Consequence Management Monitoring Strategies

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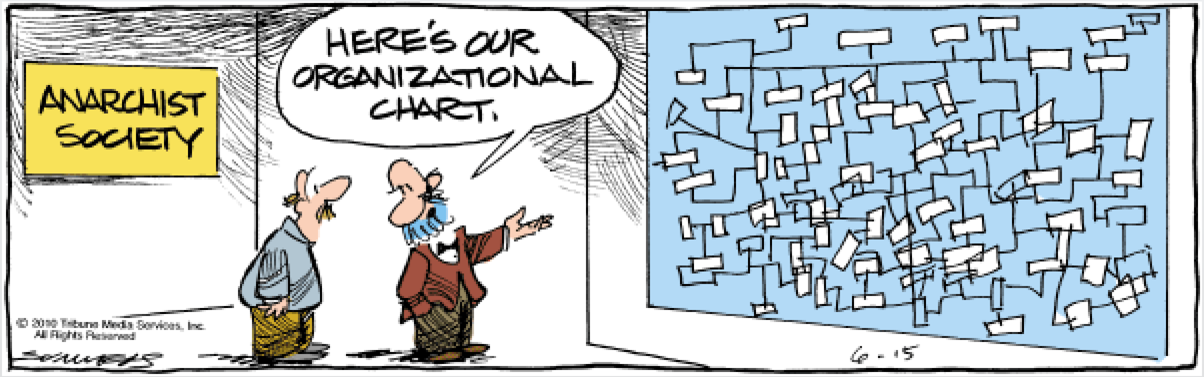
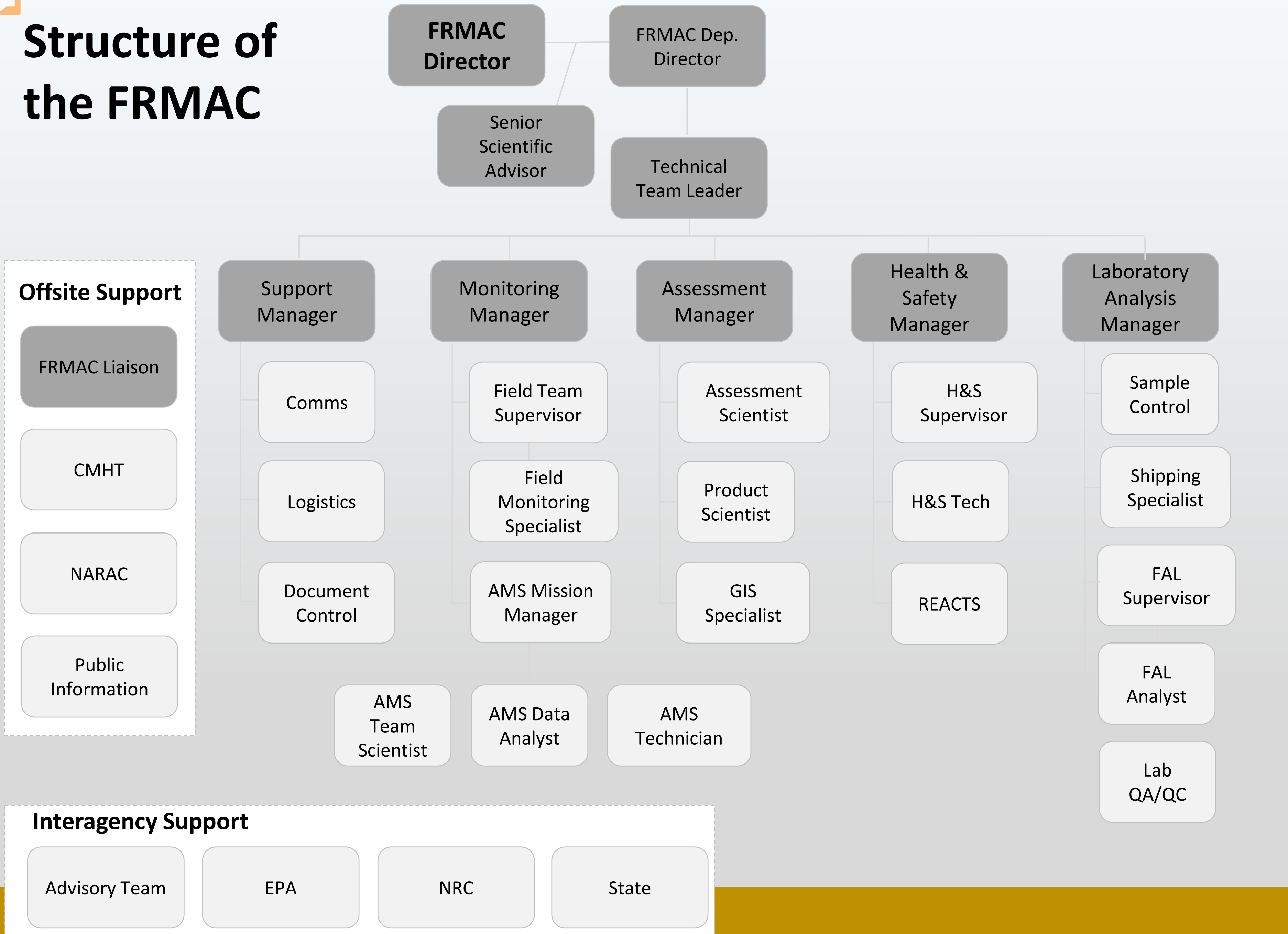
Command Structure in Monitoring Division

