DOE/NV/25946--410

RADIOLOGICAL CONTINGENCY PLANNING FOR THE MARS SCIENCE LABORATORY LAUNCH

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Abstract

This paper describes the contingency planning for the launch of the Mars Science Laboratory scheduled for the 21-day window beginning on September 15, 2009. National Security Technologies, LLC (NSTec), based in Las Vegas, Nevada, will support the U.S. Department of Energy (DOE) in its role for managing the overall radiological contingency planning support effort. This paper will focus on new technologies that NSTec's Remote Sensing Laboratory (RSL) is developing to enhance the overall response capability that would be required for a highly unlikely anomaly. This paper presents recent advances in collecting and collating data transmitted from deployed teams and sensors. RSL is responsible to prepare the contingency planning for a range of areas from monitoring and assessment, sample collection and control, contaminated material release criteria, data management, reporting, recording, and even communications. The tools RSL has available to support these efforts will be reported. The data platform RSL will provide shall also be compatible with integration of assets and field data acquired with other DOE, National Aeronautics and Space Administration, state, and local resources, personnel, and equipment. This paper also outlines the organizational structure for response elements in radiological contingency planning.

I. INTRODUCTION

Scheduled to launch in the fall of 2009, Mars Science Laboratory (MSL) is part of the National Aeronautics and Space Administration's (NASA's) Mars Exploration Program, a long-term effort of robotic exploration of the red planet.[1] MSL is a rover that will assess whether Mars ever was, or is still today, an environment able to support microbial life. In other words, its mission is to determine the planet's "habitability." The MSL rover will carry a radioisotope power system that generates electricity from the heat of plutonium's radioactive decay. This power source gives the mission an operating lifespan on Mars' surface of a full Martian year (687 Earth days) or more, while also providing significantly greater mobility and operational flexibility, enhanced science payload capability, and exploration of a much larger range of latitudes and altitudes than was possible on previous missions to Mars.

The U.S. Department of Energy (DOE) provides technical support to the requesting agency such as the Federal Bureau of Investigation, Department of Defense, NASA, or a state agency to address the radiological consequences of an event. These activities include measures to alleviate damage, loss, hardship, or suffering caused by the incident; protect public health and safety; restore essential government services; and provide emergency assistance to those affected. Under a Memorandum of Understanding between DOE and NASA, an Advance Launch Support Group (ALSG) will be established to assist in any emergency radiological monitoring for NASA's MSL launch.

II. MISSION OBJECTIVES AND CAPABILITIES

The Remote Sensing Laboratory (RSL), located at Nellis Air Force Base, will provide a modified Consequence Management Response Team (CMRT), which will become part of the ALSG.

II.A. Mission

At the request of NASA, the U.S. Department of Energy, National Nuclear Security Administration (NNSA) has directed that a modified CMRT, with personnel and associated equipment, be deployed in support of the MSL Launch, which is scheduled for September 2009 at the Kennedy Space Center (KSC) near Cocoa, Florida.

II.B. Objectives

The objectives of the support afforded by RSL are to integrate safety into every task; organize and deploy a modified CMRT as part of the ALSG; provide support to the Radiological Control Center (RADCC); provide personnel to support offsite field team operations; provide monitoring instrumentation to support offsite and onsite field teams; establish communications support directly connecting all locations: RADCC, local National Guard Armory (where ALSG is located), and Florida Department of Emergency Management Mobile Command Center, Brevard County Emergency Operations Center (BCEOC), and the Joint Information Center (JIC); maintain presence during launch opportunity; respond to any anomalies or emergencies; and archive data.

II.C. ALSG Capabilities

The capabilities that the ALSG brings include radiological monitoring, sample collection and processing, geographic information systems (GIS), communications, training of responders, technical and operational expertise, health and safety of responders, medical guidance for radiological injuries by imbedding the NNSA Radiation Emergency Assistance Center/Training Site (REAC/TS), and secure, legally accountable maintenance of data.

The purpose of support afforded by RSL is to coordinate, define, and organize all the radiological monitoring and assessment[2], logistics, and communications requirements for the

ALSG, RADCC, JIC, and BCEOC prior to the launch. In addition, the RSL will identify the necessary assets needed to meet the various organizational and overall mission objectives set forth in various plans. Main sites designated to receive NNSA and contractor support are listed in Table I.

This overall support will ensure quick and positive methods of communicating information pertaining to the radiological assessment, field monitoring, and the reporting of any urgent developments directly related to an unexpected radiological release between the ALSG, RADCC, JIC, and BCEOC. In addition, it addresses the need to provide informational data to the DOE, the National Operations Center (NOC), and the Florida Emergency Operations Center (FL EOC) using the DOE Emergency Communications Network (ECN).

