



Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831— 6269

March 3, 2000

The Honorable John T. Conway, Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, NW
Suite 700
Washington, DC 20004-2901

Dear Mr. Chairman:

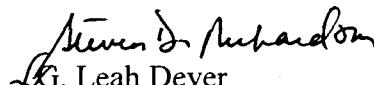
REPORT ON OAK RIDGE NATIONAL LABORATORY (ORNL) FIRE PROTECTION DEPARTMENT BASELINES NEEDS VALIDATION

As discussed in Dr. Krebs' letter to you dated October 28, 1999, enclosed is the final report on the ORNL Fire Protection Department Baseline Needs Validation study. The Board expressed interest in this evaluation in regard to ORNL Building 3019.

Solicitation for hiring two additional trained firefighters per shift has begun. This will increase the Fire Department's staffing level from five to seven firefighters per shift. A Corrective Action Plan addressing each conclusion of the report has been requested from the contractor by March 13, 2000. This response will be provided to the Oak Ridge Defense Nuclear Facilities Safety Board Site Representative when received by the ORNL Site Office.

If additional information is required, please contact me, or have your staff contact Harold Monroe at (865) 576-9439.

Sincerely,


G. Leah Dever
Manager

Enclosure

cc w/enclosure:
Mark Whitaker, S-3.1, HQ/FORS
Bob Poe, SE-30, ORO
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Department of Energy

Washington, DC 20585

February 2, 2000

MEMORANDUM FOR EDWARD G. CUMESTY
OAK RIDGE NATIONAL LABORATORY SITE MANAGER

FROM:

MATTHEW B. COLE *Matthew B. Cole*
OAK RIDGE NATIONAL LABORATORY FIRE PROTECTION
NEEDS VALIDATION STUDY
TEAM LEADER

SUBJECT:

REPORT ON OAK RIDGE NATIONAL LABORATORY
FIRE PROTECTION DEPARTMENT BASELINES NEEDS
VALIDATION

Attached is the report on the Oak Ridge National Laboratory (ORNL) Fire Protection Department Baseline Needs Validation study that you requested be performed, signed by the team that prepared it. This report has been reviewed by affected stakeholders, ORNL, and DOE line management. Changes requested have been made without any major disagreement by the team that conducted the study. The conclusions and recommendations made in the report will be beneficial to you in making resource decisions for the ORNL Fire Protection Department.

We request that you transmit this report to the Defense Nuclear Facilities Safety Board, under separate cover, due to their interest in this matter in regard to ORNL Building 3019. Please coordinate this with the Departmental Representative to the Defense Nuclear Facilities Safety Board.

Please contact me at 301-903-8388 if you need further information.

Attachment

cc w/attachment:
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R. Poe, ORO
J. Landmesser, ORO
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Printed with soy ink on recycled paper

OAK RIDGE NATIONAL LABORATORY

FIRE PROTECTION DEPARTMENT
BASELINE NEEDS VALIDATION



November 19, 1999

Executive Summary

At the request of the Department of Energy (DOE) Oak Ridge National Laboratory (ORNL) Site Manager, an independent team of fire protection and emergency services professionals visited Oak Ridge National Laboratory to study and validate the capabilities of the ORNL Fire Protection Department. This study was performed during the week of November 15-19, 1999. The Team was requested to address and evaluate:

- Personnel levels
- Apparatus and equipment
- Overall emergency remediation capability
- Incident command
- Staff "call-back"
- The Three-site Common Response Plan
- Mutual Aid with the City of Oak Ridge and Fire Protection Engineering Capability

The Team was organized and chaired by the DOE Office of Science (SC). It was composed of Matthew Cole from the Office of Science as the Chairperson; Jim Landmesser from the DOE Oak Ridge Operations Office; Dennis Kubicki from the Office of Environment, Safety and Health; and Gordon Veerman, Chief of the Argonne National Laboratory Fire Department. Doug Paul from the ORNL Site Office greatly assisted the Team in its efforts.

The frame of reference used for this review was DOE Order 420.1, "Facility Safety," which includes all relevant National Fire Protection Association (NFPA) standards, and DOE fire safety guidance documents. This DOE Order is in the ORNL set of Work Smart Standards. To the extent that this body of criteria did not explicitly address an issue, the Team applied its judgement and experience. It is important to note that there are no standards explicitly establishing requirements for fire department response capability for industrial sites or municipalities. Defining the needed response capability requires an exercise such as this study as a starting point.

The methodology used in this effort included personal interviews, document reviews, a tour of selected site facilities, and collaborative deliberation with ORNL stakeholders. Conclusions were reached after deliberations involving identified stakeholders and other interested parties. This was not an attempt to reach unanimous agreement, nor was it an attempt to impose the view of a small group of people upon ORNL. A strong effort was made to include stakeholder input to the recommendations and conclusions of this effort. This report received a review and critique by affected stakeholders and representatives of line management in DOE and ORNL. Suggested revisions were incorporated as much as possible.

Factors relevant to the mitigation of emergencies and how well those factors can be applied in the ORNL situation were examined in order to develop recommended staffing levels. A primary part of this examination was the choice of emergency response scenarios that could reasonably occur at ORNL, then the analysis of those scenarios to determine functions required to perform mitigation and rescue activities in the time before outside help could be expected to arrive.

