLs, ILs, and projected doses, particularly calculations that require more focus and attention to detail.

3.1.4.3. Data Quality Assessment

The CMHT can be tasked with conducting data quality review and data integration review for data collected by field teams or the Laboratory Analysis Division and accepting that data into CBRNResponder or other data repository.

3.1.4.4. Data Products

Product Scientists within the CMRT and CMHT will work together to provide data products that meet the needs of decision makers as well as deployed teams. Data products consist of decision support products, situational awareness products, reports, memos, and other map products.

3.1.5. National Atmospheric Release and Advisory Center (NARAC)

NARAC provides atmospheric modeling that will predict the downwind location of released material. These predictions are initially based on source term assumptions and observed or predicted weather information. As monitoring data becomes available, it will be incorporated into the model to provide an improved estimate of contamination levels and location. The NARAC modeling system can calculate dose, dose rate, air concentration and ground deposition levels. NARAC model results are frequently contoured at DRLs provided by the Assessment

Division to assist in answering CM questions and concerns. Refer to https://naracweb.llnl.gov for more information.

3.1.6. Federal Agencies Within the FRMAC

Qualified federal agency personnel may be used as part of the FRMAC and be integrated into various positions such as Assessment Scientists. These personnel will work alongside CMRT personnel as part of the FRMAC in supporting incident response.

3.2. Interactions with Public Health and Safety (PHS) Teams

NNSA Office of Nuclear Incident Response provides several teams within Public Health and Safety (PHS) including the Radiological Assistance Program (RAP), AMS, and National Search Team (NST) described in detail elsewhere that provide support during nuclear/radiological emergencies (Ref. DOE07).

Early in an incident the RAP may be the first NNSA asset on site. The Assessment Division will work with the RAP Federal Team Leader (FTL), RAP Team Captain and CMHT to identify data collected before arrival of the CMRT. This may be as simple as merging the CBRNResponder event used by RAP with the event used for the FRMAC response. Once the CMRT has been established some RAP team members may serve in the Assessment Division if qualified as Assessment Scientists upon request by the TTL to the RAP FTL.

3.3. Interactions with other DOE Response Assets

Depending on the type of incident other NNSA assets will be involved. While all deployed NNSA assets have health physics support, their primary role is to provide radiation protection support to the deployed team and not support public health and safety.

3.3.1. Nuclear Incident Team

The Nuclear Incident Team (NIT) acts as the DOE/NNSA Headquarters coordination focal point during an incident involving deployment of emergency response assets. While members of the CMRT Assessment Division may not directly interact with the NIT, it is important to understand that the NIT provides interagency coordination and situational awareness for DOE/NNSA leadership, and members of the CMHT Assessment Division may be tasked with providing technical information during routine situation updates with the NIT. RFIs for CM may be generated from these interactions and should be prioritized among RFIs received externally through FRMAC.

3.3.2. Accident Response Group/Joint Technical Operations Team

The mission of the Accident Response Group (ARG) is to support render safe and disposition of US Stockpile weapons. The mission of the Joint Technical Operations Team (JTOT) is to support render safe and disposition of nuclear devices. During an ARG/JTOT response, health physics personnel will be engaged in monitoring activities in direct support of the ARG/JTOT team. It may be some time before any data collected by these personnel will be available to the CMRT Assessment Division. Some of this data may be classified but unclassified data could be made available electronically and, in some cases, may be made available through CBRNResponder or other application program interface (API). Prior to any monitoring data

being released by the ARG/JTOT, the team FTL will have to approve the classification of the data.

The JTOT Home Team performs assessments of potential consequences to response teams and the public during render safe activities, in coordination with NARAC. Note that these operations are usually conducted with a high level of operational security. Briefing products generated by the JTOT Effects Analyst could be useful for CM situational awareness. In addition, the JTOT Effects Analyst can provide information regarding source terms, locations, explosive information, and other prompt effects.

3.4. Interactions with Stakeholders

3.4.1. Primary Jurisdictional Authorities (County/Parish/District/State/Tribal Nation/Territory)

The CMRT and its subordinate Assessment Division will coordinate with the various jurisdictional agencies through both UC and the FRMAC Liaisons and incorporate environmental justice factors into the response. These agencies make up the primary customers of the information, recommendations, and data produced by the Assessment Division.

3.4.2. State Agencies

The Assessment Division will work with various state agencies including Departments of Health/Agriculture/ Environment, etc. or their equivalents and incorporate environmental justice factors into the response. As decision making agencies within the state, they may provide guidance and direction on selection of parameters used dose assessments.

3.4.3. Federal Agencies

Coordination and communication with various federal primary and support agencies such as the NRC, EPA, FDA, etc. is done through Liaison Officers and incorporate environmental justice factors into the response. This interaction may involve input on source terms, assessment method application, parameter selection, etc.

3.5. Interactions with Other Organizations

3.5.1. Advisory Team for Environment, Food, and Health (Advisory Team)

The Advisory Team may provide support to the incident and interface with the Assessment Division. The Advisory Team provides direct support to the Federal Coordinating Agency which provides the leadership, expertise, and authorities to implement critical and specific aspects of the response. The Assessment Division will share technical information with the Advisory Team and provide products to them as requested.

The Advisory Team develops coordinated advice and recommendations on environmental, food, health, and animal health matters for the Coordinating Agency and SLTT governments. The team includes representatives from the EPA, USDA, FDA, CDC, and other federal agencies, as warranted by the incident. The Advisory Team uses information provided by relevant sources to develop guidance on issues related to:

1. Environmental assessments (field monitoring) required for developing recommendations,
2. PAGs and their applications,
3. PARs using data and assessment from the FRMAC,
4. Protective actions to prevent or minimize contamination of milk, food, and water and to prevent or minimize exposure through ingestion,
5. Recommendations for minimizing losses of agricultural resources from radiation effects,
6. Availability of food, animal feed, and water supply inspection programs to ensure wholesomeness,
7. Recommendations for recovery, return, and cleanup issues,
8. Relocation, reentry, and other radiation protection measures prior to recovery.
9. Disposal of contaminated livestock,
10. Resources available for analytical analysis of food and livestock products,
11. Health and safety advice/information for the public and for workers,
12. Estimate effects of radioactive releases on human health and environment,
13. Other matters as requested by IC or the Coordinating Agency.

The Advisory Team operates in both a remote and onsite mode. The remote team can stand up within two hours or less to begin providing support and recommendations while the onsite team is in transit to the JFO. The arrival time of the onsite team is estimated to be 24-48 hours, but this is highly dependent on infrastructure and other logistical issues resulting from the emergency situation. When the onsite team is fully deployed and situated, an onsite team leader will be designated and the onsite team will continue to coordinate with the remote team, which will be led by the Advisory Team Chair or designee.

If deployed, the Advisory Team is expected to integrate the Senior Response Official and the FRMAC Director to provide technical expertise to the IC/UC and the Coordinating Agency. On a technical level, the Advisory Team works closely with the FRMAC Assessment Division to implement appropriate advice and guidance. The Advisory Team may also provide liaisons to coordinate with the JFO and SLTT government Emergency Operations Centers (EOCs) as needed. Therefore, the Advisory Team may be in several locations at any one time, including being co-located with the FRMAC. It has no independent authority and will not release information or make recommendations to the public unless authorized to do so by the Coordinating Agency.

3.5.2. Argonne National Laboratory

Personnel from Argonne National Laboratory (ANL) are available to provide supplemental expertise to the standard FRMAC assessments using the Residual Radioactivity (RESRAD) family of codes which perform calculations based on the Operational Guidelines Task Group (OGT) methodology. ANL personnel will be activated as needed to perform the calculations that are only available through RESRAD. ANL personnel are activated by contacting the DOE Watch Office, who will contact the ANL EOC to request OGT support.

3.5.3. Pacific Northwest National Laboratory

Pacific Northwest National Laboratory (PNNL) maintains the Office of Nuclear Incident Response Azure environment referred to as the Secure Hosting Infrastructure for the Radiological Emergency Response Enterprise (SHIRE) which hosts various CM tools and

software. PNNL also uses the Visual Sample Plan (VSP) software for supporting long term environmental survey planning or determining priorities for sampling efforts. VSP subject matter experts are available as a resource for CMHT.

3.5.4. Savannah River National Laboratory

Savannah River National Laboratory (SRNL) uses the ALGE model for modeling releases into a watershed. ALGE and watershed subject matter experts are available as a resource for the FRMAC as necessary.

4. CONCEPT OF OPERATIONS

4.1. Deployment

The Assessment Division deploys as part of the CMRT and as part of the CMHT. Details of the notification, activation, mobilization, and deployment process are described in the CMRT Operations manual once completed. Assessment Division members who are part of the CMHT would report to their respective site location.

Assessment Division personnel reporting for CMRT should deploy with enough personal gear for several days to several weeks depending on the nature of the incident/accident. Additionally, personnel will have their own laptop with all required software loaded. Assessment Division personnel reporting for CMHT will need to bring their own laptop to their respective site location if required.

CM responses typically involve the activation of the CMHT followed by deployment of CMRT, depending on the scale of the response. Regardless of the scale of the response, some or all of the activities described in this section must be accomplished.

4.2. ICS Integration

The CMRT provides resources to a radiological/nuclear incident. There are many ways that the CMRT and its resources can be integrated into the ICS. The CMRT can remain as a single entity or with other primary and supporting agencies form a FRMAC, as described in the FRMAC Operations Manual (Ref. FRMAC10). Secondly, the CMRT resources can be distributed among the various ICS Sections with the Assessment Division being placed in the Planning Section of one of the MACS entities such as the JFO or other location as dictated by local plans.

4.2.1. Check-in

The Assessment Division Manager will ensure that Assessment Division personnel are properly checked-in and will maintain accountability of Assessment Division personnel for the duration of the incident. Check-in procedures will vary by locality and the maturity of the response. However, the Assessment Division Manager must ensure that their personnel are properly credentialed and signed in using an ICS Form 211, *Incident Check-In,* or equivalent.

4.2.1.1. Incident Briefing

The Assessment Division Manager will ensure that Assessment Division personnel are briefed on the incident including incident/accident history, incident objectives and priorities, current and planned actions, resources assigned, facilities established, incident organization, safety and security and RFI and tasks. Relevant information should also be passed to the CMHT Assessment Division for their situational awareness. The current ICS Form 201, *Incident Briefing* or current *Incident Action Plan* is the definitive resource for this briefing.

4.2.1.2. Integration

As was noted previously, there is no standard way that FRMAC is integrated and organized into the ICS or MACS given the modular nature of the ICS and MACS. It is incumbent upon the Assessment Division leadership to understand how FRMAC Divisions and leadership names and

structure may change when integrated into the response. An updated ICS Form 203 *Organizational Assignment List* and ICS Form 207, *Incident Organization Chart* will show how the response is organized and where and how the FRMAC is integrated. The Assessment Division leadership must understand where other elements of the FRMAC are located and how they are organized in the response. One of the core features of NIMS is common terminology to define resources, facilities, and position titles. Table 1 shows the ICS supervisory position titles for various ICS organizational levels. The deployed Assessment Division may be organized as a unit, task force, or team.

Table 1. ICS Supervisory Position Titles

Organizational Level	Title	Support Position
Branch	Director	Deputy
Division/Group	Supervisor	NA
Unit	Leader	Manager
Strike Team/Task Force	Leader	Single Resource Boss
Team	Boss, Leader	NA

4.2.1.3. Establish the Assessment Division

The CMRT Assessment Division Manager works with the TTL to identify space for the Assessment Division within an area identified by the Support Division. The Assessment Division Manager identifies needed resources such as tables, chairs, extension cords, WiFi, etc. to the Support Division. Appendix C provides a list of items for the Assessment Division Manager to consider when establishing and operating the Division.

4.3. Operations

4.3.1. Request for Information Process

The Assessment Division operations are primarily driven by an RFI process:

- **Identify the problem or request:** What question needs to be answered or evaluated?
- **Collect Data:** Gather measurements and other information to help understand and resolve the question
- **Analyze Data:** Analyze the data and refine the models describing the radiological release to answer the question
- **Interpret Data:** Assign meaning to analyzed data, and
- **Communicate:** Communicate the answer to decision makers or the requester in the form of a data product

Typically, this process begins with an RFI from stakeholders or interagency partners. However, particularly early in a response, the FRMAC may generate internal RFIs to address the two default RFI tasks – characterize the release and support protective action decisions. The Assessment Division Manager coordinates with the other FRMAC leadership to propose areas where additional data is required, where samples need to be collected, or other information is required. As data becomes available, Assessment Scientists and Product Scientists work to review the data, update the COP, revise any models or calculations required to answer the question, and resolve the questions that were asked. Depending on the RFI, either the Assessment Scientist will create the FRMAC Report (Appendix F) describing the data used and calculation(s) performed to answer the question and/or the Product Scientist will work with the GIS Specialist to develop a map product for communicating the information to the stakeholder.

