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Joint Warfare Analysis

Analysis of Communications Effectiveness for First Responders during TOPOFF 2000

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EXECUTIVE SUMMARY

ES.1 INTRODUCTION

Exercise Top Officials (TOPOFF) 2000 was designed to assess the Nation's crisis and consequence management capability by presenting a challenging series of geographically-dispersed terrorist threats and acts to Federal, State, and local agencies. TOPOFF was a Congressionally-mandated, "no-notice" national exercise that began on 16 May, 2000 and ran through 24 May, 2000. Live exercise play was conducted in two host cities, Denver, CO, and Portsmouth, NH. Each city was presented with a mock terrorism event, involving a Weapon of Mass Destruction (WMD), to test the response of agencies at the State and local levels.

ES.2 JHU/APL INVOLVEMENT IN TOPOFF

The Johns Hopkins University Applied Physics Laboratory (JHU/APL), under a cooperative agreement with the National Institute of Justice (NIJ), conducted a technology assessment of First Responder Communications equipment used during TOPOFF. This assessment was focused on exercise operations conducted in the Portsmouth, NH area. Because the WMD used in Portsmouth was a chemical weapon, dispersed via an exploding vehicle, this venue provided the greatest level of operational stress for First Responder Communications equipment.

Analysts from JHU/APL were placed at key nodes in the Portsmouth, NH locale during TOPOFF. Exercise events at the Portsmouth Dispatch Center, Police Department Incident Command Post, Fire Department Incident Command Post, and the explosion site itself were observed and recorded by these analysts. The direct, immediate goal of this effort was to contribute to the understanding of which communications technologies were employed during TOPOFF, what technology deficiencies existed, and to identify technology needs as a result of observed TOPOFF activities.

ES.3 ANALYSIS METHODOLOGY

In general, the plan was to employ a three-level hierarchy of measures to assess communications systems effectiveness. Critical Operational Issues (COIs) represent the top-level measures needed to assess how well the overall objectives were achieved. Next, event specific Measures of Effectiveness (MOEs) as well as system-specific Measures of Performance (MOPs) were identified for all aspects of the incident. Data collection requirements were derived from these MOEs and MOPs.

Figure ES-1 shows the analysis hierarchy. The two COIs are Interoperability and Communications Security. Under these COIs are three MOEs: Timeliness, Ease of Use and Security Level. At the next level down, these MOEs are further divided into seven MOE components: Setting Up Communications, Transmitting Data, Commonality, Reliability, Mobility, Redundancy, Level of Security and Operational Impact. Under each of these seven MOE components are system-specific MOPs.

In addition to these quantitative measures, a semi-quantitative assessment of First Responder Communications equipment was conducted. Analysts' detailed logs, observations and interviews with First Responder participants were used to assess the subjective elements of communications equipment performance. Questionnaires were designed to elicit First Responder views of both current equipment capabilities and future technology needs.

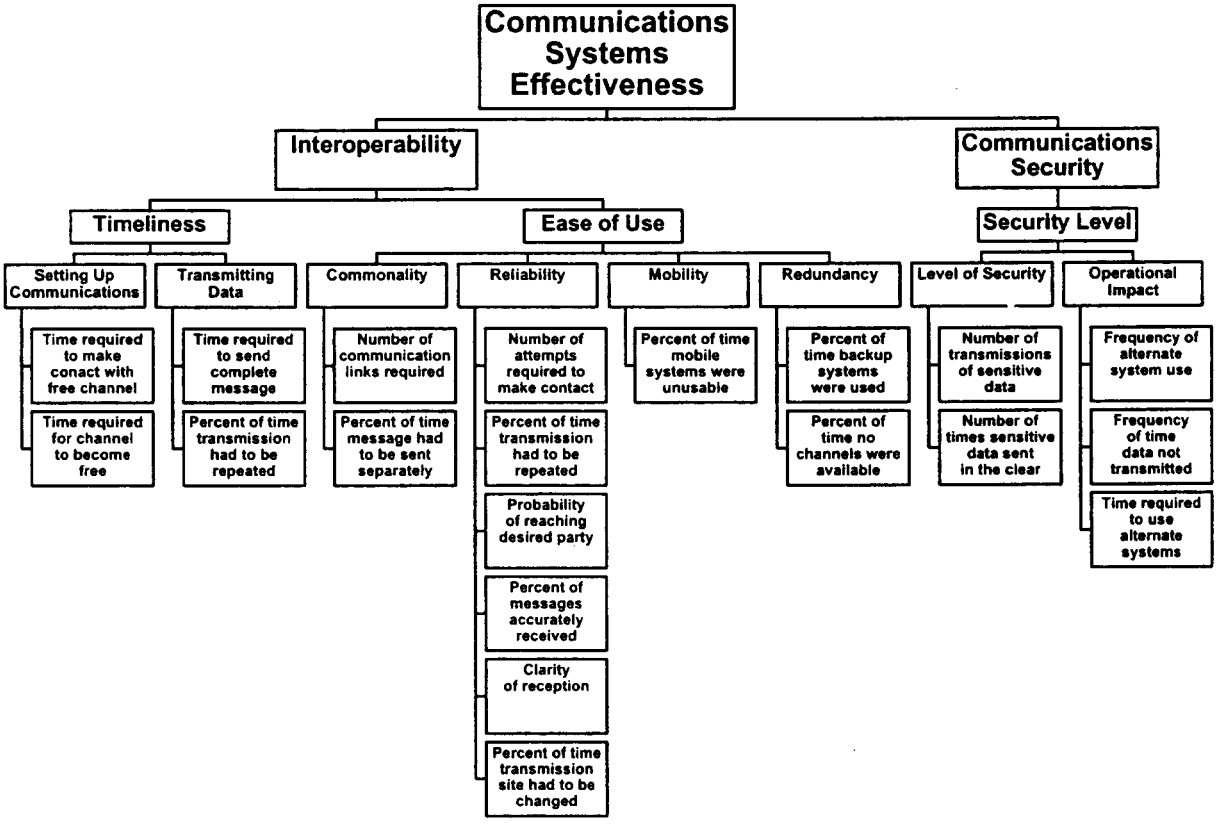


Figure ES-1 Analysis Hierarchy

ES.4 EXERCISE ARTIFICIALITIES

Since TOPOFF 2000 was an exercise and all the participants were aware of that fact, there were a number of significant differences between the exercise scenario and a real event. These differences, or exercise artificialities, must be kept in mind in the analysis and interpretation of the results. The major artificialities and their impact on the analysis include the following:

- There was not the heavy public use of the communications system that would have occurred in a real event, resulting in unrealistically better performance for the first responder's cellular phones. In a real event the heavy public use would also severely tax the dispatch center's ability to handle incoming calls.
- Since there were no real terrorists or victims, there were no concerns about sending sensitive data in the clear. The emphasis on using encryption would have been much higher in a real event.
- Since there were no real victims or real chemical agent, stress levels were much lower. Participants would have been much more concerned about communications and interoperability problems in a real event.
- The requirement to positively identify the chemical agent effectively halted operations for much of the first day. In an actual event with real victims, the first responders would have likely acted much sooner based on their own best estimate of the agent.
- "Contaminated" equipment and fire and police personnel were not always taken out of action during the exercise, reducing the stresses on the first responders. This also allowed there to be more resources for use by first responders.
- Periodic breaks called by the exercise controllers gave the first responders an opportunity to plan ahead.

Despite these exercise artificialities, the TOPOFF exercise identified a number of problems that would be expected to occur to a greater degree in a real terrorist event. The major uncertainty is how much more serious these problems would be in a real event.

ES.5 GENERAL SCENARIO DESCRIPTION

The exercise site was located at the New Hampshire Port Authority (NHPA). Figure ES-2 shows the location of the primary TOPOFF exercise site relative to the city of Portsmouth, NH. Figure ES-3 shows an expanded view of the TOPOFF incident site with the approximate locations of buildings shown and key locations for events indicated by the circled letters. The distance scale applies to the landmass, the water in blue, and the locations of Market Street and the Route 1 Bypass. The building sizes and locations are not drawn to scale. The port facility is separated from Market Street by a chain fence, shown by the dashed line with a gate into the port in the approximate location marked G.

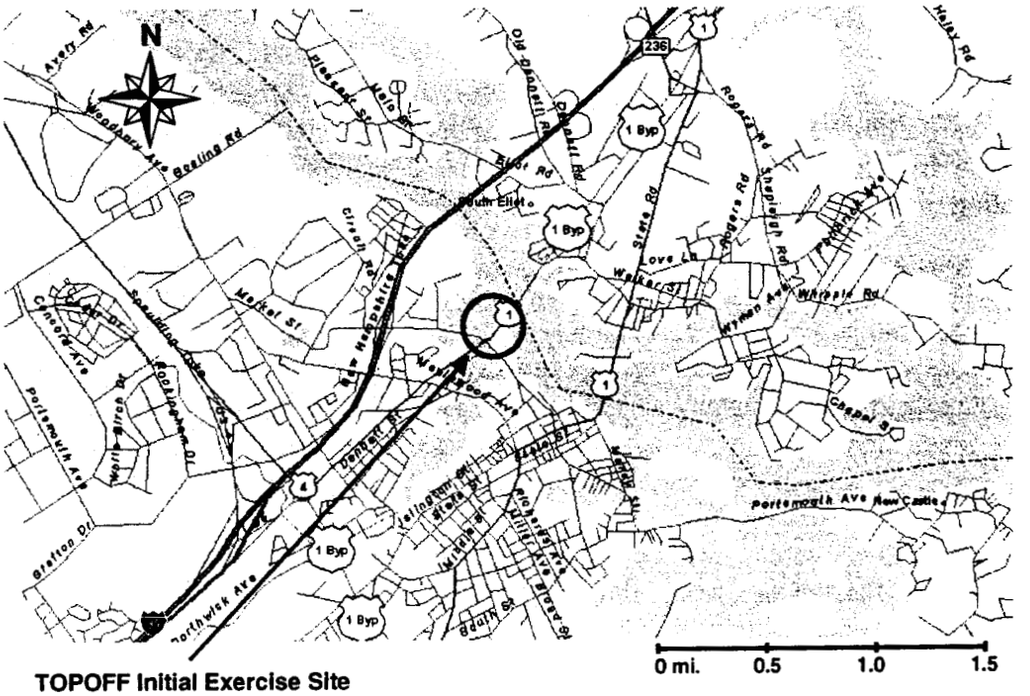


Figure ES-2 Portsmouth and TOPOFF Site

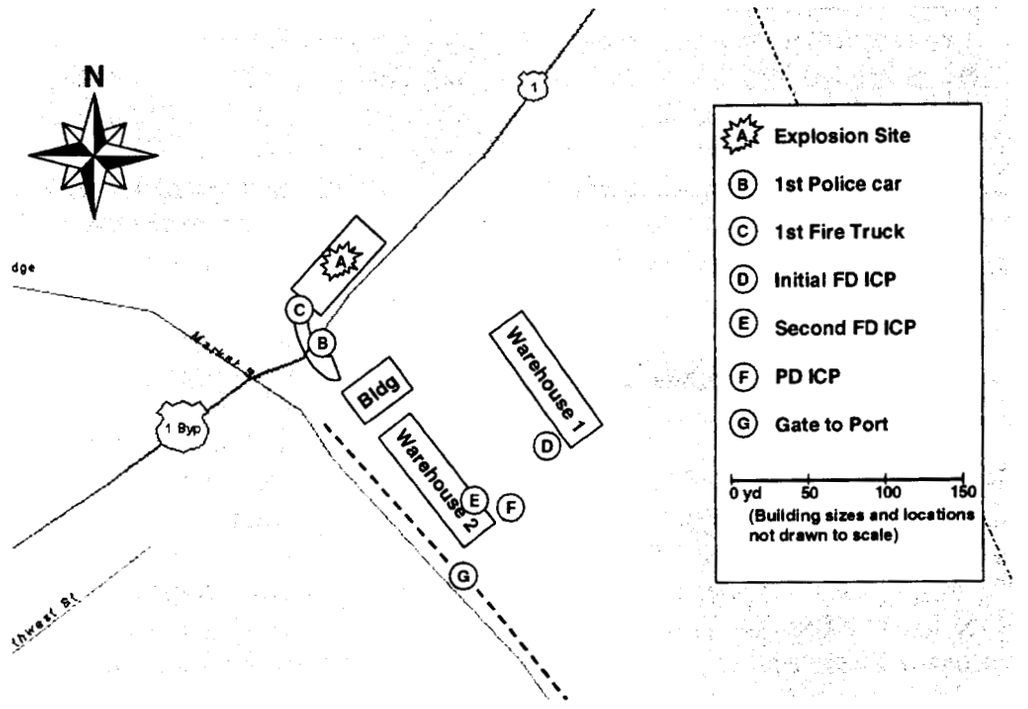


Figure ES-3 TOPOFF Initial Exercise Site

The port facility where the buildings are located, to the SE of the Route 1 overpass, is fairly level and mostly paved. Along the Route 1 overpass, the land rapidly drops off about 20 feet, to a flat paved area slightly above sea level. This lower paved area is where the van exploded and the chemical was released, at the location marked A. The Route 1 overpass itself is elevated and supported by a number of concrete piers. A curved, paved road leads under Route 1 from the upper level of the port to the lower level. This curved road or ramp coincides with the locations marked B and C on the figure.

ES.6 KEY EXERCISE EVENTS

The exercise began at 8:24 a.m. with a call to Portsmouth Dispatch, following the simulated explosion at location A (see Figure ES-3). The Portsmouth Police arrived on the scene first at 8:27 a.m. and drove part of the way down the ramp under the Route 1 overpass. The police car then backed up to a spot under the overpass marked B and the police officer exited the car and took up a position with a rifle beside one of the concrete piers supporting the overpass, a short distance away from the ramp. The first fire engine arrived at 8:30 a.m. and drove down the ramp past the police car and entered the contaminated zone, stopping at the location marked C and called on the radio for assistance.

Events moved quickly after the arrival of the fire truck. The Portsmouth Fire Department Captain called for hazardous material (HAZMAT) support at 8:34 a.m., full protective gear for the fire fighters at 8:39:30 a.m., and self-contained breathing apparatus at 8:44 a.m., when he declared this was a mass casualty incident (MCI). Additional Fire Department trucks and ambulances began arriving by 8:39 a.m., with a second fire truck also entering the contaminated zone at location C. Fire trucks and ambulances from the surrounding towns as well as additional Portsmouth Police and Rockingham County Sheriff officers also began arriving on the scene. By 8:54 a.m., the Portsmouth Fire Chief had arrived on the scene in a Fire Department utility truck and as the Incident Commander (IC), set up an Incident Command Post (ICP) on the upper level, at location D in Figure ES-3. The IC issued a 4th alarm at 9:09 a.m. By 9:23 a.m., the Portsmouth Police Department began raising concerns about the potential for a secondary explosive device. The IC established a full ICP at 9:27 a.m. with Commanders for operations, safety and HAZMAT, and issued a 5th alarm at 9:42 a.m. This 5th alarm coupled with a level 3 MCI "maxed" out the Portsmouth Fire Department's resources.

By 10:20 a.m., the IC had received enough information that he was able to assess the chemical agent as likely being mustard. After this time, the levels of activity begin to decrease, apparently for two basic problems. First, the possible existence of a second explosive device prevented sending in HAZMAT teams to take extensive samples to definitely identify the chemical agent. Second, the inability to get samples to (1) verify the agent was mustard and (2) verify that there were no other chemical agents hampered decontamination efforts and body recovery.

At 7:00 p.m., several different HAZMAT teams began investigating the incident site. By 7:30 p.m. the Portsmouth Police have been relegated to site/perimeter security with the Federal Bureau of Investigation (FBI) taking over the investigation.

More HAZMAT and Evidence Recovery Team activities took place overnight with TOPOFF activities at the incident site complete by 8:00 p.m. the next morning.