The roles and responsibilities of the Fire Protection Department are firmly justified by DOE Directives, contractual obligations, Code of Federal Regulation (CFR) requirements, and the standards promulgated by the National Fire Protection Association (NFPA). The minimum level of personnel, mobile apparatus, equipment, and program activities (such as training) that are deemed necessary to fulfill these can only be established on the basis of a comprehensive "Needs Assessment" such as called for by DOE Order 420.1. Such an assessment was performed by a consultant to the Lockheed Martin Corporation in October, 1996, covering the fire departments at the entire Oak Ridge Reservation. The conclusions of this assessment have been challenged both at the Y-12 Site and at ORNL, due to several factors; we will discuss our differences and reasons for those differences later in this report.

The ORNL incident command system has some subtle characteristics that can result in problems due to a division of command and the decision-making process. These are discussed in the report.

In the review of the Fire Protection Engineering Department, the Team noted that certain services such as design development, code research, the development of technical specifications, among others, have had to be curtailed. The Team viewed these developments with concern because they may result in, among other things, inadequate design and installation of fire protection systems, substandard or unsafe facility modifications, higher construction costs, and unanalyzed operations that may pose significant fire risks to the public and site workers. Additionally, it was noted that the "closure rate" on outstanding fire safety audit findings has leveled off since the reduction in staff. This also may be a precursor to a higher level of fire risk in the future. The onset of new major construction projects at ORNL may exacerbate this situation.

The Fire Protection Department is staffed by a group of conscientious and dedicated professionals who have historically and consistently demonstrated their abilities to effectively respond to a wide spectrum of fire safety and emergency services contingencies. The personnel are well-trained, experienced and competent in both the mitigation of emergency situations at ORNL and the satisfactory completion of the many routine responsibilities of the Department. The low fire loss rates and other related statistics at ORNL provide ample evidence that the Fire Protection Department's efforts, combined with engineered systems, have been successful in reducing fire risk and, thus, assuring the continued safety of site workers and the public from the consequences of a fire or related events. The fleet of mobile apparatus and emergency response equipment meets or exceeds all industry and DOE standards and is generally being well serviced in conjunction with a

comprehensive maintenance program. The professionals interviewed during this study were well aware of the need for an effective emergency response capability such as the ORNL Fire Department provides and the management systems necessary to maintain and strengthen it.

Based on this study, the Team concludes that:

The 1996 Baseline Needs Assessment was not completely valid with regard to a number of issues. In particular, it overly conservative in its proposed response to postulated emergency scenarios.

ORNL's overall capability to mitigate time-critical emergencies does not meet management expectations due to staffing, training, and command issues

The ORNL Fire Department staffing levels are insufficient to meet minimum management expectations for initial response to credible fire, medical, and hazardous materials emergencies

The ORNL Fire Department is neither trained nor equipped to effectively mitigate a credible hazardous materials scenario requiring immediate action for rescue of victims or protection of nearby workers

A functioning incident command system exists, although some weaknesses were observed relevant to command authority

The Common Response Plan and Mutual Aid with the City of Oak Ridge is generally functional, but cannot be relied upon for time-critical emergencies

The fire protection engineering staff is presently able to fulfill its responsibilities, despite the recent reduction in personnel. Future construction projects will impose a significant burden on the existing staff.

ORNL Fire Department equipment and apparatus meet National Fire Protection Association (NFPA) standards. Providing and maintaining a third pumper is not necessary to fulfill the primary

needs of ORNL.

Staff callback times are acceptable for backup purposes, but are not acceptable for primary response to emergencies.

Frequency of joint training exercises with outside fire departments is not adequate to assure effective implementation of the Common Response Plan.

The above conclusions are predicated on the assumption of a degree of risk by DOE and its site contractors. The risk lies with certain emergency scenarios that could occur under some circumstances. Such scenarios include, but are not limited to: a fire involving multiple fire areas, an incident involving mass casualties, or multi-faceted emergencies (e.g. a hazardous materials spill which results in a fire and personal injuries). These types of large consequence incidents have a low probability of occurrence, however, and should not be the basis for staffing decisions.

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1.0 Introduction

At the request of the Department of Energy (DOE) Oak Ridge National Laboratory (ORNL) Site Manager, an independent team of fire protection and emergency services professionals visited Oak Ridge National Laboratory to study and validate the response capability of the ORNL Fire Department. This study was performed during the week of November 15-19, 1999. The Team was requested to address and evaluate:

- Personnel levels
- Apparatus and equipment
- Overall emergency remediation capability
- Incident command
- Staff "call-back"
- The three-site Common Response Plan
- Mutual Aid with the City of Oak Ridge
- And Fire Protection Engineering Capability

Please note that, when the term "Fireground Incident Commander" is used in this report, it refers to the ORNL officer in charge of all incidents to which the ORNL Fire Department responds. It is not meant to only apply to situations where there are fires.

2.0 Methodology

The methodology used in this effort included personal interviews, document reviews and a tour of selected site facilities. Additionally, a significant amount of deliberation among the various "stakeholder" groups was necessary to reach a degree of consensus. A list of documents reviewed and personnel interviewed is provided in Appendices "A" and "B" respectively. The report received a review and critique by DOE and ORNL line managers and affected stakeholders. Comments received were incorporated into the final draft to the greatest extent possible.

The Team was organized through discussions between the DOE Office of Science (SC), ORNL Site Office and the Office of Environment, Safety and Health (EH). An agreement was reached that the Office of Science would chair the Team. It was composed of Matthew Cole from the Office of Science as the Chairperson; Jim Landmesser from the DOE Oak Ridge Operations Office; Dennis Kubicki from the Office of Environment, Safety and Health; and Gordon Veerman, Chief of the Argonne National Laboratory Fire Department. Doug Paul from the ORNL Site Office greatly assisted the Team in its efforts.