4.3.1.1. RFI Generation

FRMAC RFIs are received from stakeholders and interagency partners to CMRT/CMHT via various means, including Incident Objectives, an online RFI portal, FRMAC Liaison Officers, CMHT email, and CMHT bridge line. All RFIs are ultimately entered into the Consequence Management Operational System (COSMOS) for management. RFIs are also internally generated by CMRT/CMHT within COSMOS. These internal RFIs capture CM self-taskings as well as tasks from the execution plan for meeting IC/UC Objectives.

4.3.1.2. RFI Resolution

As RFIs are received, the TTL, THTL, and Assessment Division Managers review the requested information, translate the request into actions FRMAC must take to address the RFI, assign the RFI to a workflow of FRMAC positions to perform the technical work to address the RFI, and prioritize the RFI among other open RFIs. Typical FRMAC workflows are described in more detail in Appendix G. During development of the workflow, it is helpful if the TTL, THTL, or Assessment Division Managers identify what action(s) is/are expected at each workflow step.

Responders address each RFI in priority order and capture relevant data in the RFI details. Once the workflow is complete, the RFI is reviewed by the TTL, THTL, or Assessment Division Managers, as well as the FRMAC Director or FHTL (unless generated for internal CM use only). Once approved, the RFI is considered complete and the final report or product is delivered to the requester, typically via CMweb.

4.3.1.3. Default RFIs for FRMAC

The FRMAC must maintain a proactive support posture during a radiological response, particularly in the early phases of an incident when direction from IC may be delayed. Unless otherwise instructed, the fundamental purpose of the FRMAC is to develop and maintain the COP of the radiological release and to support decision maker's protective action decisions in order to ensure the safety of the public. To proactively address this mission, the FRMAC assumes that two default RFIs need to be addressed each operational period: characterize the release, and revise the public protection supporting products. Unless instructed otherwise by IC, the Assessment Division Manager reviews these default RFIs, revises them for the current situation, and implements them for resolution during the operational period. The default RFI process is intended primarily for the early phases of a response to allow the FRMAC to begin

planning and operations in anticipation of requests from IC as well as SLTT organizations. It is very likely that the tasking from IC will eventually include these fundamental tasks.

a. Default RFI – Characterize Release

One of the primary missions of the FRMAC is to develop, maintain, and refine the COP of the radiological release. Each operational period, the Assessment Division Manager should coordinate with the NARAC Scientists, Assessment Scientists, and Product Scientists to determine where additional data would best improve the current models and COP. The Assessment Division Manager should then coordinate with the Monitoring Division Manager to prioritize what data might be collected during the next operational period. When the data is collected, the Assessment Division will perform the data integration review, which can lead to refining the COP based on the new data. This default RFI should typically result in the generation and/or revision of any situational awareness products maintained by the FRMAC. Examples of these situational awareness products may include monitoring status maps, worker protection maps, and related products designed to help maintain situational awareness of the radiological environment.

Part of characterizing the release is determination of the radionuclide mixture released and deposited. Early in a response the mixture may be assumed from default scenarios, as described in FRMAC Assessment Manual, Volume 3 (Ref. FRMAC23A). As the response matures, data such as estimated or modeled inventory released may be available. A determination of radionuclides deposited will require in-situ gamma spectroscopy and soil sample analysis. Deposited mixtures will vary both geographically and temporally and must routinely be updated. The effort to characterize the radionuclide mixture must be prioritized in the execution plan.

As the response matures, effort must be made to validate calculation input assumptions such as resuspension factors, particle size distributions, and weathering corrections.

b. Default RFI – Public Protection

The other primary mission of the FRMAC is to support SLTT decision maker's decisions regarding protective action decisions. In order to maintain a proactive posture, the second default RFI for the FRMAC is to develop and revise protective action decision products based on the current COP of the release and default EPA protective action guidance. The goal of this RFI is to ensure the FRMAC is proactive in supporting decision makers, by developing support products until formal instruction is received. It is highly likely that IC and the SLTT decision makers will specifically request this once support is available – superseding this default RFI. Note: whenever there is a significant change to the COP the current decision support products should be revised to reflect the updated COP. This can be done by entering a new RFI to update the decision support products.

4.3.2. Interaction with NARAC

NARAC is a key partner/component of the Assessment Division, providing the primary modeling capability for radiological emergencies involving the dispersal of radioactive materials. In the initial phases of the response, the Assessment Division, in collaboration with NARAC Scientists, work to collect information about the release – radionuclide source term, release mechanism, release location, weather, etc. This information is used by NARAC Scientists to

develop the initial COP model of the incident. From this initial COP model, the Assessment Division begins to coordinate with the other FRMAC Divisions to collect data and observations to confirm the COP model. Product Scientists work with the COP model to develop the initial protective action decisions support products. As data becomes available, the Assessment Division performs a data integration review, comparing the data collected and the current COP model. The Assessment Division works with NARAC to revise the COP model based on the data. This process repeats as more data is collected until the COP is developed enough to be representative of the data collected. NARAC and Assessment Division personnel also work together to generate situational awareness and protective action decision-making products, as requested by SLTT stakeholders or UC, or to address questions raised through the RFI process.

4.3.3. Data Quality Objective Development

"Data quality" refers to the accuracy, integrity, applicability, and completeness of the products generated by the assessment process. The data quality of an assessment depends on the quality of the inputs to the assessment, the quality of any assumptions made, and the quality of the calculations performed. Requirements for particular assessment products will drive data collection priorities. The type and quality of data must be appropriate for the intended use. Therefore, the data quality needs for each product must be clear. This is addressed using the DQO process (Ref. EPA06).

During the early and intermediate phases of an incident, a formal DQO process cannot be employed. However, the Assessment Division will attempt to apply the principles of the DQO process wherever practical. The DQO process will become more formal and documented as the incident matures. The DQO process is the basis for the Assessment Division's contribution to the execution plan that specifies which measurements or samples are to be collected and how they are to be collected. It also specifies the required sensitivity and analyses.

DQOs are the qualitative and quantitative statements derived from the outputs of the DQO process that:

- Clarify the study objective,
- Define the most appropriate type of data to collect,
- Determine the most appropriate conditions for collecting data, and
- Specify tolerable limits on decision errors, which will be used as a basis for establishing the quantity and quality of data needed to support FRMAC decisions.

DQOs are used to develop a scientific and resource-effective execution plan and establish performance or acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of a study (Ref. EPA06). The DQO process consists of seven steps. Although the DQO process is depicted as a linear sequence of steps below, in practice it is iterative; the outputs from one step may lead to reconsideration of prior steps. During the first six steps of the DQO process, the Assessment Division will work with the Monitoring and Sampling Division and/or Laboratory Analysis Division to develop the decision performance criteria that will be used to develop the data-collection design. The final step of the process involves developing the data-collection design based on the DQOs. The first six steps should be completed before the Monitoring and Sampling Division attempts to develop

the daily field team instructions because this final step is dependent on a clear understanding of the first six steps taken as a whole.

Each of the seven steps is described briefly below:

Step 1: State the Problem. Concisely describe the problem to be studied. Review similar prior responses and existing information to gain a sufficient understanding to define the problem. Example elements of problem description: study objectives/regulatory context, persons or agencies/organizations involved in the study, persons or agencies/organizations who have an interest in the study, political issues surrounding the emergency, sources and amount of funding, and previous survey results. This step is performed by Assessment Division Manager at the start of the RFI resolution process and could require discussion with the stakeholder who generated the RFI.

Step 2: Identify the Goal of the Study. Identify what question(s) the radiological monitoring and sampling will attempt to resolve, and what actions may result. Example question: Does the mean contaminant concentration exceed EPA Relocation PAG? This step is also performed by Assessment Division Manager at the start of the RFI resolution process and could require discussion with the stakeholder who generated the RFI.

Step 3: Identify Information Inputs. Identify the information that needs to be obtained and the measurements that need to be taken to answer the question(s). This step is performed by Assessment Division Manager or the Assessment Scientist.

Step 4: Define the Boundaries of the Study. Define spatial and temporal components of the population that will be covered by the problem statement. Essentially, determine when and where data should be collected. This step is performed by Assessment Division Manager in collaboration with the Monitoring Division Manager and/or Laboratory Analysis Division Manager and should consider practical limitations related to available resources and real-world obstacles.

Step 5: Develop the Analytic Approach. Define the statistical parameter of interest, specify the action level, and develop the logic for drawing conclusions from findings. This step is performed by the Assessment Scientist and should include a detailed consideration of the assumptions used in the derivation of the action level and documentation of any deviations from the defaults identified in FRMAC Assessment Manual, Volume 2 (Ref. FRMAC23).

Step 6: Specify Performance or Acceptance Criteria. Define data acceptance criteria based on consideration of the consequences of making an incorrect decision. This step is performed by Assessment Division Manager in collaboration with the Monitoring Division Manager and/or Laboratory Analysis Division Manager and could require discussion with the stakeholder who generated the RFI.

Step 7: Develop the Plan for Obtaining Data. Evaluate information from the previous steps and generate alternative data-collection designs. Choose the most resource-effective design that meets all DQOs. This step is performed by Assessment Division Manager in

collaboration with the Monitoring Division Manager and/or Laboratory Analysis Division Manager.

The DQO process is a flexible planning tool that can be used more or less intensively as the situation requires. For situations that require multiple decisions, such as emergency monitoring and assessment, where the resolution of one decision leads to the evaluation of subsequent decisions, the DQO process can be used repeatedly through all the response phases. Often, the decisions that are made early in the response will be preliminary in nature. They might require only a limited planning and evaluation effort. As the emergency phase nears conclusion and the possibility of making a decision error becomes more critical, the DQO process would be applied more intensively.

A data-collection design specifies the final configuration of the environmental monitoring or measurement effort required to satisfy the DQOs. It designates the types and quantities of samples or monitoring information to be collected; it specifies where, when, and under what conditions the data should be collected; it identifies what variables are to be measured; and outlines the FRMAC monitoring and assessment procedures to ensure that sampling design and measurement errors are controlled sufficiently to meet acceptable decision error rates specified in the DQOs.

4.3.4. Data Quality Assessment

The FRMAC utilizes a two-tier review process in examining the data collected during a response. The first-tier review is the traditional QA/QC review of the data collection process and data entry into an incident database. For the data that passes the QA/QC review, the next step (second-tier) is to review the data against all other data collected and evaluate it against the COP. This review is intended to examine the assumptions and models in the COP to ensure it best represents the ground truth of the release. It also serves to help identify potential outlier data that could indicate either true outliers or very localized phenomena that are not represented on the scale of the overall models being developed for the release. This tier of review is essential in determining if the data collected is sufficient to justify updating or evolving the model(s) used for the COP, as well as for the development and evolution of FRMAC's situational awareness of the post-release environment.

