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**TITLE: FEDERAL RADIOLOGICAL MONITORING AND ASSESSMENT CENTER
ANALYTICAL RESPONSE**

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ABSTRACT

The Federal Radiological Monitoring and Assessment Center (FRMAC) is authorized by the Federal Radiological Emergency Response Plan to coordinate all off-site radiological response assistance to state and local governments, in the event of a major radiological emergency in the United States. The FRMAC is established by the U.S. Department of Energy, National Nuclear Security Administration, to coordinate all Federal assets involved in conducting a comprehensive program of radiological environmental monitoring, sampling, radioanalysis, quality assurance, and dose assessment. During an emergency response, the initial analytical data is provided by portable field instrumentation. As incident responders scale up their response based on the seriousness of the incident, local analytical assets and mobile laboratories add additional capability and capacity. During the intermediate phase of the response, data quality objectives and measurement quality objectives are more rigorous. These higher objectives will require the use of larger laboratories, with greater capacity and enhanced capabilities. These labs may be geographically distant from the incident, which will increase sample management challenges. This paper addresses emergency radioanalytical capability and capacity and its utilization during FRMAC operations.

INTRODUCTION

The Federal Radiological Monitoring and Assessment Center (FRMAC) provides the organization and structure to coordinate all Federal agency radiological monitoring and assessment efforts and activities. A FRMAC is established and coordinated by the U.S. Department of Energy (DOE), National Nuclear Security Administration (NNSA), but includes personnel from a number of other Federal agencies, including the U.S. Department of Defense (DoD), U.S. Environmental Protection Agency (EPA), U.S. Nuclear Regulatory Commission (NRC), U.S. Food and Drug Administration (FDA), U.S. Centers for Disease Control and Prevention (CDC) and the U.S. Department of Agriculture (USDA). Within the United States, the state and local governments have the primary responsibility for ensuring the health and safety of the public. The Lead Federal Agency (LFA) is the Federal agency that owns, authorizes, regulates or is otherwise deemed responsible for the facility or radiological activity causing the emergency and that has the authority to take action on-site. The FRMAC is responsible for providing the LFA and the state, tribal, and or local authorities involved in a radiological incident with a single source of compiled, quality-controlled monitoring and assessment data. The DOE provides various capabilities to support the FRMAC including management and

technical personnel, command and control, communications equipment, administrative and logistical personnel and equipment. In addition, the FRMAC coordinates, integrates, and directs the efforts of the personnel and equipment responding from the other Federal agencies in accordance with the Federal Radiological Emergency Response Plan (FRERP).

RESPONSE TO AN EVENT

The initial DOE response to a radiological incident is called Consequence Management (CM). Initially there may be an activation of a Consequence Management Planning Team (CMPT) that assesses the incident and recommends the level of response. If the situation warrants, a Consequence Management Response Team I (CMRT I) composed of approximately fifteen management and technical staff is expected to depart for the incident scene within four hours of notification. The CMRT I initiates the technical response, establishes on-site communications and liaison with the state(s) and the LFA, determines support requirements, defines the appropriate level and composition of a FRMAC response, locates a suitable site for FRMAC operations, and initiates logistical support for the CMRT II. CMRT II, if activated, is the second phase of the Consequence Management response. CMRT II is expected deploy 6-8 hours after notification with additional personnel and several aircraft loads of equipment, dependent upon the size and location of the incident. The CMRT will transition into the FRMAC as representatives of other agencies arrive (24-36 hours after notification). This response is diagramed in Figure 1.

The term early phase is usually used to describe the time during an incident where there is a continuing release of radioactivity (plume) or a threat of further releases. During this time there is little capacity for analytical radiochemistry and decisions will be made based on predictive dispersion models supplemented with field radiation measurements. Dose assessments will be based on source term, atmospheric modeling, field monitoring, and surveillance. The CMRT I is provided with plume predictions prepared by the National Atmospheric Release Advisory Center (NARAC) and is ready to assess the data available on-the-scene as well as the data acquired by field teams. Initial planning estimates indicate the early phase will not exceed 96 hours. The analytical response during this phase will be limited to field instrumentation, mobile laboratories, and local analytical capability.