The frame of reference used for this review was DOE Order 420.1, "Facility Safety," which includes all relevant National Fire Protection Association (NFPA) codes and standards, and DOE fire safety guidance documents. This Order is in the ORNL set of Work Smart Standards. To the extent that this body of criteria did not explicitly address an issue, the Team applied its judgement and experience. It is important to note that there are no standards explicitly establishing requirements for fire department response capability for industrial sites or municipalities. Defining the needed response capability requires an exercise such as this study for a starting point.

The methodology used in this effort included personal interviews, document reviews and a tour of select site facilities. After this information-gathering phase was completed, and some internal discussion among the Team, deliberations and discussions with all parties involved were held. This was not an attempt to reach unanimous agreement, nor was it an attempt to impose the view of a small group of people upon ORNL. It was an honest effort to include stakeholder input to the recommendations and conclusions of this study. This report received a peer review and critique by representatives of line management in DOE and

Factors relevant to the mitigation of emergencies and how they apply to the ORNL situation were examined in order to develop recommended fire department staffing levels. A primary part of this examination was the choice of emergency response scenarios that could reasonably occur at ORNL, then the analysis of those scenarios to determine functions required to perform mitigation and rescue activities in the time before outside help could be expected. Two scenarios were developed for ORNL: a fire in a laboratory with one or more injured persons, and a hazardous materials incident requiring extensive protective clothing and breathing apparatus for immediate entry and rescue.

3.0 Fire Department Organization and Responsibilities

The ORNL Fire Department is part of the Fire Protection Department, which reports to the ORNL Office of Laboratory Protection. The Office of Laboratory Protection reports to the Associate Director for Operations, Environment, Safety, and Health. Mr. David Baity is the Fire Department Manager; Fire Chief Harold Rose reports to him. There are 21 full time firefighters, including shift commanders, and one full-time relief firefighter. There are five full time firefighters who work days only, performing fire protection system Inspection, Testing, and Maintenance (ITM). There is one day-shift only Commander; one Lieutenant; one Captain; the Chief; and the Fire Department Manager.

The firefighters work in 12-hour shifts - from 8:00 AM - to 8:00 PM, then back to 8:00 AM. To accommodate this schedule, there are a total of four separate groups of firefighters - Shifts A, B, C, and D. Each shift has five firefighters. The ITM firefighter/technicians work only during days, with varying starting and ending times. During the "day" shift, there can be up

to ten firefighters, plus a several-person command staff available. From evening to shift end, and on the night shift, there is only one commander and four fighters available.

The principal responsibilities of the ORNL Fire Department include:

- Emergency Medical Response
- Manual Fire Suppression
- Emergency Search and Rescue
- Technical (Confined Space, Trench, etc.) Rescue
- Fire Protection System Inspection, Testing and Maintenance
- Fire Prevention/Fire Safety Training Activities
- Fire Alarm/Communication Services
- Management and Administration Responsibilities (Reporting, Budget, etc.)
- Mutual Aid and "Common Response Plan" Roles
- Pre-fire Planning

The ORNL Fire Department provides five persons on the day shift who perform fire protection system inspection, testing, and maintenance. Although this effort was not examined extensively during this review, the Team concludes that some effort could be saved if ORNL requested an exemption to the NFPA requirement to inspect fire extinguishers monthly, instead inspecting them on a quarterly basis.

The roles and responsibilities of the Fire Department are firmly justified by DOE Directives, contractual obligations, Code of Federal Regulation (CFR) requirements, and the standards promulgated by the National Fire Protection Association (NFPA). The minimum level of personnel, mobile apparatus, equipment, and program activities (such as training) that are deemed necessary to fulfill these can only be established on the basis of a comprehensive "Needs Assessment" such as called for by DOE Order 420.1. Such an assessment was performed by a consultant to the Lockheed Martin Corporation in October, 1996, covering the fire departments at the entire Oak Ridge Reservation. The conclusions of this assessment have been challenged both at the Y-12 Site and at ORNL, due to several factors: we will discuss our differences and reasons for those differences later in this report.

4.0 Personnel Levels

In order to establish personnel levels for emergency response, it is first necessary to determine what type of emergency is likely to occur on site. The Team developed two credible emergency scenarios which the ORNL Fire Department could reasonably expect to encounter. Note that these postulated scenarios are representative of many that could likely occur on site. The functions required for emergency rescue and immediate stabilization of the incident, as required either by law, contractual obligation, DOE policy, or practicality were

then laid out. The staffing required to perform those functions was then developed, using as much collateral duty as possible among the persons required, to maintain the numbers of personnel as low as safely possible. For example, in one scenario involving a building fire, we have stated that the Fireground Incident Commander could be the second person of the Rapid Intervention Team, required for the safety of the firefighters inside the building.

The two scenarios are:

Emergency Scenario A

- ▶ Occurs after normal working hours
- ▶ Involves one or more researchers working in a laboratory which has automatic sprinkler protection
- ▶ A fire or explosion occurs
- ▶ There may be hazardous materials involved
- ▶ The researchers are injured during the event

This scenario was chosen because it represents a very real possibility in any laboratory or industrial facility. It is basically a fire with an injury. It is also very possible that a fire will occur, or some violent event such as a small explosion in a laboratory, where there are multiple injuries. We are giving credit for installed fire protection systems. It is still quite possible to have violent events occur that injure individuals in chemical laboratories with installed automatic fire sprinkler systems. The "standard" scenario defined in guidance for DOE Order 420.1, is a fire with an injury, such as we are postulating here.