4.3.4.1. Data Quality Review

The first tier of the data quality assessment process is the traditional QA/QC data review. This review is performed by the Division responsible for collecting the data. Performing the QA/QC data review step within the collecting Division allows for the Division manager (or designee) to directly contact the collecting team to resolve any non-conformances (missing data, incorrect units, incorrect date/time, etc.) and "repair" the data to allow it to be used as part of the COP. This data review step should be handled via the procedures of the generating Division such as the Monitoring and Sampling Division, or other sample/measurement collecting resource as part of the generation process:

- FRMAC Field Survey Data: FRMAC Monitoring and Sampling Manual Vol. 1, Appendix 1: QA/QC Check (Ref. FRMAC19)
- SLTT Field Survey Data: Reviewed according to SLTT published procedures (varied)

- Laboratory Sample Results: FRMAC Laboratory Analysis Manual Volume 1 (Ref. FRMAC13)
- DOE AMS Aerial Measurements: AMS Operations Manual (Ref. RSL14)
- DOE Mobile/Backpack Data

a. Field Survey Data Review

For field surveys, the data quality review is typically performed by the Field Team Leader following procedures in the FRMAC Monitoring and Sampling Manual (Ref. FRMAC19). During this data review, the data reviewer (Field Team Leader or designee) may attempt to correct any discrepancies, such as missing metadata items, potentially incorrect units, transposed latitude/longitude, etc., by contacting the field team to discuss the discrepancy. If it can be resolved, the data record should be amended with a comment added describing what was changed and why. If the discrepancy cannot be corrected, the data should be rejected, with comment as to why the data was rejected. If there are no discrepancies in the data, it should be approved. The results of this data review (or QA/QC review) should be documented in the database as the Monitoring Review. If Assessment Division personnel are tasked with supporting the Monitoring Review, those personnel should be provided with appropriate permissions to conduct the review.

b. Laboratory Sample Results Data Review

For laboratory sample results, the data quality review is typically performed by the QA/QC Specialist following procedures in the FRMAC Laboratory Analysis Manual (Ref. FRMAC13). This review ensures that the laboratory results provided to the FRMAC meet the analytical QA/QC requirements provided to the laboratory (Minimal Detectable Activity (MDA), L_C, correct units, etc.). This review also checks the data to be uploaded to the database (the electronic data deliverable (EDD)) matches the data reported by the laboratory. This review is performed using spot checks of the data and calculations, review of the QA/QC documents and results provided in the data package, review the laboratory quality flags, and review the Analysis Request Form (ARF) QC requirements. The QA/QC specialist will flag any discrepancies as non-conformances and attempt to resolve them with the laboratory. Data that passes the QA/QC review is then marked as accepted. Likewise, data that does not pass QA/QC is marked as rejected. Uploading the laboratory data to the incident is currently considered to be an indication that it has completed the data quality review.

c. Aerial Measurement Surveys

For aerial measurement surveys, the raw data is reviewed by the AMS Scientist for quality and completeness. The AMS Scientist will then process the data to the format specified by the RFI, typically either a dose rate map or an isotope map, following the procedures in the AMS Manual (Ref. RSL14). The AMS Scientist will work with the Product Scientist to prepare the AMS data for incorporation into data or map products. Both raw and processed AMS data is typically stored in the Data Analysis Repository (DAR).

d. Mobile/Backpack Surveys

For backpack and mobile surveys, the raw data is reviewed by the AMS Scientist for quality and completeness. The AMS Scientist will then process the data to the format specified by the RFI, typically either a dose rate map or an isotope map, and prepare it for incorporation into a data

product. Both raw and processed survey data is typically stored in the Advanced Visualization of Data (AVID) File Repository. It can be accessed by Product Scientists for reprocessing and evaluation during the data integration review process. Availability permitting, AMS and NST Home Team Scientists may also be able to assist in processing and analyzing survey data and may be requested by the FRMAC to assist the Product Scientists during a response.

e. Fixed Monitoring Station Data

Fixed monitoring station data, when available, will be reviewed and analyzed by the Product Scientist as part of the data integration review. For systems that telemeter data in real time, the Product Scientist will typically be tasked to analyze the data and convert it to a usable form or will have access to software tools to help process the data (e.g., ECAMs). For stations that collect samples as well as provide measurements (EPA RadNet stations, for example), the Product Scientist may reach out to the Laboratory Analysis Division for assistance with the sample results accompanying a fixed monitoring station.

f. Dosimetry Data

Dosimetry data, particularly personal dosimetry data, will be reviewed by the Health and Safety Division Manager to remove any personally identifying information prior to releasing the data for review by Assessment Scientists as part of the Dose Assessment function. Environmental dosimetry data approved for assessment use will be reviewed by the Assessment Scientist to evaluate dosimetry models and calculations that were used. The approved dosimetry data will also be evaluated by the Assessment Division as part of the data integration review for inclusion in the COP.

g. Other Data types

Other data types will be reviewed by the Assessment Division to evaluate both the data quality and utility for understanding the radiation environment following a radiological incident. These will be handled on a case-by-case basis by the Assessment Division and documented in a FRMAC Report (Appendix F) summarizing how the data is handled.

4.3.4.2. Data Integration Review

Following the data quality review, the data is reviewed by the Product Scientist responsible for the data integration review. This review consists of ensuring that data taken in time series such as from AVID telemetering mobile or backpack data at a single location is consistent with the mixture decay rate, data taken in spatial series has no anomalous high or low values, alpha/beta/gamma ratios are consistent, evaluating whether action levels (DRLs, AALs, IL, etc.) are exceeded, etc.

The Product Scientist reviews the data collected from multiple sources against the COP to determine if the data supports the current models and assumptions in the COP, challenges the models and assumption in the current COP, or if sufficient data exists contradicting the current data under analysis to render it suspect. The data integration review is not simply a review of the new data, but is a review of the entirety of the integrated data and models providing the COP to evaluate how the new data might support or challenge assumptions in the current COP.

The data integration review serves as the primary mechanism for evolving the COP to ensure it provides the most realistic and defensible model of the release. Data is primarily evaluated

against the accumulation of all other data, model, and calculations to determine if it supports the current COP or challenges it. If the data is in good agreement with the current models and existing data, it is added to the data supporting the COP. If the data challenges the COP, the Product Scientist should flag the data and potential challenges to the current COP models and data and notify the Assessment Division Manager.

The Assessment Division Manager should initiate discussion with FRMAC leadership to decide if more data is needed to resolve this conflict. This could result in the generation of a new RFI tasking the FRMAC to collect more data and perform additional analyses. This will likely end with either more data collected to support modifying the assumptions and models in the COP, or enough additional data collected to be able to flag the initial data as potentially suspect. As the response progresses into the late phase, sufficient data may already be available to flag new data as potentially suspect. Data flagged as suspect may not be incorporated in the current COP but it will always be present in the database. As additional data is collected and the COP evolves, data previously identified as suspect may become supporting data for the revision of the COP, so the Product Scientist should be prepared to re-evaluate data during the data integration review process.

4.3.4.3. Data Product Management

The FRMAC is responsible for maintaining all records generated during the response until the records can be turned over to the Coordinating Agency. The primary tasks of the Assessment Division are the generation of calculations, products, or reports as deliverables for RFIs. All formal products shall be considered primary records and should be indexed and archived by the FRMAC. All supporting calculations, assumptions, and data/literature searches generated to support these products should also be archived along with the primary record.

The recommended minimum recordkeeping requirements for the Assessment Division information during the initial response phase include:

- All products, records and supporting documents/reports should be recorded or transcribed into an electronic repository appropriate for the data being archived. The repository should either be cloud-based or routinely backed up and protected. Note – currently both CMweb and COSMOS meet these requirements. Properly indexed and filed, the Office 365 environment maintained by DOE (the SHIRE) can also be used to meet this requirement for strictly DOE information as outside agencies cannot access it.
- In the incident, paper records are needed in absence of functioning electronic means. Daily paper records are deposited at the FRMAC for scanning into electronic repository. Additional electronic data archives may be created provided they offer the same level of data protection as the primary repository. These archives are expected to be used to store supporting documents, such as data search notes, hand calculations, and other hand-generated intermediate products, but not for final products. Any electronic data archives created should be indexed and easily searchable to support record retrieval.
- Any data received in an electronic format outside of the primary repository should be uploaded to the database. 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 transcribed to the electronic repository. 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 equivalent method, until it can be electronically archived.

4.3.4.4. Data Archiving for Transfer to EPA

In the late phase (recovery phase) of an incident, the EPA will assume the management role for the FRMAC. As part of this transition, the EPA will establish the final recordkeeping requirements and identify what records are subject to those requirements. Once established, those requirements will fully replace these recordkeeping requirements. All existing documents will be transferred to the transition team for evaluation and archiving. The FRMAC will maintain all records and databases under the existing recordkeeping guidelines (above) until the final requirements are established and implemented.

4.3.5. Dose Assessment

Dose assessment is a critical function performed in support of the Assessment Division objective to interpret radiological conditions in terms of the PAGs. Assessment Scientists are responsible for translating PAGs into measurable quantities such as DRLs and ILs, which are then used in a variety of ways depending on the step of the RFI process. For example, when measurements must be collected to support an RFI, DRLs and ILs are used to determine DQOs and corresponding detection limits. Once data is available, DRLs and ILs are used as thresholds for comparison. DRLs, ILs, and projected doses are also used in the creation of various data products.

Dose assessment calculations are an iterative process. As further information is requested from the Assessment Scientists and gathered by various stakeholders including the Advisory Team over the course of a response, data is collected and analyzed, and calculations are updated. In addition, it should be noted that some calculations may be time varying and/or spatially dependent.

The following sections describe the types of dose assessment calculations performed by Assessment Scientists over the course of the response.

4.3.5.1. Early Phase

At the start of a response, it is likely that little information or data will be available to use in dose assessment calculations. Initial calculations may rely on default assumptions defined in FRMAC Assessment Manual, Volume 2 (Ref. FRMAC23). FRMAC Assessment Manual, Volume 3 also provides assumptions that apply for pre-assessed scenarios that can be used until incident-specific information becomes available (Ref. FRMAC23A).

Dose assessment calculations require definition of a radiological source term. In the early phase, Assessment Scientists work with NARAC and SLTT authorities to determine an initial source term to use in Public Protection calculations. Public Protection calculations are used to evaluate the radiological impacts to members of the public from exposure to radioactive material. This

impact is typically communicated through a map product that supports initial protective action decisions concerning evacuation and shelter. Contours on data products correspond to Public Protection DRLs which relate a PAG to a measurable quantity such as a dose rate or ground concentration. DRLs are calculated by Assessment Scientists using Turbo FRMAC and provided to NARAC to contour atmospheric dispersion results. DRLs are also compared to field measurements to help determine where PAGs might be exceeded in the impacted area. Assessment Scientists can also calculate projected doses based on measurement data in specific areas.

4.3.5.2. Intermediate Phase

Once initial protective actions such as evacuation and shelter are addressed, dose assessment calculations are used to support intermediate phase protective actions such as relocation, food interdiction, and restrictions on drinking water. Relocation decisions are supported using Public Protection DRLs and projected dose calculations like in the early phase, but will incorporate more data as it is collected over the course of the response. Food and drinking water have separate PAGs, so they are addressed using separate dose assessment calculations. Although food interdiction and drinking water restrictions are described as intermediate phase protective actions in the EPA PAG Manual (Ref. EPA17), SLTT concerns may necessitate identification of potentially impacted agricultural areas and drinking water sources during the early phase.

For food ingestion considerations, Assessment Scientists calculate Ingestion DRLs which are used as environmental indicators of areas where foods being produced in that area might exceed the FDA guidance for allowed radioactive concentration in foods. This impact is also typically communicated through a map product. Potentially contaminated food products must ultimately be sampled and analyzed by the Laboratory Analysis Division to provide the sensitivity required for comparison to ILs. Once analysis results are available, Assessment Scientists compare them to the FDA (DIL) or FRMAC Intervention Level (FIL). DILs are listed in FRMAC Assessment Manual, Volume 2 (Ref. FRMAC23) and are also accessible in Turbo FRMAC. Turbo FRMAC is used to calculate FILs for radionuclides not included on the FDA DIL list.

The EPA provides separate PAGs for ingestion of contaminated drinking water (Ref. EPA17). Assessment Scientists calculate Water DRLs that are concentrations of radionuclides in drinking water which correspond to the EPA Water PAGs. These DRLs are calculated using Turbo FRMAC and are provided to the Laboratory Analysis Division for setting detection limits for water sample analysis. When sample analysis is complete and results are available, Assessment Scientists compare the results to the DRLs and use the results to calculate projected doses for comparison to the PAGs.

4.3.5.3. Worker Protection

The Assessment Division may be asked by the Health and Safety Division to perform Worker Protection calculations in support of FRMAC field operations. This task would be initiated through an internally generated RFI. Dose assessments in support of worker protection include projected doses, stay times, turn-back limits, and DRLs. These calculations are performed by Assessment Scientists and utilize the default assumptions documented in FRMAC Assessment Manual, Volume 2 (Ref. FRMAC23) but can be adjusted for specific exposure scenarios and work shift in consultation with Health and Safety personnel.

4.3.5.4. Technical Review

Depending on the RFI, the Assessment Scientist may be responsible for creating a FRMAC Report (Appendix 6.6) describing the data used and calculation(s) performed to answer the question. All calculations intended for release must be reviewed. A second Assessment Scientist will review the input assumptions and attempt to reproduce the calculation. Once the calculation is reviewed it is ready for incorporation into data products.

4.3.6. Revision of Common Operating Picture (COP)

4.3.6.1. Data Integration Review

Product Scientists work with the GIS Specialist(s) to spatially compare the collected data against the current deposition model to evaluate how well the current COP dispersion model matches the collected data and to identify areas where there are discrepancies that require further investigation and analysis. For a full-scale response, this process will typically include the integration and analysis of aerial surveys, mobile surveys, field team measurements, sample results, and potentially fixed monitoring location data. All collected data will be compared against the data available to determine if the data is consistent, or if there is data that requires further analysis. The integration review may require processing the data to convert like data sources to common units – for example, conversion of beta contamination measurements from counts per minute (cpm) to activity per unit area (Bq/m^2) – to support intercomparison. This analysis will also require using the COP model for the source term to compare the predicted alpha to beta, alpha to gamma, and beta to gamma ratios to the measured values. If the new data is in good agreement with the existing data, it will be integrated with the database and used to support the COP dispersion and source term models. This data will also be available for fine tuning the COP models. If data is found to challenge the current COP, it will be flagged for analysis and for additional data collection to investigate. If the new data is confirmed, the COP models will be revised based on the new data available, which will likely result in the development of new COP models to be tested against the integrated database.