III. CONCEPT

To ensure continuity of information between first responders, supporting agencies, and field monitoring teams in the event of an accident related to the launch, a reliable communication path between all facilities and associated field monitoring teams will be needed. A common path will be provided via dedicated Ku Band satellite, wideband microwave 802.11 wireless, terrestrial, and radio frequency (RF) links, which will be installed and maintained by the RSL Communications Group. The path will provide the facilities with internet protocol voice, data, video, and video conferencing services. The path will also include Raw Internet and access to the Federal Radiological Monitoring and Assessment Center (FRMAC) Web, which resides on the RSL network, as well as connectivity to the NNSA ECN nationwide data network via the Mobile ECN (MECN) satellite communications package. Informational data will be supplied via the MECN, Web access to the FRMAC Web and GIS Web Portals, and video conferencing using the ECN multi conferencing unit. RSL will resolve interoperability issues that exist between

KSC and RSL radio systems. RSL may utilize existing Land Mobile Radios and traditional RF repeaters.

IV. RESPONSIBILITIES

Under mutual agreement, the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office will provide the necessary systems and equipment from RSL to meet NNSA mission requirements.

The RSL Mission Leader will maintain accountability of all personnel and equipment under their control throughout the deployment. RSL planners will provide the following:

- Air transportation to Cocoa, Florida, for all RSL MSL mission personnel
- 53′ open-sided flat-bed truck to transport equipment deployed to the Cocoa National Guard Armory
- 20,000-pound forklift to offload and load equipment pallets at the Armory
- Enclosed box trucks to transport and protect equipment
- Liquid Nitrogen

V. MSL RADIO NETWORKS

RSL Communications will supply the tentative listing of the MSL radio networks that are to be used for the NNSA and NNSA-associated radio communications. Networks will be supplied for Aerial Measuring System (AMS) NNSA aircraft, AMS tracking and data networks, offsite monitoring teams, NNSA offsite personnel, and U.S. Environmental Protection Agency offsite monitoring teams. All NNSA handheld and base station radios will be encrypted with the appropriate key to ensure voice privacy between the networks. Radio networks provided by RSL will be interfaced into the RADCC radio consoles as described in KSC procedures via a KSC-provided interface terminal in the RADCC.

VI. MONITORING OPERATIONS

In the event of anomaly, plans have been developed to deploy ten monitoring teams offsite KSC and at least eight monitoring teams onsite KSC. The offsite and onsite teams will be armed with 4-inch high-volume air samplers, Violinists, Alpha survey meters, portable generators, and environmental sample collection tools, as required.

Thirty locations have been identified for continuous air monitoring by Environmental Continuous Air Monitors (ECAMs). These ECAMs will automatically transmit the sampling data to the data center.

VI.A. FRMAC Web

The FRMAC Web is an Internet-based data dissemination application used to assist local, state, and federal decision makers during a radiological incident. This secure web-based information system provides a convenient method of sharing consequence management information, such as event status data, plume model predictions, measurement data, and other data essential for decision makers.

NNSA currently maintains the resource and has facilitated near real-time data sharing between FRMAC federal agencies and state and local organizations. National Atmospheric Release Advisory Center (NARAC) and FRMAC have established these Web sites for sharing information with multiple agencies. The effort has also laid the foundation for rapidly developing sharing and automated distribution tools for a wide variety of customers. Authorization to the information on the web is controlled by the Lead Federal Agency through the FRMAC Director via the RSL FRMAC Web Administrator. Requests to access the FRMAC Web are processed through the RSL FRMAC Web Administrator.

VI.B. Data Assessment

Goals of the ALSG in assessing offsite data are to identify areas in which there is a potential for early health effects; highlight and notify the assessment manager of any unexpected findings; maintain awareness of monitoring and laboratory work underway; maintain awareness of action requests and their progress; review all incoming data and not get confused by redistribution of copies; correlate incoming data with Monitoring Plan and Action Requests, expediting high priority items; and correlate incoming sample data with Monitoring Plan and Action Requests, expediting high priority items.

Actions and objectives of the management information system employed by ALSG are to assist the assessment manager with assignment of priority and detection limits to samples submitted for analysis; develop a characterization of the radiological scenario; summarize key aspects for presentation to decision makers; produce GIS maps with data; produce the Protective Action Guideline (PAG) Zone Map set at least once per shift; use NARAC/Sandia Hazard Response Capability for early PAG Zone Maps; assure Monitoring and Sampling Status Map is produced at least twice per shift; obtain Posting and Location Identifier maps at least twice per shift; prepare maps that integrate several data types on one base for comparison; direct application of conversion factors to data sets; ensure Quality Assurance (QA)/Quality Control working closely with GIS and Data Center; perform quality reviews of data; pursue and resolve quality issues; assign assessment quality "flag"; prepare QA cover sheet for all products; approve and release as many assessment products as possible; maintain QA records of assessment division activity; and maintain assessment library.