ES.7 RESULTS

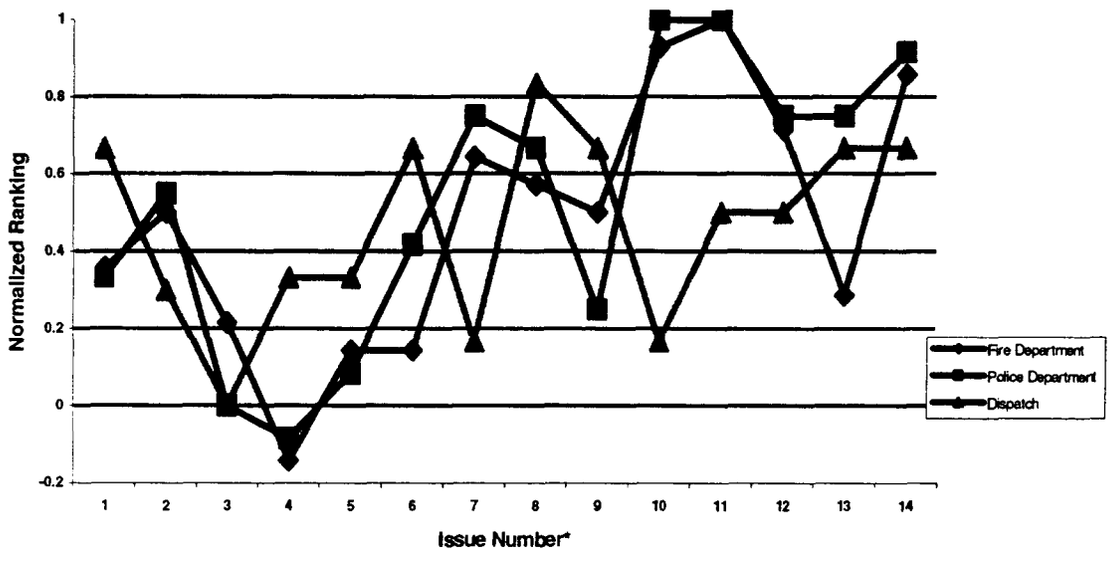
JHU/APL analysts maintained a continuous presence at the exercise site during the high level of activity on the first day of the exercise. There was one analyst positioned with the Incident Commander (from the Portsmouth FD), one at the Police Department Incident Command Post, one in the combined police/fire Dispatch, and an "at-large" person at the incident site. Analysts' logs included key observed on-scene communications events, with any particular issues/problems noted. When the pace of the exercise slowed, the analysts administered questionnaires/ interviews to many of the participating first responders from each area, Fire, Police and Dispatch. The analysts used these questionnaires to elicit comments concerning the communications performance during the exercise and to determine their communications needs The conclusions and recommendations presented in this report are based on the detailed logs, analyst observations and the quantified results from the questionnaires HAZMAT crews were not considered to be first responders, however, some recommendations regarding their communications effectiveness were made based on analyst observations and informal discussions with some team members.

ES.7.1 QUESTIONNAIRE RESULTS

The questionnaire results from each department have been normalized and are summarized in Figure ES-4. Each of the 14 questions was posed as an issue and allowed a response ranging from +2 for strongly agrees to –2 for strongly disagrees. There were seven interviewees from the Fire Department, six from the Police Department and three from the Dispatch Center. The sum of the scores for each question was normalized by the number of interviewees from that Department. Consequently the normalized scores range from +1 for strongly agree to –1 for strongly disagree. A score around 0 indicates either no opinion among the interviewees or a strong difference of opinion, and the latter was usually the case. The majority of these questions were derived from the *Inventory of State and Local Law Enforcement Technology Needs* prepared for NIJ in March 1998.

A surprising result was that both the Fire and Police Departments had very similar views and the most highly ranked issues were the same. Both felt that a command post/ communications vehicle (#11) and cellular phones (#10) are needed for a chemical terrorism event. Both Departments had command post vehicles but the Fire Department IC did not make use of either of the ones available to him and the use of the PD command post was minimal. The reasons for this disparity are not clear. In the case of the Fire Department ICP, one possible

reason is that the IC had 10-15 people surrounding him and neither of the available command posts had room for that many people. Another possible reason is that the ICP staff was composed of personnel from several different Fire Departments who were not familiar with the equipment in the two command posts. Some training of those personnel would have been required in real-time, and the level of activity at the FD ICP was too fast-paced in the early stages of the exercise to allow that training. Another possible reason is the IC may have been accustomed to operating out of the back of his Fire Department van and chose to stay with that familiar mode of operation. In the case of the police department, the command post did not have its full complement of capability (no direct line for phones or fax) and space was also an issue.



***Issues:**

1. Communication system(s) performance during the exercise sufficiently supported your (first responder) operations.
2. Communication Systems performed adequately in the following areas: Reliability; Clarity; Range; Endurance; Usability (size, hand vs head sets, etc.)
3. The communication system(s) performance significantly impacted the scenario outcome.
4. The communication system(s) performance would be notably different in an actual terrorist event from what was observed in the exercise.
5. Unique communication system capabilities are required
6. Encrypted or private communications systems are
7. Non-voice (fax, image transmission, etc.) communications systems are needed
8. Backup communications capabilities are needed
9. Systems limitations inhibited communications/ interoperability between different agencies
10. Cellular phones are needed.
11. A command post/communications vehicle is needed
12. A real-time information management system for the Incident Commander is needed.
13. An inter/intra-agency secure data communications system is needed
14. On-scene laptops with a reach-back capability to relevant databases are needed.

Figure ES-4 Summary of Survey Results

All participants made use of their cellular phones during the exercise but many were concerned about possible system overload during an actual event. The respondents felt that the cell phones provided a more secure means of communications since no encrypted radios were available for use.

The next most highly ranked issue was the need for laptops with reach-back capability (#14). This would provide links to chemical information databases, access to medical information, and property data. This capability is not currently available.

The need for encryption of radios or a secure communications system (#6, #13), did not rank high in the responses for either Department, however many of the comments were related to this issue. In contrast, this was the highest ranked need identified in the *Inventory of State and Local Law Enforcement Technology Needs.* There are two possible reasons for this difference. One reason is that since there were no real terrorists involved, concerns about security were not as high as they would have been in a real situation. This also is true in that there were no actual casualties, so there was no need to protect their identities from the public. The other reason is that situation awareness was a major issue in the exercise, particularly for the IC, so both FD and PD personnel rated it high in their survey responses since it was foremost in their minds.

The Dispatch Center results differed from those of the other respondents. The top rated issue based on their responses was that backup communications capabilities are needed, although none were needed during the exercise (#8). The Dispatch respondents felt that communications system performance adequately supported their operations (#1), although they did have recommendations for improvements. Several of these recommendations related to the need for encrypted radios and secure communications, which was their next highest rated issue. Their new computer-aided dispatch (CAD) program is more difficult and cumbersome to use than their earlier system, slowing down some operations as a result.

ES.7.2 MEASURES OF EFFECTIVENESS

Observations by the analysts and the results of the survey questionnaires provided information that addressed most of the MOEs.

Timeliness MOE

Setting Up Communications refers to the time required to 'make-contact' with the desired recipient of the communication attempt.

In the opening phases of the exercise, the time for Portsmouth FD units to set up communications using hand-held radios with other fire department units was very short. Within the first hour, however, as many Fire Department units began reporting from other local jurisdictions, channel congestion became severe and a number of messages required retransmission or apparently were not received at all. This channel congestion lasted for several

hours until most of the responding units had arrived and been briefed on the situation and assigned their roles.

PD personnel operating within the PD ICP and at the incident site were able to successfully make contact with desired parties within their own organization. Because the Portsmouth PD were using an alternate channel with no repeater, there were areas at the incident site where portable radios were ineffective. In some cases this delayed an officer's ability to immediately establish communications. Also, because there was only one channel, which was used for operational and administrative communications, important radio calls were sometimes delayed.

Inter-agency communications were less successful. Representatives from the other agencies were typically required to either go through the command post or to physically make contact with the person they wanted to contact.

Transmitting Data is related to how timely communications were once contact was established. Radio communications within agencies (between fire fighters and between police officers) were generally good, although on the Fire Department channels, congestion was extremely heavy during the first few hours of the exercise and a number of messages required retransmission or were apparently not received. There was virtually no ability among the units to use fax machines to transmit tabular or graphical data; the majority of the data transmissions were by voice.

Ease of Use MOE

Commonality is a measure of how easily agencies can communicate with each other using different communication systems. The various Fire Departments all have at least two common frequencies on their hand-held radios, allowing them all to easily communicate. As previously stated, the downside of this commonality is channel congestion when there are many first responders, impacting timeliness and data transmission. The Portsmouth FD also had two recently assigned tactical frequencies that only they could use. While these new channels reduced some of the radio channel congestion, they also reduced commonality and interoperability among all of the Fire Department first responders to some degree.

In contrast, there was not a great deal of commonality between FD units and the police. Here commonality was provided by either having liaison personnel from the different agencies assigned to the FD ICP or by interfacing through the Portsmouth Dispatch Center. In the case of the police, the communications van used as the PD ICP had the capability to communicate with FD personnel via radios on a separate frequency and was sometimes used to relay messages from one agency to another. Dispatch was also used to relay some messages. The relaying of messages was sometimes a problem because often the messages got 'mixed-up' in the re-communication. It also made it more difficult to ask questions and conduct needed conversations. As a result, some potentially critical information was passed solely within the sender's own agency. It also could be a burden on Dispatch and the command posts to try to

relay everything. Because of their close proximity at the incident site, many messages were relayed verbally between the FD ICP and the PD ICP rather than by radio.

Reliability refers to how effectively communications systems operated. Overall reliability for communication systems was good, and the short transmission ranges over the incident site resulted in good signal strength and clarity, provided open channels were available. The biggest problem with reliability was the channel congestion on the FD channels in the early hours, with the result that a number of messages had to be retransmitted and a number were apparently not received.

Police portable radios had batteries with an eight-hour endurance. Most radios lasted this long, but there was a shortage of spare batteries causing many radios to be inoperable after the first eight hours of the exercise. The communications van experienced two generator failures, but power was quickly restored and communication operations were not significantly impacted.

Clarity and bleed-over affected the quality of police department communications in some instances. The "dead spots" caused by using the alternate channel assigned for the exercise also impacted communications reliability.

Mobility refers to how frequently mobile communication equipment is usable. During this exercise mobility was generally good for all communication equipment. All of the FD first responders had hand-held radios with several selectable frequencies, allowing them to easily move about. As mentioned above, the short communication ranges over the exercise site meant that most hand-held radio transmissions had good signal strength and clarity. As previously mentioned for the police, however, portable radios performed well with a few noted exceptions in the areas of clarity, dead spots, and a lack of spare batteries.

Redundancy refers to the level and availability of backup communications in case the primary communication system, in this scenario radios, failed. Because of the small geographic extent of the incident site, runners with messages functioned as an adequate backup system when fire department radio channels were too congested to support the first responders in the opening hours of the exercise. A need was expressed by several first responders for a backup repeater for their duplex radio systems to allow redundancy from the incident site to other locations in the event their primary repeater failed.

For a longer scenario some form of backup communications would have been necessary for the police communications system. For the radios themselves, multiple frequencies would have provided a form of backup. Officers expressed a desire to have laptops in their vehicles as a secondary means of communication. They also agreed that cellular phones could be useful as a back up if the system was not overloaded by the general public. The communication van supplies some level of redundancy, but it should have a backup generator to ensure continuous operations.

Security Level

Secure communications were not identified as a major need by the Fire Department first responders. There are apparently two reasons for this. First, the Fire Department typically does not have the need for secure communications except when they do not want to release the names of victims. Second, many of the Fire Department first responders had Nextel radio/phones that they used when they needed to communicate sensitive information. In effect, the Fire Department first responders apparently had an adequate level of security for their operations.

Secure communications were not utilized during this exercise. Although lack of secure communications did not impact the scenario outcome, they may have under different circumstances. All Portsmouth PD officers expressed a strong need for secure communications capability, whereas those associated with the Rockingham County Sheriff's Department did not think they were necessary for local personnel. In many cases it was the Portsmouth PD number one technology requirement. One officer stated, "Communications equipment should be flexible, secure, and dependable."

ES.8 CONCLUSIONS AND RECOMMENDATIONS

Shortage of radio frequencies was cited by most of the Fire Department interviewees as a problem, and several suggested radio trunking as a possible solution. Trunking is an expensive solution because trunking systems require new radios and all of the Police/Fire Departments that would potentially respond to a terrorist event would need to have their equipment upgraded in order for them to be able to communicate. The worst period of radio congestion was only during the first few hours of the exercise, primarily because so many units were responding. A significant portion of the radio traffic, and later cellular phone traffic, appeared to be getting information and checking status rather than issuing commands. If status information could be posted to a wireless-accessible site (e.g., local internet with mobile laptops), then the communications congestion overload problem might be reduced as well as the need for more frequencies. The Fire and Police Departments would also have a capability that would be widely useable in other aspects of a terrorist incident as well as everyday work.

Situation awareness (SA) for the Fire Department was an area where there were a number of deficiencies. White boards and grease pencils were used to show SA, and updates on the situation were generally received by radio or verbal discussions. There was a strong recognition by the exercise participants of the need for a better command post capability and real-time information management system. Some of the radio communications overload was associated with simply getting updates on Fire Department units' status and location. A more automated information management system that provided this type of situation awareness could help reduce communications overload while providing other value. The participants also saw such an information management system as a capability that would be useful in everyday work as well.

A mobile command post was one of the highest ranked needs identified by both the Fire and Police Departments, although the command posts available during the exercise were underutilized, in part because of their small size. While it is expensive to produce a complete, packaged mobile command post, it might be more cost-effective to produce a packaged, turnkey information management system that could be installed by local communities in one of their own vehicles. The local communities could then select a vehicle appropriate for their size requirements. Key issues in such a turnkey system are ease of use, reliability and maintainability. Small communities do not have the manpower to dedicate to keeping complex computer systems up and running, or the funds to provide extensive training. Another factor for why the mobile command posts were not used in the TOPOFF exercise was apparently unfamiliarity with the equipment and how to operate it. Key elements of such a command post/information management system that should be considered include:

- A standardized system that is easy to learn and intuitively simple to operate could avoid these problems.
- Networked access to a variety of databases—chemical, GIS, maps, medical information.
- The ability to display the location of responding mobile units using GPS tracking transponders.
- The ability to transmit, receive and display video images (e.g., transmit video images of patient injuries to the local hospitals).

Interoperability was another area where there were deficiencies observed by all agencies. Many of the problem areas during the exercise involved development of common situational awareness, command and control issues and interoperability issues. In the very beginning of the exercise, the Fire Department first responders drove past the police car and into a contaminated area because there was apparently no procedure/capability for on-scene police and other units to issue warnings to other first responders en route to the scene. Problems often resulted because the participants don't normally work together on exercises of this magnitude, and they did not know one another's procedures or capabilities. The opportunity for regular training and simulation can be a viable solution to many of these problems. A simulation/training environment that creates realistic streams of data that the various parties can transmit to one another could meet many of the training needs and could probably be developed without requiring advanced simulation tools.

Interagency communications among first responders needs to be improved so that face-to-face communications do not need to be relied upon. Radios with multiple channels, and a simple, possibly hands-off, way to switch channels could enhance interagency communications. However, this would be most effective if procedures were in place to use different channels for different functions. Based on the responses, this would have to be a secure system, at least on some channels.

Communications between members within a HAZMAT team is difficult because of their suits, very inefficient, and detracts from operational tasking. This capability could be enhanced with wireless networking but another possible solution, which would also enhance inter-team communications, would be to provide a speaker-type capability that would project speech external to the suit and allow others to hear you at a reasonable distance from the source.

In addition to the communications effectiveness assessment some other areas for technology contributions were also noted.

With large numbers of victims, tracking their location and heath status took considerable effort during the exercise, and would have been a greater problem in a real event. Small GPS-equipped tracking units that could be attached to each victim, possibly with a health status monitoring package, with the ability to display the data on a real-time information management system would help considerably in situational awareness.

Identification of toxic agents was a significant problem during the exercise, producing a delay of well over 12 hours. In real events and every day work, the Fire Department cannot afford such delays. Some ability to use field-deployable sensors with quick-readout measurements of the more likely chemical agents would provide better protection to FD first responders without significantly compromising their day-to-day effectiveness. Response times in minutes or less are needed; other additional units arriving on the scene can inadvertently enter the contaminated areas, as actually happened during the exercise.