The persons with whom we talked about their expectations of the ORNL Fire Department were almost unanimous in that they believe that the Fire Department should concentrate on rescue before the start of fire suppression activities - so we chose to assign two firefighters to perform that function. OSHA requires that a buddy system be used when entering facilities for the purposes of rescue or structural firefighting, so two firefighters are required. A Fireground Incident Commander (FIC) is necessary to direct operations and maintain overall awareness of the scene. This person can also function as the second person on the "Rapid Intervention" Team - which stands by with appropriate equipment to enter the facility and intervene to rescue the firefighters inside if they encounter difficulty. It is necessary that the fire department pumper be operated by a trained firefighter. And finally, the presence of an emergency medical team is necessary to stabilize, treat, and transport the injured person. Functions such as that of Fireground Safety Officer can also be performed by the FIC. The ORNL Emergency Squad can be used to perform other tasks that are not time-critical, such as decontamination, radiation monitoring beyond what the Fire Department normally does, and control of water runoff.

Staffing Required for Emergency Scenario A

<u>Required Function</u>	<u>Number of Personnel</u>
Fireground Incident Commander (FIC)	1*
Fire Suppression	0
Search and Rescue Team	2
Rapid Intervention (backup team)	1 (FIC is second member)
Emergency Medical Services	2
Pumper Operator	1
Fire Department Safety Officer	0 (FIC Does this)
Other Support Functions	ORNL E-Squad
TOTAL	7

*Also serves as part of Rapid Intervention Team and as Safety Officer

The timely mitigation of Emergency Scenario A requires a total of seven trained firefighters/officers. This is two more than are on site during the back and weekend shifts in the ORNL Fire Department.

Emergency Scenario B

- ▶ Occurs after normal working hours
- ▶ Involves hazardous materials requiring OSHA "Level A" entry
- ▶ Involves transportation or large vehicles
- ▶ People in the vehicles require rescue and medical treatment

Emergency Scenario B is a "classic" hazardous materials incident involving a large vehicle such as a truck which is either carrying hazardous materials or which impacts a tank of some hazardous material at ORNL such as sulfuric acid near the HFIR Reactor or diesel fuel at the Steam Plant. The driver of the vehicle has been injured and is in need of rescue and medical treatment. Entry to the scene requires a full protective ensemble and breathing apparatus. This is what OSHA defines as a "Level A" situation. The functions below are outlined in 10 CFR 1910.120, Hazardous Waste Operations and Emergency Response. We have stretched the use of collateral duty to its maximum limits in this proposed staffing arrangement to fulfill these functions which are required by law. We have especially stretched the decontamination function, saying that this is not time-critical and can be performed when

members of the ORNL Spill Response Team who are trained to perform this function. or mutual aid from a nearby fire department can be mustered and established on the emergency scene.

Staffing Required for Emergency Scenario B

<u>Required Function</u>	<u>Number of Personnel</u>
Fireground Incident Command	1
Entry Team	2
Backup Team	2 (1 also doubles as Ops Officer)
Medical	0 (Standby crew provides)
Decontamination	0 (provided afterward by Spill Response Team)
Safety Officer	0 (handled by FIC)
Operations Officer	0 (handled by Backup Team)
Recorder	0 (E-Squad could perform this function)
Standby Crew	2 (also doubles as Recorder and Medical Officer)
TOTAL	<u>7</u>

Depending on the interpretation of 29 CFR 1910.120, a minimum of 11 to 14 trained individuals are required to begin operations at a hazardous materials incident involving a "Level A" entry. We have presented a staffing model for this Scenario B that allows entry for rescue and emergency stabilization with only seven persons. There is a major problem with the current situation, however, because the ORNL Fire Department personnel are only trained to the Hazardous Materials Operations level under OSHA 1910.120, which does not allow them to take action in emergencies such as Scenario B except to call for trained personnel. They cannot legally take actions to provide emergency mitigation of a hazardous materials incident at ORNL. They must call the ORNL Spill Response Team to mitigate the emergency, which is relatively fast during normal working hours, but which can take twenty to thirty minutes and more after that. The Team concludes that this is an unacceptable length of time in which to be able to begin mitigation of a hazardous materials emergency.

In addition to not having the required training to effect rescue and perform emergency stabilization at such hazardous materials incidents, the ORNL Fire Department does not have the necessary equipment to perform these functions. This is discussed further under the apparatus and equipment section of this report.

The Team recommends that the ORNL Fire Department personnel be trained to the OSHA Hazardous Materials Technician level so that they can actually perform entry at a hazardous materials incident for the purpose of emergency rescue and stabilization. Appropriate equipment needs to be located with the ORNL Fire Department so that they can utilize it in a timely manner for the purposes of emergency rescue and stabilizing a hazardous materials

emergency. The Team wishes to stress that this recommendation is only for the immediate actions required for emergency rescue and stabilization of a hazardous materials incident; it is not a recommendation for the ORNL Fire Department to perform the site spill cleanup function.

Note that, in Scenario B, the ORNL Fire Department is also understaffed to perform a minimum set of responsibilities, as well as not having an adequate level of training for this type of incident. On the basis of the above scenario analyses, which are typical of many credible scenarios on site, the Team concludes that the ORNL Fire Department lacks sufficient resources to provide timely and effective response to credible emergency scenarios.

The Team recommends that shift personnel levels be increased where necessary to maintain the levels required to safely, effectively, and quickly mitigate the emergencies described in the above two scenarios.

