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REVIEW REPORT

OFFICE OF AUDITS

GLENN RESEARCH CENTER NEEDS TO BETTER DEFINE
ROLES AND RESPONSIBILITIES FOR
EMERGENCY RESPONSE

OFFICE OF INSPECTOR GENERAL



National Aeronautics and
Space Administration

Final report released by:

signed

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Acronyms

EPP	Emergency Preparedness Plan
ERT	Emergency Response Team
FY	Fiscal Year
HSPD	Homeland Security Presidential Directive
ICS	Incident Command System
IRIS	Incident Reporting Information System
MOU	Memorandum of Understanding
NIMS	National Incident Management System
NPR	NASA Procedural Requirements
SCBA	Self-Contained Breathing Apparatus

OVERVIEW

GLENN RESEARCH CENTER NEEDS TO BETTER DEFINE ROLES AND RESPONSIBILITIES FOR EMERGENCY RESPONSE

The Issue

This review was initiated in response to two hotline complaints concerning the Glenn Research Center at Lewis Field: the first concerned laboratory safety and the review process for granting safety permits, and the second concerned first responders and their actions during a January 2006 fire in a Glenn underground tunnel. Our report, “Effective Inspection Program Key to Improving Laboratory Safety at Glenn Research Center” (IG-07-032, September 24, 2007), addressed laboratory safety and the process for reviewing, approving, and maintaining safety permits for Glenn laboratory operations. This report addresses the response to Glenn emergencies.

The primary goal of an emergency response system is to mitigate the harmful effects of an emergency by preventing loss of life, serious injury, and damage to property or the environment. Federal requirements for emergency response are contained in Homeland Security Presidential Directive (HSPD)-5, “Management of Domestic Incidents,” February 28, 2003. HSPD-5 establishes general emergency response requirements for all Federal agencies and requires that Federal agencies develop and administer the National Incident Management System (NIMS). NIMS provides a consistent Nation-wide template to enable all government, private sector, and nongovernmental organizations to work together during domestic incidents and includes the implementation of an Incident Command System (ICS) during each emergency response. ICS is a standard, on-scene, all-hazards incident management system that applies to firefighters, law enforcement personnel, hazardous materials teams, rescuers, and emergency medical teams. ICS is designed to facilitate the work of cross-functional teams in a smooth, coordinated effort under a single management system. This enables responders to effectively work together in preparing for, preventing, responding to, and recovering from emergencies.

At Glenn, the organizations responsible for emergency response include the Office of Security Management and Safeguards; the Safety and Mission Assurance Directorate; and the municipalities of Brook Park, Ohio, and Fairview Park, Ohio. The Glenn Emergency Management Coordinator is assigned to the Office of Security Management and Safeguards and is responsible for preparing the Glenn Emergency Preparedness Plan (EPP). The Glenn EPP requires that emergency responders comply with ICS during all Center emergencies.

We reviewed the management of Glenn’s emergency response system and its adherence to Federal and NASA guidance. We analyzed the actions taken by Glenn responders during 10 of the 572 emergencies experienced at Glenn during fiscal years (FYs) 2005 through 2007. The details of our review’s scope and methodology are in Appendix A.

Results

The lack of clearly defined roles, responsibilities, and lines of authority for Glenn responders, along with the absence of memorandums of understanding (MOU) with off-site responding organizations, has negatively affected the Center’s ability to implement ICS and respond effectively to emergencies. When ICS is not properly implemented during an emergency, the chain of command and lines of communication can become confused, increasing the risk of injury for responders and other personnel, as well as increasing the risk of damage to NASA assets. For at least two of the emergencies that we reviewed, that confusion could have resulted in serious injury to the responders and further damage to Glenn assets.

We found that the Glenn first responders failed to adequately implement ICS during each of the 10 emergencies that we reviewed. Specifically, Glenn emergency responders

- did not keep a safe distance from the emergency scene or adequately assess the nature of the emergency (2 out of 10);
- did not initiate an emergency notification protocol based on the severity and type of emergency (5 out of 10);
- failed to isolate and deny entry into areas “immediately dangerous to life and health”¹ (3 out of 10);
- allowed personnel to enter hazardous environments without appropriate respiratory protection (2 out of 10);
- failed to provide critical institutional information to responding fire departments (4 out of 10); and
- failed to ensure that all reports related to the emergency response contained accurate and consistent information (10 out of 10).

Although the EPP required Glenn emergency responders to implement ICS when responding to emergencies, it did not clearly define the roles, responsibilities, authority, and limitations for each of the responders and responding organizations under ICS. In

¹ An area with an atmosphere that will cause irreversible adverse health effects or impair an individual’s ability to escape is “immediately dangerous to life and health,” according to the Occupational Safety and Health Administration Act, 29 Code of Federal Regulations 1910 (Standard Number 1910.134).

addition, Glenn did not have MOUs with local police, fire, and rescue departments designating how they should coordinate and integrate with the Glenn responders during an emergency. Glenn's ability to respond effectively to on-site emergencies is contingent on the mobilization and use of resources from multiple and diverse response organizations. When properly implemented, ICS provides a management system that allows these resources to be effectively managed and integrated.

Management Action

To improve the effectiveness of Glenn's emergency response system, we recommended that the Chief, Office of Security Management and Safeguards, review the roles and responsibilities assigned to each of the responding organizations and ensure that the responders are qualified to assume those roles and responsibilities and can effectively and timely respond to Glenn emergencies. Once the review is completed, the Chief, Office of Security Management and Safeguards, should revise the EPP, if necessary, based on the results of the review. We also recommended that the Chief, Office of Security Management and Safeguards, revise the EPP to require that each Glenn organization with an emergency response role develop standard operating procedures detailing the specific responsibilities for their respective responder personnel. To ensure that the standard operating procedures complement the EPP and do not provide contradictory information, we recommended that the EPP be revised to require the Glenn Emergency Management Coordinator to review and approve the standard operating procedures before implementation. We also recommended that the EPP require the Emergency Management Coordinator to reconcile all emergency response reports filed, to include those by off-site responding organizations, to ensure that the reports are accurate and consistent. Finally, we recommended that the Glenn Director establish MOUs with all non-NASA organizations that respond to emergencies at the Center. The Emergency Management Coordinator should participate in developing those MOUs.