Another related problem was the interactive issues of the chemical agent identity and the possibility of a secondary device. The possible secondary device prevented detailed sampling to better identify the agent while uncertainty about the agent prevented detailed searching for a secondary device. Robotic sampling systems might help side step this difficulty. Discussions with personnel during the exercise indicated that robotic solutions had been tried in the past and robots that could emulate human behavior (e.g., reach through car windows to take samples off seats) had proven too expensive while inexpensive small robots had proven too incapable. With the continuing advances in robotics, however, it might be possible to build a cost-effective robot for sampling/searching that could be useful in many situations.

During high intensity operations, Computer Aided Dispatch (CAD) programs should not hinder a Dispatcher's ability to perform his/her duties. Development of a system that is easy to use, operates efficiently, and generates good reports is recommended.

ES.9 SUMMARY

TOPOFF 2000 provided a number of significant insights into the capabilities and needs of first responders to handle a major terrorist incident. Although the Fire and Police Departments from Portsmouth and the surrounding local jurisdictions performed extremely well during the exercise, a number of important deficiencies were identified:

- There was an insufficient number of radio channels to handle the volume of radio traffic during the early phase of the exercise.
- There were interoperability problems, especially between the different agencies.
- There was a lack of situational awareness, which compounded the radio congestion problem because a portion of the radio traffic was devoted to checking on status and location of units.
- There was a lack of training for handling large events where units from many different jurisdictions must work together, which further compounded the interoperability problem.

A number of areas where NIJ could help provide technological solutions were identified. Major opportunities include:

- Improvements to the communications systems, including a mobile command post capability, solutions to the channel congestion problem, and greater interoperability of the first responders during the beginning phases of an incident
- Real-time information management tools with reach-back to a variety of databases
- Tools and programs for distributed training and simulation

Section 1

INTRODUCTION

1.1 GENERAL

Exercise Top Officials (TOPOFF) 2000 was designed to assess the Nation's crisis and consequence management capability by presenting a challenging series of geographically-dispersed terrorist threats and acts to Federal, State, and local agencies. TOPOFF was a Congressionally mandated, "no-notice" national exercise that began on 16 May, 2000 and ran through 24 May, 2000. Live exercise play was conducted in two host cities, Denver, CO, and Portsmouth, NH. Each city was presented with a mock terrorism event, involving a Weapon of Mass Destruction (WMD), to test the response of agencies at the State and local levels. Additional simulated events from other cities were injected by the exercise control group to test the response at the Federal level to a nationwide coordinated terrorism event.

Exercise TOPOFF 2000 was sponsored by two Federal agencies, the Department of Justice (DOJ) and the Federal Emergency Management Agency (FEMA), designated by Presidential Decision Directive (PDD)-39 as the Lead Federal Agencies (LFA) in the Federal Response Plan (FRP). Exercise TOPOFF 2000 was the largest peacetime terrorism exercise ever sponsored by DOJ or FEMA. Early feedback from exercise controllers, observers, and participants indicates that the majority of exercise objectives were met in all exercise venues.

Exercise TOPOFF 2000, which incorporated design input from crisis and consequence managers across the nation, provided an opportunity to capitalize on government efforts to date, gauge progress, and chart future endeavors. Exercise TOPOFF 2000 provided an opportunity to rehearse and evaluate emergency response capabilities designed to save lives and protect property when potentially catastrophic, terrorist-related conditions are imminent or occur.

1.2 JHU/APL INVOLVEMENT IN TOPOFF

The Johns Hopkins University Applied Physics Laboratory (JHU/APL), under a cooperative agreement with the National Institute of Justice (NIJ), conducted a technology assessment of First Responder Communications equipment used during TOPOFF. This assessment was focused on exercise operations conducted in the Portsmouth, NH area. Because the WMD used in Portsmouth was a chemical weapon, dispersed via an exploding vehicle, this venue provided the greatest level of operational stress for First Responder Communications equipment.

Analysts from JHU/APL were placed at key nodes in the Portsmouth, NH locale during TOPOFF. Exercise events at the Portsmouth Dispatch Center (Combined Police and Fire), Police Department Incident Command Post, Fire Department Incident Command Post, and

the explosion site itself were observed and recorded by these analysts. The direct, immediate goal of this effort was to contribute to the understanding of which communications technologies were employed during TOPOFF, what technology deficiencies existed, and to identify technology needs as a result of observed TOPOFF activities.

JHU/APL's role was a distinct, but complementary, one to the TOPOFF exercise observers who examined the policies, plans, systems, procedures, staffing and facilities used at all levels of participating Government agencies and/or departments.

1.3 ANALYSIS METHODOLOGY

A detailed description of the analysis methodology is provided in JHU/APL's report, JWR-00-012, "Combined Data Collection and Analysis Plan for Communications Effectiveness for First Responders during TOPOFF 2000". In general, a three-level hierarchy of measures was employed during the analysis. Critical Operational Issues (COIs) represent the top-level measures needed to assess how well the overall objectives were achieved. Next, event specific Measures of Effectiveness (MOEs) as well as system-specific Measures of Performance (MOPs) were identified for all aspects of the incident. Data collection requirements were derived from these MOEs and MOPs. The COIs, MOEs, and MOPs used for the assessment are shown in Table 1-1. A detailed description of each of these measures is provided in the document referenced above.

In addition to these quantitative measures, a qualitative assessment of First Responder Communications equipment was conducted as well. Analyst observations and interviews with First Responder participants were used to assess the subjective elements of communications equipment performance. Questionnaires were designed to elicit First Responder views of both current equipment capabilities and future technology needs. Table 1-2 provides the issues addressed in our assessment.

Table 1-1

HIERARCHY OF MEASURES

Critical Operational Issues		
▪ Interoperability between first responders (timeliness and ease of use) ▪ Communications Security for first responders		
Measures of Effectiveness		
Timeliness ▪ Setting up communications ▪ Transmitting data	**Ease of Use** ▪ Commonality ▪ Reliability ▪ Mobility ▪ Redundancy	**Security Level** ▪ Level of security ▪ Operational impact of security
Measures of Performance		
▪ Time required to make contact when channel is clear (S) ▪ Time required to wait for available channel to become free (S) ▪ Time required to send complete message (T) ▪ Percent of time retransmission of a message was required (T)	▪ # of communication links required to reach desired party (C) ▪ Percent of time same message had to be sent separately to reach different parties (C) ▪ # of attempts required to make contact (R) ▪ Percent of time retransmission of a message was required (R) ▪ Probability of reaching desired party (R) ▪ Ratio of accurately received messages to messages sent (R) ▪ Clarity of reception (R) ▪ Percent of time transmission site had to be changed to eliminate interference (R) ▪ Percent of time Incident Commander was unable to use mobile comms equipment (M) ▪ Percent of time backup communications channels were used (R) ▪ Percent of time no comms channels were available (R)	▪ # of transmissions of sensitive data (L) ▪ # of times sensitive data was broadcast in the clear (L) ▪ # of times sensitive data not transmitted because of security concerns (O) ▪ # of times alternate comms systems were used to transmit sensitive data (O) ▪ Time required to reach and use those alternate comms systems (O)

Table 1-2

Primary Issues from Questionnaires

1.	Communication system(s) performance during the exercise sufficiently supported your (first responder) operations.
2.	Communication Systems performed adequately in the following areas: • Reliability • Clarity • Range • Endurance • Usability (size, hand vs head sets, etc.)
3.	The communication system(s) performance significantly impacted the scenario outcome.
4.	The communication system(s) performance would be notably different in an actual terrorist event from what was observed in the exercise.
5.	Unique communication system capabilities are required for a chemical terrorist event
6.	Encrypted or private communications systems are needed for a chemical terrorism event.
7.	Non-voice (fax, image transmission, etc.) communications systems are needed for a chemical terrorism event.
8.	Back-up communications capabilities are needed for a chemical terrorism event.
9.	Systems limitations inhibited communications/ interoperability between different agencies?
10.	Cellular phones are needed for a chemical terrorism event.
11.	A command post/communications vehicle is needed for a chemical terrorism event.
12.	A real-time information management system for the Incident Commander is needed for a chemical terrorism event.
13.	An inter/intra-agency secure data communications system is needed for a chemical terrorism event.
14.	On-scene laptops with a reach-back capability to relevant databases are needed for a chemical terrorism event.

1.4 SCOPE OF REPORT

This report concentrates on first responders to a terrorist chemical event. The main emphasis is on the roles and needs of the local community first responders during the first few hours, before all of the various State and Federal agencies have arrived. The data in the report come from direct observations of Fire Department (FD), Police Department (PD), and Dispatch activities during the TOPOFF 2000 exercise and after-action interviews with a number of first responders. The report identifies the needs of these first responders during the opening hours of a terrorist chemical event.

Section 2

TOPOFF EXERCISE SUMMARY

2.1 GENERAL SCENARIO DESCRIPTION

2.1.1 SITE DESCRIPTION

Figure 2-1 shows the location of the primary TOPOFF exercise site relative to the city of Portsmouth, NH. The exercise site was located at the New Hampshire Port Authority (NHPA), shown by the circled area on the map. Figure 2-2 shows an expanded view of the TOPOFF incident site with the approximate locations of buildings shown and key locations for events indicated by the circled letters. The distance scale applies to the landmass, the water in blue, and the locations of Market Street and the Route 1 Bypass. The building sizes and locations are not drawn to scale. The port facility is separated from Market Street by a chain fence, shown by the dashed line with a gate into the port in the approximate location marked G.

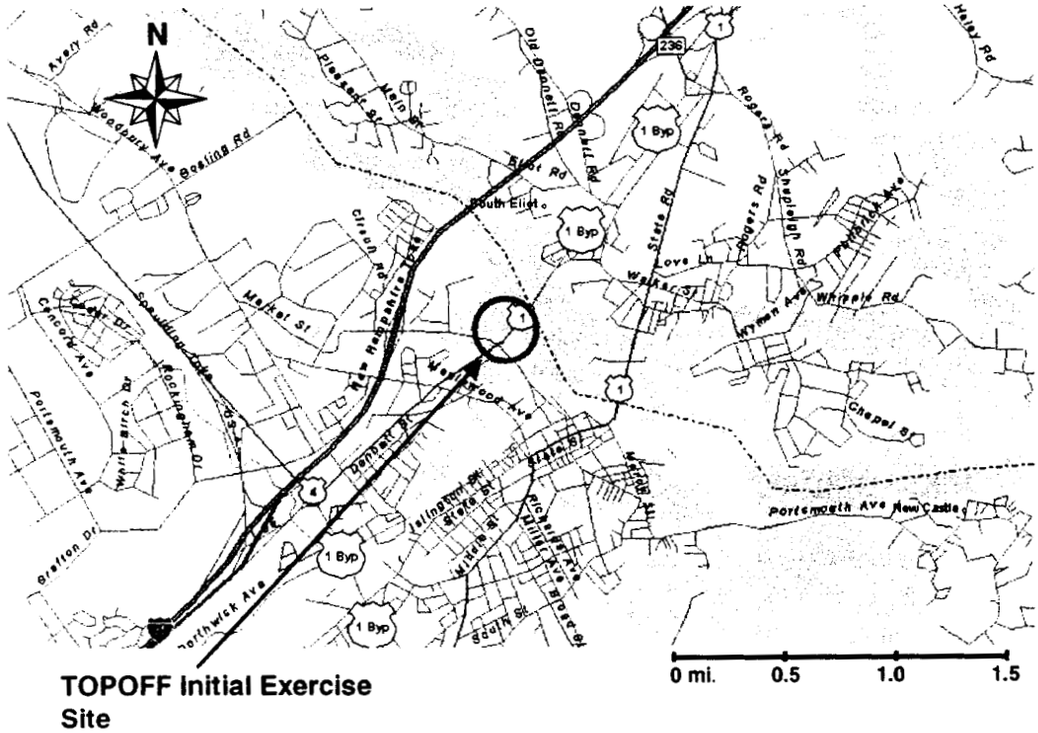


Figure 2-1 Portsmouth and TOPOFF Site

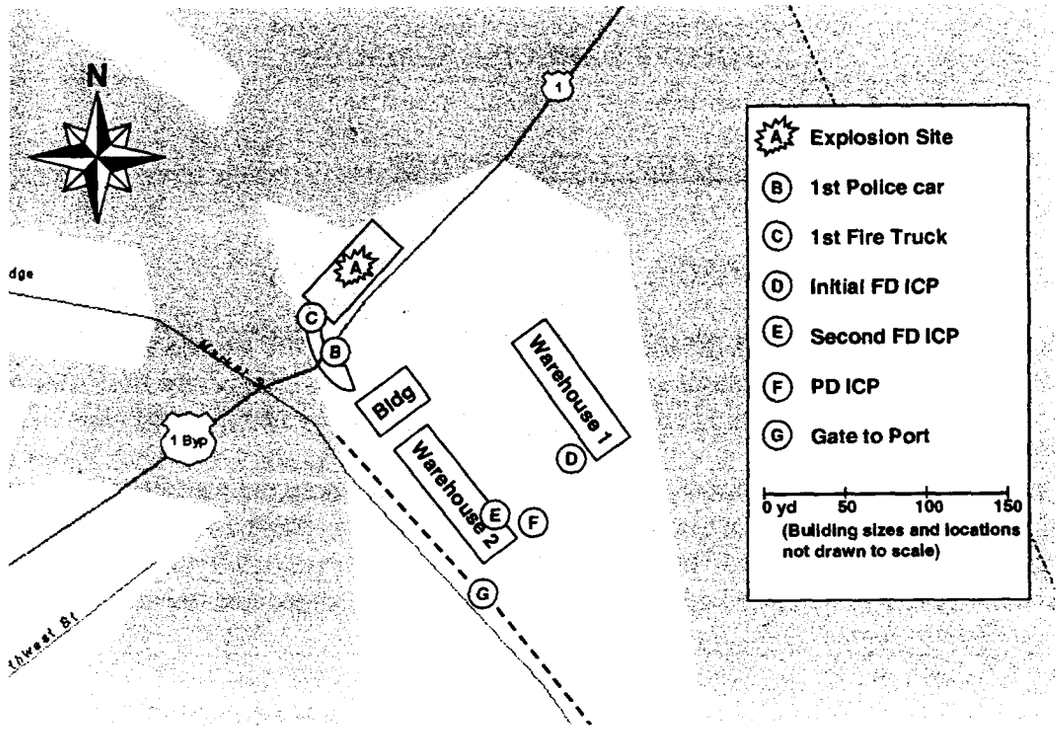


Figure 2-2 TOPOFF Initial Exercise Site

The port facility where the buildings are located, to the southeast of the Route 1 overpass, is fairly level and mostly paved over. Along the Route 1 overpass, the land rapidly drops off about 20 feet, to a flat paved area slightly above sea level. This lower paved area is where the runners were congregated and where the van exploded, at the location marked A. The Route 1 overpass itself is elevated and supported by a number of concrete piers. A curved, paved road leads under Route 1 from the upper level of the port to the lower level. This curved road or ramp is shown near the locations marked B and C on the figure.

2.1.2 KEY EXERCISE EVENTS

The basic timeline for key events involving the first responders is shown in Table 2-1. The exercise began at 8:24 a.m. with a call to Portsmouth Dispatch, following the simulated explosion at location A (see Figure 2-2). The Portsmouth Police arrived on the scene first, at 8:27 a.m., and drove part of the way down the ramp under the Route 1 overpass. The police car then backed up to a spot under the overpass marked B and the police officer exited the car and took up a position with a rifle beside one of the concrete piers supporting the overpass, a short distance away from the ramp. The first fire engine arrived at 8:30 a.m. and drove down the ramp past the police car and entered the contaminated zone, stopping at the location marked C

and called on the radio for assistance. In later discussions with the Captain in charge of that fire engine about why they had gone past the police car, the response was that they didn't see the police officer or any warnings that they should not proceed beyond that point.

Events moved quickly after the arrival of the fire truck. The Portsmouth Fire Department Captain called for hazardous material (HAZMAT) support at 8:34 a.m., full protective gear for the fire fighters at 8:39:30 a.m. and self-contained breathing apparatus at 8:44 a.m., when he declared this was a mass casualty incident (MCI). Additional FD trucks and ambulances began arriving by 8:39 a.m., with a second fire truck also entering the contaminated zone at location C. Fire trucks and ambulances from the surrounding towns as well as additional Portsmouth Police and Rockingham County Sheriff officers also began arriving on the scene. Except for the first few vehicles on the scene, most of the later arrivals stayed in the upper section of the port area, south of the warehouses, or outside the port area along Market Street. By 8:54 a.m., the Portsmouth Fire Chief had arrived on the scene in a Fire Department utility truck and as the Incident Commander (IC), set up an Incident Command Post (ICP) on the upper level, at location D in Figure 2-2. The IC issued a 4th alarm at 9:09 a.m. By 9:23 a.m., the Portsmouth Police Department began raising concerns about the potential for a secondary explosive device. The IC established a full ICP at 9:27 a.m. with Commanders for operations, safety and HAZMAT, and issued a 5th alarm at 9:42 a.m. This 5th alarm coupled with a level 3 MCI "maxed" out the Portsmouth Fire Department's resources.