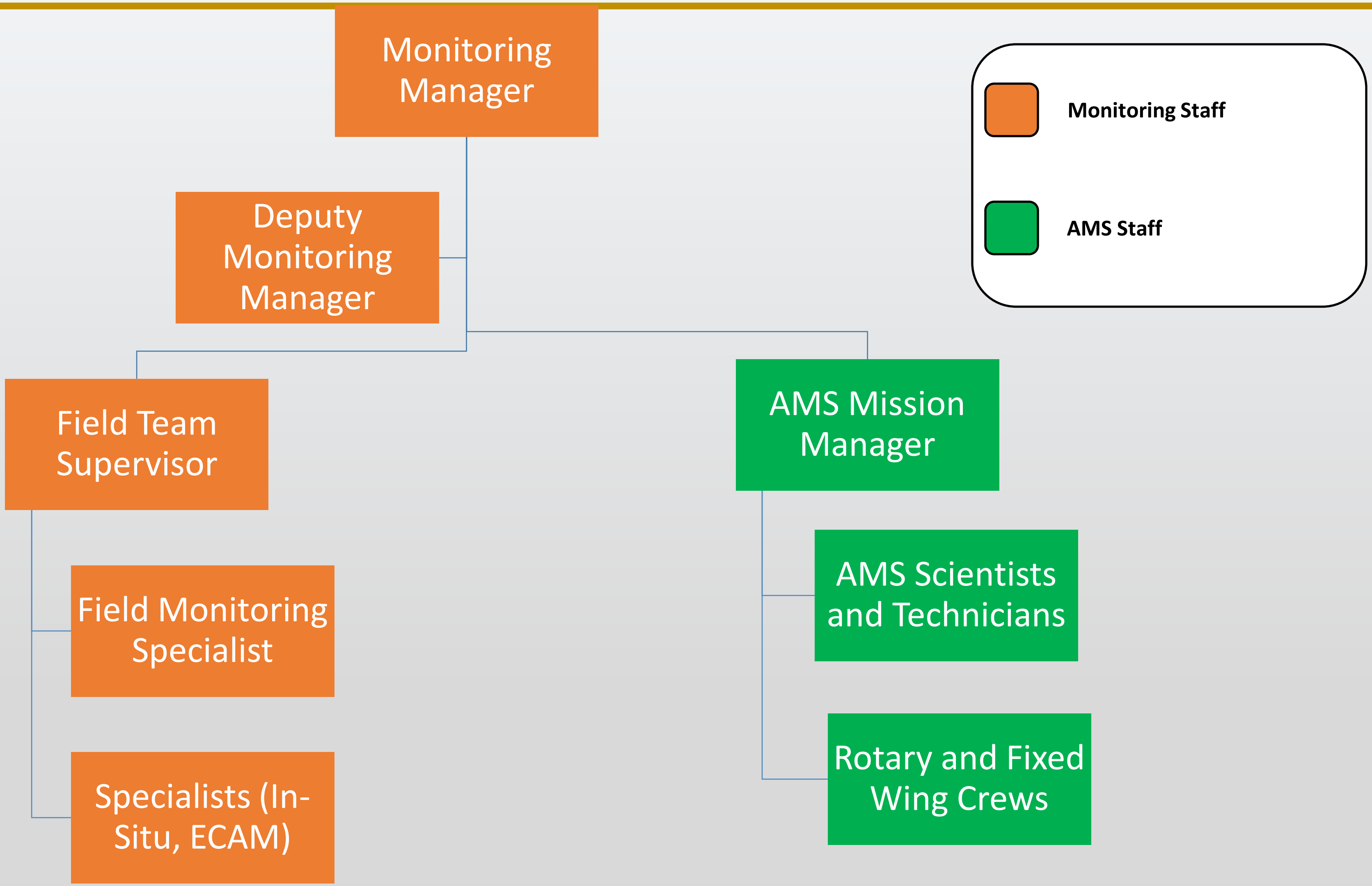


- This is the Federal Radiological Monitoring and Assessment Center (FRMAC) structure.
- NATO will follow a different structure