During the initial phase of the incident, analytical data needed for assessment increases exponentially. Data Quality Objectives (DQOs) are adjusted to be commensurate with the urgency of the decision at hand, and the risk of potential consequences from an incorrect decision. The intermediate phase will require better data quality as longer-term exposure risks are evaluated. The intermediate phase could last up to 30 days depending on the magnitude of the incident. During this phase, the role of field measurements and mobile laboratory assets will decline if they are not be able to meet the DQO's needed for assessment decisions. The role of local analytical capability may also decline depending on its capacity and ability to adapt to these increasing DQOs. Larger capacity and greater capability laboratories across the country will likely become the mainstay of the analytical effort as the incident evolves into the recovery phase. The relative role of field measurements, mobile laboratories and fixed laboratories will depend on the radionuclides of concern for the specific incident or emergency.

As the situation stabilizes, the operational management of the FRMAC will pass to the EPA. Many agencies that are part of the FRMAC will have continuing responsibilities during the recovery phase (USDA, FDA, CDC). DOE will continue to provide support during this transition. Analytical efforts will most likely be supported by fixed laboratory facilities.

ANALYTICAL ASSETS

There are a wide variety of analytical resources available to the FRMAC in response to a radiological event. These resources can be broadly categorized according to their organizational type (Figure 2). Laboratories within each category are not differentiated as to whether they are mobile or fixed. The largest number of laboratories can be categorized under the broad label of commercial. Commercial laboratory activities typically perform measurements of radioactivity for a fee or as part of a business activity done for a fee. Examples include: environmental testing laboratories, quality assurance laboratories and nuclear power plant laboratories. Laboratories that are government owned/contractor operated form a second category. These can also be referred to as Management and Operating contractor laboratories. State laboratories can be found organized under a variety of agencies (Health, Environment or Nuclear) which varies from state to state. The “state” category also includes organizations such as county, municipal, and other local governmental authorities. Department of Defense laboratories are those of the uniformed services. University and college laboratories are typically associated with nuclear engineering and chemistry departments at larger schools and those with research reactors. Examples of “other Federal” laboratories are those operated by the EPA, U.S. Geological Service, and other Federal agencies.

FIELD TEAMS

The Radiological Assistance Program (RAP) teams are the DOE’s first responders. Most of these teams are equipped with high-purity germanium (HPGe) detectors and commercial software for in-situ measurements of areal deposition. The RAP teams have a variety of air sampling equipment that is used to sample the extent of contamination and estimate resuspension factors. The RAP teams also have specialized instruments such as Field Instrument for the Detection of Low Energy Radiation (FIDLER), which are useful for incidents involving nuclear weapons or radioactive thermoelectric generators that utilize plutonium-238. Existing RAP mobile laboratories are no longer funded by NNSA but may be supported by other organizations. RAP field team analytical capability is being increased by outfitting of their HPGe systems with portable shields. The shield reduces the detector background so that more sensitive analysis of air filter particulates or cartridges can be performed in the field. The CMRT II deploys with additional instrumentation that increases the capacity for field analysis of samples.

MOBILE LABORATORIES

Mobile laboratories that are located within a timely response range to the event location will deploy to the FRMAC location and augment the field analysis performed by the RAP team(s) and CMRT personnel. Most mobile laboratory assets are associated with state government agencies, and will be supplemented by Federal assets (DoD, DOE, and EPA) and available commercial mobile laboratories. State mobile laboratories will probably be first to arrive because

of their proximity to the incident. Depending on the location, commercial mobile laboratories in the region would arrive next. Federal assets would be last to arrive given their geographical dispersion and transportation requirements. While some mobile laboratories are capable of shipment by air, the coordination needed to procure military or commercial airlift capacity may lead to an overland deployment and subsequent delay in the response. With constant driving, a mobile laboratory could conceivably reach any CONUS (continental United States) event location in less than 48 hours. The DOE mobile laboratory (HOTSPOT at Livermore, California) is military air transportable, but is geographically isolated from the population centers in the eastern part of the U.S. The EPA maintains mobile laboratories at Montgomery, Alabama, and Las Vegas, Nevada, that could respond in a timely manner. There are also DoD mobile laboratories located at Fort Monmouth, New Jersey and Brooks Air Force Base, Texas.

The timeliness of a mobile laboratory response is being addressed within DOE by the creation of a modular, multi-modal, laboratory (LM3). This system is totally self-contained and self-supporting for seven days of operation (power, HVAC, and consumables). The laboratory fits into seven shipping containers (Internal Airlift/Helicopter Slingable Containers) that measure 108"x48"x60" with a shipping volume of 125 cubic feet and a payload of 5000 pounds. This system is transportable in commercial cargo aircraft of virtually any size, as well as being compatible with truck and rail shipment options. This "lab in a box" will be located in the eastern portion of the U.S. A second LM3 will be assembled to replace the HOTSPOT and RASCAL mobile laboratories for coverage of the western portion of the U.S. The LM3 is designed to be on-site and operational, 36 hours after notification, depending on the incident location and transportation mode.