Because inclement weather was expected, the IC decided at 9:48 a.m. to move the ICP to the inside of warehouse 2, at location E. The Police Department set up their ICP just outside this warehouse at location F in the Rockingham County Sheriff's Department mobile command post. By 10:20 a.m., the IC had received enough information that he was able to assess the chemical agent as likely being mustard.

After this time, the levels of activity begin to decrease, apparently for two basic problems. First, the possible existence of a second explosive device prevented sending in HAZMAT teams to take extensive samples to definitely identify the chemical agent. Second, the inability to get samples to (1) verify the agent was mustard and (2) verify that there were no other chemical agents prevented decontamination efforts and body recovery.

These two problems also reinforced one another; not knowing the agent for certain hampered investigations to search for a second explosive device, which in turned hampered sampling efforts. As a consequence, most of the afternoon was spent trying to resolve these two issues and Fire Department personnel from Portsmouth and adjoining areas largely just waited. By 5:30 p.m., the situation had still not been resolved. The Civil Support Team (CST) reported at 5:30 p.m. that their mobile laboratory had verified that the agent was sulfur mustard. However, they still needed verification from a fixed laboratory, as well as verification that no other chemical agents were present.

At 7:00 p.m., several different HAZMAT teams began investigating the incident site. By 7:30 p.m. the Portsmouth Police have been relegated to site/perimeter security with the Federal Bureau of Investigation (FBI) taking over the investigation.

More HAZMAT and Evidence Recovery Team activities took place overnight with TOPOFF activities at the incident site complete by 8:00 a.m. the next morning.

Table 2-1

TOPOFF Timeline

Time	Event
Saturday, 5/20/2000	
8:24 a.m.	Exercise begins (1st alarm).
8:27 a.m.	Police car, Unit 4, Portsmouth PD arrives at incident site/New Hampshire Port Authority (NHPA)[1].
8:29 a.m.	Fire engine, Engine #6, Portsmouth FD, arrives NHPA.
8:30 a.m.	2nd alarm ("Level 3/Mass Casualties") Ambulance #2, PFD, arrives NHPA
8:32 a.m.	Portsmouth FD Captain (Engine #6/PFD) calls for assistance; directs fireman to (1) begin triage, (2) check perimeter, and (3) watch for suspicious things.
8:34 a.m.	Portsmouth FD Captain calls for HAZMAT. Unmarked Portsmouth PD unit arrives (Police Chief).
8:36 a.m.	Portsmouth FD Captain puts in a call for police and security support. Engine/Ladder #4/PFD arrives incident site. Portsmouth FD Captain reports bodies in the water. Ambulance #3/ Portsmouth FD arrives NHPA.
8:37 a.m.	Engine/Ladder #2/PFD arrives NHPA.
8:38 a.m.	Engine #1/ Portsmouth FD arrives NHPA.
8:39 a.m.	Portsmouth FD truck, Ladder #2, proceeds to incident site.
8:39 a.m.	Portsmouth FD Captain calls for full protective gear for the fireman. Command Post 1/ Portsmouth FD arrives NHPA.
8:41 a.m.	Newington FD/Chief arrives NHPA.
8:42 a.m.	Unit #8/ Portsmouth PD arrives NHPA.
8:43 a.m.	Engine #_ Portsmouth FD arrives NHPA. Ambulance #4 Newington FD arrives NHPA. Fire & Rescue Unit # /North Hampton arrives NHPA.
8:44 a.m.	PFD Captain calls for self-containing breathing apparatus and announces probable chemical contamination. PFD Captain declares MCI. Unmarked police unit arrives NHPA.
8:46 a.m.	Ambulance/Rye FD arrives NHPA. Engine #5 Portsmouth FD arrives NHPA. Two unmarked police units (Sheriff #2 and #3/Rockingham County) arrive.

[1] Arrival times are for entry into New Hampshire Port Authority grounds or to "incident site" (actual location of casualties), as noted.

Time	Event
8:48 a.m.	Special Hazard Unit/ Portsmouth FD arrives NHPA. Ambulance/York Volunteer FD arrives NHPA.
8:49 a.m.	Ambulance Newington departs NHPA.
8:50 a.m.	Ambulance Rye FD departs NHPA.
8:51 a.m.	Crime Scene Unit/ Portsmouth FD arrives NHPA.
8:52 a.m.	3rd alarm called in.
8:54 a.m.	ICP established (Portsmouth FD). Portsmouth PD liaison at ICP reports missing police officer Ambulance North Hampton arrives NHPA.
8:55 a.m.	Ambulance/York Volunteer FD departs NHPA. Ambulance/Seabrook FD arrives NHPA. Rockingham County Sheriff #2 & #3 relocate vicinity ICP.
8:58 a.m.	IC calls for water decontamination, US Coast Guard contacted.
9:00 a.m.	HAZMAT Engine #1/Portsmouth Naval Shipyard arrives NHPA. Communications Van/PD arrives NHPA. Pease Fire Dept. Tanker/Crash/Rescue Engine with HAZMAT trailer[2] arrive NHPA.
9:02 a.m.	Rockingham County Sheriff #4 arrives NHPA. Engines and Ambulances lining up outside NHPA; including units from North Hampton, Seabrook, Dover.
9:04 a.m.	Ambulances North Hampton/Seabrook depart (never entered/reentered NHPA).
9:05 a.m.	Ambulance/City of Dover enters NHPA. Unmarked PD unit arrives NHPA.
9:09 a.m.	IC transmits 4th alarm call
9:12 a.m.	Ambulance #44 Seabrook FD arrives NHPA. Unmarked Rockingham County Sheriff unit arrives NHPA.
9:14 a.m.	Rockingham County Sheriff # 11 arrives NHPA. Fire and Rescue Unit #3/City of Dover arrives NHPA.
9:16 a.m.	Fire Chief/Rye arrives NHPA.
9:17 a.m.	Rockingham County Sheriff # 12 arrives NHPA.
9:18 a.m.	Fire & Rescue pickup truck/North Hampton arrives NHPA.
9:19 a.m.	Exercise pause-ICP establishment discussed.
9:20 a.m.	Emergency vehicle (Blazer)/Exeter arrives NHPA.
9:22 a.m.	Fire & Rescue pickup truck/Dover arrives NHPA.
9:23 a.m.	Portsmouth PD raises concerns about a secondary explosive device
9:26 a.m.	Ambulance #142/Kennebunk arrives NHPA. Ambulance/New Market arrives NHPA. Emergency Operations Center (EOC) set up at the Central Firehouse.
9:27 a.m.	IC begins setting up full ICP with commanders for operations, safety and HAZMAT.
9:34 a.m.	Fire & Rescue/Forestry #1/ Hampton, with trailer arrives NHPA. Engine/Pease AFB arrives NHPA. Rockingham County Sheriff #_ arrives NHPA. Rescue #2/Ogunquit FD arrives NHPA.
9:35 a.m.	Fire & Rescue/Special Response Unit/Ogunquit with trailer arrives NHPA.
9:38 a.m.	Interstate Emergency Unit ("MASK") arrives NHPA.

[2] Trailers generally contained HAZMAT supplies/equipment.

Time	Event
9:42 a.m.	IC issues 5th alarm call. Public Works/NH Highway Division van and dump truck arrive NHPA.
9:44 a.m.	Fire & Rescue pickup with trailer arrives NHPA.
9:45 a.m.	Fire 4x4/Deputy Chief/Kittery FD arrives NHPA.
9:48 a.m.	IC decides to move the ICP inside warehouse 2 because of predictions of inclement weather. FBI arrive NHPA.
9:50 a.m.	Alcohol, Tobacco & Firearms (ATF) personnel arrive NHPA.
9:58 a.m.	Rockingham County Sheriff Communications van is set up as the Police ICP near the relocated FD ICP.
9:59 a.m.	Rockingham County Sheriff #1 arrives NHPA.
10:20 a.m.	IC announces he believes the chemical agent was mustard.
10:30 a.m.	Engines at incident site are deemed contaminated and abandoned.
10:32 a.m.	IC calls meeting and informs assistants that he is not getting reports on radio that he should.
10:38 a.m.	IC has coordination meeting at ICP with representatives from Portsmouth PD, FBI and other agencies. IC announces some Portsmouth FD equipment entered hot zone and is contaminated. Portsmouth PD provides an update on the bomb and suspects. New personnel arriving (e.g., FBI) receive verbal descriptions of the area.
10:45 a.m.	Status: ~25 victims (live) remain at incident site, no response personnel present.
10:58 a.m.	IC comments that with so many frequencies in use, difficult to follow what's happening; on the other hand, if only one frequency, can't communicate because of communications overload.
12:01 p.m.	IC called for information on number of patients to be transported (hospitals had not been given that information yet).
12:20 p.m.	Portsmouth PD liaison officer was not near the ICP when IC needed to ask him questions; IC had to call the Portsmouth PD to request liaison.
12:30 p.m.	Confusion about whether there is a secondary explosive device, preventing HAZMAT teams from going in to take detailed samples of the agent.
1:16 p.m.	IC comments to his staff on the number of conflicting reports that he is receiving.
1:43 p.m.	IC announces the ICP will move to the EOC downtown as soon as agent is identified.
2:37 p.m.	Rapid Assessment and Initial Detection (RAID) team begins setting up and announces "it will take an hour to set up and discover what the agent is."
3:30 p.m.	Decision to move the ICP is rescinded; Portsmouth FD and PD will maintain operations at the Port site overnight.
4:11 p.m.	Communications van/Rockingham County loses power. Restored quickly.
4:18 p.m.	Communications van/Rockingham County loses power 2nd time.
5:15 p.m.	State Medical Examiner states that they need pictures of bodies in the context of the disaster scene since their personnel are not allowed to enter the explosion site to conduct an investigation.
5:30 p.m.	RAID team reports their mobile van has identified the agent as sulfur mustard, but they still need final fixed lab verification verifying both that identification and the absence of any other agents.
7:00-7:30 p.m.	HAZMAT Teams (5), including Civil Support Detachment for Weapons of Mass Destruction (CSD/WMD), investigating incident site.
7:25 p.m.	Local law enforcement (Portsmouth PD) relegated to site/perimeter security.

Time	Event
9:43 p.m.	CSD/WMD departing NHPA.
11:00 p.m.	Mobile Command Unit/Nashua arrives NHPA. Control Group declares that secondary devices are "administratively" cleared. Enables FBI HAZMAT teams to operate at incident site during the night.
11:23 p.m.	Safety brief for HAZMAT teams prior to incident site entry.
Sunday 5/21/2000	
12:55 a.m.	HAZMAT teams depart staging area, heading for incident site. (Teams are Evidence Response Team, Hazardous Material Response Team, and Explosive Ordnance/ Bomb Disposal.)
1:00 a.m.	HAZMAT teams arrive incident site (evidence gathering, sketching scene, pictures, etc.)
1:08 a.m.	FBI robot with surveillance camera deployed in the vicinity of incident site.
1:25 a.m.	HAZMAT teams recalled.
1:26 a.m.	HAZMAT teams exit area.
1:30 a.m.	HAZMAT teams being decontaminated.
2:47 a.m.	Request for CSD/WMD support for Chem-Bio Incident Response Force (CBIRF) operations to begin at 7:00 a.m.
3:21 a.m.	HAZMAT teams (10 personnel) depart for incident site (follow-on evidence gathering).
3:25 a.m.	HAZMAT team arrives incident site.
4:01 a.m.	Three personnel depart, one with torn MOPP gear.
4:07 a.m.	Two escort HAZMAT personnel return to incident site.
4:16 a.m.	HAZMAT teams depart incident site, return through DECON.
4:27 a.m.	FBI robot retrieved manually.
6:10 p.m.	CBIRF arrives NHPA.
6:50 p.m.	CBIRF personnel (with gas masks, gloves) enter incident site for victim removal from incident site. National Medical Recovery Team (NMRT) decontaminates bodies.
7:15 p.m.	CBIRF/NMRT tasking complete at NHPA/incident site.
8:00 p.m.	TOPOFF activities at NHPA are complete.

2.2 EXERCISE ARTIFICIALITIES

There were several events that impacted all participants in the exercise and were directly related to it being an exercise and not a real terrorist attack.

An inability to get a final, official confirmation of what agent was used (and equally important, that there were no other agents used) effectively halted many operations by noon. Much of the afternoon was spent awaiting final lab confirmation that mustard gas was the agent and that there were no other agents present.

This problem of agent identification and the ceased operations was an artificiality of the exercise. In real situations, even those involving HAZMAT, the Portsmouth FD does not wait for final identification and negative confirmation, but goes ahead and handles the situation

with HAZMAT teams. Rapid response is essential to save victims and contain fires. Given that terrorist incidents with hazardous agents will only be rare occurrences compared to the normal rate of fires and HAZMAT releases, the Portsmouth FD concept of operations (CONOPS) for dealing with terrorist events needs to be considered. It would seem that the Portsmouth FD must treat each event as a typical event, possible with HAZMAT, and respond quickly in order to save victims and control damage and fires. Waiting to confirm that an event is not a chemical attack before moving equipment and personnel would make the Portsmouth FD largely ineffective in its day-to-day operations.

A related artificiality is that if there were an actual chemical agent used, much of the Portsmouth FD's equipment and many of both the Fire and Police Departments' personnel would be contaminated and affected by the agent very quickly. This would increase the number of casualties, lengthen the decontamination process, and require additional personnel and equipment to respond to the incident.

Another artificiality, which particularly affected communications equipment performance during this exercise, was the non-participation of the general public. In the event of an actual terrorist attack, communications overload could have been a major problem. Radio communications may not have been impacted as significantly as standard and cellular phone usage, which would have significantly impacted the Dispatch Center, but still may have been overwhelmed. During the exercise, communications were in no way impeded by high volume civilian traffic.

Although TOPOFF was intended to be a "no-notice" exercise, some of the local first responders were aware of the starting time of the exercise. This was related to having the required number of personnel available for both real world and exercise events. This may have impacted the quick response time by many of the local area fire departments.

Despite these artificialities, the exercise highlighted real problems in the areas of radio channel congestion, deficiencies in situational awareness, and interoperability problems within agencies and between agencies. These same problems would be expected in a real terrorist event, but their magnitude and impact would likely be much greater in a real event.

2.3 DATA COLLECTION LIMITATIONS

Several data recording difficulties occurred during this exercise. In the initial phases of the exercise, the radio usage was so high that it was not possible to manually log all the events. As more and more fire department units and ambulances arrived on scene, the IC was making several radio calls a minute, sometimes switching from one handheld radio to another at times, and other times switching frequency on the radio he was holding. As a result, it was not always clear who was being called, or what frequency was being used.

As communication loads and resulting interference begin to increase, additional data logging problems became apparent. While it was possible to observe and record instances where the IC could not make contact and had to repeat the call, other communications problems were not so easy to recognize. These other problems included:

- The party being called did not clearly receive the message and had to request a repeat transmission
- The party being called did not understand the message correctly
- Parties calling the IC had to make several attempts to make contact
- Parties attempting to call the IC simply could not get through

The reason for the transmission problem (e.g., poor clarity, broken transmission, being "stepped on", no free channel, etc.) was not always obvious to an observer at the ICP. The recent addition of two tactical frequencies to the PFD added to the data collection difficulties. These new frequencies were heavily used by the PFD, but transmissions over them could not be recorded at the Portsmouth Dispatch Center because of equipment incompatibilities.

The mode of operation at the ICP also produced difficulties for data collection. A crowd of participants, including fire fighters from the Portsmouth and other Fire Departments, as well as liaison personnel from other agencies like the Portsmouth Police Department surrounded the IC. The IC alternated between conducting discussions with members of this group and using radios or a cell phone to communicate with other parties. Several members of this group were acting as assistants or as liaison to the IC, and these members would often receive orders from the IC that resulted in their making radio calls of their own. Alternatively, they would also receive radio calls that would require they have discussions with the IC. In short, the ICP was a dynamic scene of multiple conversations and incoming and outgoing communications occurring simultaneously. It would be difficult for one, or even several observers to manually log all the important developments.