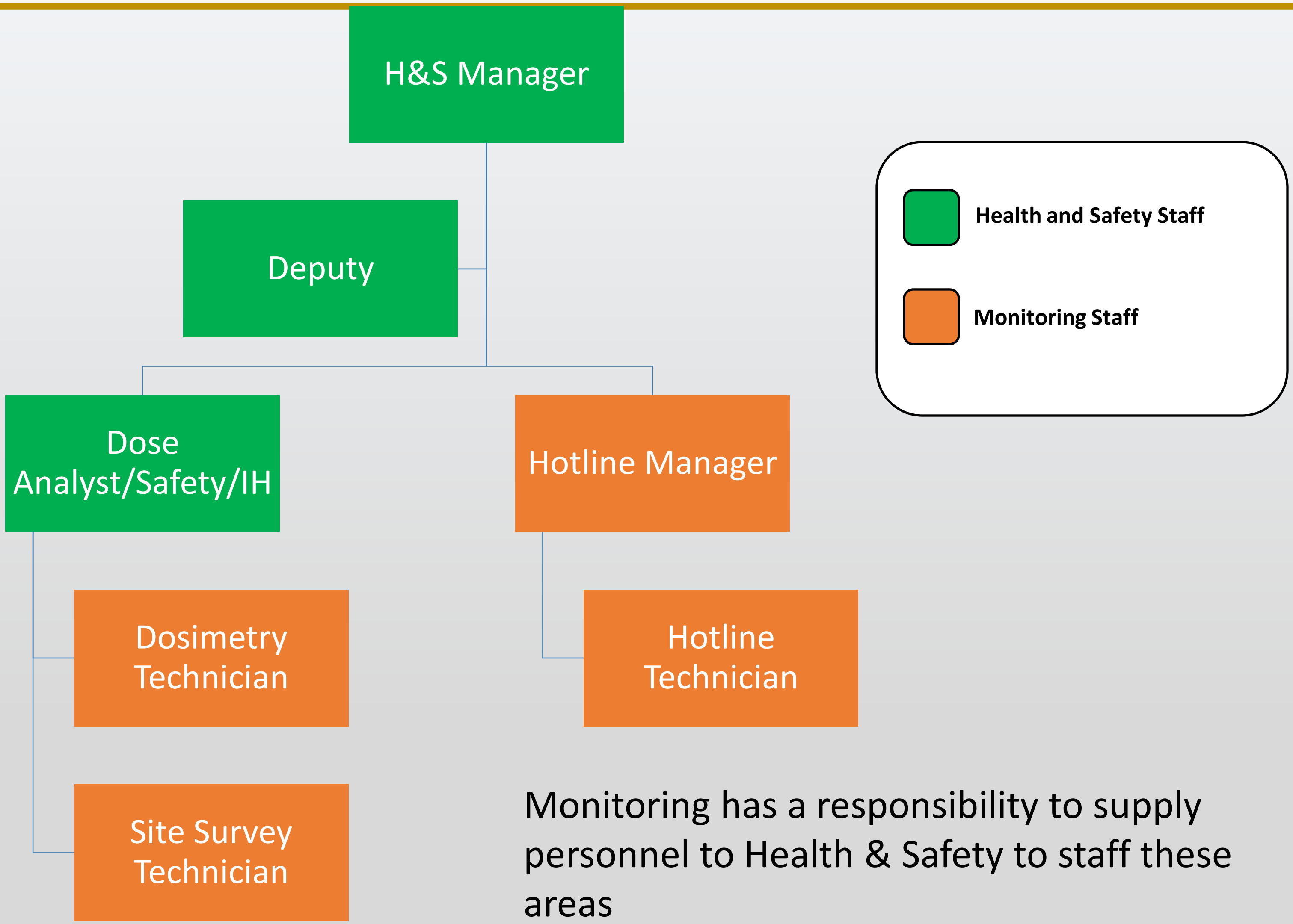
Structure of the FRMAC



Monitoring Organization Charts



Health & Safety Organization Charts



Monitoring has a responsibility to supply personnel to Health & Safety to staff these areas

Roles and Responsibilities

- Monitoring Manager and Deputy
- Team Supervisor
- AMS Mission Manager
- Field Monitoring Specialist

Monitoring Manager and Deputy Roles

- Manage operations for the division
- Attend/participate in planning meetings
- Help create overall response plans
- Complete field team instructions
- Brief AMS Missions Managers and Field Team Supervisors on objectives and expectations
- Review field team data
- Relay information up the command chain

Responsibilities Pre Deployment

- Work with staff to gather all initial information on incident
  - Type of incident, source term, metrology, current status and contact info for state, local responders performing monitoring activities
- Confer with Management Team to discuss response priorities
- Obtain all available plots or monitoring data from First Responders
- Brief the Field Team Supervisor to begin selecting equipment to palletize and then organize teams
- Work with the Health and Safety Manager to share information, personnel, and resources.