In a response to a draft of this report, the Glenn Director concurred with our recommendations and described actions to be taken by the Center to improve the effectiveness of Glenn's emergency response system. First, the Glenn Emergency Management Coordinator will review the roles and responsibilities of on-site and off-site emergency responders by November 30, 2009. Second, the Chief, Office of Security Management and Safeguards, in conjunction with the Director of Center Operations, the Director of Safety and Mission Assurance, and the Emergency Management Coordinator will analyze and determine the best organization for emergency response and incorporate the results into the Center EPP by July 30, 2009. Third, the Emergency Management Coordinator, in cooperation with the Chief, Security Management and Safeguards Office; Chief, Safety, Health, and Environmental Division; the Office of Chief Counsel; and the Center Director's Office, will initiate negotiations to establish MOUs with adjoining or jurisdictional organizations that provide fire suppression, fire rescue, emergency medical services, police, and hazardous chemicals and materials response by December 10, 2009. Fourth, the Safety, Health, and Environmental Division will develop a new emergency

action plan for each facility at Glenn by April 23, 2009. (See Appendix B for the full text of management's comments.)

Within the period of the audit, Glenn instituted the use of the ICS and implemented an aggressive training effort to upgrade the credentials of emergency responders. Glenn indicated in their response that they have met and exceeded all NASA required NIMS training by training 114 individuals, with seven of the 114 trained to ICS 300 level and five of the 114 trained to the ICS 400 level.

We consider management's proposed actions to be responsive. The recommendations are resolved and will be closed following verification that all actions have been completed.

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INTRODUCTION

Background

The primary goal of an emergency response system is to effectively mitigate or lessen the harmful effects from an emergency by preventing loss of life, serious injury, and damage to property or the environment. Common elements of an emergency response system are site assessment, safety, rescue, containment, mitigation, recovery, and documentation.

The Federal Government established general emergency response requirements in Homeland Security Presidential Directive (HSPD)-5, "Management of Domestic Incidents," February 28, 2003. HSPD-5 directs all Federal agencies to develop and administer a National Incident Management System (NIMS). NIMS provides a consistent approach that enables Federal, state, and local governments to work together in preparing for, preventing, responding to, and recovering from emergencies. NIMS requires the implementation of an Incident Command System (ICS), which is an on-scene management system that provides a standard structured approach for responding to emergencies.

Incident Command System. ICS is a standard, on-scene, all-hazards incident management system that is used by all levels of government—Federal, state, and local—as well as many private sector and nongovernmental organizations. ICS is applicable across all disciplines, including firefighters, law enforcement personnel, hazardous materials teams, rescuers, and emergency medical teams. The system is not exclusive to any single discipline or circumstance; instead, ICS is designed to be flexible, allowing responders from all jurisdictional levels and across all functional disciplines to work together in a smooth, coordinated effort under a single management system. ICS uses a top-down modular organizational structure that emphasizes a strict chain of command that begins with the on-scene Incident Commander. The Incident Commander is the individual in overall command of the emergency response effort. The first responder on the scene assumes the role of the Incident Commander until relieved by a more qualified authority, such as the fire chief in the case of a fire.

Glenn Research Center Emergency Response Organizations. The primary organizations responsible for emergency response at Glenn are as follows:

- The Office of Security Management and Safeguards, Center Operations Directorate, is responsible for Glenn's Emergency Preparedness Program and emergency response for all security-related emergencies. Within the Office of Security Management and Safeguards are the Emergency Management Coordinator and the support services contractor, Knight Protective Services, which provides security guards and dispatchers.

- The Safety, Health, and Environmental Division of Glenn’s Safety and Mission Assurance Directorate is responsible for emergency response for non-security related emergencies. Within the Division’s Safety Branch, selected safety specialists are designated as Center “first responders.” As part of their duties, those personnel are required to respond to all Glenn emergencies during regular duty hours. The Division also provides occupational health specialists and environmental engineers when needed for injuries or chemical spills.
- The municipalities of Brook Park and Fairview Park provide fire, medical, and police services for Glenn emergencies such as fires, personnel injury, chemical spills, and criminal investigations.

Depending on the type and severity of the emergency, Glenn may also deploy an Emergency Response Team (ERT). In addition to personnel from Glenn’s Security and Safety Offices, the ERT may include personnel with other functional areas of expertise (such as facilities, communications, and media relations).

NASA Guidance. NASA’s implementing guidance for NIMS is contained in NASA Procedural Requirements (NPR) 8715.2, “NASA Emergency Preparedness Plan Procedural Requirements,” Change 3, March 3, 2005. In accordance with NPR 8715.2, Glenn developed and implemented an Emergency Preparedness Plan (EPP) in October 2006. The Glenn EPP requires that emergency responders comply with ICS during all Center emergencies.

Objectives

Our overall objective was to evaluate the effectiveness of Glenn’s emergency response system. Specifically, we evaluated the adequacy of Glenn’s emergency response policies and procedures, the implementation of those policies and procedures, and Glenn management’s oversight of the emergency response system. See Appendix A for details of the review’s scope and methodology, our review of internal controls, and prior coverage.

Other Matters of Interest

During our review, we identified nine Glenn facilities that had inadequate emergency evacuation plans. Because evacuation plans are an element of emergency preparedness and not emergency response, we discuss the issue separately on page 13 of this report. The discussion describes the need for Glenn to ensure that evacuation plans are up to date and that the plans include maps showing both primary and secondary routes of escape.

ICS NOT ADEQUATELY IMPLEMENTED DURING GLENN EMERGENCIES

Glenn first responders failed to adequately implement ICS during each of the emergencies that we reviewed. Specifically, we identified 26 instances of ICS noncompliance during our review of 10 Glenn emergencies that occurred during fiscal year (FY) 2005 through FY 2007. For those 10 emergencies, the Glenn emergency responders

- did not keep a safe distance from the emergency scene or adequately assess the nature of the emergency (2 out of 10);
- did not initiate an emergency notification protocol based on the severity and type of emergency (5 out of 10);
- failed to isolate and deny entry into areas “immediately dangerous to life and health”² (3 out of 10);
- allowed personnel to enter hazardous environments without appropriate respiratory protection (2 out of 10);
- failed to provide critical institutional information to responding fire departments (4 out of 10); and
- failed to ensure that all reports related to the emergency response contained accurate and consistent information (10 out of 10).

Noncompliance with ICS occurred due to the lack of clear guidance regarding the roles and responsibilities of the Glenn responders and the responding organizations. Although the EPP contained general information concerning those roles and responsibilities, it did not require that more specific guidance be prepared at the organizational level. In addition, Glenn did not have memorandums of understanding (MOUs) with local police, fire, and rescue departments designating how they should coordinate and integrate with the Glenn responders during an emergency.

The lack of clearly defined roles, responsibilities, and lines of authority for Glenn responders, along with the absence of MOUs with off-site responding organizations, has negatively affected the Center’s ability to respond effectively to emergencies.

² An area with an atmosphere that will cause irreversible adverse health effects or impair an individual’s ability to escape is “immediately dangerous to life and health,” according to the Occupational Safety and Health Administration Act, 29 Code of Federal Regulations 1910 (Standard Number 1910.134).