It was also not possible to manually log all the Police activities at the incident site, although less dynamic than those at the ICP, they were not as centralized.

The original analysis plan included the use of tape recordings made at the Dispatch Center of all communications as a key data source for calculating most of the quantitative MOPs. However, two weeks before the exercise, the Portsmouth Fire Department was assigned two additional tactical frequencies that could not be recorded at the Dispatch Center. Since the Portsmouth FD used these two frequencies extensively for their own communications during the exercise, the lack of recording capability at the Dispatch Center resulted in a significant data gap. In addition, many of the communication problems observed in the field were associated with problems like the inability to get a free channel to make a transmission and the misinterpretation of messages when they were received. Problems like these are not easily quantified from tape recordings alone. Because of these issues and the unrecorded transmissions, it was concluded that the available Dispatch Center recordings would provide only a partial, and possibly misleading, calculation of the MOPs. Consequently, the

available data recordings were obtained from the Dispatch Center as backup, but were not analyzed for this report.

In future exercises of this type, several possible solutions should be considered. More observers should be assigned to key sites like the ICP, with different tasking for each observer about what to record. One observer might be assigned to the IC while another to the Assistant IC, for example. Videotaping and audio recording of the activities at the ICP and other key areas at the incident site would provide an invaluable record for reconstructing detailed events. Finally, scanners to help follow both sides of all the radio communications would help, especially if these transmissions could be recorded (assuming there are no legal restrictions in doing so).

The end result of all of this was that this precluded our ability to collect all the data necessary to calculate the MOPs previously defined and our assessment is based entirely on analyst observations and the questionnaires administered to the key participants.

Section 3

COMMUNICATIONS PERFORMANCE

3.1 OVERVIEW

This section discusses the analysis and findings for the Portsmouth Fire Department, Police Department, and Dispatch Center first responders in three separate subsections. Each subsection includes a short introduction, artificialities of the exercise relative to that agency, equipment used, an operations summary, observed performance, and lessons learned and recommendations. In addition, a fourth section provides the same discussion for HAZMAT teams, although they are not typically considered first responders. Finally, the section concludes with an overall summary.

3.2 PORTSMOUTH FIRE DEPARTMENT

3.2.1 INTRODUCTION

The Portsmouth Fire Department was one of the major first responders to the incident, and the Portsmouth FD IC was the overall Incident Commander for much of the first day and night of the TOPOFF exercise. A large number of Fire Department mobile units and ambulances also responded from Portsmouth and surrounding areas and towns. As a result, Fire Department mobile units and ambulances represented the dominant first responders for the early hours of the exercise, placing significant demands on their communications systems and their interoperability.

3.2.2 ARTIFICIALITIES

There were a number of artificialities in this exercise from the Fire Department's perspective. In particular, since there were no real victims, the stress levels among the fire fighters were much lower. Had real people been dead and dying, demands on communications equipment would have been higher and the first responders would have been much less tolerant of communications failures and uncertainty about the situation. There were also no real terrorists involved, eliminating the possibility that terrorists might intercept first responder communications and trigger secondary explosions when first responders were congregated near a secondary device. In a real event, encryption and data security might be a significant concern to the first responders. In post-exercise interviews, however, encryption/data security was not at the top of the Fire Department first responders' list of priorities.

During the exercise, the exposed and injured "victims" were left in the port area for several hours before being transported to hospitals; in a real event, that transport would have taken place much sooner. Townspeople and relatives would probably also have congregated on

the accident area and placed additional communication demands on the telephone systems trying to find out the status of victims. The timeouts ordered periodically by the controllers gave the first responders an opportunity to think about their next actions; in a real event, this opportunity would not occur. The requirement to positively identify the chemical agent effectively halted operations for much of the first day. In an actual event with real victims, the first responders would have likely acted much sooner based on their best estimate. "Contaminated" equipment and fire and police personnel were not always taken out of action during the exercise, reducing the stresses on the first responders. Finally, because the weather turned cold, simulated decontamination of the "victims" using actual water sprays did not occur, preventing the first responders from testing their decontamination procedures on large groups of people.

Despite these exercise artificialities, the TOPOFF exercise identified a number of problems that would be true in a real event as well. These problems are identified and described in subsequent paragraphs of this section. All of these problems would occur in a real terrorist event; the real question that can't be answered with the exercise data is how much more serious these problems would be in the real event.

3.2.3 EQUIPMENT USED

Fire Department personnel had multiple methods of communication. Personnel with the mobile units primarily used hand-held radios with a variety of selectable frequencies. Two frequencies, 154.19 MHz and 154.28 MHz, were common to the various Fire Departments from the surrounding towns as well as Portsmouth. The first frequency is a general calling frequency used throughout the coastal area by Fire Departments, Police Departments and other agencies. The second frequency is a mutual-aid frequency and appeared to be used largely by Fire Department units from Portsmouth and the other towns. In addition, the Portsmouth Fire Department had been assigned two new frequencies, referred to as Tac2 and Tac3, a few weeks earlier that only they could use. To reduce radio channel congestion, Portsmouth FD units apparently used these new frequencies to communicate with one another, leaving the 154.28 MHz-frequency open for the FD units from other locations. A common fallback mode when fire personnel were not able to contact one another at the exercise site by hand-held radio was to send runners with messages. Since the distances were only about 150 yards, this fallback communications mode was feasible, but did introduce additional delays.

In addition to the handheld radios, the Portsmouth FD also had a duplex radio system that connected units in the field with the Portsmouth Dispatch Center and the fire stations. These radios transmitted on 154.340 MHz and received on 153.770 MHz. The FD had a repeater on the roof of their central fire station in Portsmouth. The Incident Commander had one of these radios mounted in the back of his utility van. The IC used the tailgate of this van as his ICP throughout the exercise. A number of FD personnel were also equipped with Nextel radio/cellular phones. These units can be used as either radios or cellular phones, and they are apparently much less sensitive to transmissions interception than the handheld radios.

The Portsmouth FD had a mobile communications van, which was a converted ambulance. This van was equipped with a duplex radio operating on the FD frequencies, a computer with modem, television set, maps, emergency guides and data books and white boards used to track status of events. This van was initially set up next to the Fire Department ICP and left there after the FD ICP was moved inside the warehouse. Eventually this communications van was also moved inside the warehouse. The van had room for about four people to sit; the IC did not use this van to any extent and it was eventually turned over to FD Emergency Medical Services (EMS) personnel. The Amesbury FD also provided a mobile communications van that was located just outside the warehouse. The Amesbury van was not used to any significant extent by the IC.

Some FD personnel had access to fax machines. Inter-agency communications (e.g., Portsmouth FD and Portsmouth PD) were generally handled by having a representative from that other agency being assigned to the FD ICP. The inter-agency communications were then typically handled as verbal discussions between the IC and the agency representative.

3.2.4 OPERATIONS SUMMARY

In the early stages of the exercise, the primary communications mode appeared to be the hand-held radios operating on the 154.19 MHz, 154.28 MHz, and the two Portsmouth FD Tac frequencies. The short distances at the exercise site, about 150 yards, and to downtown from the exercise site, about 1.5 miles, made it possible for most of the transmissions to be received with no clarity problems and little interference. Contact usually seemed to be made on the first transmission attempt. When the IC arrived and established an FD ICP about one-half hour into the exercise, the IC relied on two hand-held radios and a fixed radio on the Fire Department duplex frequency in the back of his utility truck. The IC would alternate between the three radios depending on who was calling him and whom he was calling.

The basic operating mode at the FD ICP was that the IC stood near the back of the utility truck/ICP surrounded by a group of perhaps 10-15 people. Some of these people were other Fire Department personnel that were assisting in the ICP operation. Other members of the group acted as liaison between the Fire Department ICP and other agencies such as the Police Department. These liaison personnel communicated via radio and/or cell phone with their various Command Posts and then interacted verbally with the appropriate FD personnel. Other members of the group were representatives from newly arrived units that would report for instructions and then leave. The IC alternated between talking with members of this group at the FD ICP and communicating with distant units by radio and cell phone.

As the additional fire and ambulance units from other towns responded and arrived on the scene, the level of traffic and resulting interference on the radio channels begin to increase. The Portsmouth FD units began communicating with one another on their two new Tac frequencies, leaving the 154.280-MHz frequency for the other Fire Departments and reducing some of the radio traffic on that mutual aid frequency. However by 9:30 a.m., an hour into the exercise, the IC had to make multiple attempts to contact some parties by radio and had to

request retransmission of some messages. At 10:32 a.m., the IC called a staff meeting around the ICP and complained that he was not getting reports from the various posts around the exercise site on radio, presumably because of the heavy radio traffic.

As additional agencies arrived and set up their command posts at more distant sites, there were sometimes problems reaching those sites by radio. For example, a Joint Operations Center (JOC) was established by the FBI at Pease Air Force Base to integrate interagency emergency management functions and to coordinate all intermediate and final resolution operations. Because of the distance of the JOC from the exercise site, direct radio communications were not possible with the JOC. Communications between the JOC and the FD ICP had to be routed through the Emergency Operations Center (EOC), which had been set up by local and state government representatives at the Portsmouth central fire station at 9:26 am.

The worst period for communications congestion was during the first two to three hours of the exercise. As the day progressed, communication levels began to decrease for several reasons. First, the majority of responding FD units had arrived and received their instructions within the first few hours. Second, the outstanding issues with chemical agent identification and secondary explosives stalled many FD activities by noon. Third, FD personnel began to rely more heavily on their Nextel cellular phones rather than hand-held radios.

3.2.5 OBSERVED PERFORMANCE

Survey Results

During the second day of the exercise, interviews were conducted with a number of FD first responders using a questionnaire developed as part of the data collection plan. Seven FD representatives were interviewed:

1. The Incident Commander
2. The Assistant Incident Commander
3. The Communications Assistant at the ICP
4. The first FD on-scene responder
5. The Fire Department EMS Officer for the exercise
6. The Fire Department Incident Safety Officer for the exercise
7. A Fire Department "trusted agent" for the exercise

The survey had 14 primary questions (see Table 1-2) about communication system performance and needs, and the interviewee was asked to respond in the range from "strongly agree" to "strongly disagree" with the question. The interviewees were also encouraged to provide detailed comments. The results from the surveys are included in the Appendix, together with individual responses and comments. These questionnaires provided invaluable information and insight into the communications needs and other needs of the first responders.

There was universal agreement from the interviewees that a real-time command post/communications vehicle is needed, which is surprising since two such Fire Department command posts were available during the exercise and neither was used to any significant degree. The reasons for this disparity are not clear. One possible reason is that the IC had 10-15 people surrounding him and neither of the available command posts had room for that many people inside. In particular, the Portsmouth Fire Department communications van could accommodate only about four people and they had to be seated. Another possible reason is that the ICP staff was composed of personnel from several different Fire Departments who were not familiar with the equipment in the two command posts. Some training of those personnel would have been required in real-time, and the level of activity at the FD ICP was too fast-paced in the early stages of the exercise to allow that training. Another possible reason is the IC may have been accustomed to operating out of the back of his Fire Department van and chose to stay with that familiar mode of operation.

There was near unanimous agreement that cellular phones would be needed in a terrorist event. The Portsmouth FD Commanders had cellular phones and appeared quite familiar with their use. One interviewee noted that cellular phones have significant coverage gaps in rural areas, limiting their general utility. This weakness may be offset by a lower probability of terrorist attacks in such thinly populated areas.

There was very strong agreement that laptop computers with reach-back capability for accessing a variety of databases, including chemical, medical and geographical, would be useful and that a real-time information management system would be valuable in both a terrorist event and in everyday work.

There was general, but not overwhelming, agreement on several issues. Backup communication capabilities were seen as needed for a real event, but no specific capabilities other than a backup repeater were mentioned. Systems limitations did inhibit communications/ interoperability between the Fire Department and other agencies such as the police, but liaison problems seemed as important as shortage of radio frequencies. Most of the interviewees felt the communications system performance would not have been different in an actual event.

There was less agreement that the communications system sufficiently supported the Fire Department in their first responder role, with three interviewees noting that the performance deteriorated after the initial phase of the exercise. There was strong agreement that more radio channels were needed; six out of seven interviewees cited this need. A major source of this channel congestion was the large number of mobile units from different Fire Departments that responded to the event. Starting about one-half hour into the exercise, radio traffic became very heavy as these additional units began to report in, and that congestion continued for several hours until the units had arrived and been assigned tasks.

Interviewee opinions were more mixed on the remaining questions, with about as many interviewees disagreeing as agreeing. Neither encryption nor a secure inter/intra-agency

data system was seen as key requirements, and no unique communications systems capabilities were seen as needed.

Measures of Effectiveness

As stated in Section 2, the MOPs could not be calculated because of the inability to collect the necessary quantitative data. However, observations by the analysts and the results of the survey questionnaires provided information that addressed most of the MOEs.

Timeliness

- Setting Up Communications

This MOE refers to the time required to 'make-contact' with the desired recipient of the communication attempt. In the opening phases of the exercise, this time to set up communications using hand-held radios was very short. Within the first hour, however, as many Fire Department units began reporting from other locations, channel congestion became severe and a number of messages required retransmission or apparently were not received at all. This channel congestion lasted for several hours until most of the responding units had arrived and been briefed on the situation and assigned their roles.

Fire Department communications with other agencies were less successful. Representatives from the other agencies were typically required to either go to the Fire Department ICP or to physically make contact with the person they wanted to contact.

- Transmitting Data

This MOE is related to how timely communications were once contact was established. Radio communications between fire fighters were generally good, although congestion was extremely heavy during the first few hours of the exercise and a number of messages required retransmission or were apparently not received. There was virtually no ability among the mobile FD units to use fax machines to transmit tabular or graphical data; the majority of the data transmissions were by voice.

Ease of Use

- Commonality

This MOE is a measure of how easily agencies can communicate with each other using different communication systems. The various Fire Departments all have at least two common frequencies on their hand-held radios, allowing them all to easily inter-communicate. As previously stated, the downside of this commonality is channel congestion where there are many first responders, impacting timeliness and data transmission. The Portsmouth FD also had two recently assigned tactical frequencies that only they could use. While these new channels

reduced some of the radio channel congestion, they also reduced commonality and interoperability among all of the Fire Department first responders to some degree.

In contrast, there was not a great deal of commonality between FD units and other agencies like the police. Here commonality was provided by either having liaison personnel from the different agencies assigned to the FD ICP or by interfacing through the Portsmouth Dispatch Center. This lack of commonality produced problems at the very beginning of the exercise when there was no way for the on-scene police to warn the fire trucks en route; consequently, the Fire Department first responders drove past the police car and entered the contaminated area.

- Reliability

This MOE refers to how effectively communications systems operated. MOPs contributing to this MOE include system clarity, percentage of successful communication attempts, number of retransmission requirements, and percentage of time a transmission site had to be moved. Overall reliability for communication systems was good, and the short transmission ranges over the incident site resulted in good signal strength and clarity, provided open channels were available. The biggest problem with reliability was the channel congestion in the early hours, with the result that a number of messages had to be retransmitted and a number were apparently not received.

- Mobility

This MOE refers to how frequently mobile communication equipment is usable. During this exercise, mobility was good since almost all of the FD first responders had hand-held radios with several selectable frequencies, allowing them to easily move about. As mentioned above, the short communication ranges over the exercise site meant that most hand-held radio transmissions had good signal strength and clarity.

- Redundancy

This MOE refers to the level and availability of backup communications in case the primary communication system, in this scenario radios, failed. Because of the small geographic extent of the incident site, runners with messages functioned as an adequate backup system when radio channels were too congested to support the first responders in the opening hours of the exercise. A need was expressed by several first responders for a backup repeater for their duplex radio systems to allow redundancy from the incident site to other locations in the event their primary repeater failed.

Security Level

- Level of Security and Operational Impact of Security

Secure communications were not identified as a major need by the Fire Department first responders. There are apparently two reasons for this. First, the Fire Department typically does not have the need for secure communications except when they do not want to release the names of victims. Second, many of the Fire Department first responders had Nextel radio/phones that they used when they needed to communicate sensitive information. In effect, the Fire Department first responders apparently had an adequate level of security for their operations.