4.3.6.2. Revision of the Source Term

Product Scientists work to curate a data set to support the evaluation of the current model for the source term. Depending on the scenario, there will likely be a team of scientists involved in the discussion of the source term, particularly if the magnitude of the source is also being evaluated. This team may also involve other Assessment Scientists, Product Scientists, Radiological Assessment System for Consequence Analysis (RASCAL) specialists (DOE or NRC), NARAC Scientists, and other specialties (explosives, fire, site historians, etc.). Upon revision of the source term, the Assessment Division Manager should initiate a new RFI to revise all map products that have been superseded or made obsolete by incidents that were developed using the previous version of the COP models. Typically, this will include the most recent versions of protective action and situational awareness map products.

4.3.6.3. Identification of Data Needed to Revise COP Models

Based on the data integration review, the Product Scientists should coordinate with the NARAC Scientists and others that supported the data integration review to identify locations where; (a) data challenges the COP model, (b) insufficient data has been collected to complete the COP review, and (c) areas where additional data would help refine the models underlying the COP. These areas, along with the type and density of data required, should be prioritized and the

resulting list made available to the Assessment Division Manager to support the planning activities for the next operational period.

Product Scientists work to curate a data set for NARAC Scientists to use in revising the dispersion model for the release. Product Scientists coordinate with NARAC to identify the most useful data for use in revising the dispersion models. Product Scientists curate the data set, converting to the requested units where necessary, and transmit the data to NARAC.

Whenever the COP dispersion or source term models are revised, the Assessment Division Manager should initiate a new RFI to revise all map products that have not been superseded or made obsolete by incidents that were developed using the previous version of the COP models. PAG and situational awareness maps that have been superseded or are no longer being requested by IC should only be revised upon request. Upon revision of the dispersion model, Product Scientists should notify the Assessment Division Manager to initiate a new RFI to revise all current PAG and situational awareness map products to use the new COP models.

4.3.6.4. Revision of Protective Action Guidance Map Products

Product Scientists coordinate with the GIS Specialist(s) to revise existing PAG map products to reflect changes in the COP. Following a revision of the dispersion models, the DRL calculations, or key assumptions underlying the COP, all PAG map products should be reviewed and revised as needed. A similar process is used to create new PAG map products starting with the appropriate templates. Upon revision of a product, the Product Scientist should notify the Assessment Division Manager that the product is ready for technical review. After passing technical review, the TTL, THTL, or Assessment Division Manager should begin the federal approval review process for release of the updated products.

4.3.6.5. Update Situational Awareness Products

Product Scientists coordinate with the GIS Specialist(s) to revise existing situational awareness products to reflect changes in the COP. Following a revision of the dispersion models, the DRL calculations, or key assumptions underlying the COP, all situational awareness products should be reviewed and revised as needed. All situational awareness products will also need to be evaluated for revision for the next operational period, as they often detail the current working conditions (worker protection maps) or the overall status of the response (monitoring status maps). Product Scientists should coordinate with the Health and Safety Division Manager and the Monitoring Division Manager before revision of worker protection maps for the upcoming shift to ensure the correct dose limits, PPE assumptions, and stay times are included. Revision could require additional calculations by an Assessment Scientist. Upon revision of a product, the Product Scientist should notify the Assessment Division Manager to initiate technical review. After passing technical review, the Assessment Division Manager should begin the final technical and federal approval review process for release of the updated products.

4.3.6.6. Develop New Map-Based Products

For an RFI that is best resolved by the creation of a new data product, the Product Scientist will coordinate the development of the new product. First, the Product Scientist should contact the person or agency requesting the product to ensure that the question to be answered and the information requested on the product are fully understood. The Product Scientist will identify

what new surveys, samples, or observations will be required to support developing the product. The Product Scientist will work with an Assessment Scientist to calculate any product-specific DRLs, and work with NARAC Scientists if any new model runs are required for the product. Then the Product Scientist will coordinate with the GIS Specialist to either build a completely new product or adapt an existing product template to best display the information requested. Upon revision of a product, the Product Scientist should notify the Assessment Division Manager to initiate technical review. After passing technical review, the Assessment Division Manager should begin the federal approval review process for release of the new product. Once approved for release, the Assessment Division Manager should contact the Liaison working with the requesting agency to explain the new product and support the Liaison briefing the requesting agency on the new product as needed.

4.3.7. Product Generation

Data products consist of decision support products, situational awareness products, reports, memos, and other map products. Product Scientists are responsible for coordinating the development of any decision support products, situational awareness products, or other map-based products for the FRMAC. A Product Scientist will be assigned as the lead coordinator for each map-based product to be generated. The Product Scientist will then coordinate with other elements of the FRMAC to gather the data, calculations, and models required to support the assigned product. These coordination interactions may include:

- NARAC – Requests for additional model runs (incorporating specific DRLs, extended range, increase resolution, etc.)
- Assessment Scientists – Request for new DRL or other calculations to support product
- Monitoring and Sampling – Request additional survey locations or status of surveys underway
- AMS Scientist – Request analysis of aerial data (conversion to dose rate, isotope extraction, etc.)
- GIS Specialist – Request for GIS data on locations of specified facilities from the available databases

State/County Personnel – Request for state/county specific information that was specified for the product, such as boundaries of declared evacuation areas, location of shelters, etc. This request should be passed through the Liaison to the stakeholder agency whenever possible.

The Product Scientist will then work with the GIS Specialist to design the requested product, select the data to incorporate into the product, and draft the language for the title and legends. Once complete, a second Product Scientist or the Assessment Division Manager will coordinate the technical review of the product. The initial Product Scientist assigned to the product will coordinate the revision and refinement of the product until it passes technical review and completes the final technical and federal approval review process for release.

For requested products that are not map products, the Assessment Division Manager will assign either an Assessment Scientist or Product Scientist to coordinate the development of the product and produce a FRMAC Report or Memo. These coordination interactions may include many of the same interactions described above for generating a map product. Once complete, a second

Assessment Scientist, Product Scientist, or the Assessment Division Manager will coordinate the technical review of the product. The initial Assessment Scientist or Product Scientist assigned to the RFI will coordinate the revision and refinement of the product until it passes technical review and completes the final technical and federal approval process for release.

4.3.7.1. Decision Support Products

Decision support products are designed to present model and measurement data to decision makers in a manner designed to support protective action decisions. These products are based on protective action decision thresholds. Typically, the EPA PAG values will be used, particularly early in a response, but the decision makers may have alternative values that they would like to use or evaluate for protective actions. Common examples of decision support products include:

- Shelter/Evacuation Products: Map product showing contours corresponding to the predicted areas exceeding the PAG values for evacuation or sheltering-in-place.
- Relocation/Exclusion Zone Products: Map product showing contours corresponding to the predicted areas exceeding the PAG values for relocation. This product can also be used to establish the long-term exclusion zone around a release location.
- Agriculture Embargo/Areas of Concern Products: Map product showing contours corresponding to predicted areas where growing crops or raising cattle for meat or dairy may result in food products with contamination levels exceeding the IL.

4.3.7.2. Situational Awareness Products

Situational awareness products are designed to present information to responders, response planners, and command about the COP for the current operational period or for planning future operations. Appendix 6d provides examples of various situational awareness products. Common examples of decision support products include:

- Worker Protection Maps: Map products showing predicted dose to workers for the current or future operational period. There are many versions of this product, including dose rate contours, stay time maps, integrated dose maps, turn-back limit maps, etc.
- Monitoring Status Maps: Map products showing where measurements and samples have been collected. This product is typically updated at the end of every shift to show the overall monitoring status. Versions of this product may focus on monitoring activities planned for the current shift or identifying areas to be covered in the upcoming shift.
- Deposition Maps: Map products showing the current COP deposition model intended for use internally for mission planning or to provide awareness to field personnel. This can also include smoke plots indicating potential impacted areas or direction, or projected releases based on the worst-case scenario for planning (e.g., modeling a predicted accident scenario for a NASA launch to determine where to pre-position ECAMs and monitoring teams).

4.3.7.3. FRMAC Reports

FRMAC Reports (Appendix 6.6) are formal responses to RFIs that are not answered well with map products, intended for stakeholders, headquarters personnel, or other decision makers. These reports will use either the FRMAC Report format (Appendix 6.6) or other format specified by the requesting agency. Examples of FRMAC Reports could include safety assessments for

critical facilities, review of measurements as compared to background, recommendations on sampling requirements, etc.

4.3.7.4. FRMAC Memos

FRMAC Memos (Appendix 6.6) are internal documents intended for sharing results within the FRMAC. Examples of FRMAC Memos include summaries of calculations for DRLs, ILs, turn-back limits; literature searches for transfer factors, resuspension factors, or other information; development of monitoring plans, etc.

4.4. Tools

4.4.1. Data Collection and Storage Tools

This section introduces the primary databases and data collection systems that may be used as part of a FRMAC response. Software tools listed here are those that the Assessment Division personnel will need to be aware of and/or interact with during a response, and it is not a complete list.

4.4.1.1. FRMAC Database

All FRMAC data will be collected in a central cloud-based database synchronized with a deployable field server at the FRMAC location. The FRMAC database will be synchronized with CBRNResponder. This will provide access to all data collected by both FRMAC and SLTT teams responding to the incident, provided the SLTT agencies are partnered with the FRMAC on the CBRNResponder incident. This synchronization will also provide SLTT partners with access to FRMAC collected data through CBRNResponder.

4.4.1.2. CBRNResponder

The CBRNResponder Network is the national standard for the collection and management of radiological data. CBRNResponder is a cloud-based database that can be accessed on smartphones, tablets, specially designed instruments and via the web, allowing it to be employed at all levels of government during a response to a radiological or nuclear emergency. The CBRNResponder links to the CBRNResponder database and user interface including CBRNResponder App.

All FRMAC personnel that will be viewing and managing data should register for a CBRNResponder account at https://www.cbrnresponder.net/. All data in CBRNResponder will be synchronized with the FRMAC database. Assessment Division personnel should access data using the FRMAC database, since this will provide access to all FRMAC data collected as well as the analysis tools developed to support data assessment activities. Assessment Division personnel should still maintain access to CBRN Responder so that they can assist SLTT personnel using CBRNResponder to access data and review products.

4.4.1.3. Advanced Visualization of Data (AVID) and the Data Analysis Repository (DAR)

AVID is primarily used for the collection, processing, and analysis of aerial measurement and vehicle (or backpack) surveys, serving as both the data collection and data processing tool for dense data sets. AVID includes tools to view and analyze geospatial data, perform calculations and analysis on the data, and generate limited map products and processed data sets.

The DAR serves as the primary repository for storing both raw data and processed data, along with the metadata detailing how the raw data was analyzed. Advanced users can use AVID to convert aerial or mobile survey data into dosimetry units, or to perform spectral extractions to estimate radionuclide activity deposited on the ground. They can also extract selected data sets for use by NARAC in revising dispersion model predictions or to support the development of map products.

Typically, the Product Scientist will work with the AMS Home Team Scientist to analyze or process aerial measurement data to generate data packages for NARAC and/or for incorporation into data or map products.

AVID training is currently optional for Assessment and Product Scientists. Trained scientists can download AVID through the Remote Sensing Lab Portal at https://rslportal.doerer.us/.

4.4.1.4. Digital Field Monitoring (DFM) Data Entry System

FRMAC monitoring teams use the Digital Field Monitoring (DFM) software to enter data to the FRMAC Database. The DFM software package also includes routing and dispatching tools, and field measurement simulation capabilities to support the field teams during deployments and exercises/trainings.

4.4.2. Geospatial Analysis Tools

GIS index data by geographic location. Geospatial analysis tools support the analysis of indexed data by geographic location. For a response, all outdoor radiological data is indexed by geographic location (indoor data, if collected, is more complicated). GIS tools allow for spatial analysis of the collected data to examine how radiological material is dispersed. GIS tools are also used to identify locations of critical infrastructure, populations that may be at risk, land used for agriculture, highways and roadways, etc.

4.4.2.1. ArcGIS

ArcGIS is a GIS analysis software package created by ESRI, inc. ArcGIS is a fully functional GIS analysis toolkit, and can be used to search infrastructure and land-use databases, process geospatially indexed data, and overlay geospatial data on maps. ArcGIS is the primary tool used by the Assessment Division to create map products.

GIS Specialists are typically required for most analyses or queries using ArcGIS unless the scientist is well trained with ArcGIS. Access to ArcGIS Online or Pro is license controlled. Contact the GIS Specialist Skillset Lead to request a license and access to ArcGIS Online.