Responsibilities – In the Field

- Develop the operations plan. Work with Command to:
  - Get enough info to complete field team instructions
  - Support Health & Safety with staffing and resources
  - Prioritize action requests and conflicting task
- Work with the AMS Mission Manager to determine aerial survey missions
- Develop and brief assignments for field teams
  - Some of this can be delegated to a Deputy

Responsibilities Within the Command Structure

- Request resources from Command to support monitoring teams in field when required
- Coordinate activities with the Operations Section for field teams and aerial assets

If Requested:

- Attend Planning Meetings to brief Command on the resources and capabilities
- Participate in regular tactics and planning meeting to support development of the Incident Action Plan (IAP)

How it Really Works

IN REAL LIFE…

- The Monitoring Manager attends a lot of meetings.
  - There is not enough time for the manager to attend to meetings and operations.
- The Deputy Monitoring Manager is typically the operational manager.
  - Works with the Team Supervisor
  - Creates field team instructions
  - Reviews data
  - Reports to the Monitoring Manager on field activities

Team Supervisor Roles

Before Team Deployment

- Assist in deployment activities
  - Assist with palletizing deployment equipment
  - Field team composition
  - Establish communications with field teams
- Ensure necessary equipment available and ready
- Brief the field team instructions

During Field Deployment

- Establish communications with field teams
- Reroute or change task
- Approve data

After Field Deployment

- Take report from field team
- Return to Monitoring Manager (or Deputy) and report status

AMS Mission Manager/Scientist

- Coordinate flights/ ensure safety of assigned personnel
- Brief AMS staff on objectives
- Communicate flight details and situational awareness to the Monitoring Manager
- Assist the Monitoring Manager with mission planning
- AMS data product creation/review

Field Monitoring Specialist Roles

- Instrument checks before deployment
- Follow field team instructions and collect data
- Communicate status to Team Supervisor
- Help less experienced field team members and/or specialty field teams

AMS

- AMS is a separate asset from the ground teams but are part of overall monitoring
- AMS uses sodium iodide based radiation detection system (manufactured by RSI) in their fixed wing or helicopter to characterize large areas.

AMS (cont.)

- The AMS Mission Manager is in charge of the mission. The mission crew consists of the following personnel:
  - Pilot
  - Co-pilot
  - AMS Mission Manager
  - AMS Equipment Specialist

- Other necessary AMS personnel include: mechanics, data scientists, and data analysts as part of the AMS home team.

Default Guidance

- Data is required/expected from the Monitoring Division even before official objectives are set by command.
- Initially, the Monitoring Division does not need to wait for state/local objectives to collect data.
  - Default plans can be developed prior to an event
  - See Monitoring and Sampling Manual, Volume I (2019), Appendix E-F for an example of US guidance.

https://www.nnss.gov/pages/programs/FRMAC/FRMAC_DocumentsManuals.html

Default Turn Back Limits

- The default **turn-back limits** for the first shift (assuming no active plume) are as follows:
  - Exposure rate: 5 millisieverts per hour (mSv/hr)
  - External dose: 5 millisieverts (mSv) per shift

- This will ensure that the teams are able to respond for up to 10 shifts before an emergency dose guidance of 50 mSv is exceeded.
  - Short term recovery operations
  - Implement urgent protective actions
  - Environmental sampling

(Note that IAEA GSR Part 7 establishes <500 mSv for lifesaving activities)

Default Hold Points

- The default *__hold points__ for the first shift (assuming no active plume) for contamination are as follows:
  - Alpha: 0.9 mega becquerels per square meter (MBq/m^2) or 5.4E5 disintegrations per minute per 100 square centimeters ($dpm/100\ cm^2$) or meter off scale
  - Beta: 167 MBq/m^2 or 1E8 $dpm/100\ cm^2$ or meter off scale

- Dose rate: 0.5 millisieverts per hour (mSv/hr)
- Start of the contaminated boundary: 5 times background.

**Field team must check in with Team Supervisors at hold points to receive further instructions. This may be to don respirators and continue work, enact stay time restrictions, or turn back at these levels.*

Default Guidance Initial Actions

Objective 1

Confirm the deposition model and initial first responder data, determine the isotopic mix, and begin to define the deposition boundary to determine the areas of radiological concern.