Other Fire Department Performance Issues

In addition to the communications issues discussed above, a number of other Fire Department issues were identified during the exercise. Since these other issues directly impacted the Fire Department's role as first responders and are amenable to technology solutions, they are included in this section of the report.

- Situation Assessment

A number of problems occurred that are associated with situation assessment, and these problems impacted both communications and the course of the exercise. Four of the five top ranked questions in the survey (see the Appendix) all deal with aspects of situation assessment. Situation assessment was never very good during the early hours of the exercise and the IC apparently never saw the actual incident site, relying primarily on verbal descriptions of the site and radio reports from various units. Several times the IC commented on some of the shortcomings: it was difficult to follow all the activity with multiple radio frequencies in use (10:58 a.m.), radio reports were not being received (10:32 a.m.), and conflicting reports were being received (1:16 p.m.).

The Assistant IC, with a grease pencil and white board (about 2 ft high and 3 ft wide), maintained situation assessment at the FD ICP. This method is apparently the Portsmouth FD's standard way of monitoring the location of equipment and FD Commanders on the scene. Figure 3-1 shows the white board as it was configured about 10:30 a.m. The white board has a set format with permanently labeled categories and boundaries. The center portion of the white board is blank to allow a rough drawing of the incident site and equipment/command post locations. Grease pencil entries and drawings are shown in red italics in the figure to distinguish them from the permanent text. The on-scene Commander's name was used on the actual white board; in Figure 3-1, this name is replaced with the Commander's title. As the situation changes, grease pencil entries on the white board are updated. As a consequence, the white board provides a picture of only the current situation without any history of how the situation developed. Other shortcomings are that the whiteboard can be easily erased by accident and it only shows what is reported to the IC.

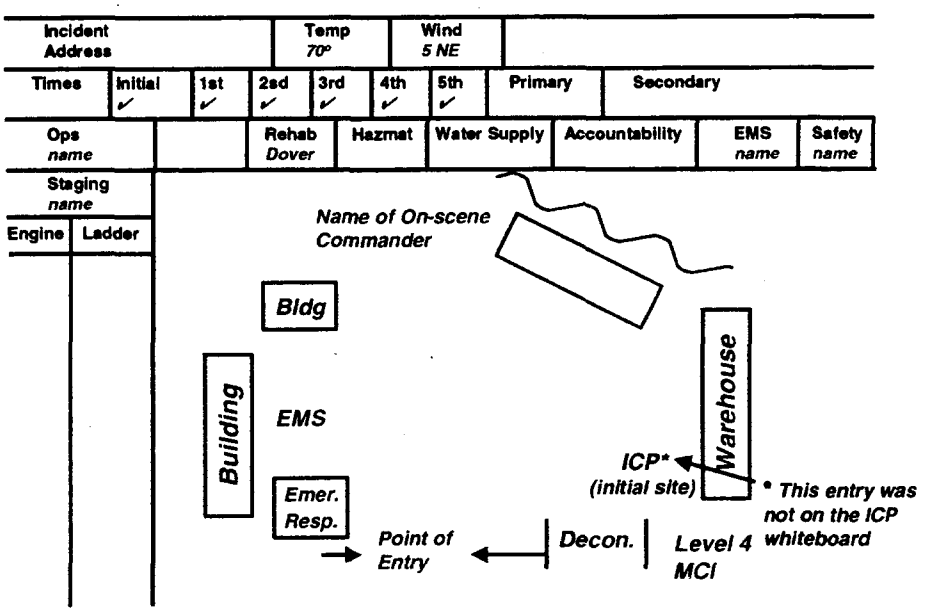


Figure 3-1 ICP Situation Board

The IC spent a fair amount of time making calls to check on the status of equipment that he had requested. This use of radio communications to simply maintain information on equipment location and status loads down the communications system with unnecessary radio traffic and distracts the IC from concentrating on understanding the situation and making longer-range plans. GPS tracking of the mobile Fire Department units from Portsmouth and the surrounding areas and display of their locations on a computer terminal at the FD ICP would have eliminated the need for some of these check-up calls. A related issue was tracking victims and their health and transport status. There were a number of repeated inquiries trying to ascertain where the victims were, what their medical status was, and to which hospital they were being transported. Had this been a real event with actual casualties, this victim-status issue would have probably been a much more significant problem. Monitoring tags that could be attached to the individual victims to provide their basic vital signs and GPS location with the information displayed on a situation assessment computer terminal could help alleviate this problem.

In observing the activity around the FD ICP, it was clear that many questions about status and events (e.g., what kinds of symptoms did the victims have) were being personally directed to the IC from a variety of people. This questioning further distracted the IC from concentrating on understanding the situation and decision-making. Staff at the ICP that could have handled those questions would have further reduced demands on the IC. Again, an easy-to-understand computer display of the situation would have helped reduce some of the questions.

By late morning, a second white board was started at the ICP to display the evolving command structure. This was a completely blank white board with no permanent formatting. As the command structure evolved, boxes were added to show new command organizations. Figure 3-2 shows this second white board as it evolved through the day. Some of the command blocks would include the name of the on-scene Commander; these names have been replaced with just the word "name" in Figure 3-2. The blocks in black are the original command structure at approximately 11:30 a.m.; the red blocks indicate the additional command structure that had evolved by the end of the first day, around 5:00 p.m.

Most of the exercise was conducted with no visual imagery of the actual explosion site. Eventually a fire truck with a boom extension was used later in the day to raise a camera high enough to get a picture down into the incident site.

Other FD teams wanted maps showing sewer lines and outfalls for use in planning decontamination efforts. Specifically, the question was whether water runoff from decontamination efforts at the site would flow out through sewer outfalls and contaminate other areas. It is not clear whether they were ever able to obtain this information.

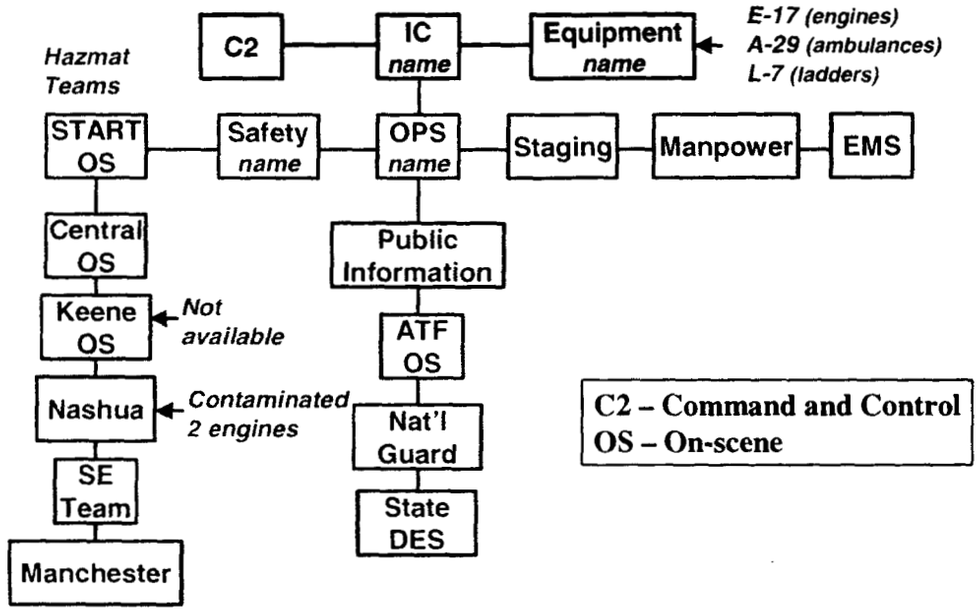


Figure 3-2 ICP Command Structure

There was also fairly early recognition that a chemical agent had been used, and probable identification of the agent was made by the Fire Department IC within two hours of the exercise start. However, an inability to get a final, official confirmation of what agent was used (and equally important, that there were no other agents used) effectively halted many Fire

Department operations by noon. Much of the afternoon was spent awaiting final laboratory confirmation that mustard gas was the agent and that there were no other agents present. It is not clear to what degree these delays were self-imposed to allow all the participating agencies to have a role and to what degree these delays would have been tolerated in a real event.

- Fire Department Interoperability

Interoperability between the various Fire Departments from various localities seemed fairly good since the Fire Departments all had a common mutual-aid frequency and the fire fighters knew one another. However, there were still some difficulties. There was a reluctance to use the available mobile communications vans and equipment, possibly because of lack of training prior to the exercise and the inability to train in the midst of a fast-moving exercise. There was also some confusion in the early phases of the exercise since the first responders were not familiar with working with one another in a major ICP structure with well-defined roles and responsibilities for the ICP staff. Despite their common fire-fighting background, there are probably differences in the practices and procedures for the different Fire Departments. As a consequence, many decisions that should have been made by the ICP staff were passed up to the IC, distracting him from longer range planning. An efficient, inexpensive way to provide training between the different units might eliminate many of these interoperability difficulties.

There was also confusion among the non-Portsmouth Fire Department units about where hospitals (and presumably other facilities) were located in Portsmouth. The Portsmouth FD also had two dedicated tactical radio frequencies that were not available to the Fire Department units from surrounding locales. While these dedicated frequencies eased radio channel congestion for the Portsmouth FD somewhat, they did detract from interoperability with other Fire Department units.

The Portsmouth FD did not have the same radio frequencies as the Portsmouth PD used. Interface with the Police Department was via a liaison police officer physically assigned to the FD ICP; on occasion, this person was not there when the IC wanted to communicate with the PD. As discussed earlier, this lack of interoperability also produced problems at the very beginning of the exercise.

3.2.6 LESSONS LEARNED AND RECOMMENDATIONS

Communications

The communications systems of the Fire Department first responders effectively supported the TOPOFF exercise for the most part. There were communications systems overloads for the first several hours as expected, but Fire Department personnel worked around those problems by relying on messages and personal contact. The small geographic size of the exercise site was an important factor that made this work-around possible. The limited extent of

the exercise site also did not stress the radio communications system; the participants generally judged radio messages as clear when they were able to make contact.

Shortage of radio frequencies was cited by most of the interviewees as a problem, and one interviewee suggested radio trunking as a possible solution. Since the issue is really a shortage of frequencies rather than interoperability of systems, radio trunking systems that automatically switch the user to an open frequency seems an appropriate solution. Modular interconnect systems like the ACU-1000 which easily link different communications systems together for interoperability would not be useful here for solving the frequency congestion problem.

Improving the communications systems to increase the effective number of frequencies appears to be an expensive option with limited utility. Trunking systems require new radios and all Fire Departments that would potentially respond to a terrorist event would need to have their equipment upgraded in order for them to be able to communicate. The worst period of radio congestion was only during the first few hours of the exercise, primarily because so many units were responding. An advanced communications system that could handle that level of loading would likely not be needed during the normal Fire Department activities. Moreover, much of the radio traffic, and later cellular phone traffic, appeared to be getting information and checking status rather than issuing commands. If status information could be posted to a wireless-accessible site (e.g., local internet with mobile laptops), then the communications congestion overload problem might be reduced. The Fire Departments would also have a capability that would be widely useable in other aspects of a terrorist incident as well as everyday work.

There was fairly wide agreement that headsets would be very useful for the first responders in the field, leaving both hands free to do other things. Mobile repeaters that could be set up, at or near, the FD ICP would provide more range and the ability to reach the remote sites were also cited several times as a worthwhile backup system.

Situation Awareness

Situation awareness (SA) for the Fire Department was an area where there were a number of deficiencies. White boards and grease pencils were used to show SA, and updates on the situation were generally received by radio or verbal discussions. The IC commented several times during the early phases of the exercise that he did not have complete situational awareness. A fraction of the radio traffic, and the IC's time, was spent calling units to receive updates or their status and location. Similarly, there was considerable confusion on the status and location of victims from the explosion.

There was a strong recognition by the exercise participants of the need for a better command post capability and real-time information management system. Some of the radio communications overload was associated with simply getting updates on Fire Department units' statuses and locations. A more automated information management system that provided this

type of situation awareness could help reduce communications overload while providing other value. The participants also saw such an information management system as a capability that would be useful in everyday work as well. Consequently, this area might be the most valuable for NIJ technological enhancements.

There was near unanimous agreement during the survey that a command post/communications vehicle would be useful in both terrorist events and every day work. There was a general recognition that reach-back to databases and a real-time information management system would be very valuable in both terrorist events and regular work. It was also clear during the exercise that some form of automated situational awareness displays to replace the white boards would benefit Fire Department first responders in two significant ways. First, such displays would enhance their level of situational awareness and second, they would help eliminate that portion of the communications traffic that is simply checking the status of units, reducing the communications demands and resultant likelihood of missing messages.

While it is an expense to produce a complete, packaged mobile command post, it might be much more cost-effective to produce a packaged, turn-key information management system that could be installed by local communities in one of their own vehicles. Key issues are ease of use, reliability and maintainability. Small communities do not have the manpower to dedicate to keeping complex computer systems up and running, or the funds to provide extensive training. One factor for why the mobile command posts were not used in the TOPOFF exercise was apparently unfamiliarity with the equipment and how to operate it. Key elements of such a command post/information management system that should be considered include:

- A standardized system that is easy to learn and intuitively simple to operate could avoid these problems.
- Networked access to a variety of databases—chemical, GIS, maps, medical information.
- The ability to display the location of responding mobile units using GPS tracking transponders.
- The ability to transmit, receive and display video images (e.g., transmit video images of patient injuries to the local hospitals).

Interoperability

Interoperability was another area where there were deficiencies observed. Many of the problem areas during the exercise involved development of common situational awareness, command and control issues and interoperability issues. Problems often resulted because the participants don't normally work together on exercises of this magnitude, and they did not know one another's procedures or capabilities. The ability for regular training and simulation can be viable solutions to many of these problems. A simulation/training environment that creates realistic streams of data that the various parties can transmit to one another could meet many of the training needs and could probably be developed without requiring advanced simulation tools.

The actual physical layout of an exercise site is not required for simulating many of the issues related to command and control, situational awareness and interoperability. Many of these issues are dominated by communications interchanges between separated parties who are trying to develop a common picture of the situation and inter-operate to handle it. Such issues can be explored in a distributed communications environment using a hypothetical scenario and artificially generated data. A very valuable contribution might be to develop a distributed simulation system that links to the first responder's normal communication and information management systems and provide a realistic synthetic exercise environment.

Other Areas for Technology Contributions

With large numbers of victims, tracking their location and health status took considerable effort during the exercise, and would have been a greater problem in a real event. Small GPS-equipped tracking units that could be attached to each victim, with a possible health status monitoring package, with the ability to display the data on the real-time information management system would help considerably in situational awareness.

Identification of toxic agents was a significant problem during the exercise, producing a delay of well over 12 hours. In real events and every day work, the Fire Department cannot afford such delays. Some ability to use field-deployable sensors with quick-readout measurements of the more likely chemical agents would provide better protection to Fire Department first responders without significantly compromising their day-to-day effectiveness. Response times in minutes or less are needed; other additional units arriving on the scene can inadvertently enter the contaminated areas, as actually happened during the exercise.

Another problem was the interactive issues of the chemical agent identity and the possibility of a secondary device. The possible secondary device prevented detailed sampling to better identify the agent while uncertainty about the agent prevented detailed searching for a secondary device. Robotic sampling systems might help side step this difficulty. Discussions with personnel during the exercise indicated that robotic solutions had been tried in the past and robots that could emulate human behavior (e.g., reach through car windows to take samples off seats) had proven too expensive while inexpensive, small robots had proven too incapable. With the continuing advances in robotics, however, it might be possible to build a cost-effective robot for sampling/searching that could be useful in many situations.

Data Collection in Future TOPOFF-like Experiments

Several lessons were also learned concerning data collection during exercises of this magnitude. The FD Incident Command Post is an area of intense, dynamic activity during the first several hours of an exercise like this. Many personnel are involved and multiple interactions and communications are occurring simultaneously. Adequately documenting the major events requires several observers that are familiar with the expected operations at an ICP. Video taping with audio recording of the FD ICP activity and using radio scanners with

recording systems (if legal) also can provide a valuable set of data to be used in reconstructing actual events. Such a data collection system should be seriously considered for any future such exercises.