4.4.2.2. Google Earth

Google Earth is a limited GIS software package available on the web or as a download (Google Earth Pro). Google Earth can be used for simple GIS database inquiries of the public domain (address look-up, state/county boundaries, etc.) and simple data visualization. It does not have the learning curve required for ArcGIS and can be easily used by Assessment Scientists and Product Scientists to examine data or perform simple GIS data searches. Google Earth can be downloaded at https://www.google.com/earth/versions/#earth-pro.

4.4.2.3. FRMAC GIS Portal

The FRMAC GIS Portal is a web-based dashboard that shows curated FRMAC map products for easy visualization of data. The portal provides access to the current set of situational awareness products, real-time status maps for monitoring and sampling, and a curated set of decision support products. The GIS portal also provides Product Scientists with a mechanism to review and edit map products under development and coordinate with the GIS specialists. The GIS Portal is accessible through the SHIRE.

4.4.3. Analytical/Modeling Tools

4.4.3.1. Turbo FRMAC

Turbo FRMAC is a software that performs complex calculations to quickly evaluate radiological hazards during an emergency by assessing impacts to the public, workers, and the food supply. Turbo FRMAC calculations are based on methods established by the FRMAC in Assessment Manual, Volume 2 (Ref. FRMAC23). Turbo FRMAC is pre-populated with default settings for many of the required calculation inputs, and settings can be customized for specific incidents or regulations. The Turbo FRMAC software also includes Radionuclide Viewer for easily retrieving various radiological data and dose coefficients available in the underlying Dose Coefficient File Package (DCFPAK) database, and Mixture Manager for management of radionuclide mixtures based on modeled source terms or collected data for use in Turbo FRMAC calculations.

Turbo FRMAC is used primarily by Assessment Scientists and can be downloaded after creation of an account at https://nirp.sandia.gov/.

4.4.3.2. Radiological Assessment System for Consequence Analysis (RASCAL)

RASCAL is an NRC software for rapid assessment of an incident or accident at an NRC-licensed facility. RASCAL evaluates atmospheric releases from nuclear power plants, spent fuel storage pools and casks, fuel cycle facilities, and radioactive material handling facilities. RASCAL-generated source terms are provided to the CMHT to generate source terms for use in NARAC atmospheric dispersion models and Turbo FRMAC.

RASCAL can be obtained after obtaining a Radiation Protection Computer Code Analysis and Maintenance Program (RAMP) account at https://ramp.nrc-gateway.gov/.

4.4.3.3. RESRAD

The RESRAD code suite is used to assess potential human and biota radiation exposures from environmental contamination. FRMAC may call upon RESRAD experts in specific situations to assist in performing assessments. Examples include the use of RESRAD-BUILD to assess human exposures in a contaminated building or use of RESRAD-BIOTA, RESRAD-ONSITE, or RESRAD OFFSITE to assess long-term impacts of contamination migration in the environment.

RESRAD can be obtained after obtaining a RAMP account at https://ramp.nrc-gateway.gov/.

4.4.3.4. Visual Sampling Plan (VSP)

VSP is a software tool that supports the development of a defensible execution plan based on statistical sampling theory and the statistical analysis of sample results to support confident

decision making. VSP couples site, building, and sample location visualization capabilities with optimal sampling design and statistical analysis strategies.

The Assessment Division uses VSP to assist in developing execution plans. As measurements become available, they can be loaded into VSP for visualization, statistical analyses, and guidance on additional sampling locations. Future sample locations can be selected using:

- the expert judgment of the user using map imagery and model contours to guide placement,
- adaptive placement algorithms to optimally fill un-sampled areas, or
- random placement algorithms.

Planned sample locations from VSP can be uploaded to CBRNResponder or exported to Global Positioning System (GPS) units to guide collection by field teams.

4.4.4. RFI Management

4.4.4.1. Consequence Management Operational System (COSMOS)

The Consequence Management Operational System (COSMOS) provides a standardized approach to prioritizing and tracking RFIs 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 progress and communicate updated prioritization immediately to all CMRT and CMHT personnel.

COSMOS is a web-based tool that is hosted on the SHIRE at https://cosmos.doerer.us/. An external RFI portal that does not require SHIRE access is available for partners to electronically submit RFIs to FRMAC which directly feeds the COSMOS application. Incident-specific links to this portal will be provided to external partners during a response. RFIs may also be received into COSMOS from the NIT via the Incident Response Information System (IRIS), which is integrated with COSMOS.

4.4.5. Communications Tools

The communication tools that will be used for a particular incident need to be identified early and those mechanisms established. Persistent bridge lines and video teleconferences have been found to be the best method of communication between multiple nodes.

4.4.5.1. CMweb

CMweb (https://cmweb.llnl.gov) is the distribution site for approved FRMAC Consequence Management Products to the Interagency. It is also the location for CMRT/CMHT working level information including the Incident/Exercise Log, asset and team working folders.

4.4.5.2. Microsoft Teams

Microsoft Teams has become a valuable communication tool within NA-84. This tool can be used for sharing files, establishing persistent virtual meetings using audio and video. While our partners can participate in the virtual meetings, they will not have access to the Teams file

sharing capability unless they have a SHIRE account. Therefore, the SHIRE is not a suitable platform for sharing with partner agencies.

4.4.6. Other

The CMHT can establish a WebEx meeting and a persistent bridge line to make communication between the field and the home team available. Other telecommunication systems such as the NNSA Emergency Communication Network (ECN) may be used. Additionally, telephone calls to individuals are effective when coordination between the field and the home team needs to occur.

5. OPERATIONAL SUPPORT

The Assessment Division Manager works with the Support Division Manager to identify appropriate facilities for the Assessment Division. Key requirements include robust communications capability which includes internet connections, cellular, WIFI, and telephone. Sufficient space should be provided for the Assessment Division and allow for space for meetings and group discussions.

APPENDIX A. DEFINITIONS

Accident	A deviation from the normal operations or activities associated with a hazard, which has the potential to result in an emergency.
Assessment	Evaluation and interpretation of information to develop a technical basis for making decisions; for example, an evaluation of radiometric data that may include dose estimates and recommendations for protective actions to minimize harmful effects from radiation.
Common Operating Picture	A single identical display of relevant information shared by more than one organization. A COP facilitates collaborative planning and combined execution and assists all echelons to achieve situational awareness.
Coordinating Agency	The federal agency that owns, authorizes, regulates, or is otherwise responsible for managing deployment of personnel and response to an emergency with the authority to take whatever action is necessary to stabilize the situation.
Curate	The process of creating, organizing and maintaining data sets so they can be accessed and used by people looking for information. It involves collecting, structuring, indexing and cataloging data for users in an organization, group or the general public. Data can be curated to support response decision-making and other purposes.
Deploy	The act of physically relocating assets, personnel, and equipment to the site of an emergency or incident.
Emergency Operations Center	The center from which emergency response personnel and teams receive field instructions and directions during emergency situations. Emergency Operations Centers are usually staffed and operated by state, tribal, and local government personnel.
Geographical Information System	A system for linking information to a particular geographical location. GISs are generally capable of producing maps that show the location of the information.
Incident Command System	A standardized on-scene emergency management construct specifically designed to provide for the adoption of an integrated organizational structure that reflects the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries. ICS is the combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure, designed to aid in the management of resources

	during incidents. It is used for all kinds of emergencies and is applicable to small as well as large and complex incidents. ICS is used by various jurisdictions and functional agencies, both public and private, to organize field-level incident management operations.
Joint Field Office	A temporary federal facility established locally to provide a central point for federal, state, tribal, or local executives with responsibility for incident oversight, direction, and/or assistance to effectively coordinate protection, prevention, preparedness, response, and recovery actions. The JFO will combine the traditional functions of the Joint Operations Center (JOC), the Federal Emergency Management Agency (FEMA) Disaster Field Office (DFO), and the Joint Information Center (JIC) within a single federal facility
Monitoring	Continuing collection of data to assess information, determine adequacy of radiation protection practices, and to identify potentially significant changes in conditions or radiation protection.
Protective Action Guide	The projected dose to an individual from an unplanned release of radioactive material at which a specific protective action to reduce or avoid that dose is recommended.
Sheltering	The use of a structure for radiation protection from an airborne plume and/or deposited radioactive materials. Effectiveness diminishes with time due to infiltration.

APPENDIX B. REFERENCES

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EPA06 *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, U.S. Environmental Protection Agency, Washington, DC, 2006.

EPA17 *PAG Manual: Protective Action Guides and Planning Guidance for Radiological Incidents*, EPA-400/R-17/001, U.S. Environmental Protection Agency, Washington DC, January 2017.

FEMA17 *National Incident Management System*, Federal Emergency Management Agency, October 2017.

FRMAC10 *FRMAC Operations Manual*, Federal Radiological Monitoring and Assessment Center, May 2010

FRMAC13 FRMAC Laboratory Analysis Manual, Federal Radiological Monitoring and Assessment Center, December 2013.

FRMAC19 *Monitoring and Sampling Manual, Vol. 1, Revision 3, Monitoring Division Operations*, Federal Radiological Monitoring and Assessment Center, April 2019.

FRMAC20A FRMAC Product Guide 2020, Explanation of FRMAC Products, FRMAC Product Scientists. 2020.

FRMAC23 *FRMAC Assessment Manual, Vol. 2, Overview and Methods*, Federal Radiological Monitoring and Assessment Center, May 2023.

FRMAC23A *FRMAC Assessment Manual, Vol. 3, Pre-Assessed Scenarios*, Federal Radiological Monitoring and Assessment Center, May 2023.

RSL07 *Implementation of the National Incident Management System (NIMS)/Incident Command System (ICS) in the Federal Radiological Monitoring and Assessment Center (FRMAC) – Emergency Phase*, DOE/NV/25946—179, Remote Sensing Laboratory, Nellis Operations, April 2007.

RSL14 *Aerial Measuring Systems, Operations Manual*, Remote Sensing Laboratory, March 2014.

APPENDIX C. ESTABLISHING AND OPERATING THE ASSESSMENT DIVISION

C.1. Operational Tasks

1) Identify a location for the deployed Assessment Division. Co-locate the Assessment Scientists, Product Scientists, and GIS Specialists in a collaborative work environment. Also consider proximity to assessors in other Federal and SLTT organizations and the Advisory Team.
2) Designate a Deputy if not already identified. The Deputy will work with Assessment Division personnel to keep work on RFIs on track and coordinate with the CMHT as needed when the Assessment Division Manager is occupied. Ensure an Assessment Manager is identified for the CMHT Assessment Division.
3) Share Assessment personnel roster across CMRT and CMHT.
4) Introduce Assessment personnel to Advisory Team and other Federal and SLTT assessors.
5) Establish or identify communications channels with other response elements (RAP, State, Liaisons, etc.)
6) Provide a daily situation briefing to the CMRT and CMHT Assessment Division to ensure everyone maintains situational awareness and understands the priority of effort for the day.
   a) Situation Update
   b) Relevant Incident Objectives
   c) Review of RFIs in progress
   d) Specific taskings and priorities for the day
7) Identify any resources needed for the Assessment Division including power, wifi networks, tables, chairs, printers, etc.
8) Prioritize (or assist TTL) RFIs
9) Establish a lead for each RFI assigned to CMRT and work with the CMHT Assessment Division Manager to identify leads for RFIs assigned to the CMHT Assessment Division.
10) Establish a procedure to initiate RFIs that are verbally provided to the Assessment Division.
11) Establish a tracking worksheet for internal tasks that do not rise to the level of an RFI.

Table 2. Assessment Task Tracking Worksheet

Task Number	What is Requested	When Requested	Who Requested (Name/Phone/Email	Assessment Lead	Completed
1					
2					

12) Ensure (with TTL) federal approval is obtained for appropriate RFIs
13) Establish the primary and backup mechanisms for internal Assessment Division information sharing (e.g., Teams channel or folder, CMweb folder, etc.).
14) Establish a standing bridge line, WebEx, or Teams Call for the Assessment Division.
15) Ensure report templates are available in a location accessible by Assessment Division personnel.

16) Work with NARAC to ensure designated Assessment Scientists and Product Scientists are added to relevant CMweb groups for NARAC run review and product sharing.
17) Work with the Monitoring Division Manager to ensure designated Assessment Scientists and Product Scientists are added to CBRNResponder monitoring and sampling Owning Organizations to allow them to conduct monitoring and assessment reviews of data if interacting with data within CBRNResponder. Assessment personnel will need permission to interact with data if doing so through the FRMAC database
18) Establish a recurring time to conduct CMRT and CMHT Assessment Division synchronization meetings.
19) If a night shift is operating, an updated daily situation briefing should be provided by the Assessment Division Manager to ensure the night shift best supports operations in the next operational period.
20) Maintain awareness of fitness of Assessment personnel

C.2. Technical Tasks

1) Assign a Product Scientist to examine existing data to determine an initial radionuclide mix.
2) Assign an Assessment Scientist to begin initial public protection calculations.
3) Ensure reoccurring RFIs are established for products where required.
4) Review calculations/products for completeness and applicability.