Specifically, when ICS is not properly implemented during an incident, the chain of command and lines of communication can become confused, increasing the risk of injury for responders and other personnel, as well as increasing the risk of damage to NASA assets. During at least two of the emergencies that we reviewed, that confusion could have resulted in serious injury to the responders and further damage to Glenn assets.

Glenn’s Emergency Response System

Glenn’s emergency response system is initiated when the Emergency Dispatch Center is notified of an alarm or receives a 911 call (see Figure 1). The nature of the emergency dictates whether the dispatcher contacts only Glenn responders or contacts both Glenn responders and local municipalities.

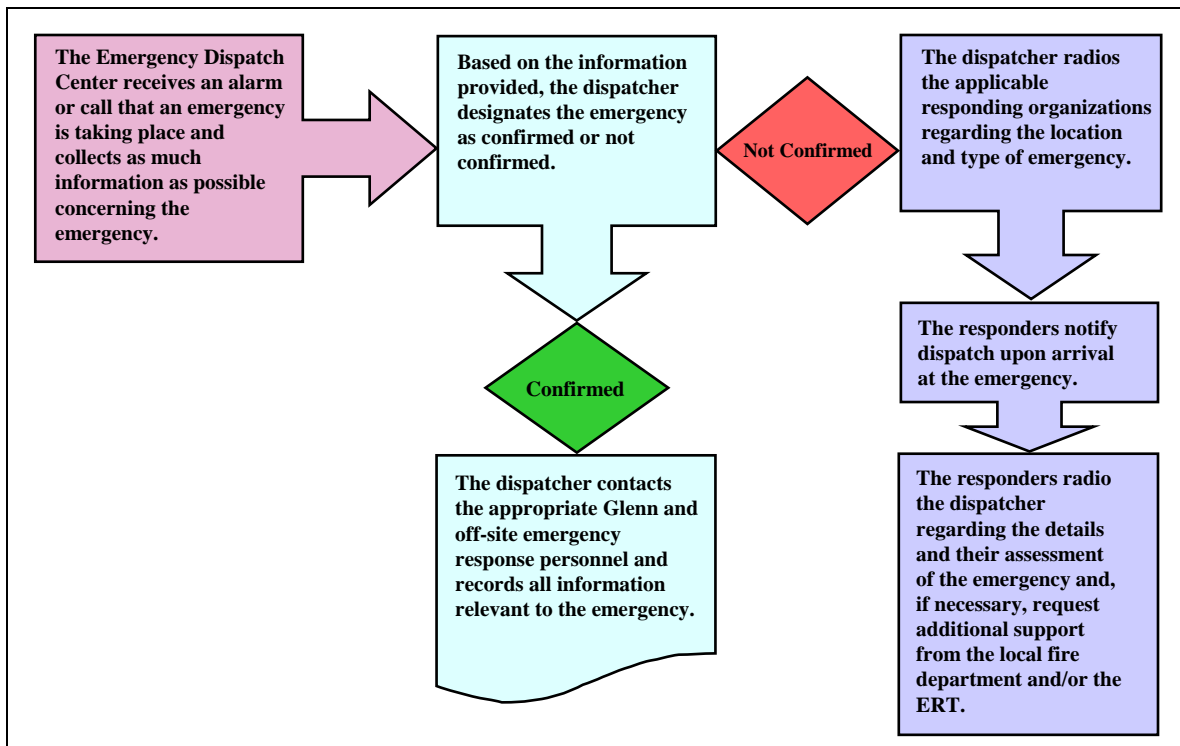


Figure 1. Flowchart of Glenn’s Emergency Response System

Regardless of the type of emergency, generally the Glenn first responders are the first to arrive on scene and, as such, assume the Incident Commander role until relieved by a more qualified authority. As initial Incident Commander, the first responders direct the initial emergency response and mitigation activities, which according to the ICS and the Glenn EPP consist of

- providing immediate response to the scene;
- assessing the situation;
- notifying the Emergency Dispatch Center if Glenn or municipality resources are needed;
- evacuating the area, if necessary; and
- establishing a command post and notifying the dispatcher of its location.

Once relieved by a more qualified authority (such as a fire chief in the case of a fire), the first responders are required to provide support to the new Incident Commander.

ICS Noncompliance

We reviewed Glenn's response to 10 emergencies during FYs 2005 through 2007 (listed in Table 1). We selected those emergencies from the Incident Reporting Information System (IRIS), NASA's database for recording mishaps.³ Mishap classifications range from a Type A Mishap, which is the most severe, to a Close Call, which is the least severe. To cover the spectrum of Glenn emergencies, our sample selection included at least one emergency from each mishap classification (see Appendix A for details of our sampling plan).

³ NASA defines a mishap as an unplanned event that results in injury to personnel or damage to property. NASA categorizes mishaps based on the severity of injury to personnel or total cost of damage to property.

Table 1. Emergencies Selected for Review			
Date	Emergency	IRIS Number	Classification
June 13, 2007	exterior building fire	2007-164-00005	Type C Mishap
May 4, 2007	interior building fire	2007-124-00010	Close Call
April 5, 2007	exterior gas line rupture	2007-096-00019	Close Call
July 25, 2006	construction site injury	2006-206-00011	Type B Mishap
April 6, 2006	interior chemical release	2006-097-00002	Type D Mishap
January 9, 2006	interior tunnel fire	2006-010-00001	Type A Mishap
November 7, 2005	employee injury	2005-340-00011	Close Call
July 27, 2005	low-oxygen alarm	2005-209-00003	Close Call
March 16, 2005	mercury spill	2005-097-00005	Close Call*
March 9, 2005	fire and explosion	2005-069-00008	Type C Mishap
* IRIS classified this emergency as "First Aid," which is not required to be recorded in IRIS. As such, we considered this a "Close Call."			

During each of the 10 emergencies that we reviewed, the Glenn first responders failed to adequately implement ICS. Specifically, the responders failed to adequately assess the incident from a safe distance, implement appropriate emergency notification procedures, isolate and deny entry, use appropriate personal protective equipment, share critical information with responding municipalities, or fully document all emergency response activities.

Safe Approach and Assessment. During the July 27, 2005, low-oxygen alarm and the March 9, 2005, fire and explosion, Glenn first responders failed to maintain a safe distance from the emergency while performing their initial assessment. ICS requires responders to assess the emergency from a safe distance, which is typically upwind and upslope. The overall priorities when assessing an emergency and determining the appropriate level of response are (1) life safety, including the safety of the responders; (2) incident stabilization; and (3) property preservation. At Glenn, this initial assessment is reported to the Emergency Dispatch Center, along with a request for municipality assistance if needed.