RESTRICTED CAPABILITY LABORATORIES

Analytical assets are critical to provide timely data to CM/FRMAC assessors. Those facilities that are not impacted by the event will be the first ones called upon. Some of these facilities may not normally analyze "real world" samples for radioactivity but because of their proximity can still fill an analytical need during the earliest stages of an incident. Asset identification and qualification is an ongoing project, as new organizations are created and others dissolve, merge, relocate, or reorganize. The immediacy of an event and the need for a quick answer will determine the role of a local asset. There may be an expanded capability laboratory asset that is physically close to the event but not affected by the event. Obviously that would be a best-case scenario and that laboratory would be utilized to its capacity from the earliest stages of an event.

EXPANDED CAPABILITY LABORATORIES

Laboratories that have extended ability to conduct analysis for virtually any radionuclide occurring in a wide variety of media (soil, water, vegetation) and have a thorough quality assurance program. These laboratories are typically audited and accredited by several organizations (DOE's Laboratory Accreditation Program, National Voluntary Laboratory Accreditation Program, and National Environmental Laboratory Accreditation Program) and participate in multiple radiological performance testing programs. Some of these laboratories have existing contracts with DOE field offices that provide for 24-hour turn-around time. The laboratories closest to the event would be utilized as early as feasible. Transportation of samples

to these laboratories would initially be by courier. Laboratories geographically removed from the event would have samples transported by commercial package delivery services.

UTILIZATION OF ANALYTICAL RESOURCES

A national database of radioanalytical assets has been compiled. Figure 3 shows the geographic distribution of radioanalytical assets. This database is as inclusive as possible, but does not include every possible organization with radioanalytical capability.

The database contains objective information on the number and type of personnel, instrumentation, and quality systems of each organization. Each of these areas is also subjectively rated for basic capability and capacity. Laboratories with very limited capability and capacity in a specific area would be rated a “C” for analyses that rely on that component. Typical laboratories that would fit into this rating can be characterized by their limited instrumentation and lack of chemical separation capability. Without knowing the scope or location of a particular event, an organization with this capability may fill an analytical need during a response because of location and availability. During the early phase of an event, an order-of-magnitude estimate of activity or a qualitative result may meet the DQO. In certain circumstances, speed is more important than absolute accuracy. Examples of analytical assets that would fit into this category are: a small college that has a germanium lithium detector used for demonstration purposes, a commercial entity that uses a HPGe for internal quality control purposes, a nuclear power plant laboratory with only gamma spectroscopy capability, or a commercial environmental or water testing laboratory that has a gas proportional counter that is used for analyzing gross alpha and beta in drinking water. Each of these entities could have a role in the analytical response to an event.

Laboratories that have limited analytical production capabilities are subjectively rated “B” laboratories. These laboratories have a larger instrumentation base than the “C” labs, can perform limited radiochemical separations, and have a quality-assurance program in place. These labs may have accreditation for a portion of their analytical capability and participate in performance testing verification of their proficiency. Many mobile laboratories would fit into this category. Other examples of these types of laboratories are similar to the entities specified earlier. “B” laboratories would generally be larger and more diversified than the “C” labs and would have production systems in place (sample receiving, Laboratory Information Management System, waste disposal, billing, etc.). These labs would be utilized early in any event and would continue to receive samples through the intermediate stage. If this type of lab were able to increase their capacity and capability, they would continue to be used to support increasing DOE analytical needs.

Laboratories with extensive analytical resources, quality assurance systems, and production systems are subjectively rated an “A” laboratory. Laboratories that currently meet these criteria are typically government owned/contractor operated laboratories associated with DOE National Laboratories, and commercial laboratories with existing contractual relationships with DOE field offices. Many of these labs also participate in the DOE Environmental Monitoring Consolidated Audit Program and have contracts managed by the DOE Integrated Contract Procurement Team.

CONCLUSION

The analytical response of FRMAC to a radiological event is scalable to the event, leverages existing resources, and provides the quality of data needed in a timely manner. This will allow health assessors to provide defensible recommendations needed to protect the health and safety of the public impacted by a radiological event.

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Figure 1 Response Timeline

Figure 2 Laboratories by Organizational Type

Figure 3 Number of labs per State

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