Assessment Responsibilities: Gather information to estimate radionuclide source term information and dispersal mechanism.

- Develop initial map products illustrating areas of radiological concern (such as evacuation/shelter in place areas, relocation areas).
- Provide dose assessment and stay times for returning state, county, and city residents to their homes in affected areas.
- Provide assessment for return of residents for normal occupancy.
- Required measurements/samples include direct measurements for alpha, beta, exposure rate readings, air concentration levels, and radionuclide identification made with a High-Purity Germanium (HPGe) detector.

Initial Actions: Aerial Monitoring

Objective 1

Aerial Monitoring Responsibilities:

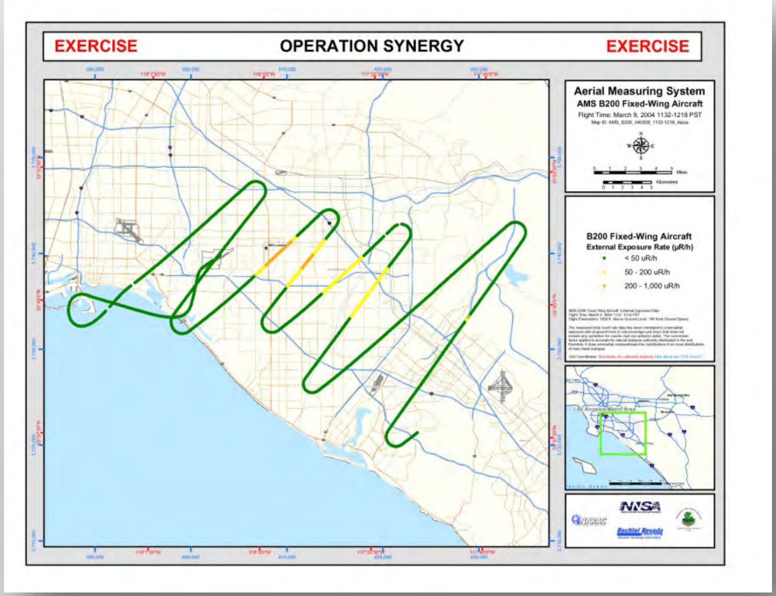
- Characterize deposition/exposure footprint. Focus on evacuated areas and adjacent non- controlled areas.
- Conduct fixed-wing surveys at 305 meters in altitude.
- If time is limited, a serpentine pattern can be performed. If there is time for a more complete survey, a line spacing of 500 m can be utilized.
- Helicopter aerial surveys will be conducted at 46 m altitude with 92 m line spacing to delineate contaminated areas (focusing on evacuation and relocation areas) to the extent practical.

AMS Mission Parameters

On-Call Response Phase

✓ *Large Area (>65 km^2)*

- Altitude: 150-305 meters
- Spacing: 1.5-8.0 km
- Speed: 140 knots
- Fixed-wing Aircraft



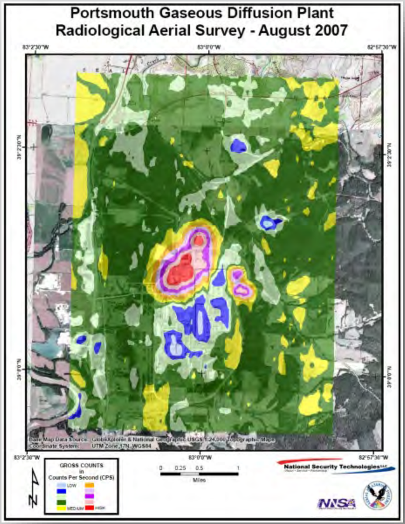
Radiological Mapping Phase

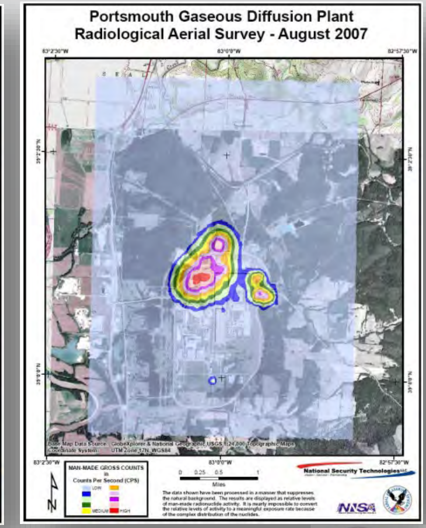
✓ *Rapid Overview – Emergency Response*

- Altitude: 152 meters
- Spacing: 0.8 km
- Speed: 80 knots
- Helicopter

✓ *Small Area (<65 km^2) – Detailed Survey*

- Altitude: 15-92 meters
- Line Spacing: 30-184 meters
- Speed: 70 knots





Initial Actions

Objective 1

Field Team Responsibilities:

- Characterize deposition/exposure footprint. Perform transects of the deposition footprint. Focus on evacuated areas and adjacent non-controlled areas. Identify contaminant re-suspension and air concentration levels near the accident site and at downwind locations.