APPENDIX D. DATA PRODUCTS AND VISUALIZATION EXAMPLES

There are two general categories of data products generated by the Assessment Division: visualization products (also known as map products) and reports. Visualization/map products are designed to summarize data and communicate analyses visually, usually using a map to provide a geospatial frame of reference. Reports are a "catch-all" category for products that communicate assessment information that is not readily adaptable to a visual or map-based product.

Visualization products are typically created to address a particular question or communicate specific information. They can be categorized as either decision support products or situational awareness products.

Decision support products are designed to assist decision makers in making protective action decisions. Common examples of decision support products include evacuation/shelter products, relocation products, and agricultural embargo (or impact) products. Examples of each of these types of decision support products are shown below (Figures 3-8).

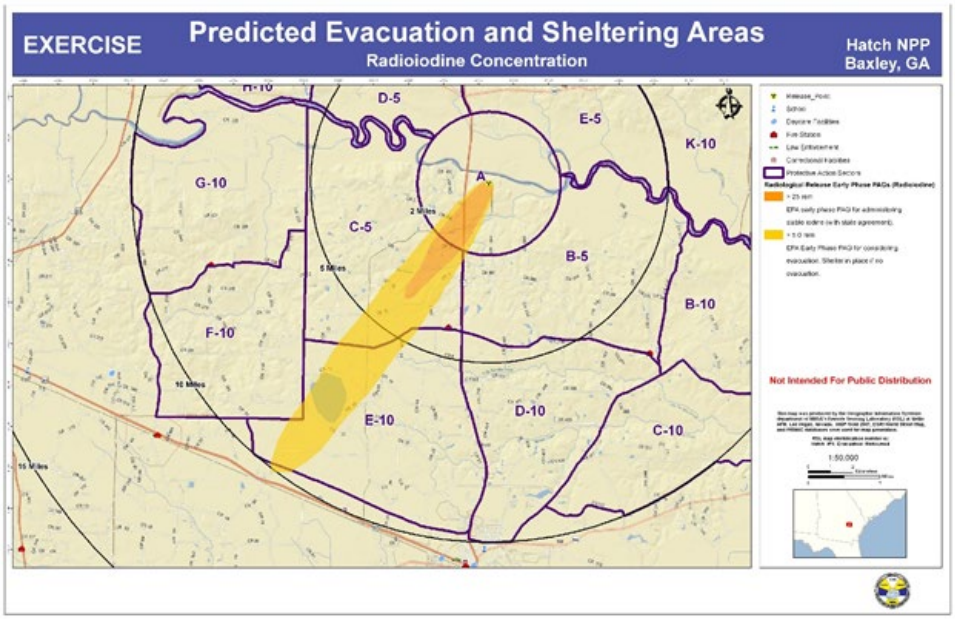


Figure 3. Predicted Evacuating and Sheltering Areas (Example)

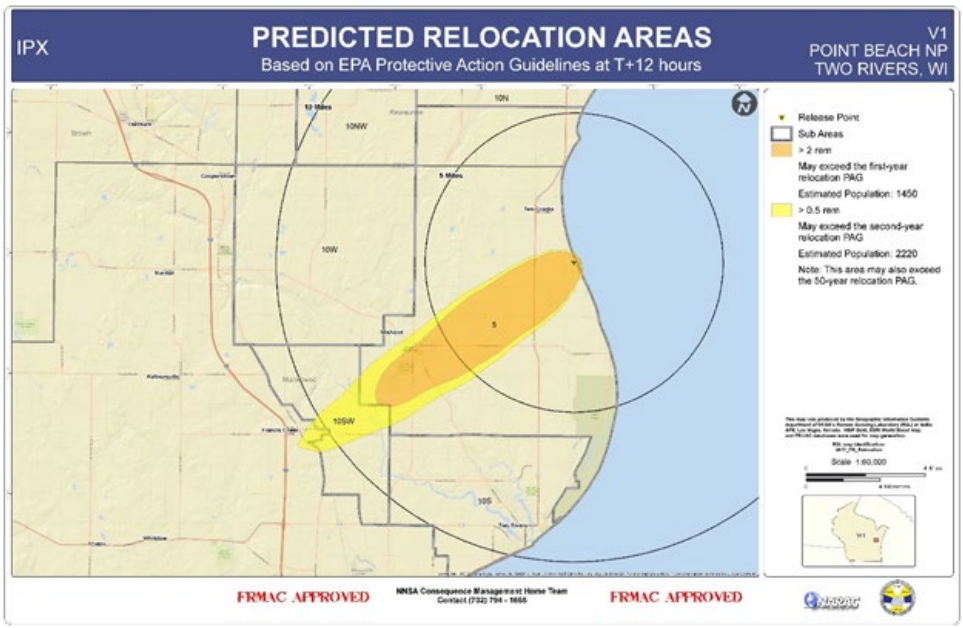


Figure 4. Predicted Relocation Areas (Example)

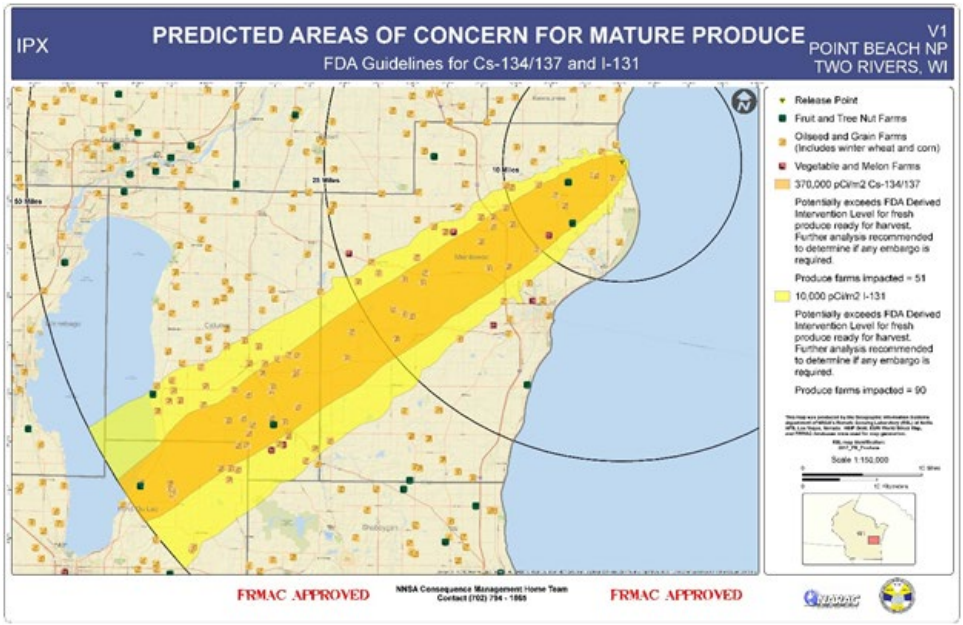


Figure 5. Predicted Areas of Concern for Mature Produce (Example)

Situational awareness products are primarily intended to provide situational awareness to responders and planners and/or to assist with planning operations. Examples of situational awareness products include monitoring status/results maps, worker protection maps, etc.

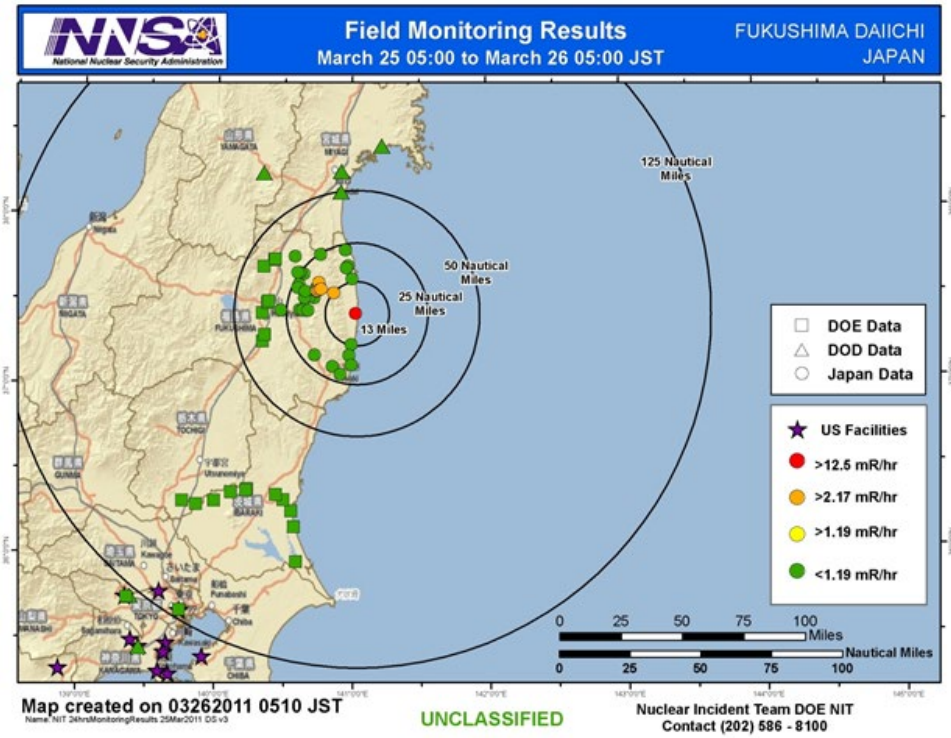


Figure 6. Field Monitoring Results (Example)

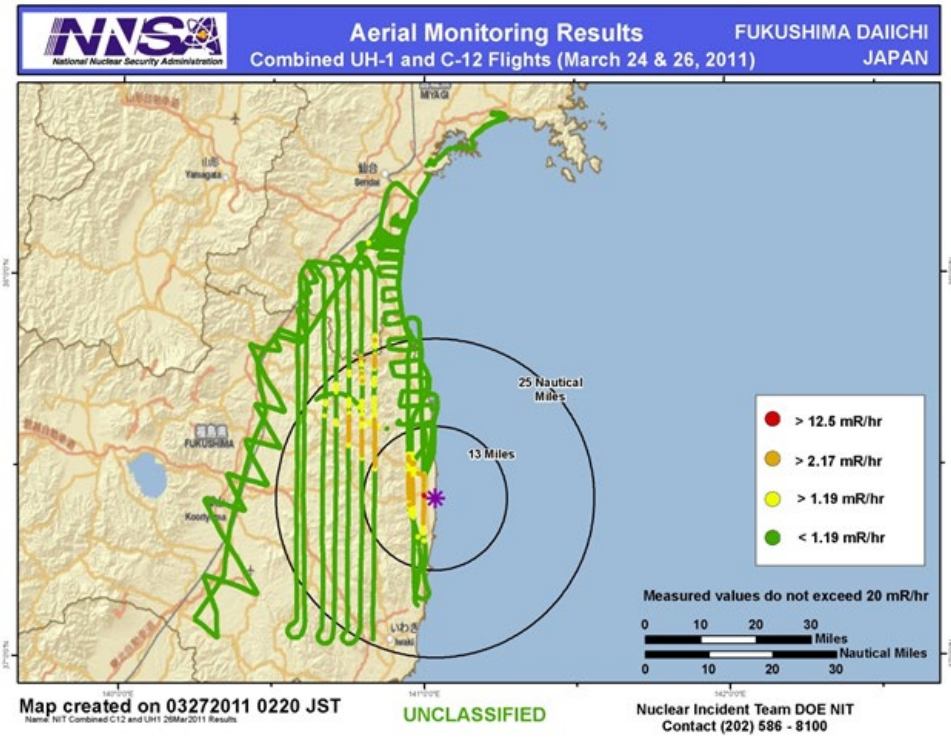


Figure 7. Aerial Monitoring Results (Example)

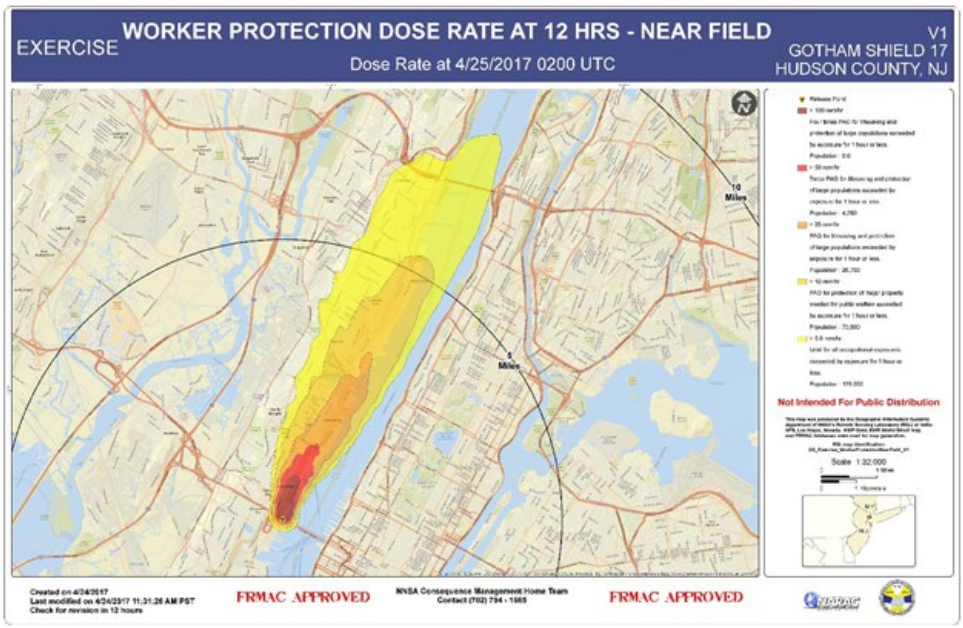


Figure 8. Worker Protection Dose Rate at 12 Hrs 0 - Near Field (Example)

FRMAC reports are typically written documents designed to summarize data or communicate analyses that are not ideally conveyed in a visualization product. Recent examples of FRMAC reports include:

- Laboratory case narratives reviewing and discussing sample results
- Habitability assessment for critical infrastructure (e.g., water treatment plant)
- Dose estimates for harvester operators working contaminated fields

Additional examples of FRMAC products can be found in the FRMAC Product Guide 2020 (FRMAC20A).