During the initial assessment of the July 27, 2005, low-oxygen alarm, the Glenn responders failed to keep a safe distance from an oxygen-deficient atmosphere when they entered a building without adequate respiratory protection. Specifically, the first responders entered two rooms in which the percentage of oxygen had dropped to unsafe levels due to a nitrogen leak. Any imbalance or displacement of oxygen by nitrogen within a given space can pose an asphyxiation hazard and because nitrogen is both

odorless and tasteless, unprotected victims have little or no warning of exposure until they collapse from the lack of oxygen. In this instance, the first responders escaped injury only because the nitrogen (which is heavier than oxygen) had not reached the breathing level (mouth and nose) of the responders.

The Glenn responders also failed to keep a safe distance from the March 9, 2005, fire and explosion. During the initial response, the first responders failed to assess the incident from a safe distance and instead entered the area where the fire and explosion occurred. Shortly after they entered that area, a second explosion occurred; the concussion from the second explosion was significant enough to cause temporary hearing loss to one of the responders.

Emergency Notification Protocol. During five emergencies—the April 5, 2007, exterior gas line rupture; the July 25, 2006, construction site injury; the January 9, 2006, interior tunnel fire; the July 27, 2005, low-oxygen alarm; and the March 16, 2005, mercury spill—the Glenn responders failed to initiate an emergency notification protocol based on the severity and type of the emergency. In accordance with ICS and the Center’s EPP, once an emergency is declared and an Incident Commander and command post initiated, the Incident Commander should contact dispatch to ensure that all required resources, including personnel and equipment, are notified and en route to the emergency. That emergency notification protocol includes notifying Glenn’s ERT during certain types of Center emergencies. Notification of the ERT is vitally important because of the organizational and functional expertise the ERT provides to the Incident Commander. For the 10 emergencies that we reviewed, Table 2 illustrates those instances in which the ERT should have been notified but was not.

Table 2. Emergencies Requiring ERT Notification					
ERT Notification Criteria	Emergency				
	April 5, 2007 (exterior gas line rupture)	July 25, 2006 (construction site injury)	Jan. 9, 2006 (interior tunnel fire)	July 27, 2005 (low-oxygen alarm)	March 16, 2005 (mercury spill)
Type A, B, or C Mishap		X	X		
Municipality response requested		X	X		
Center or building evacuation or closure			X		
Major power failure			X		
Fire or explosion			X		
Medical emergency requiring transport to hospital		X			
Hazardous material release and chemical spill	X		X	X	X

Hazard Isolation. During three emergencies—the July 25, 2006, construction site injury; the July 27, 2005, low-oxygen alarm; and the March 9, 2005, fire and explosion—Glenn first responders failed to “isolate and deny entry”⁴ to the incident scene, including areas that were “immediately dangerous to life and health.” ICS requires the Incident Commander to ensure the safety of personnel, including emergency responders, by isolating the scene, denying unnecessary access, and preventing harmful exposures. Under ICS, isolation—securing the scene—is the first step in the protective action process and is implemented to prevent injury to the emergency responders and to establish control over the emergency scene. The Incident Commander is responsible for ensuring that all response activities are focused on preventing further injury to personnel or damage to property.

⁴ The U.S. Department of Transportation’s Emergency Response Guidebook defines “isolate hazard and deny entry” as a means to keep personnel away from hazardous environments.

During the July 25, 2006, construction site injury, first responders failed to secure the scene of the incident and to clear the area of nonessential personnel. In this incident, a construction worker was seriously injured when he fell from an extension ladder. According to two Glenn Safety Engineers who responded to the incident, the area was not fully cleared of nonessential personnel until after the arrival of the fire department. In this incident, only those individuals directly involved in providing care to the injured worker should have been permitted to remain in the area. The Incident Commander should have immediately isolated the area surrounding the victim to ensure the safety of personnel, to provide sufficient space that would allow the responders to provide care, and to protect the victim's privacy.

The incident scene was also not secured during the July 27, 2005, low-oxygen alarm and the March 9, 2005, fire and explosion. In both cases, the first responders failed to isolate and deny entry into the area around the incident and unnecessarily exposed themselves to a situation that could have been immediately dangerous to life and health.

Respiratory Protection. During the January 9, 2006, interior tunnel fire and the July 27, 2005, low-oxygen alarm, the Glenn first responders failed to use appropriate respiratory protective equipment when responding to a potentially hazardous environment. ICS requires all emergency responders to use appropriate personal protective equipment for the tasks they are to perform.



Figure 2. Responder Using Self-Contained Breathing Apparatus

Glenn's "Occupational Health Programs Manual," Chapter 4, "Respiratory Protection Program," February 2007,⁵ addresses this ICS requirement by specifying the required equipment. A self-contained breathing apparatus (SCBA), as shown in Figure 2, should be used in an unknown, oxygen-deficient, or immediately dangerous to life and health atmosphere. Glenn's Manual further requires that personnel be trained in the use and limitations of an SCBA before using it.

In the January 9, 2006, interior tunnel fire, the Glenn first responders and the City of Brook Park's Fire Chief were operating under a unified command system.⁶ During this emergency, a Brook Park firefighter and two Glenn employees were permitted to enter a building filled with dense smoke without respiratory protective equipment. The fire, which had originated in an electrical splicing chamber inside an underground utility

⁵ The Manual is continually updated; respiratory requirements were in effect at the time of the emergencies.

⁶ Under ICS, a unified command system is when two or more agencies work together to manage an incident.

tunnel, had resulted in the propagation of dense smoke throughout the tunnel and into adjoining buildings. As such, anyone entering the tunnel or buildings should have been wearing personal protective equipment, including respiratory protection to prevent asphyxiation. The unified command also allowed one of the Glenn first responders to borrow an SCBA from one of the responding fire departments and, on two separate occasions, he accompanied the firefighters into the smoke-filled buildings. The first responder did not have the authority, training, or certification to use the SCBA. Without such authority, training, and certification, the first responder may not have been aware of the limits of the SCBA, which could have resulted in injury to him and the other responders.

During the July 27, 2005, low-oxygen alarm, the first responders entered a building without appropriate respiratory protection. At the time of this incident, the first responders had been removed from the Center's respiratory protection program and, as a result, did not have access to respiratory protective equipment such as an SCBA. Because the first responders believed that they were expected to respond to potentially oxygen-deficient atmospheres, they entered two rooms where the oxygen had been reduced to an unsafe level, unnecessarily exposing them to an asphyxiation hazard.