- Initially, field teams will perform the standard suite of surveys and samples until enough information about the type of release can be determined.

- At each sampling location, perform:
  - Gamma exposure rate surveys at 1 meter above ground level
  - Alpha, beta, and gamma contamination surveys at ground level

Deposition Measurements by Ground Teams

- Identify isotopic mix and verify deposition models by taking appropriate radiation measurements using available roadways to traverse the predicted footprint.

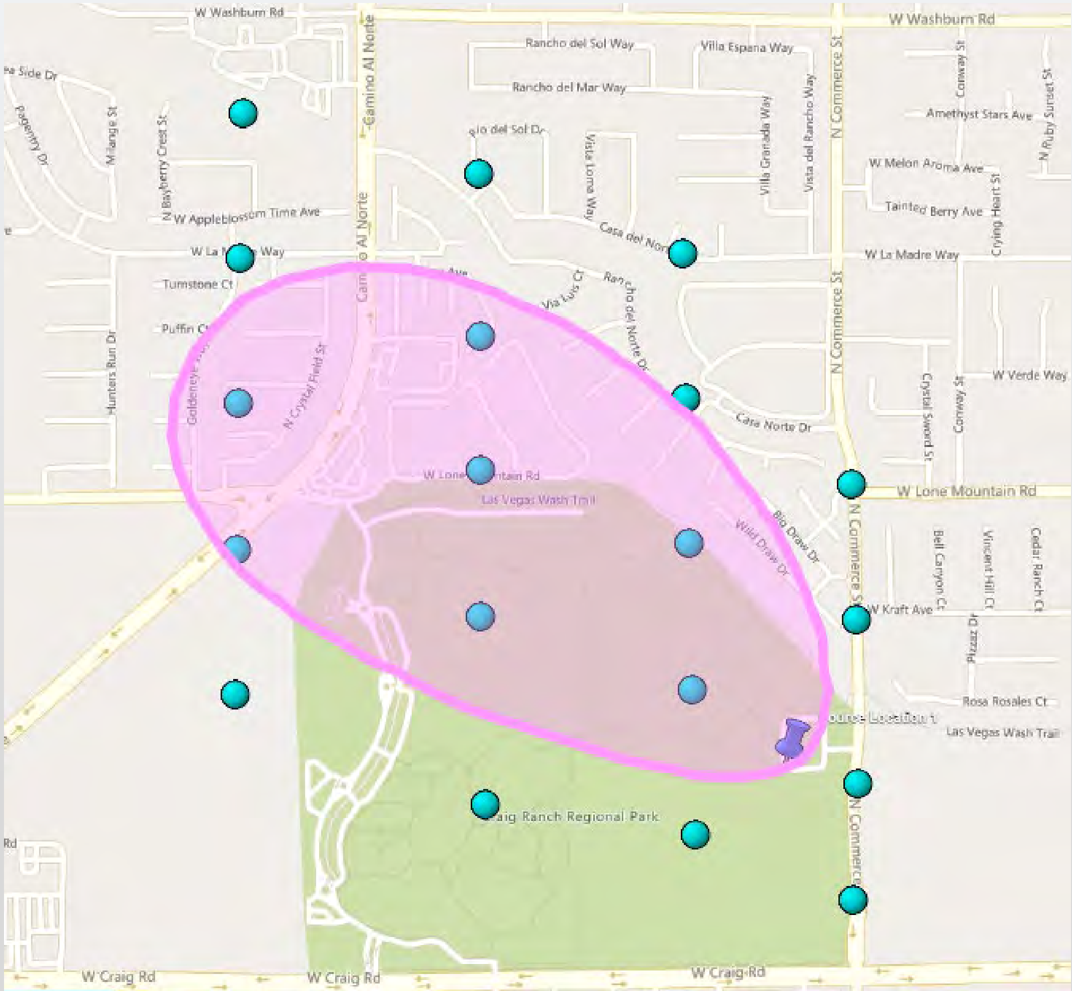
- The chosen roadways and flight paths should intersect a representative number of predicted radiation contours.

- The monitoring strategy for the routes and spacing of survey locations should include input from:

    - Assessment and GIS on the spacing of data points relative to the ground deposition contours and map scale for the various briefing products.