The three primary presentation formats of data products are as follows:

VI.B.1. Interactive mapping

The quickest method for retrieving data needed for an assessment is through interactive mapping. This type of information can generally be derived directly from the GIS by sitting down at a terminal and querying data interactively on the system. The requestor gets the necessary information, and no other products are required. This is an effective tool used by assessment scientists to review data and check the validity of both measurement and spatial information associated with new data points.

VI.B.2. Computer displays projected to large screens

Often, ALSG scientists need to view data for group discussion that might lead to generation of protective action recommendations or just to understand the general status of the response. To meet this requirement, GIS screen displays can be projected to large format to guide the group discussion. This is a quick method to disseminate information without time lags associated with hard copy printing.

VI.B.3. Hard copy maps and tabular summaries

Hard copy maps are often necessary for analysis of radiological data conditions, providing radiological status to the lead federal agency or other ALSG organizations, or for dissemination at press briefings, etc. Hard copy products also represent a snapshot in time, indicating conditions at the time of printing only, and can be easily referenced based on map numbering information.

The Current Radiological Conditions Map is a best estimate of the present dose rate. It is used primarily as a Health and Safety aid to guide/plan field operations. This map is *not* used to convey PAG comparison. If the resuspension dose is negligible, then this is just external exposure rate. However, if resuspension dominates the external dose, then this map is the deposition multiplied by the appropriate dose conversion factor. The process for production of

these maps is to first determine if the dose is external or inhalation. If external exposure dominates, then the assessment scientist obtains all exposure rate data available including AMS and imports these into GIS as separate coverage areas. If inhalation dose dominates, the assessment scientist obtains all marker nuclide data available including AMS and imports these into GIS as separate coverage areas. The assessment scientist has GIS set legend break points at the desired values using different colors for each with the highest as red and the lowest as blue. (The defaults are 10 mrem/h, 2.5 mrem/h, 1 mrem/h, 0.5 mrem/h and 0.05mrem/h.) The assessment scientist plots that comparison as a single coverage; inspects the plot and draws on it the best estimate for the selected contour levels; and has GIS digitize the hand drawn map as the current condition coverage. The assessment scientist presents this coverage as the Current Radiological Conditions Map, including a text box to explain the nature of the map.

The PAG Zone Map indicates zones in which particular PAGs are exceeded. Two versions (Near Field and Far Field) are required, because some PAGs will only be exceeded very near the incident cite (<10 miles), while others may be exceeded to great distances (>50 miles). The maps may show any combination of these six zones: Evacuation (Early Phase), Sheltering (Early Phase), Relocation (1 year), Long Term Objective (2 year), Long Term Objective (50 year), and Ingestion (food embargo).

The Monitoring/Sampling Status Map summarizes the location and type of all monitoring and sampling data that has been collected up to the current time. The purpose of the Monitoring/Sampling Status Map is two-fold: (1) portray the progress of the monitoring effort and (2) convey some concept of quality and confidence for the PAG Zone Map. Previous data ("assessed" flag set) are plotted first in a muted color. Current data being reviewed ("Verified" flag set, but assessment's flag not yet set) are plotted last in a bold color. Thus, new data

overwrites old data. The maps continually grow in density and diversity of data collected. They do not reflect the level of radiation, concentration, or dose. Unique colors or symbols are used for each measurement and sample type.

VII. CONCLUSIONS

Work activities associated with an unlikely anomaly during the launch of the MSL will be supported by RSL. These activities include data acquisition and assessment, support of communications systems, and support of both NNSA and NASA, as required, to quickly assess any change in the radiological environment. Tools recently developed and/or procured for NNSA, such as FRMAC Web and ECAMs, will be employed.

ACKNOWLEDGMENTS

The author wishes to acknowledge the staff of the RSL and NSTec, as well as NNSA, and NASA.

REFERENCES

1. http://marsprogram.jpl.nasa.gov/msl/index.html
2. FRMAC Assessment Manual, vol. 1-3, Sandia National Laboratories. Albuquerque, NM, U.S. Department of Energy, National Nuclear Security Administration (2003).

TABLE I. Functional Group and Location of Group.

Function	**Location**
Advance Launch Support Group	Cocoa National Guard Armory Cocoa, Florida
Radiological Control Center	Kennedy Space Center (KSC), Operations and Checkout Building, KSC, Florida
Joint Information Center	Kennedy Space Center (KSC), KSC, Florida
Range Operation Control Center	Cape Canaveral Air Force Station Cape Canaveral, Florida
Brevard County Emergency Operations Center (BCEOC)	BCEOC, Cocoa, Florida
U.S. Department of Energy (DOE) Emergency Communications Network	DOE Washington, D.C.
National Operations Center (NOC)	Homeland Security Operations Center Herndon, Virginia
Florida Emergency Operations Center (FL EOC)	FL EOC
Remote Sensing Laboratory (RSL) Network Operations Center	RSL, Las Vegas, Nevada