5.0 Fire Department Apparatus, Equipment, and Facilities

The fleet of mobile fire apparatus and inventory of emergency response equipment has remained essentially unchanged since the 1996 "Needs Assessment." There are two functioning pumpers (Engines 1 and 2), a light rescue truck, two ambulances, and some utility vehicles. A third pumper (Engine 3) is in the inventory, but it is out of service and is not expected to be returned to service. The ORNL Fire Department has an apparatus replacement program, with a goal of rotating pumpers from front line to reserve every 10 years, then replacing them after another 10 years. Hazardous materials response vehicles and trailers are not in the inventory of the ORNL Fire Department, but are rather under the responsibility of the Bechtel Jacobs Co. at ORNL in its role as a waste management and cleanup contractor. The Team inspected the apparatus and equipment inventories and noted that they were well maintained and in accordance with the relevant NFPA standards.

The ORNL management consistently indicated to us that property protection was of less importance than life safety in fire emergencies at ORNL. The Team used that information in the choice of emergency scenarios for developing staffing needs. This desire to focus on life safety, and the staffing level developed for that in the fire scenario postulated only requires one pumper for response. With one front line pumper needed to handle the postulated emergency scenario, and one pumper required as a reserve, there is no need to maintain a third pumper. In the unlikely event that a third pumper would be needed in the future (because of some unforeseen sequence of events that renders Engines 1 and 2 unserviceable) a third pumper could be obtained through a "loan" from another DOE site. There was no evidence in the station logs or other sources that Engines 1 and 2 were out of service for any significant period of time within the past, which would necessitate the continued maintenance

of the third pumper. But, as they age (Engine #1 is currently 10 years old and Engine #2 is currently 19 years old), age-related out of service time will obviously increase.

Considering the current and future construction activity on site and the ORNL Fire Department's responsibility for wildland fire fighting, the Team concludes that Engine 2 should be replaced with an "urban interface" unit designed to handle situations involving wildland and forest fires that encroach upon the built environment. This should be done at Engine 2's scheduled replacement time. The ORNL Fire Department has been considering this approach in its plans for the replacement of Engine 3, which the Team has concluded is not necessary in the ORNL Fire Department's operations. Replacing Engine 2 with a vehicle of this nature would be a better option.

One of the Team's recommendations is that the ORNL Fire Department be trained and given the responsibility for rescue and emergency stabilization of hazardous materials incidents. This also requires that appropriate equipment be immediately available for use by the ORNL Fire Department when necessary to mitigate hazardous materials emergencies.

The ORNL Fire Station is located on the west side of the ORNL site. It also houses site security personnel. The apparatus bay of the fire station just has room to house the existing primary and reserve fire apparatus, with the inoperable Engine 3 currently sitting outside. The Fire Station has no sleeping quarters at this time. The alarm dispatch room located in the fire station is not separated from the rest of the facility by fire resistive construction as called for in the NFPA Fire Alarm System standard - NFPA 72. The Team concludes that this facility is minimally functional for use as a fire station.

There are some facilities at ORNL that are significant distances from the single fire station, including the National Spallation Neutron Source facility, which is in the design stage. The time to respond to these facilities may be between 5 to 10 minutes, or more in inclement weather. Given the infrequent calls to these remote facilities, the Team concludes that this is an acceptable risk.

6.0 Incident Command

The ORNL uses a "Laboratory Shift Superintendent" (LSS) system to mitigate emergency events. The Laboratory Shift Superintendent serves as the Emergency Director for emergency events, calling upon resources as he/she believes necessary to mitigate the emergency situation at hand, and interfacing with organizations outside of ORNL.. The Laboratory Shift Superintendent Department has established protocols for training its personnel to serve in the LSS function and for the LSS to serve as incident commander. The LSS protocols are written such that the senior Fire Department Officer responding to a fire emergency is supposed to be in charge of that emergency. The determination of who is in charge, however, requires a positive determination from the LSS that the situation involves a fire and that the senior Fire

Department Officer is indeed the one in charge of the immediate incident scene. Even after determination has been made that the senior Fire Department Officer is in charge, requests for outside assistance must go through the LSS.

There are some subtle yet powerful problems that can occur with this division of command and decision-making process. Delays in the initial handoff of incident command from the LSS to the Fire Incident Commander can allow an emergency to increase in severity. This need for a handoff can also result in hesitation by the Fireground Incident Commander to call for resources to be brought to bear upon an emergency, again possibly allowing the emergency to become more severe.

The Team concludes that the senior officer responding to an emergency from the ORNL Fire Department should be the Fireground Incident Commander until such time as he or she believes that the situation can be safely handed off to the LSS. This will eliminate any confusion about handoffs. The ORNL Fire Department Incident Commander should have the authority to procure resources necessary for the timely mitigation of an emergency. He or she should be responsible for the command function, as well as be accountable for his or her actions. The Laboratory Shift Superintendent's vital function in obtaining outside assistance as requested and interfacing with external organizations should continue.

The LSS office should incorporate improved training on fire department operations into the LSS qualifications process. The LSS should also work more closely with the ORNL Fire Department to lower the possibility of miscommunication when calls for resources are made by the Incident Commander.

The ORNL Fire Department does not currently designate a second-in-command person on its shifts. The designation of a person in this function enables the entry team at an emergency scene to better function. Officers in the ORNL Fire Department are also not formally certified to appropriate national standards. The Team concludes that the ORNL shifts should designate a second-in-command person, and establish a certification program for its officers.