Information Sharing with Local Municipalities. During four emergencies—the June 13, 2007, exterior building fire; the May 4, 2007, interior building fire; the January 9, 2006, interior tunnel fire; and the March 9, 2005, fire and explosion—the Glenn responders did not share critical information with the responding local fire departments. ICS requires responders to establish a process for gathering, sharing, and managing all incident-related information. The Glenn EPP addresses this ICS requirement by requiring Glenn first responders to provide prefire plans,⁷ blueprints, maps, and other supporting documentation to responding fire and emergency personnel for use during on-site emergencies. However, during these four emergencies, the Glenn first responders did not have access to all necessary information and, therefore, could not provide it to the responding fire departments. Although the first responders did carry prefire plans in their vehicles, they did not carry or have electronic access to utility maps, evacuation plans, chemical inventory lists, or Material Safety Data Sheets.⁸ Further, the prefire plans that the Glenn responders did have were either not provided to the responding firefighters or the plans failed to include relevant information. If appropriately designed and implemented, prefire plans are invaluable to responding fire departments because the plans identify hazards that could potentially impact firefighter safety. For each of the four emergencies, the responding firefighters entered a building without having crucial knowledge of the building layout and the location of potential hazards, which significantly increased their risk of injury.

⁷ Title 15, United States Code, Chapter 49, Section 2227, "Fire Safety Systems in Federally Assisted Buildings," defines a "prefire plan" as specific plans for firefighting activities at a property or location.

⁸ Material Safety Data Sheets contain information concerning the properties and hazards of chemicals used and stored in the workplace, including the engineering and personal protective equipment necessary to protect personnel from hazardous exposure.

Inconsistent and Incomplete Documentation. The response documentation for all 10 emergencies that we reviewed was inconsistent and incomplete. ICS requires responders to develop an Incident Action Plan and to maintain accurate and complete files to document the major steps taken during an emergency response. ICS also requires responders to retain all emergency-related documentation for legal, analytical, and historical purposes.

The Glenn EPP implements the ICS requirement by requiring the dispatcher to maintain a log of all emergency actions taken. However, the logs did not always contain sufficient information or were in conflict with other response documentation. For example, during the May 4, 2007, interior building fire, the notification and response times recorded in the Emergency Dispatch Log were different from the times recorded in the Security Log and the Brook Park Fire Department report.

We also noted that the Emergency Dispatch Logs did not always include

- notification of the emergency to security personnel and the Brook Park Fire Department;
- information regarding who assumed the initial role of Incident Commander or the next person who assumed the role of Incident Commander;
- arrival times of the first responders, local fire departments, and emergency medical services; and
- the time the emergency was terminated.

The Glenn EPP also requires the first responders to provide daily reports to the Safety, Health, and Environmental Division regarding their response activities, but does not provide guidance as to the content of the reports. During the July 25, 2006, construction site injury, the first responder report simply stated that a male was observed lying on the ground, that Safety Office personnel had been requested, and that the fire department had transported the victim to a local hospital. The report failed to provide pertinent information regarding the emergency, such as the extent of the victim's injuries, that the area was not immediately cleared of nonessential personnel, or that the Brook Park Fire Department had trouble hoisting the person out of the construction site. An accurate record of such information is critical for historical purposes and for effectively recording "lessons learned."

Roles and Responsibilities Not Clearly Defined

The Glenn responding organizations did not clearly define the roles and responsibilities for the personnel required to implement ICS during on-site emergencies. Glenn guidance regarding emergency response is under the purview of the Office of Security Management and Safeguards. Within that office is the Emergency Management Coordinator, who is responsible for developing the Center's EPP. The EPP provides

general guidance regarding roles and responsibilities of first responders as well as other Glenn emergency responders. We do not expect the EPP to contain more than general guidance; however, the EPP should require that the responder organizations develop supplemental guidance containing specific information concerning roles and responsibilities during an emergency. None of the responder organizations had such supplemental guidance.

For example, Glenn first responders report to the Safety Branch of the Safety and Mission Assurance Directorate's Safety, Health, and Environmental Division. However, the Safety Branch had not instituted a standard operating procedure to define first responders' tactical actions, lines of authority, qualifications, or use of personal protective equipment. In addition, the first responders' position descriptions did not include details concerning responsibilities, limitations, and performance evaluation standards associated with first responder duties. The other response organizations apparently had not been made aware of those responsibilities and limitations either because in two of the emergencies—the July 27, 2005, low-oxygen alarm and the January 9, 2006, interior tunnel fire—the Emergency Dispatch Center dispatched the first responders to potentially oxygen-deficient atmospheres after the first responders had been removed from the Center's respiratory protection program.

Memorandums of Understanding Not Prepared

Because Glenn does not have the necessary resources to effectively mitigate major emergencies, the Center is dependent on off-site emergency responders. To ensure that all emergency responders properly coordinate and integrate their resources during an emergency, Centers are required to establish MOUs with the off-site responding organizations. Specifically, paragraph 11.3 of NASA Standard 8719.11, "Safety Standard for Fire Protection," August 2000, requires Centers to have written agreements when an off-site, non-NASA fire service organization provides fire suppression, fire rescue, emergency medical services, and hazardous materials response.

This is a repeat finding, as that lack of MOUs was cited in two safety audits conducted by the NASA Office of Safety and Mission Assurance, the first in December 2005 and the second in May 2008. In response to the December 2005 safety audit, Glenn indicated that an MOU with the City of Brook Park was 40 percent complete and that the projected completion date was July 30, 2006. However, as of the date of this report (2 years later), Glenn had not finalized that MOU.

Increased Risks to Personnel, Property, and Mission

Glenn is continuously exposed to potential hazards and emergencies due to its mission and operations, as well as acts of nature. These emergencies could result in the loss of life, serious injury, or property damage that could negatively affect NASA's operations

and missions. To manage its risks, Glenn should have a clear process for responding to on-site emergencies that follows a strict chain of command where subordinate responders report through that chain to the on-scene Incident Commander. The strict adherence to a chain of command reduces the potential for miscommunication and confusion. Glenn's lack of clearly defined roles, responsibilities, and lines of authority for its first responders, along with the absence of MOUs with off-site responding organizations, has negatively affected the Center's ability to respond effectively to emergencies. During at least two of the emergencies that we reviewed—the March 9, 2005, fire and explosion and the July 27, 2005, low-oxygen alarm—the lack of defined roles and responsibilities could have resulted in serious injury to the responders and other NASA personnel and further damage to Glenn assets.

Other Matters of Interest

During our review of Glenn's emergency response system, we visited 10 facilities on Glenn's main campus (Lewis Field) that should have had emergency action plans. Of the 10 facilities, 6 did not have plans and 3 had plans that were missing critical elements required by Federal and Glenn guidance, such as evacuation routes (primary and secondary), identification of evacuation monitors, and post-evacuation assembly locations where accountability could be determined for all personnel.