    - For most incidents, the spacing for deposition surveys can vary from hundreds of feet near the release point to many miles between data points down range where the deposition is more uniform.

Transect Example



Exposure rate surveys are the most important early on. The results can easily be compared to radiological emergency guidance.

Performing transects through the area will help determine the size of the area and if any areas need protective actions (like evacuating or sheltering in place).

Exposure rate results can be used to update contaminant modelling.

Deposition Measurements by Ground Teams

- Depending on the type of radiological release and the suspected source term, some basic, general principles can be applied as follows:
  - Gross alpha and beta measurements will provide many more data points per total survey time if there has not been any appreciable precipitation or weathering of the deposition.
  - In-situ gamma spectrometry systems are the preferred field team instrument to be used with an exposure rate meter to confirm the gamma-emitting constituents in the deposition footprint.
- The number of field in situ measurements should be planned to limit total exposure to the ground team members.
- Generally, in-situ measurements should be performed in areas where the exposure rate is less than 0.03 mSv/hr because of system dead time.
- As a rule of thumb, measurements and/or samples should be collected at every order-of-magnitude change in measured radiation levels.

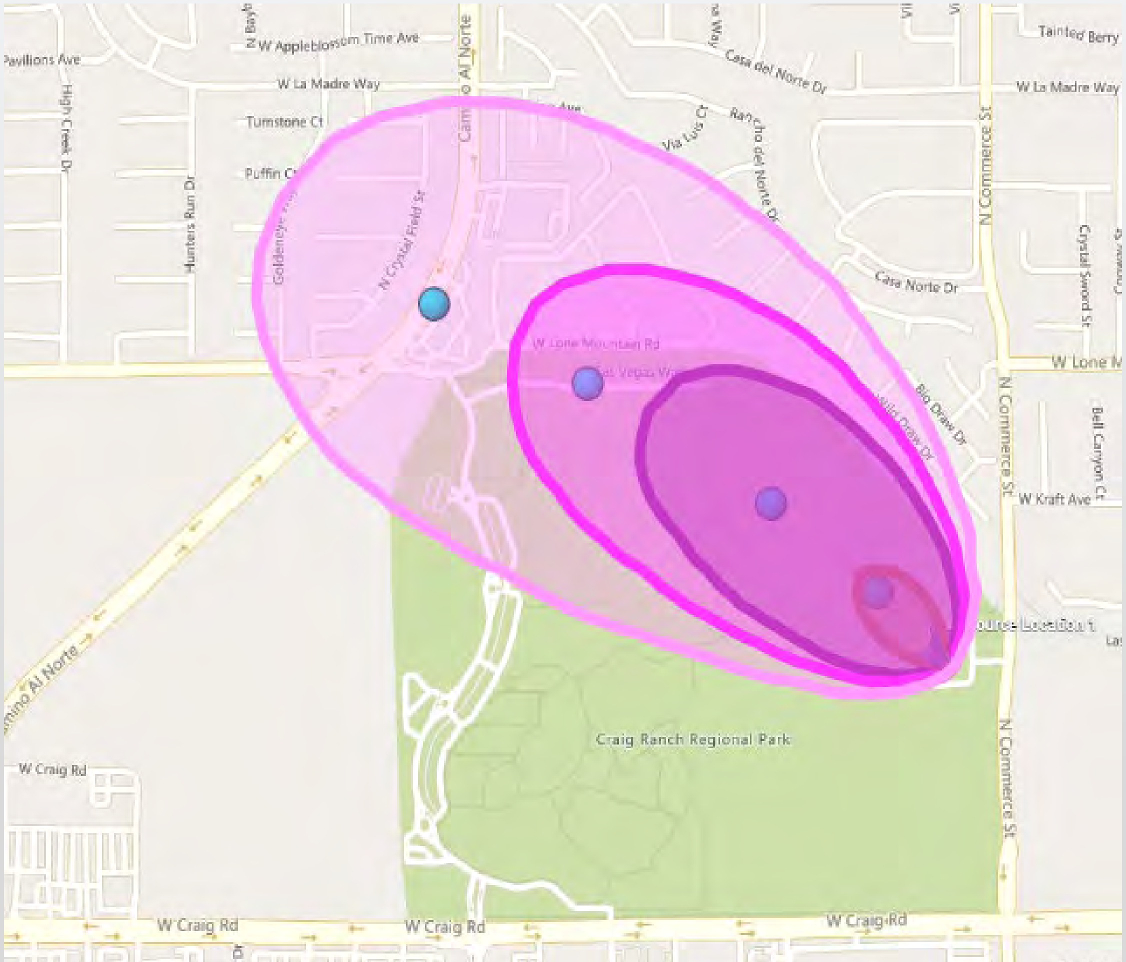
Field Team Responsibilities - Sampling

- In situ measurements, soil samples, air samples, and other samples will be collected at a periodic frequency (based either on distance or by order of magnitude change in exposure/contamination rates).