The DOE Office of Independent Oversight and Performance Assurance did a follow-up review of the Emergency management Program at ORNL in October, 1999. Although they did not specifically comment on the incident command structure, they identified lack of procedures as a problem, along with several other findings.

7.0 Staff "Call-back" Effectiveness

To summon additional personnel to respond to site emergencies or other needs, the ORNL Fire Department exercises its "call back" procedure, wherein off-shift personnel are contacted and directed to return to the site. The only bases the Team had to evaluate the effectiveness of this procedure were to review the "Station Log" and to discuss the process with the

individuals involved. The review of the Log and discussions with Fire Department personnel indicated that the "call back" system was acceptable for replacing personnel who have responded to emergencies, but that use of the "call back" system for any primary response would take too much time. Individuals could be contacted and arrive at ORNL as early as 30 minutes afterward, which is acceptable for use as a backup but which is far too much time for primary response to emergencies. The Team concludes that the staff "call-back" system is effective only for secondary response to emergency situations.

8.0 Common Response Plan and Mutual Aid with the City of Oak Ridge

Additional resources (apparatus, equipment and personnel) for responding to site emergencies at ORNL are generally available from the Fire Departments at the Y-12 and ETTP sites under the "Common Response Plan," and from the City of Oak Ridge. The level of assistance is directly related to availability of these resources at any given time at the other sites, but is generally taken to be one pumper with three firefighters from each site. Significant assistance is not rapidly available to ORNL because of this limited response from each of the mutual aid sites. The limited response and the time for assistance to arrive at ORNL must be accordingly factored into resource determinations.

A significant limitation of the potential effectiveness of the Common Response Plan and mutual aid from the City of Oak Ridge is the absence of an established program for joint training among the fire departments involved. As with all mutual aid situations, outside responders will not be as familiar with the ORNL site as the ORNL Fire Department, and will require ORNL assistance to be effectively used to mitigate an emergency. Another significant problem is that radio frequencies differ among the responding fire departments, so radio communication would be difficult. The ORNL Fire Department also shares its emergency radio frequency with other users on the site, also complicating emergency communications.

Because of the autonomous nature of the contractors that run the sites, there is no one organization that exists to coordinate a joint training program. The solution for this may require that the DOE Oak Ridge Operations Office act to coordinate joint training and to resolve issues such as radio communication.

The Team concludes that the Common Response Plan is hampered by a lack of joint training among the fire departments involved and radio communications difficulties.

9.0 Overall Emergency Remediation Capability

Because the site does not have sufficient personnel on duty during the night time and weekends, the Team concludes that there is an insufficient emergency capability during these time periods, based on credible emergency scenarios. The Team considered a number of possible emergency scenarios including; medical emergencies, facility fires, hazardous materials incidents, rescues, and the later scenarios combined with a single casualty requiring medical assistance. During day shifts, with the presence of additional fire fighters and fire department officers present as well as the availability of the full staff of the Spill Rescue Team and Emergency Squad, the site is fully capable of responding in a timely and effective manner to the spectrum of anticipated emergencies. These personnel resources are supplemented by a fleet of mobile emergency apparatus and other vehicles (such as earth moving equipment), as well as a complete inventory of emergency equipment (such as personnel protective equipment, manual fire fighting equipment, medical supplies, spill response equipment, among other resources). The only significant aggravating conditions are the lack of a common and unfettered emergency radio communication capability and a dearth of joint experience/training with off site emergency response organizations.

During off shifts, the site has the resources to respond effectively to a limited set of anticipated emergencies. These include a small fire; a simple technical rescue or a single medical emergency. In the event of a hazardous material incident involving a casualty (such as could occur in a vehicle accident), or a fire involving a casualty (such as could occur in a laboratory accident) there are insufficient personnel to provide effective, timely mitigation of the emergency.

The Team found that more time needs to be allotted to training of firefighters to better enable them to mitigate emergencies. This includes both basic skills such as ladder evolutions, pumper operations, and ventilation, as well as more advanced skills such as high-angle and trench rescue techniques. An annual live-fire training exercise would greatly assist in maintaining skills. The Team witnessed a live fire training exercise in flammable gases during its review.

The Team could find no evidence in pre-plans, Fire Hazard Analyses, building hazards assessments, Safety Analysis Reports, Bases for Interim Operations, or emergency preparedness assessments that the site has comprehensively considered time-critical emergency scenarios and rationalized, on a technical basis, that it can safely delay emergency response and effective mitigation without significant consequences. The Team, by doing a rather cursory review, was able to highlight a number of conditions (the Sulfuric Acid Tank at HFIR, Chlorine Tank at Building 4509, and the 2-ton Propane Tank at the Steam Plant) that could be involved in a credible incident with significant such consequences.

The Team concludes that effective overall emergency remediation capability is not present due to a lack of adequate staffing, lack of adequate training, and vulnerabilities with the Incident Command System.

10.0 Fire Protection Engineering

The Team reviewed the roles and responsibilities of the engineers within the Fire Protection Department. These activities are clearly justified in relation to Lockheed Martin Energy Research's (LMER's) responsibilities to DOE as an M&O contractor, current site conditions (including general operations and fire hazards), and the expectations of a fire protection engineering staff as delineated in DOE Directives and NFPA standards. These responsibilities include, but are not necessarily limited to:

- Facility Fire Protection Engineering Surveys
- General Engineering Consultation*
- In-plant Consultation*
- Consultation to the ORNL Fire Department
- Engineering Services to Outside Auditors/Appraisers
- Training and Personal Development

*This includes design and construction review and code/standard interpretations.