The Occupational Safety and Health Administration Act, 29 Code of Federal Regulations 1910 (Standard Number 1910.38), requires employers to have a written emergency action plan for each location with 10 or more employees. The emergency action plan should include procedures for emergency evacuations, illustrate the primary and secondary routes of egress,⁹ and define a process for accounting for all employees. In addition, the Glenn Safety Manual, Chapter 27, "Building Evacuation Plan Program," requires the development and implementation of an emergency action plan for each building. The plans must be developed and implemented in accordance with each location's unique operational environment and should be prominently posted in each facility and work location.

⁹ The Glenn Safety Manual defines emergency egress as the process by which a continuous and unobstructed way of exit travel is maintained from any point in a building to a predetermined safe location. Typically, this is accomplished by overlaying arrows onto facility maps pointing in the direction of travel to the building exits.

Recommendations, Management's Response, and Evaluation of Management's Response

Recommendation 1. We recommended that the Chief, Office of Security Management and Safeguards, review the roles and responsibilities assigned to each of the responding organizations, to include the off-site organizations, and ensure that the responders are qualified to assume those roles and responsibilities and can effectively and timely respond to Glenn emergencies. The Chief, Office of Security Management and Safeguards, should revise the EPP to reflect any changes in roles and responsibilities based on the review, if necessary.

Management's Response. The Glenn Director concurred, stating that the Glenn Emergency Management Coordinator will review the roles and responsibilities of on-site and off-site emergency responders to ensure they are qualified and authorized to perform those responsibilities and revise the Center EPP to reflect changes in roles and responsibilities by November 30, 2009. Specifically, he stated that the Emergency Management Coordinator will examine the Glenn EPP and Safety Manual to identify specified and implied roles and responsibilities. In addition, the review will include an assessment of

- composition and roles of the ERT;
- coordination with partner agencies; and
- training.

Evaluation of Management's Response. Management's proposed actions are responsive. The recommendation is resolved and will be closed upon completion and verification of management's corrective action.

Recommendation 2.a. We recommended that the Chief, Office of Security Management and Safeguards, revise the EPP to require that the Glenn organizations with personnel expected to respond to emergencies develop standard operating procedures that, at a minimum, include a clear definition of specific roles, responsibilities, authority, and limitations.

Management's Response. The Glenn Director concurred, stating that the Chief, Office of Security Management and Safeguards, in conjunction with the Director of Center Operations, the Director of Safety and Mission Assurance, and the Emergency Management Coordinator, will analyze and determine the best organization for emergency response and incorporate the results into the Center EPP by July 30, 2009. Specifically, he stated that the revision will incorporate standard operating procedures that include clear definition of specific roles, responsibilities, authorities, and limitations. Additionally, efforts are underway to incorporate all Center emergency response tasks as a function of the ERT, which will allow better utilization of the ICS principles.

Evaluation of Management's Response. Management's proposed actions are responsive. The recommendation is resolved and will be closed upon completion and verification of management's corrective action.

Recommendation 2.b. We recommended that the Chief, Office of Security Management and Safeguards, revise the EPP to require that the Glenn Emergency Management Coordinator review and approve the organizational level standard operating procedures to eliminate any conflict between the responding organizations and the EPP.

Management's Response. The Glenn Director concurred, stating that the Chief, Office of Security Management and Safeguards, in conjunction with the Director of Center Operations, the Director of Safety and Mission Assurance, and the Emergency Management Coordinator, will analyze and determine the best organization for emergency response and incorporate the results into the Center EPP by July 30, 2009. Specifically, the revision of the EPP will require the Emergency Management Coordinator to review and approve the standard operating procedures of the ERT and all responding organizations to ensure there are no conflicts.

Evaluation of Management's Response. Management's proposed actions are responsive. The recommendation is resolved and will be closed upon completion and verification of management's corrective action.

Recommendation 2.c. We recommended that the Chief, Office of Security Management and Safeguards, revise the EPP to require that the Glenn Emergency Management Coordinator reconciles all emergency response reports to ensure the reports are accurate and consistent.

Management's Response. The Glenn Director concurred, stating that the Chief, Office of Security Management and Safeguards, in conjunction with the Director of Center Operations, the Director of Safety and Mission Assurance, and the Emergency Management Coordinator, will analyze and determine the best organization for emergency response and incorporate the results into the Center EPP by July 30, 2009. Specifically, the revision of the EPP will require the Emergency Management Coordinator to reconcile all emergency response reports to ensure that the information is accurate.

Evaluation of Management's Response. Management's proposed actions are responsive. The recommendation is resolved and will be closed upon completion and verification of management's corrective action.

Recommendation 3. We recommended that the Glenn Director, in coordination with the Emergency Management Coordinator, ensure that MOUs are established with non-NASA organizations that provide fire suppression, fire rescue, emergency medical services, police, and hazardous chemicals and materials response. The MOUs, at a minimum, should include the delineation of roles, responsibilities, jurisdiction, and authority of all non-NASA

organizations expected to respond to Glenn emergencies and a requirement that ICS is implemented during all Glenn emergencies.

Management's Response. The Glenn Director concurred, stating that the Emergency Management Coordinator, in cooperation with the Chief, Security Management and Safeguards Office; the Chief, Safety, Health, and Environmental Division; the Office of Chief Counsel; and the Center Director's Office, will initiate negotiations to establish MOUs with adjoining or jurisdictional organizations that provide fire suppression, fire rescue, emergency medical services, police, and hazardous chemicals and materials response by December 10, 2009. He stated that negotiations will take place with the City of Brook Park, the City of Fairview Park, Perkins Township, and the Cleveland Hopkins International Airport and that the MOUs will require the implementation of ICS during all Glenn emergencies. In addition, Glenn is negotiating with Hopkins Airport and the City of Brook Park to establish a Joint Fire Station near Glenn.

Evaluation of Management's Response. Management's proposed actions are responsive. The recommendation is resolved and will be closed upon completion and verification of management's corrective action.

Recommendation 4. We recommended that the Chief, Glenn Safety, Health, and Environmental Division, ensure that a written emergency action plan is prepared for each facility at Lewis Field. The plan should address the evacuation procedures, show the primary and secondary routes of egress, and define a process for accounting for all employees. The plan should be prominently posted in each facility and work location.

Management's Response. The Glenn Director concurred, stating that the Safety, Health, and Environmental Division will develop a new emergency action plan for each Glenn facility by April 23, 2009. He also stated that the plans will be audited to ensure that each plan incorporates evacuation procedures, egress routes, and employee accountability. In addition, the plans will be posted on the Center's intranet and in a prominent location in each building.

Evaluation of Management's Response. Management's proposed actions are responsive. The recommendation is resolved and will be closed upon completion and verification of management's corrective action.