- Sample collection will include: high-volume air (10 minutes), ground deposition (soil and vegetation together) and other samples, as necessary, to better define the plume footprint and contamination levels.

- If evaluating for resuspension of radioactive contamination, then perform the following at each sample location:
  - Contamination and exposure rate surveys
  - 10-minute in-situ survey at 1 meter above ground
  - 10-minute, high-volume air sample
  - Ground deposition (soil) sample

Sampling Example



Because sampling takes more time than exposure rates, fewer samples are collected within the area initially.

Air and soil samples are common samples to collect post incident. Air samples help determine how much radiation is breathable in the area.

Soil samples help determine the radionuclides and exact amount that has deposited on the ground. Soil sample results could be used to inform decisions on public protection.

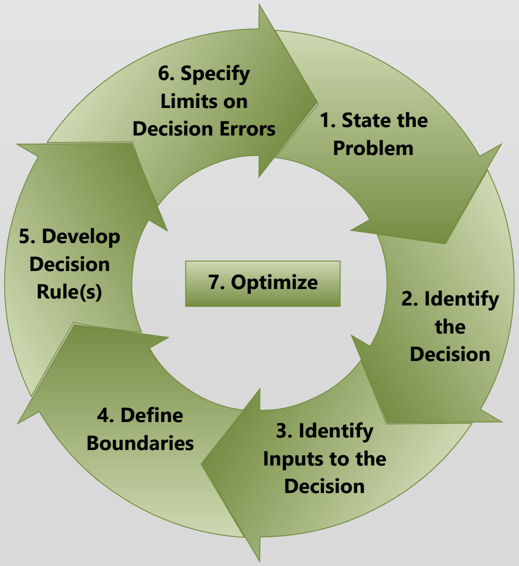
Critical Institution, Facility, and Transportation Corridor Monitoring

- Critical transportation corridors (e.g., interstate highways, federal and state highways), critical institutions, and facilities (e.g., fire and police stations, emergency operations centers, power stations, water treatment plants) within the deposition footprint may be in use throughout the entire response.
- Numerous repeated surveys may be requested as local authorities attempt to decontaminate the roads and facilities used for evacuation and response teams.
- Monitoring efforts along transportation corridors and in critical institutions and facilities must be coordinated with state and/or local officials in order to mitigate the impact to evacuation and response efforts.
- It is necessary to monitor the exteriors of the critical institutions and facilities as well as the interiors. When tasked to survey critical institutions and facilities, verify the protocol for entering both evacuated and non-evacuated buildings and whether local uniformed police or fire fighters should accompany the monitoring teams.
- Interior monitoring will include the acquisition of swipes from representative surfaces, contamination surveys, and exposure rate surveys.

Monitoring Methodology Rationale for Longer Term Work Planning

- The intermediate phase will require a greater degree of data quality as longer-term exposure risks are evaluated, as well as the use of a sample chain-of-custody process.

- The role of the on-site analytical capability of the mobile laboratories may also decline depending on their capacity and ability to adapt to these more rigorous data quality objectives.



Long Term Monitoring Responsibilities

- Environmental TLDs should be placed inside and outside of each occupied structure to determine general area dose.
- Representative individuals at each location could be assigned a TLD to wear, if warranted.
- If available, gamma-rate recorders should be placed inside the structures. The appropriateness of locating particulate and reactive gas air samplers at these stay-in locations should be determined.
- A brochure describing basic facts about radioactivity and exposure reduction techniques for inhabited structures should be distributed (https://emergency.cdc.gov/radiation/contamination.asp).

Long Term Monitoring Responsibilities

- In coordination with local officials, drinking water samples should be collected from
  - surface supplies (e.g., rivers, lakes, canals)
  - open-air water treatment facilities located in the affected area.
  - private or public wells, cisterns, and water distribution systems.
- It may be requested that sediment samples be collected along with surface water located within the deposition footprint.
- Long-term air sample locations will be established.
  - Perform low-volume air sampling within the evacuated/relocation area.
  - Collect the low-volume air samples for around 24 hours.

Long Term Monitoring Responsibilities

- The monitoring and sampling of farms, dairies, and food processing plants will, in all likelihood, be conducted at the request local officials.
- If no priorities or requests are received, the responders should consider the following:
  - Farms and dairies within the deposition footprint will receive last priority because contamination is assumed to have occurred based on their location.
  - Farms outside of the deposition footprint should be monitored in order of crop perishability.

Questions?