A significant omission from this spectrum of responsibilities is the development of Fire Hazards Analyses (FHA's); although the LMER engineering staff performs a quality assurance verification on FHAs that are completed by others (FHAs are typically developed by consultants at ORNL). The Team considered this situation and concluded that it does not represent the most optimum utilization of resources. Specifically, the total cost of developing an FHA is greater than that associated with an "in house" effort. This is due to the amount of time (and resulting cost) associated with a consultant acquiring the knowledge to begin work and it includes the time (and cost) associated with the LMER engineers correcting errors and omissions in the consultant's draft work products. Additionally, the Team noted that the staff engineers would benefit by developing a greater working knowledge of site operations and their resulting hazards if they were developing the FHAs themselves. This same argument applies to the development of fire-related portions of other safety basis documentation, such as BIOs and SARs. The Team concludes therefore and identifies as an additional "need" the inclusion of developmental work on FHAs and safety basis documentation as part of the core roles and responsibilities of fire protection engineering staff.

The Team reviewed the duties and responsibilities of the fire protection engineering staff in relation to their numbers. Noteworthy was the fact that, since 1995, the staff of professionals available to meet these responsibilities has decreased by the equivalent of 1.5 "full time equivalents." Yet, there was no tangible indication that fire safety on site has significantly diminished. The Team noted that upon loss of these staff resources, certain responsibilities have had to be altered; the most significant being the fire protection engineering assessment program. The Fire Protection Department, in conjunction with the fire protection staff of the DOE Oak Ridge Operations Office, developed and implemented an alternate schedule that achieves an acceptable level of review.

It was also noted that certain services such as design development, code research, the development of technical specifications, among others, have had to be curtailed. The Team viewed these developments with concern because they may result in, among other things, inadequate design and installation of fire protection systems, substandard or unsafe facility modifications, higher construction costs, and unanalyzed operations that may pose significant fire risks to the public and site workers. Additionally, it was noted that the "closure rate" on outstanding fire safety audit findings has leveled off since the reduction in staff. This also may be a precursor to a higher level of fire risk in the future. Finally, the Team noted a number of future projects that will pose a significant burden on the engineering staff. They include the proposed National Spallation Neutron Source Project, the new "Mouse House," and fire safety related GPP projects. It is expected that the fire protection engineering responsibilities associated with these projects will significantly constrain the engineering staff, based on their current personnel levels. Supplementing the staff with consultants is not a solution, in the Team's opinion, because an in-house staff is more economical (as noted above) and is more qualified to perform the work based on their knowledge of the site. The Team concludes that in light of these future responsibilities, a work load analysis (similar to the "Program Management Plan" of August 1991, by R. Atchley) is warranted. This would be the technical basis for justifying future fire protection engineering staff enhancements.

11.0 Discussion of the 1996 Fire Department Needs Assessment

The 1996 Fire Department Needs Assessment concluded that a minimum of ten personnel was required to initiate fire fighting activities at ORNL. This assessment used the same basic scenario that was used in Scenario A in this report, except it called for four persons operating two hose lines for fire fighting and the Fire Incident Commander being a completely stand-alone function. The Team postulated, based on information gathered from interviews, that a primary expectation of the ORNL Fire Department is that two firefighters would enter the building and perform search and rescue functions rather than initiate fire fighting. The Team also postulated that the Fire Incident Commander would serve as part of the Rapid Intervention Team. This reduces the total number of personnel required from ten to seven, while still maintaining firefighter safety and meeting the stated expectations of the ORNL Fire Department.

Over 95% of the facilities at ORNL are protected by automatic sprinkler systems, which can be relied upon with a high degree of reliability to either control or extinguish the fire without immediate fire department intervention. There are also other fire prevention and protection measures present in ORNL facilities. Because of these systems being prevalent, the Team did not conclude that fire fighting would be an immediate requirement, and that search and rescue could safely be done by two firefighters.

The Team concludes that the 1996 Baseline Needs Assessment was overly conservative in its proposed response to postulated emergency scenarios.

12.0 Conclusions

ORNL's overall capability to mitigate time-critical emergencies does not meet management expectations due to staffing, training, and command issues

The ORNL Fire Department staffing levels are insufficient to meet minimum management expectations for initial response to credible fire, medical, and hazardous materials emergencies

The ORNL Fire Department is neither trained nor equipped to effectively mitigate a credible hazardous materials scenario requiring immediate action for rescue of victims or protection of nearby workers

A functioning incident command system exists, although some weaknesses were observed relevant to command authority

The Common Response Plan and Mutual Aid with Oak Ridge are generally functional, and can provide additional resources to ORNL given enough time, but it cannot be relied upon for time-critical emergencies

The fire protection engineering staff is presently able to fulfill its responsibilities, despite the recent reduction in personnel. New (just emerging) and future construction projects will impose a significant burden on the existing staff.

ORNL Fire Department equipment and apparatus meet National Fire Protection Association standards, but providing and maintaining a third pumper is not necessary

Staff callback times are acceptable for backup purposes, but are not acceptable for primary response to emergencies

Frequency of joint training exercises with outside fire departments is not adequate to assure effective implementation

The 1996 Baseline Needs Assessment was overly conservative in its proposed response to postulated emergency scenarios

13.0 Recommendations

Augment the ORNL Fire Department staffing levels to achieve a minimum of seven trained firefighters per shift.