Scope and Methodology

We performed this review from July 2007 through July 2008 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the review to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our review objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our review objectives.

We obtained, reviewed, and analyzed Federal, NASA, and Glenn guidance pertaining to emergency response, to include HSPD-5, the Occupational Safety and Health Administration Act, NASA Standard 8719.11, NPR 8715.2, and the Glenn EPP.

To assess ICS implementation during Glenn emergencies, we selected 10 emergencies from the IRIS database and analyzed applicable documentation for the response activities. That documentation included Emergency Dispatch Logs, first responder daily reports, Brook Park Fire Department reports, Mishap Investigation Board reports, and Security Logs.

We interviewed the Glenn Emergency Management Coordinator; the first responders; the Fire Protection Engineer; the Chief, Safety, Health, and Environmental Division; an Industrial Hygienist; and the Captain of Glenn Security. We also interviewed personnel from local fire departments.

To determine whether the emergency response system had adequate oversight, we reviewed Glenn's post-incident critique reports. We also evaluated reviews and audits conducted by NASA's Office of Safety and Mission Assurance and determined whether corrective actions were taken in response to any findings and recommendations and the extent of follow-up performed to ensure that corrective actions were taken.

Sampling Plan. We obtained the population of Glenn emergencies for FYs 2005, 2006, and 2007 from the NASA IRIS database. The total population of Glenn emergencies for the 3-year period was 572: 189 in 2005, 175 in 2006, and 208 in 2007.

We selected 10 Glenn emergencies from the IRIS database based on a stratification of cases by year, then by mishap classification (Types A, B, C, and D Mishaps and Close Calls). To cover the spectrum of emergencies, we included at least one emergency from each mishap classification. Of the 572 emergencies, two were serious (categorized as Type A and Type B Mishaps). We included those two emergencies in our sample and then selected eight other emergencies, considering incident description, mishap

classification, and date of occurrence. Our review of Glenn's response to these 10 emergencies forms the basis of our results.

Use of Computer-Processed Data. We used computer-processed data from IRIS to identify the population of Glenn emergencies relative to safety issues. We did not evaluate whether IRIS contained all of Glenn's reportable incidents; however, we believe the data was adequate for selecting emergencies for more detailed review.

We identified some errors within the IRIS database and informed Glenn management, who agreed to correct the errors. The errors within IRIS did not affect the results of our review.

Review of Internal Controls

We reviewed internal controls for the Glenn emergency response process, including policies and procedures and oversight by Glenn's Chief, Office of Security Management and Safeguards, and Chief, Safety, Health, and Environmental Division. We identified internal control weaknesses in Glenn's emergency response process, which are discussed in the finding. Our recommendations, if implemented, will improve the controls over Glenn's emergency response process.

Prior Coverage

During the last 5 years, the NASA Office of Safety and Mission Assurance has issued two reports concerning Glenn's emergency preparedness. The NASA Office of Inspector General has also issued two reports that discuss safety issues at Glenn. NASA Office of Inspector General reports may be accessed over the Internet at <http://oig.nasa.gov/audits/reports/FY08/>.

NASA Office of Inspector General

"Effective Inspection Program Key to Improving Laboratory Safety at Glenn Research Center" (IG-07-032, September 24, 2007) addressed laboratory safety and the process for reviewing, approving, and maintaining safety permits for Glenn laboratory operations.

"NASA's Implementation of the National Incident Management System" (IG-06-016, August 29, 2006) found that each Center's EPP, including Glenn's, did not fully comply with NIMS requirements.

NASA Office of Safety and Mission Assurance

“NASA Institutional/Facilities/Operational Safety Audit of Glenn Research Center” (May 29, 2008) found a noncompliance issue previously reported in their December 14, 2005, report regarding no written agreement with the Brook Park Fire Department or Hopkins International Airport Fire Department for non-aircraft emergencies.

“NASA Institutional/Facilities/Operational Safety Audit of Glenn Research Center” (December 14, 2005), found that emergency preparedness was satisfactory overall; however, the Center needed to ensure that all first responders, managers, and employees were properly trained to meet the challenges of threats and disasters, and the Center needed to establish an MOU with the City of Brook Park for fire protection services.

MANAGEMENT COMMENTS

National Aeronautics and
Space Administration
John H. Glenn Research Center
Lewis Field
Cleveland, OH 44135-3191



August 18, 2008

Reply to Attn of: **Center Operations Directorate**

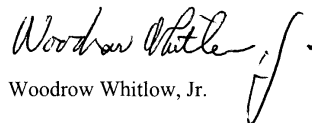
TO: NASA Headquarters
Attn: Assistant Inspector General for Auditing

FROM: A/Director

SUBJECT: Glenn Research Center's (GRC) Response to the Draft Review Report,
Glenn Research Center Needs to Better Define Roles and Responsibilities
for Emergency Response: (Assignment No. S-06-011-01)

Enclosed is Glenn Research Center's response to the Draft Review Report, "Glenn Research Center Needs to Better Define Roles and Responsibilities for Emergency Response: (Assignment No. S-06-011-01) Audit Report. As stated in this response, I concur with the audit findings and recommendations presented by the audit team, and the Center will complete all the corrective actions.

I appreciated the effort and thoroughness of the audit team and their desire to improve the overall effectiveness of our emergency response capabilities. If you have any questions or concerns, please call Mr. James E. Smith, at (216) 433-2085.


Woodrow Whitlow, Jr.

Enclosure

Recommendation 1: We recommend that the Chief, Office of Security Management and Safeguards, review the roles and responsibilities assigned to each of the responding organizations, to include the off-site organizations, and ensure responders are qualified to assume those roles and responsibilities and can effectively and timely respond to Glenn emergencies. The Chief, Office of Security Management and Safeguards, should revise the EPP to reflect any changes in roles and responsibilities based on the review, if necessary.

GRC Response: **Concur**

The GRC Emergency Management Coordinator (EMC) will review the specified roles and responsibilities of on and off-site emergency responders to ensure that they are qualified and authorized to perform these responsibilities. The review will be completed by November 30, 2009, and will be conducted concurrent with other Audit report recommended activities.

During the review the EMC will examine the current GRC Emergency Preparedness Plan (EPP), supporting annexes, and the NASA Glenn Safety Manual to identify specified and implied roles and responsibilities. The review will include an assessment of:

- Composition and Roles of the Emergency Response Team (ERT)
Members of the ERT will be drawn from qualified members of the GRC employee community. Qualifications of GRC emergency responders will determine the level of Incident Command System (ICS) participation as well as roles and responsibilities assigned during emergency responses. The majority of the recurring functions needed during emergency responses will be performed by members of the ERT.