3.3 PORTSMOUTH POLICE DEPARTMENT

3.3.1 OVERVIEW

Police first responders were primarily from the Portsmouth PD and the Rockingham County Sheriff's Department. Police first responder communications from the explosion site and from the PD ICP were, for the most part, reliable and timely within the police agencies. However, communications with other agencies were not as effective. In many cases direct verbal contact was required. Overall, portable, mobile, and command post radios operated successfully throughout the exercise, but experienced some limitations in the areas of range, clarity, and endurance. Secure communications were not utilized during the exercise, which could have posed a potential problem if terrorists had been monitoring the radios.

3.3.2 EXERCISE ARTIFICIALITIES

In addition to those exercise artificialities that affected all aspects of the assessment, there was one specific artificiality related to the assessment of the Portsmouth PD communications. Because this was an exercise, an alternate police channel was used by the Portsmouth PD for TOPOFF communications. The channel was a simplex channel with no repeater support. This caused communication dead spots that most likely would not have existed had the normal primary channel been utilized. The Rockingham County Sheriff's Department also utilized a separate channel.

3.3.3 EQUIPMENT USED

Police first responders used Motorola portable and mobile radios. The Rockingham County Sheriff's Department used Motorola HT 1250 and HT 750 portable radios. As previously mentioned, an alternate frequency was used for the exercise, without a repeater or voter receivers available. None of the police radios had an encryption capability.

Although PD first responders wore pagers, they used neither pagers nor cellular phones frequently. Cellular phone usage was much more common by FBI and ATF personnel.

In addition to portable and mobile communications, the Rockingham County Sheriff's Department communications van was utilized. This van contained a computer for logging communications, two fax machines, a telephone, eight radios, and a generator. The fax machines and telephone required connection to the van by a direct phone line, which was not done for this exercise. The radios were monitoring the New Hampshire State Police, NH Port

Authority, alternate Portsmouth Police, Portsmouth FD, Rockingham County Sheriff, US Coast Guard, and the Office of Emergency Management channels.

3.3.4 OPERATIONS SUMMARY

At 8:27 a.m., the first police car from the Portsmouth PD arrived on the scene. Two minutes later the first fire truck arrived on the scene and drove straight to the incident site. Over the next hour multiple police and fire vehicles arrived at the NH Port Authority. The police units were primarily from the Portsmouth Police Department and the Rockingham County Sheriff's Department. During this period much of the communications between police officers and fire fighters on the scene was done via direct verbal communications. Many of the fire and police units came within contamination distance of the incident scene.

At 9:19 a.m., the exercise controllers called a break and directed the FD and PD to set up ICPs. At 9:26 a.m., the EOC was activated. at the Portsmouth central fire station. At 9:48 a.m., the FBI arrived on the scene and at 9:50 a.m., the ATF arrived. At 9:50 a.m., the Rockingham County Sheriff's communications van also arrived on the scene. This van was designated as the PD ICP.

The communications van remained the PD ICP throughout the day. It was moved several times and lost power several times for short periods. The power losses did not significantly impact communications. By 6:00 p.m., the first responder role for the PD ICP had diminished to the role of site security, as the FBI took over the crime scene.

3.3.5 OBSERVED PERFORMANCE

Survey Results

Interviews were conducted with a number of PD first responders using a questionnaire developed as part of the data collection plan. Six PD representatives were interviewed:

1. First Portsmouth Police Officer on scene (called in alarm)
2. First Portsmouth Police Officer to respond
3. A Portsmouth Police Department "trusted agent" for the exercise
4. Officer in charge of the Rockingham County Sheriff Department Operations
5. Dispatcher in Rockingham County Sheriff Department Communications Van
6. A Rockingham County Sheriff's Department "trusted agent" for the exercise

All respondents strongly agreed that a command post/communications vehicle would be needed for a chemical terrorism event and in everyday operations. The Rockingham County Sheriff's Department communications van was present and was used as the Police Department command post; however, not all of its capabilities were available since they did not connect a direct phone line. Some members of the Portsmouth PD would like to have a

communications van for their department so they are not dependent on the County should a situation arise.

There was also unanimous agreement that cellular phones would be needed in a terrorist event. Cellular phones were used from the command post to communicate with other commands such as the EOC and the JOC, whereas radios were used for on-scene communications between officers. Cellular phones were used for sensitive communications since very few of the radios were encrypted.

There was near unanimous agreement on the need for laptop computers with a reach-back capability to relevant databases. These could provide information on chemical threats and terrorist groups/activities. They would also provide another means of communications without using the radio or phone and could be a way around the need for encryption of radios.

There was also strong agreement on the need for a real-time information management system for the IC and non-voice communication systems. These would allow real-time logging of all events with backup and could provide maps of the incident site that could be enlarged and transmitted as necessary. Although the command post does have fax capability, it was not used during the exercise.

Interviewee opinions were mixed on the question of encrypted or private communications systems; all of the Portsmouth PD personnel surveyed strongly agreed that they were necessary for a terrorist event as well as for many everyday situations, while the Rockingham County Sheriff's Department representatives did not see the need. There were, however, many comments made throughout the surveys that confirmed the need for secure communications.

In contrast to the encryption issue, most respondents agreed that an inter/intra-agency secure data communication system is needed for a terrorism event. It would allow the exchange of secure information with other agencies and be particularly useful during a long-term event. Several respondents stated a secure data communications system to be a must.

One question for which there was the most disagreement was that communications performance would be notably different in an actual terrorist event. One person stated that performance would be better during an actual event because the primary channels would have been in use. Another person felt there would be no difference. A third person felt that the communications performance could be different depending on the location and size of the incident site, with some areas around Portsmouth having "dead spots" where communication reception was poor.

Measures of Effectiveness

As stated earlier, the MOPs could not be calculated because of the inability to collect the necessary quantitative data. However, observations by the analysts and responses to the questionnaires provided information that addressed most of the MOEs.

Timeliness

- Setting Up Communications

This MOE refers to the time required to 'make-contact' with the desired recipient of the communication attempt. PD personnel operating within the PD ICP and at the incident site were able to successfully make contact with desired parties within their own organization. Because the Portsmouth PD were using an alternate channel with no repeater, there were areas at the incident site where portable radios were ineffective. In some cases this delayed an officer's ability to immediately establish communications. Also, because there was only one channel, which was used for operational and administrative communications, important radio calls were sometimes delayed. Separate channels for operational and administrative radio traffic would have mitigated this problem.

Portsmouth PD communications with other agencies were less successful. Police were required to either go through the command post or to physically make contact with the person they wanted to contact. Direct radio communications between the first police unit on the scene and the first fire engine on the scene may have prevented the fire engine from driving into the contaminated area.

- Transmitting Data

This MOE is related to how timely communications were once contact was established. Radio communications between police officers were, for the most part, good. Typically once communications were established the signal was not lost until the communication event was successfully completed. Because there were no direct radio communications between the police and other agencies, this MOE is not applicable for communications external to the police units.

Ease of Use

- Commonality

This MOE is a measure of how easily agencies can communicate with each other using different communication systems. As previously stated, the police were limited to communicating among themselves on their portable radios. The communications van used as the PD ICP had the capability to communicate with FD personnel and was sometimes used to relay messages from one agency to another. Dispatch was also used to relay some messages. This

was a problem because often these messages got 'mixed-up'. It also made it more difficult to ask questions and conduct needed conversations. As a result, some potentially critical information was passed solely within the sender's own agency. It also could be a burden on Dispatch and the command posts to try to relay everything. Because of the close proximity of the incident site, the FD ICP, and the PD ICP, many messages were relayed verbally rather than by radio.

- Reliability

This MOE refers to how effectively communications systems operated. MOPs contributing to this MOE include system clarity, percentage of successful communication attempts, number of retransmission requirements, and percentage of time transmission site had to be moved. Overall reliability for communication systems was good. Police portable radios had batteries with an eight-hour endurance. Most radios lasted this long, but there was a shortage of spare batteries causing many radios to be inoperable after the first eight hours of the exercise. The communications van experienced two generator failures, but power was quickly restored and communication operations were not significantly impacted.

Clarity and bleed over affected the quality of communications in some instances. The "dead spots" caused by using the alternate channel for the exercise also impacted communications reliability. The communication van was moved twice in the early hours of the exercise. A portion of the van's capabilities, specifically the fax and telephone, were not enabled at any time. They require a connection to a direct phone line that was never made.

- Mobility

This MOE refers to how frequently mobile communication equipment is usable. During this exercise mobility was good for all police communication equipment. As defined here, mobile applies to any equipment that can be transported. Mobile is not limited to the types of radios found in police cars (versus portable hand held radios). As previously mentioned, portable radios performed well with a few noted exceptions in the areas of clarity, dead spots, and a lack of spare batteries. No problems were noted with car radios. The van is somewhat limited in its mobility for full functionality in that a direct connection is required to operate the fax machines and the phone.

- Redundancy

This MOE refers to the level and availability of backup communications in case the primary communication system, in this scenario radios, failed. Because of the short duration of police first responder participation and the close proximity of all agencies to the incident site, redundant communications were not needed for this exercise. For a longer scenario some form of backup communications would have been necessary. For the radios themselves, multiple frequencies would have provided a form of back up. Officers expressed a desire to have laptops in their vehicles as a secondary means of communication. They also agreed that cellular phones could be useful as a back up if the system were not overloaded by the general public. The

communication van supplies some level of redundancy, but it should have a backup generator to ensure continuous operations.

Security Level

- Level of Security and Operational Impact of Security

Secure communications were not utilized during this exercise. Although lack of secure communications did not impact the scenario outcome, they may have under different circumstances. All Portsmouth PD officers expressed a strong need for secure communications capability, whereas those associated with the Rockingham County Sheriff's Department did not think they were necessary for local personnel. In many cases it was their number one technology requirement. One officer stated, "Communications equipment should be flexible, secure, and dependable."

3.3.6 LESSONS LEARNED AND RECOMMENDATIONS

Interagency communications among first responders needs to be improved so that face-to-face communications do not need to be relied upon. They worked in this situation because of the size of the incident site. This issue may be able to be addressed more from a procedural aspect than from a technology improvement aspect. Radios with multiple channels, and a simple, possibly hands-off, way to switch channels could enhance interagency communications. However, this would be the most effective if procedures were in place to use different channels for different functions. Based on the responses, this would have to be a secure system, at least on some channels.

Although the respondents did not rate the need for encrypted radios/secure communications high, most interviewees commented that they are essential to effectively deal with an actual event of this type. It may be that since this was an exercise plus the fact that the police were able to effectively use their cellular phones, they did not consider the need at the time.

3.4 PORTSMOUTH DISPATCH CENTER

3.4.1 OVERVIEW

The Portsmouth Dispatch Center normally provides dispatch capabilities for both the Portsmouth Fire and Police Departments. During the exercise, Portsmouth Dispatch supported both normal Police/Fire operations and exercise Police/Fire operations. Dispatch operations for both agencies were very effective during the exercise and normal Fire/Police operations were not adversely impacted. Extra staffing within Dispatch allowed a separation of functions within the communications center. The use of a separate channel for TOPOFF communications also aided in the separation of actual operations from those in the exercise.

3.4.2 EXERCISE ARTIFICIALITIES

The primary artificiality in the Portsmouth Dispatch Center was the divided use of resources for actual Police/Fire situations and exercise play. Had the exercise been a real-world event more channels and repeaters would have been available. [Also, the Dispatch Center was not flooded with incoming telephone calls from the public that may have clogged the system and/or taxed their resources.]

3.4.3 EQUIPMENT USED

The Portsmouth Dispatch equipment included Motorola, Digitize, and Eventide radios and systems. There were three main frequencies used: Portsmouth Primary, City One and Fire. There was a programmable portable radio set used to monitor frequencies being used at the exercise scene (151.425 MHz and 155.61875 MHz). Compaq computers were used in Dispatch.

All incoming phone calls and radio transmissions were recorded. The Motorola 3000N CENTRACON Series II provided a paper copy of TELEG box information; it started printing whenever a fire alarm box was triggered. There was a Computer Aided Dispatch (CAD) system that tracked the status of dispatched units.

There were also NEXTEL phones that were used by the Dispatchers. These phones, although not encrypted, did provide some degree of privacy for sensitive communications.

3.4.4 OPERATIONS SUMMARY

At 8:24 a.m., the 3000N TELEG box kicked off an alarm. At 8:28 a.m., there was a call to Dispatch reporting that shots had been fired and over 100 people were down and Portsmouth fire units and ambulances were dispatched to the scene. By 8:31 a.m., multiple fire units, ambulances, and HAZMAT units had been dispatched. By 8:46 a.m., backup fire, police, ambulance and HAZMAT units had been dispatched. By 9:40 a.m., the US Coast Guard, NH State Police, Bomb Squad, and ATF had been contacted.

Radio traffic for the exercise remained heavy in Portsmouth Dispatch until approximately 2:00 p.m. Most back up units had been contacted and dispatched by 10:45 a.m. After 10:45 a.m. traffic was still heavy, but more administrative in nature. During this time there were a few minor real-world incidents, but none of significance. After 2:00 p.m. exercise communications slowed significantly and real-world communications became more prevalent. By 6:00 p.m., there were very few exercise communications coming through Portsmouth Dispatch.

3.4.5 OBSERVED PERFORMANCE

Survey Results

Interviews were conducted with a number of Dispatch personnel using a questionnaire developed as part of the data collection plan. Three Dispatch Center representatives were interviewed:

1. Dispatcher
2. Dispatch Controller
3. Communications Supervisor

There was the most agreement on the issue of the need for backup communications capabilities during an actual terrorist event. There were backup systems in place but none were used during the exercise.

Although all respondents agreed that communications performance during the exercise sufficiently supported operations, they felt that greater performance could have been achieved. The issues raised included the fact that there were no secure communications between the command staff and the Dispatch Center, not enough positions in Dispatch and there are no privacy partitions between the positions making the Dispatch Center very loud. In addition, it was felt that their new CAD program hindered FD operations by not being able to freely assign mutual-aid companies.

There was also general agreement on several of the other issues:

- Encrypted or private communications systems are needed during a terrorist event. There is limited availability of this among the staff, but no capability in Dispatch. Encrypted radios or cellular phones could be used to assist in investigations and transmitting sensitive information. This goes along with the need for an inter/intra-agency secure data communications system.
- Most felt that systems limitations inhibited communications/interoperability between different agencies. There was no direct communications link between Dispatch and the on-scene command posts. The new CAD system contained many incorrect phone numbers for the mutual-aid companies.
- On-scene laptops with a reach-back capability would be useful to provide data quickly to the scene instead of using the radios through the dispatch center. This information would also be more secure than being transmitted via radios.

One interesting comment regarding the need for a communications/command post vehicle during a chemical terrorist event was that it would leave Dispatch to deal with other incidents in the city.

Measures of Effectiveness

Observations by the analysts and responses to the questionnaires provided information that addressed most of the MOEs.

Timeliness

- Setting Up Communications

This MOE refers to the time required to 'make-contact' with the desired recipient of the communication attempt. Overall, Dispatch personnel had good success making contact with desired parties. Because the Portsmouth City Police were using an alternate channel with no repeater, there were areas at the incident site where portable radios were ineffective. In some cases this limited or delayed Dispatch's ability to contact individual units.

Communications with other agencies (outside Portsmouth) were, for the most part, successful. There were some units that Dispatch was not able to contact, but it is unclear whether this was due to a limitation in the responders' communications gear or if they had not been provided with the correct channels for the exercise.

- Transmitting Data

This MOE is related to how timely communications were once contact was established. By nature, Dispatch communications were for the most part very brief. Usually, once contact was established, the communication event was successfully completed.

Ease of Use

- Commonality

This MOE is a measure of how easily agencies can communicate with each other using different communication systems. As previously stated, communications events with outside agencies were generally successful. The few instances where Dispatch was not able to successfully communicate with a given unit did not appear to be related to the capabilities of the equipment.

- Reliability

This MOE refers to how effectively communications systems operated. Overall reliability for communication systems was good. Despite the use of a secondary non-repeated channel, Portsmouth Dispatch was still able to successfully communicate with the majority of responding units.

The new CAD program used by the Dispatchers is more difficult to use than their previous program. It is an improvement over the previous system when it comes to writing reports, but it does not keep records as well and is more cumbersome to use. In some cases it slows down operations unnecessarily.