APPENDIX E. DATA INTEGRATION REVIEW PROCESS

The data integration review process involves evaluating and analyzing the data collected holistically against the COP to determine if the models underlying the COP need to be revised and to evaluate the data collected for outliers or other phenomena that may require additional investigation. The data integration review is typically performed by the Product Scientist, with the assistance of the GIS Specialist. The data integration review can be roughly organized into 4 tasks:

1. Assumptions Testing
2. Geospatial Distribution Testing
3. Data Completeness
4. Evaluation and Recommendations

Assumption testing involves evaluating the data against the models and assumptions underlying the COP. The first set of assumptions to be tested are those involving the source term. The data collected is analyzed to determine the measured isotope ratios (if available), the alpha:beta ratios, the alpha:gamma ratios, and the beta:gamma ratios. The observed ratios are compared against the ratios calculated for the assumed source term to determine if the data supports the current COP model for the source term or if revisions to the COP source term are required. Examining these ratios geospatially will also allow for the evaluation of the assumption that the source term can be treated as constant across the entire footprint of the release (a common assumption, especially in the early phases of a response). Additional assumptions that may be examined include resuspension coefficients, transfer factors, uptake factors, weathering rates, etc.

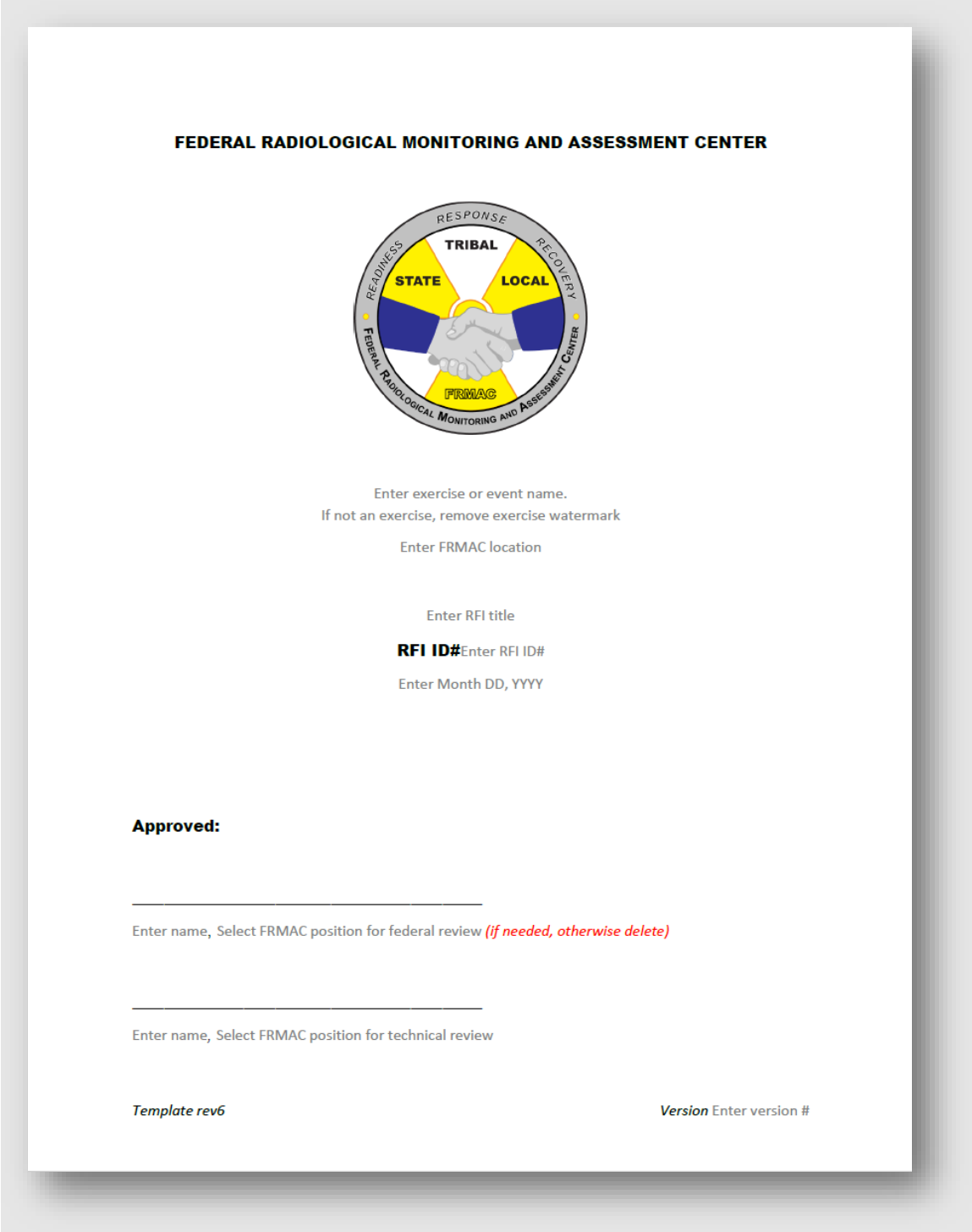
Geospatial distribution testing involves evaluating the data as it is distributed in space. Survey data, along with AMS survey data, mobile data, and any fixed location data, is plotted on a map to examine the geospatial distribution. The COP deposition models are also displayed on the map for comparison with the data. In the early phases of the response, the primary motivation for the geospatial analysis is to benchmark the COP deposition models. Data is plotted on top of the deposition models to examine how well the COP deposition model fits observed deposition. This testing can also be used to identify potential hot spots or areas that require additional investigation due to unexpected results or lack of data.

The data completeness review is an examination of the dataset in its entirety, considering any open RFIs or untested assumptions. The Product Scientist reviewing the data should coordinate with the Assessment Scientist(s) to identify any assumptions that would significantly impact the COP and that have not been tested or validated by data. The Product Scientist should also work with the NARAC Scientist(s) to identify where additional data would be most useful to benchmark and improve the deposition models in the COP.

The final step in the data integration review process is the evaluation and recommendations step. This step “closes the loop” on the evaluation of the data and the COP. Areas where the data does not support the COP should be communicated with the Assessment Division Manager. This communication should also include discussion of the data to determine if enough data exists to support revising the COP models (source term, deposition models, resuspension models, etc.) or if additional data is required to resolve any discrepancies. The Product Scientist (Data

Management) should also communicate any areas identified in the data completeness review step that would benefit from additional data collection. If the ultimate recommendation is to revise the COP, it may be necessary to repeat the data integration review process against the revised COP to evaluate the integration of the data collected and the COP models.

APPENDIX F. FRMAC REPORT TEMPLATE



FEDERAL RADIOLOGICAL MONITORING AND ASSESSMENT CENTER

RESPONSE
RECOVERY
READINESS
TRIBAL
STATE
LOCAL
FRMAC
FEDERAL RADIOLOGICAL MONITORING AND ASSESSMENT CENTER

Enter exercise or event name.
If not an exercise, remove exercise watermark

Enter FRMAC location

Enter RFI title

RFI ID#Enter RFI ID#

Enter Month DD, YYYY

Approved:

_____

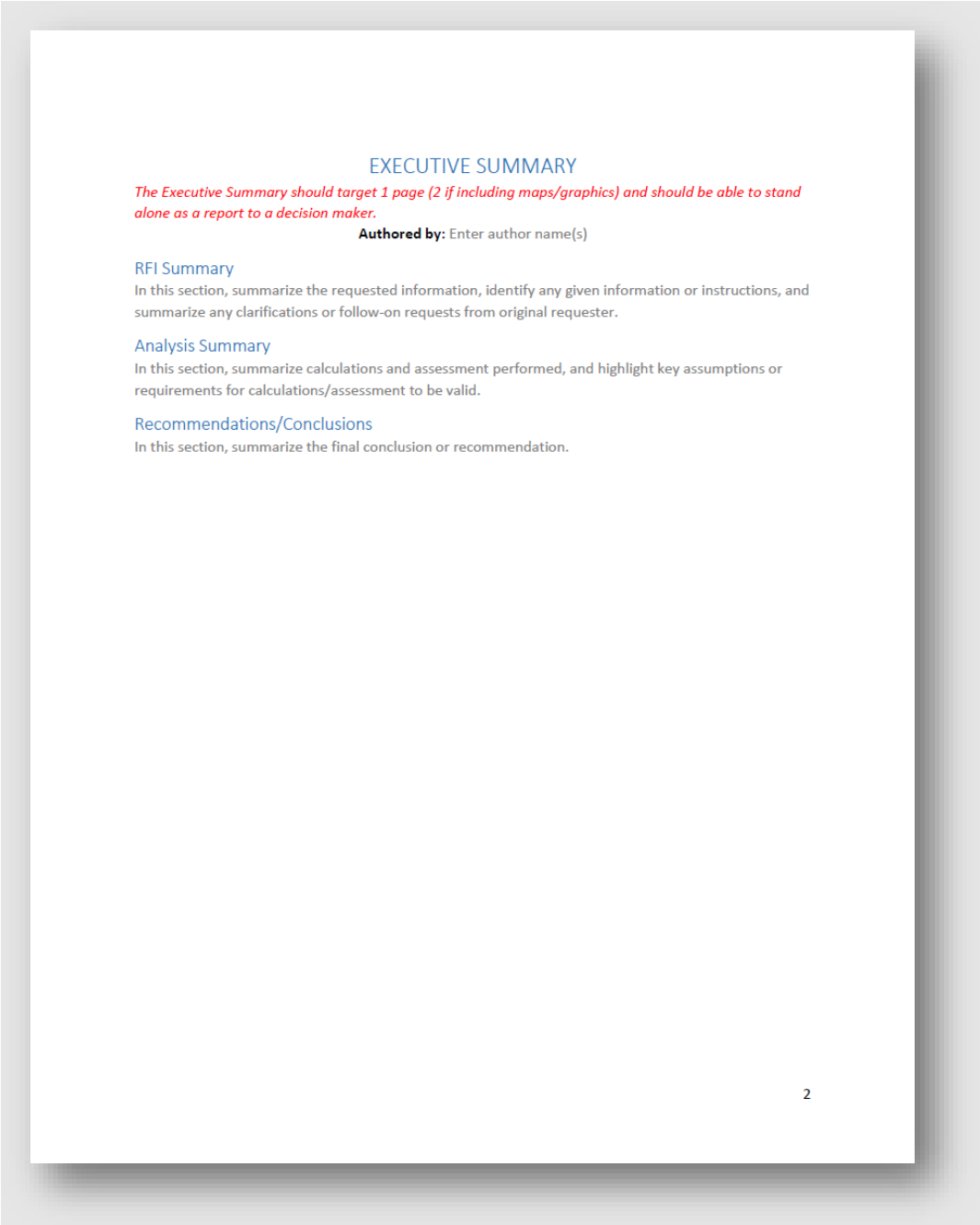
Enter name, Select FRMAC position for federal review *(if needed, otherwise delete)*

_____

Enter name, Select FRMAC position for technical review

Template rev6 *Version* Enter version #

Figure 9. Cover Page FRMAC Report Template



EXECUTIVE SUMMARY

The Executive Summary should target 1 page (2 if including maps/graphics) and should be able to stand alone as a report to a decision maker.