Within the time period of this audit, GRC has instituted the use of the ICS and succeeded in an aggressive training effort to upgrade the credentials of emergency responders. Currently GRC has met and exceeded all NASA National Incident Management System (NIMS) training requirements by training 114 individuals to date. Seven of the 114 are trained to ICS 300 level and five of the 114 are trained to ICS 400 level.

- Coordination with Partner Agencies
Some roles and responsibilities are specified in the Ohio Revised Code; i.e. Fire Chiefs will have full responsibility for fires, oil spills, and hazardous material releases within their jurisdictions. However, as is permitted by the Ohio Revised Code our assessment of the current fire response, Emergency Medical System (EMS), Hazardous Material (HAZMAT), confined space entrapment, and technical rescue response capabilities will be based on partner agency response times, adequacy of equipment, and the results of functional training scenarios documented in recent exercises.

Enclosure

Responding organizations that demonstrate full compliance with training and certifications standards will be determined to be qualified. This qualification will require the capacity to respond with full functional status within six minutes to EMS and fire emergencies and within 20 minutes for technician level HAZMAT (8 man minimum team) including Confined Space and Technical Rescue response (4 man minimum team). It should be noted that efforts continue to establish City of Brook Park and the Hopkins Airport Fire Departments presence on or near GRC, which would permit these qualification standards to be achieved.

- Training
When training or certification requirements are indicated; we will verify the currency and status of training and certifications. Validation of training and certification will afford the Chief, Security Management and Safeguards the opportunity to reassign roles and responsibilities of each responder within the ERT structure. Emergency responders without current training or certification as specified in the GRC plans and manuals will be determined to be unqualified and be removed from emergency response duties.

By November 30, 2009, the Chief, Office of Security Management and Safeguards will revise the Center EPP to reflect any changes in roles and responsibilities required based on the review results.

Recommendation 2: We recommend that the Chief, Office of Security Management and Safeguards revise the EPP to require that the Glenn

- a. Organizations with personnel expected to respond to emergencies develop standard operating procedures that, at a minimum, include a clear definition of specified roles, responsibilities, authority, and limitations.
- b. Emergency Management Coordinator review and approve the organizational level standard operating procedures to eliminate any conflict between the responding organizations and the EPP; and
- c. Emergency Management Coordinator reconciles all emergency response reports to ensure the reports are accurate and consistent.

GRC Response: **Concur**

The Chief, Office of Security Management and Safeguards, in conjunction with the Director of Center Operations, the Director of Safety and Mission Assurance, and the Emergency Management Coordinator, is currently analyzing existing emergency response organization factors to determine the best possible task organization for emergency response. We will complete this analysis and incorporate the results into the Center EPP by July 30, 2009.

The revisions to the EPP will include:

- Incorporating standard operating procedures, which include a clear definition of specific roles, responsibilities, authorities, and limitations. Current efforts include incorporating all Center emergency response tasks as a function of the ERT. Chartering, organizing, and implementing emergency response solely as an ERT activity will permit better utilization of ICS principles such as single chain of command, manageable span of control, management by objective, utilization of modular organization, and the Security Management and Safeguards Office's proprietary interest in the training and qualification of all ERT members.
- Requiring the EMC to review and approve the resulting ERT Standard Operating Procedure (SOP) along with all the operating procedures from all other responding organizations to ensure there is no conflict between operating procedures and the EPP. The EMC review will focus on specified and implied tasks, standards of response, and mission related expectations.
- Requiring the EMC to reconcile all emergency response reports to ensure that information contained in them is verified as accurate. The key documents of record will be the responding agency dispatch logs (Brook Park, Fairview Park, or Hopkins Airport Fire department). The secondary source of record information is the GRC Emergency Dispatch Log followed by the Security Officer Shift report. Safety, Facilities, and the Incident Command reports (if used) will be discussed as part of the Post Incident Review process.

All ICS level 4 and below incidents continue to require a Post Incident Review chaired by the EMC. In addition, a record of times, personnel, equipment, and response actions will be maintained as notes from the review. These documents will be amended as necessary to establish the information consistency needed to conduct proper incident or mishap investigations. All information related to criminal activity will be collected by Commissioned Law Enforcement Officers and maintained as part of their Agency's investigative process. All information collected by GRC Initial Response Team (IRT) will be maintained by the team's leadership in accordance to appropriate NASA regulations. This activity is the current practice.

Recommendation 3: We recommend that the Glenn Director, in coordination with the Emergency Management Coordinator, ensure that MOUs are established with non-NASA organizations that provide fire suppression, fire rescue, emergency medical services, police, and hazardous chemicals and materials response. The MOUs, at a minimum, should include the delineation of roles, responsibilities, jurisdiction, and authority of all non-NASA entities expected to respond to Glenn emergencies and a requirement that all ICS is implemented at all Glenn emergencies.

GRC Response: Concur

The EMC in cooperation with the Chief, Security Management and Safeguards Office, Chief, Safety, Health, and Environmental Division, the Office of Chief Counsel, and the Center Directors Office will initiate negotiations to establish memorandums of understanding (MOU's) with adjoining or jurisdictional organizations that provide fire suppression, fire rescue, emergency medical services, police, and hazardous chemicals and materials response. GRC recognizes these organizations to be the City of Brook Park, City of Fairview Park, Perkins Township, and the Cleveland Hopkins International Airport. The MOU's will require that the ICS be implemented during all Glenn emergencies. Further agreements with agencies that respond to GRC as part of the mutual aid agreements held by these agencies is not deemed necessary. To improve current inadequate response times and availability of technical rescue resources GRC is currently negotiating with Hopkins Airport and the City of Brook Park to establish a Joint Fire Station near GRC. As part of these negotiations the Center is discussing establishing a temporary Hopkins Airport Fire Station in Building 14 at GRC as an interim response organization prior to the possible Joint Fire Station. Progress of these negotiations is difficult to predict. However, we would expect the MOU's to be completed by December 10, 2009.

Recommendation # 4: We recommend that the Director, Glenn Safety, Health, and Environmental Division, ensure that a written Emergency Action Plan is prepared for each facility on Center. The plan should address the evacuation procedures, illustrate the primary and secondary routes of egress, and define a process for accounting for all evacuated employees. The plan should be prominently posted in each facility and work location.

GRC Response: Concur

The Safety Health & Environmental Division has already begun development of new emergency action plans for each facility at GRC. This effort is a work in progress and will be audited to ensure that each plan incorporates the elements prescribed (evacuation procedures, egress routes and employee accountability). The plans will be available on the Center's intranet site and a place of prominent posting will be made in each building. The Safety Health & Environmental Division will complete Emergency Action Plans for each facility at GRC by April 23, 2009.

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SEPTEMBER 3, 2008

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