Consider the "56-hour" week or other shift schedule to increase staff, including making modifications as appropriate to the ORNL Fire Station to increase its ability to support the type of emergency response force needed for ORNL and meet the safety requirements in NFPA Standard 1500. This may facilitate achieving the additional staffing levels recommended for each shift through its distribution of the available firefighters.

Clarify incident command roles and responsibilities in the Laboratory Shift Superintendent program between the Fire Department Incident Commander and the Laboratory Shift Superintendent. Provide responsibility to the Fireground Incident Commander to call in resources needed for fire and hazardous materials emergencies under the ORNL Fire Department's purview, and hold the FIC responsible for his or her actions.

The ORNL Fire Department needs to be given responsibility to effect emergency rescue and stabilization of hazardous materials incidents. Firefighters need to be trained to the OSHA Hazardous Materials Technician level so that they can actually perform entry at a hazardous materials incident for the purpose of rescue and emergency stabilization. Appropriate equipment needs to be located with the ORNL Fire Department so that it can be utilized in a timely manner for these purposes.

The LSS office should incorporate improved training on fire department operations into the LSS qualifications process. The LSS should also work more closely with the ORNL Fire Department to lower the possibility of miscommunication when calls for resources are made by the Fireground Incident Commander.

DOE and ORNL should initiate and support more joint training exercises among the three Oak Ridge Sites and the City of Oak Ridge

Consider automatic mutual aid between the ORO sites so that mutual aid will be dispatched simultaneously with the ORNL Fire Department for certain types of emergency calls

Consider the scheduled replacement of Engine 2 with an off-road, "urban-wildland" interface pumper.

More time needs to be allotted to training of firefighters to better enable them to mitigate emergencies. This includes both basic skills such as ladder evolutions, pumper operations, and ventilation, as well as more advanced skills such as high-angle and trench rescue techniques and live fire training

Evaluate the future needs for fire protection engineering support in relationship to projected responsibilities and future staff changes, e.g. retirements, through a workload analysis

The ORNL Fire Department should designate a second-in-command person for each of its shifts, and establish a certification program for its officers.

Purchase extra radios to enable off-site responders and the ORNL Fire Department to communicate on a common frequency.

Team Signatures

Oak Ridge National Laboratory Fire Department
Baseline Needs Validation
November 19, 1999

Matthew B. Cole
Matthew B. Cole, Team Leader

1-17-00
Date

Dennis Kubycki
Dennis Kubycki

1/18/00
Date

James Landmesser
James Landmesser

1/19/00
Date

Gordon Veerman
Gordon Veerman

1-21-2000
Date

Appendix A

Documents Reviewed:

- o Station Log for the ORNL Fire Department
- o August 18, 1997, Common Response Plan to Fire Emergencies
- o Baseline Needs Assessment of the ORNL Fire Department, October 1996, HSB Professional Loss Control.
- o Program Management Plan, Fire Protection Engineering Section, August 1999, R. L. Atchley.
- o ORNL Fire Protection Department, "Services Provided," September, 1999 (briefing paper).
- o ORNL Fire Protection Engineering, Staffing and Work Load Trends, (briefing paper).
- o "Fire Protection Engineering Support," (internal) Memorandum from D. Stallions to E. Krieg, July 22, 1998.
- o ORNL Fire Protection Engineering, "Assessment Frequency Criteria," May 1998.
- o Fire Protection Engineering Department, "Facility Assessment Listing and Schedule," January 22, 1994.
- o ORNL Fire Protection Engineering, "Summary of Current Activities, (undated briefing paper).
- o FIRE PROTECTION ENGINEER Meeting Minutes, Week of November 8, 1999.
- o "Fire Safety Programs." Memorandum from Edward Cumesty to Martha Krebs, dated September 10, 1998.
- o Fire Protection Department, "Self Assessment," October 1998.
- o "Building 3019 Cell 3 Cell Flooding - Fire Protection Comments." (internal) Memorandum from M. Masters to J. Rushton, June 29, 1999.
- o "Fire Protection Engineering Assessment - Buildings 7900...7971," August 6, 1999.
- o "Fire Protection Engineering Assessment - Building 4500N." June 7, 1999.
- o "Building 3019 Fire Hazards Analysis." September 1999.
- o "Emergency Management Hazards Assessment for Building 3019." (draft).
- o Fire Pre-plans for Buildings 7900, 3019, and 2029.
- o Safety Analysis Report for Building 3019. (draft).

Appendix B

Personnel Interviewed

Dr. Jerry Swanks, Associate Director for Operations, Environment, Safety, and Health
Bob Atchley, Head, Fire Protection Department
Don Stallions, Director, Office of Laboratory Protection
David Baity, Fire Department Manager
Chief Harold Rose, ORNL Fire Department
William DeRossett, Head, Emergency Preparedness Department
J. S. Abercrombie, Head, Laboratory Shift Superintendent Department
Mac Bailey, Chief, City of Oak Ridge Fire Department
Scott Hackler, Chief, Y-12 Fire Department
Frank Tauxe, Floating Shift Commander, ORNL Fire Department
Chris Copeland, President, IAFF Local 12
Eric Loy, IAFF Shift Steward
Jim Maner, Deputy Chief of Emergency Medical Services and Training Operations
Eric Laubach, Fire Protection Engineer
Mike Masters, Fire Protection Engineer
Jim Johnson, Supervisor, Spill Response Team
K. G. Edgemon, ORNL Laboratory Waste Services Organization
Bobby Davis, ORO Emergency Management Program Division Manager
Steve Johnson, ORO Emergency Management Program Division
William Harris, ETPP Fire Protection Manager