Authored by: Enter author name(s)

RFI Summary

In this section, summarize the requested information, identify any given information or instructions, and summarize any clarifications or follow-on requests from original requester.

Analysis Summary

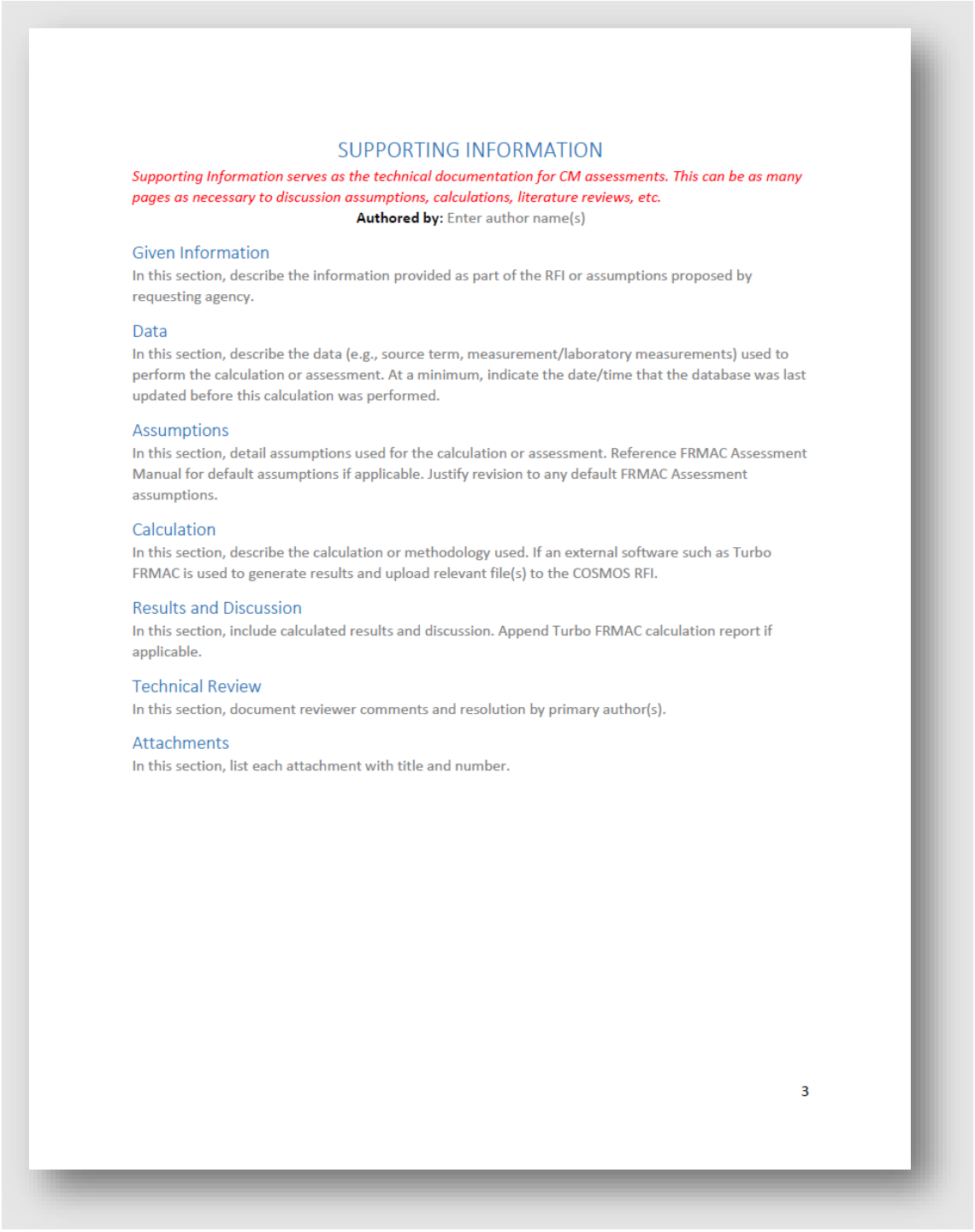
In this section, summarize calculations and assessment performed, and highlight key assumptions or requirements for calculations/assessment to be valid.

Recommendations/Conclusions

In this section, summarize the final conclusion or recommendation.

2

Figure 10. Executive Summary of FRMAC Report Template



SUPPORTING INFORMATION

Supporting Information serves as the technical documentation for CM assessments. This can be as many pages as necessary to discussion assumptions, calculations, literature reviews, etc.

Authored by: Enter author name(s)

Given Information

In this section, describe the information provided as part of the RFI or assumptions proposed by requesting agency.

Data

In this section, describe the data (e.g., source term, measurement/laboratory measurements) used to perform the calculation or assessment. At a minimum, indicate the date/time that the database was last updated before this calculation was performed.

Assumptions

In this section, detail assumptions used for the calculation or assessment. Reference FRMAC Assessment Manual for default assumptions if applicable. Justify revision to any default FRMAC Assessment assumptions.

Calculation

In this section, describe the calculation or methodology used. If an external software such as Turbo FRMAC is used to generate results and upload relevant file(s) to the COSMOS RFI.

Results and Discussion

In this section, include calculated results and discussion. Append Turbo FRMAC calculation report if applicable.

Technical Review

In this section, document reviewer comments and resolution by primary author(s).

Attachments

In this section, list each attachment with title and number.

3

Figure 11. Supporting Information for the FRMAC Report Template

APPENDIX G. FRMAC WORKFLOWS

The Assessment Division operations are primarily driven by the RFI process. As RFIs are received, the TTL, THTL, and Assessment Division Manager review the requested information, translate the request into actions FRMAC must take to address the RFI, and assign the RFI to a workflow of FRMAC positions to perform the technical work to address the RFI. Questions that can be used to determine the workflow needed to address a given RFI include:

- What is the primary position(s) needed to answer the RFI?
- Is data collection (AMS, field measurements, lab analysis samples) needed?
- Is the request for a map product?

A flowchart with these questions as decision points is shown in Figure 12. If these questions can be answered by the TTL/THTL or Division leadership, four workflow categories result, ordered in increasing complexity:

1. **Data available, Mapping NOT needed:** These RFIs typically involve only one skill set providing an update on their activities or an analysis to inform a plan. Examples include briefings, white papers, and plans or plan updates.
2. **Data available, Mapping needed:** These RFIs result in map products that require modeling by the Assessment Division, monitoring data from routine operations, or both. Examples include decision support products for shelter/evacuation, relocation, or agriculture embargo, and situational awareness products for monitoring status or worker protection.
3. **Data NOT available, Mapping NOT needed:** These RFIs require data to be collected and analyzed for a specific assessment that does not result in a map product.
4. **Data NOT available, Mapping needed:** These RFIs require data to be collected and analyzed for a specific assessment that results in a map product. This is the most complex workflow category.

Workflow steps are identified by which position owns the RFI at that point in the process, but several positions might actually be involved with activities such as planning efforts and data analysis tasks. As an example, Figure 13 explains the tasks occurring at each step of a workflow that requires collecting and analyzing samples for laboratory analysis and incorporating the results into a map product.

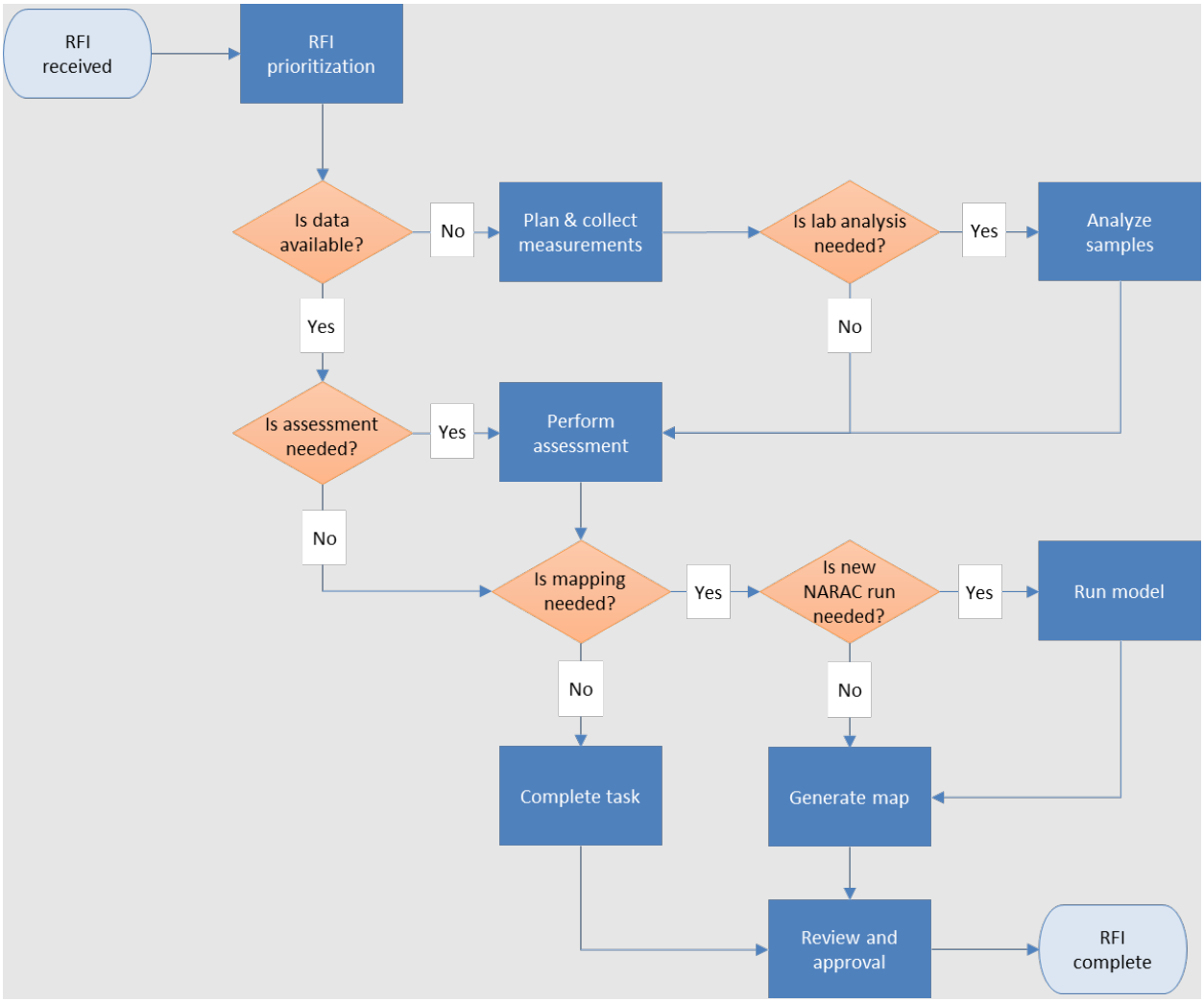


Figure 12. Flowchart of general tasks performed by FRMAC to address an RFI

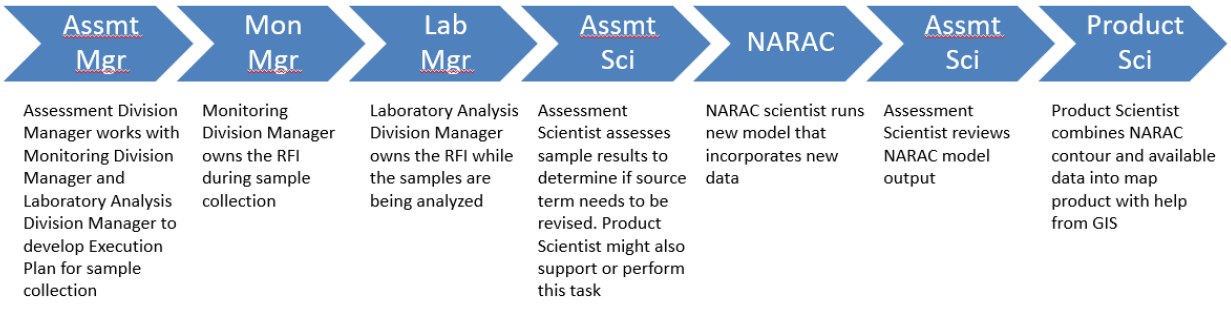


Figure 13. Example workflow showing the tasks occurring at each step for an RFI

APPENDIX H. CHANGE HISTORY

The May 2023 version is the initial release of Volume 1.