- Redundancy

This MOE refers to the level and availability of backup communications in case the primary communication system, in this scenario radios, failed. Because of the short duration of Dispatch participation, redundant communications were not needed for this exercise. For a longer scenario some form of backup communications would have been necessary.

Security Level

- Level of Security and Operational Impact of Security

Secure communications were not utilized in Dispatch during this exercise. All Dispatchers expressed a strong need for secure communications capability to assist in investigations and to transmit sensitive data.

3.4.6 LESSONS LEARNED AND RECOMMENDATIONS

For the most part, operations within Portsmouth Dispatch were effective. Where communications capabilities were limited, the limitations appeared to stem from exercise artificialities and not from equipment limitations. There was uniform agreement among Dispatchers that secure communications would be necessary if this were an actual event.

During high intensity operations, CAD programs should not hinder a Dispatcher's ability to perform his/her duties. Development of a system that is easy to use, operates efficiently and generates good reports is recommended.

3.5 HAZMAT/MOPP GEAR COMMUNICATIONS

3.5.1 INTRODUCTION

Although not normally considered as a "First Response" asset, given the nature and scope of the chemical incident depicted, the HAZMAT activities were a central component during TOPOFF 2000. As such, when the opportunity existed, HAZMAT team events and communication use were observed.

The single best opportunity consisted of a time period [7:00-7:30 p.m. 20 May (Day 1)] when five different HAZMAT teams in full MOPP gear operated simultaneously, but independently, to investigate the crime scene. Other opportunities to observe MOPP gear/communication events occurred during the morning hours (12:55-1:25 a.m. and 3:20-4:15 a.m.) of the second day (21 May) but little additional information was gained.

No questionnaires were administered to the HAZMAT teams so these insights are based solely on analyst observations and conversations with some members of the HAZMAT teams.

3.5.2 EXERCISE ARTIFICIALITIES

A few "exercise artificialities" had some impact on the operational play during TOPOFF. In particular, the lack of real urgency with dealing with victims (injured and fatalities) allowed sufficient time to coordinate HAZMAT functions across multiple organizations.

In at least one case, a torn MOPP suit, detected at the contaminated site, did not result in immediate withdrawal and decontamination of the effected participant. It was also noted that during one evolution, two of ten MOPP suits were damaged/compromised. This observation is not meant to imply that a 20% failure rate would be expected but that perhaps less attention to personal safety was paid than would be the case in a real hazardous situation.

Radios deployed to the contaminated scene external to protective gear were not decontaminated as may have been required in a real scenario. Equipment damage/loss was not considered in the scenario.

3.5.3 EQUIPMENT USED

Multiple teams with various types of portable radio frequency (RF) communications gear participated during HAZMAT operations during TOPOFF. These included hand-held walkie-talkies, either secured external to the MOPP suit or inside the suit, as well as radio equipment integrated with the MOPP gear.

Safety officers/controllers had connectivity to their personnel but no direct communications capability to the other teams.

3.5.4 OPERATIONS SUMMARY/OBSERVED PERFORMANCE

From 7:00 until 7:27 p.m. on Day 1, more than ten hours after the simulated explosion and chemical/mustard gas release, five different two-man HAZMAT teams operated at the incident site. Each team had separate tasks ranging from sketching the crime scene to collecting chemical samples to counting victims.

There was no direct communication (or capability to communicate because of non-interoperable radios) between teams at the site. Communications within a team were often by hand signals but occasionally oral communications were necessary. Oral communications were primarily verbal, i.e., without the use of radio gear. Because of the MOPP gear and inherent muffling it caused, when partners needed to speak to each other, all other activities were suspended. The communicants needed to stand in close-proximity, essentially face-to-face, and speak loudly and clearly.

Each team also had a controller that stayed back from the contaminated site. Communications between a team and their controller were minimal. They consisted of occasional time checks and status updates. Interestingly, to solve the non-interoperability problem across teams, the controllers co-located themselves so that they could all hear each other's transmissions and receptions.

It was noted that, according to procedure, all communications should be logged while a team is on task. This was not accomplished and, as one safety officer noted, when "too much is happing at once", logging is the first "chore" that is dropped.

One reliability issue was reported. One of the safety officers' batteries died but was quickly replaced with an available spare. There was no operational impact of this event.

3.5.5 RECOMMENDATIONS

Communications capability that is integrated into the MOPP gear is superior to other types of equipment that are either external or internal to the suit. Those carried external to the suit would be subject to contamination and possibly be damaged during decontamination. Radios carried internal to the suits were very cumbersome to operate.

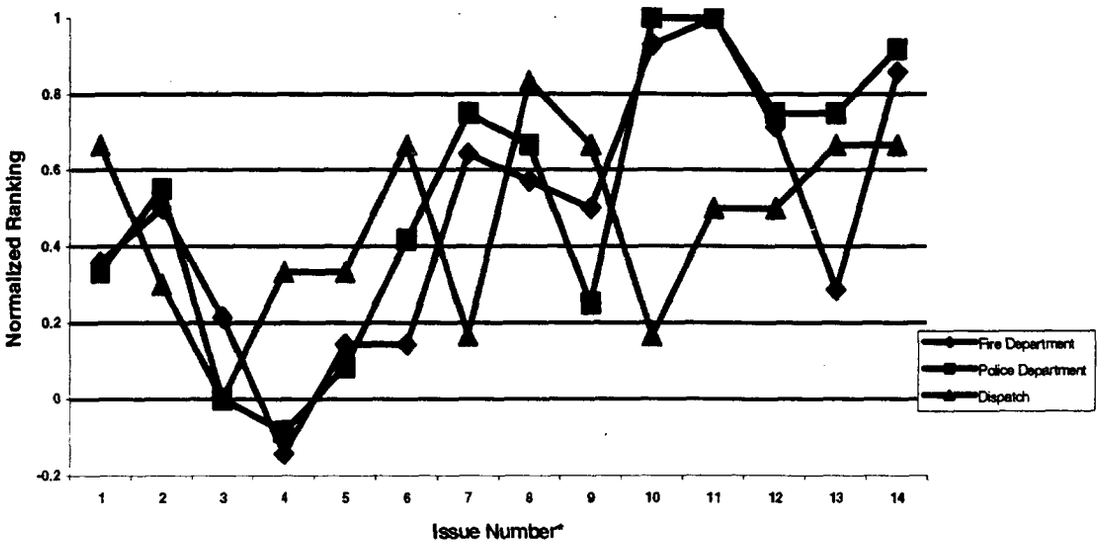
Communication between members within a HAZMAT team is difficult, very inefficient, and detracts from operational tasking. This capability could be enhanced with wireless networking but another possible solution, which would also enhance inter-team communications, would be to provide a speaker-type capability that would project speech external to the suit and allow others to hear you at a reasonable distance from the source.

While the possibility of a secondary explosive device remains present, the use of radios for communication is undesirable because of the chance that the RF may trigger the secondary device. At some point in time however, as this threat is eliminated (both by removal or by the thorough search and lack of any indications to the contrary), RF use would be authorized. It may be of value to have the capability to have an RF source that could be turned on prior to entry into the area by HAZMAT personnel with RF communications gear, to verify that RF may be utilized safely. A bad scenario would be if this device triggered an undetected RF-controlled secondary device but a worst-case scenario would be if the use of RF by personnel at the scene triggered one.

3.6 CONCLUSIONS

3.6.1 SURVEY RESULTS

The survey results from each department have been normalized and are summarized in Figure 3-3. The majority of these questions were derived from the *Inventory of State and Local Law Enforcement Technology Needs* prepared for NIJ in March 1998.



***Issues:**

1. Communication system(s) performance during the exercise sufficiently supported your (first responder) operations.
2. Communication Systems performed adequately in the following areas: Reliability; Clarity; Range; Endurance; Usability (size, hand vs head sets, etc.)
3. The communication system(s) performance significantly impacted the scenario outcome.
4. The communication system(s) performance would be notably different in an actual terrorist event from what was observed in the exercise.
5. Unique communication system capabilities are required
6. Encrypted or private communications systems are
7. Non-voice (fax, image transmission, etc.) communications systems are needed
8. Backup communications capabilities are needed
9. Systems limitations inhibited communications/ interoperability between different agencies
10. Cellular phones are needed.
11. A command post/communications vehicle is needed
12. A real-time information management system for the Incident Commander is needed.
13. An inter/intra-agency secure data communications system is needed
14. On-scene laptops with a reach-back capability to relevant databases are needed.

Figure 3-3 Summary of Survey Results

A surprising result was that both the Fire and Police Departments had very similar views and the most highly ranked issues were the same. Both felt that a command post/communications vehicle and cellular phones are needed for a chemical terrorism event. Both Departments had command post vehicles but the Fire Department IC did not make use of either of the ones available to him and the PD command post did not have its full complement of capability (no direct line for phones or fax). All participants made use of their cellular phones during the exercise but many were concerned about possible system overload during an actual event.

The next most highly ranked issue was the need for laptops with reach-back capability. This would provide links to chemical information databases, access to medical information, and property data. This capability is not currently available.

Many of the comments were related to the need for encryption of radios or a secure communications system, however this did not rank high for either Department. This was the highest ranked need identified in the *Inventory of State and Local Law Enforcement Technology Needs.* There are two possible reasons for this discrepancy. One is that since there were no real terrorists involved, concerns about security were not as sensitive as they would have been in a real situation. This also is true in that there were no actual casualties and identities to protect. The other is that situation awareness was a major issue, particularly for the IC, so both FD and PD personnel rated it high in their survey responses since it was foremost in their minds.

The Dispatch Center results differed from those of the other respondents; however, it is important to remember that there were only three respondents from Dispatch. The top rated issue based on their responses was that backup communications capabilities are needed, although none were needed during the exercise. The Dispatch respondents felt that communications system performance adequately supported their operations, although they did have recommendations for improvements. Several of these related to the need for encrypted radios and secure communications, which was the next highest rated issue.

Shortage of radio frequencies was cited by most of the interviewees as a problem, and several suggested radio trunking as a possible solution. Since the issue is really a shortage of frequencies rather than interoperability of systems, radio trunking systems that automatically switch the user to an open frequency seems an appropriate solution.

Improvements to the communications systems to increase the effective number of frequencies appear to be an expensive option with limited utility. Trunking systems require new radios and all of the Police/Fire Departments that would potentially respond to a terrorist event would need to have their equipment upgraded in order for them to be able to communicate. The worst period of radio congestion was only during the first few hours of the exercise, primarily because so many units were responding. An advanced communications system that could handle that level of loading would likely not be needed during the normal activities. Moreover, much of the radio traffic, and later cellular phone traffic, appeared to be getting information and checking status rather than issuing commands. If status information could be posted to a wireless-

accessible site (e.g., local internet with mobile laptops), then the communications congestion overload problem might be reduced. The Fire and Police Departments would also have a capability that would be widely useable in other aspects of a terrorist incident as well as everyday work.

Situation awareness for the Fire Department was an area where there were a number of deficiencies. White boards and grease pencils were used to show SA, and updates on the situation were generally received by radio or verbal discussions. There was a strong recognition by the exercise participants of the need for a better command post capability and real-time information management system. Some of the radio communications overload was associated with simply getting updates on Fire Department units' statuses and locations. A more automated information management system that provided this type of situation awareness could help reduce communications overload while providing other value. The participants also saw such an information management system as a capability that would be useful in everyday work as well. Consequently, this area might be the most valuable for NIJ technological enhancements.

While it is an expense to produce a complete, packaged mobile command post, it might be much more cost-effective to produce a packaged, turn-key information management system that could be installed by local communities in one of their own vehicles. Key issues are ease of use, reliability and maintainability. Small communities do not have the manpower to dedicate to keeping complex computer systems up and running, or the funds to provide extensive training. One factor for why the mobile command posts were not used in the TOPOFF exercise was apparently unfamiliarity with the equipment and how to operate it. Key elements of such a command post/information management system that should be considered include:

- A standardized system that is easy to learn and intuitively simple to operate could avoid these problems.
- Networked access to a variety of databases—chemical, GIS, maps, medical information.
- The ability to display the location of responding mobile units using GPS tracking transponders.
- The ability to transmit, receive and display video images (e.g., transmit video images of patient injuries to the local hospitals).

Interoperability was another area where there were deficiencies observed by all agencies. Many of the problem areas during the exercise involved development of common situational awareness, command and control issues and interoperability issues. Problems often resulted because the participants don't normally work together on exercises of this magnitude, and they did not know one another's procedures or capabilities. There was also no way for on-scene police to quickly warn en route Fire Department units of hazardous areas and situations. The opportunity for regular training and simulation can be a viable solution to many of these problems. A simulation/training environment that creates realistic streams of data that the various parties can transmit to one another could meet many of the training needs and could probably be developed without requiring advanced simulation tools.

Interagency communications among first responders needs to be improved so that face-to-face communications do not need to be relied upon. Radios with multiple channels, and a simple, possibly hands-off, way to switch channels could enhance interagency communications. Rapid, reliable communications between inter-agency units in field in the early stages of an terrorist incident can also help prevent loss of first responders by exposure to toxic materials. However, this would be most effective if procedures were in place to use different channels for different functions. Based on the responses, this would have to be a secure system, at least on some channels.

Communications between members within a HAZMAT team is difficult, very inefficient, and detracts from operational tasking. This capability could be enhanced with wireless networking but another possible solution, which would also enhance inter-team communications, would be to provide a speaker-type capability that would project speech external to the suit and allow others to hear you at a reasonable distance from the source.

3.6.2 OTHER AREAS FOR TECHNOLOGY CONTRIBUTIONS

With large numbers of victims, tracking their location and heath status took considerable effort during the exercise, and would have been a greater problem in a real event. Small GPS-equipped tracking units that could be attached to each victim, possibly with a health status monitoring package, with the ability to display the data on the real-time information management system would help considerably in situational awareness.

Identification of toxic agents was a significant problem during the exercise, producing a delay of well over 12 hours. In real events and every day work, the Fire Department cannot afford such delays. Some ability to use field-deployable sensors with quick-readout measurements of the more likely chemical agents would provide better protection to FD first responders without significantly compromising their day-to-day effectiveness. Response times in minutes or less are needed; other additional units arriving on the scene can inadvertently enter the contaminated areas, as actually happened during the exercise.

Another problem was the interactive issues of the chemical agent identity and the possibility of a secondary device. The possible secondary device prevented detailed sampling to better identify the agent while uncertainty about the agent prevented detailed searching for a secondary device. Robotic sampling systems might help side step this difficulty. Discussions with personnel during the exercise indicated that robotic solutions had been tried in the past and robots that could emulate human behavior (e.g., reach through car windows to take samples off seats) had proven too expensive while inexpensive small robots had proven too incapable. With the continuing advances in robotics, however, it might be possible to build a cost-effective robot for sampling/searching that could be useful in many situations.

During high intensity operations, CAD programs should not hinder a Dispatcher's ability to perform his/her duties. Development of a system that is easy to use, operates efficiently, and generates good reports is recommended.

Appendix

SURVEY RESULTS

The survey had 14 primary questions about communication system performance and needs, and the interviewee was asked to respond in the range from "strongly agree" to "strongly disagree" with the question. The interviewees were also encouraged to provide detailed comments.

It is possible to rank the issues in terms of perceived importance by converting the survey responses to a numerical scale. Assigning a set of values ranging from +2 for strongly agree to –2 for strongly disagree, the 14 questions can be ranked in order from strongest agreement to strongest disagreement. Question #2 had five parts; the resulting score is the average of the five individual scores. The survey results are shown in Tables A-1, A-2, and A-3, respectively, for each group of respondents (Portsmouth FD, Portsmouth PD, and Portsmouth Dispatch) in the order of strongest agreement to strongest disagreement, with the score followed by the original question number and question. The score distributions and the detailed comments are also presented in the tables.

Fire Department

Since there were seven respondents from the Fire Department, the maximum score for strongest agreement is +14 and the scores can go to –14 for strongest disagreement. These results are provided in Table A-1.

Table A-1

Fire Department Survey Results

Score	Question	Score Distributions	Comments
+14	#11 - A command post/communications vehicle is needed for a chemical terrorism event	7 interviewees (100%) strongly agreed	• 6 interviewees said such a CP would be useful in everyday work. • 1 interviewee said such a CP would NOT be useful in everyday work
+13	#10 - Cellular phones are needed for a chemical terrorism event	6 interviewees (86%) strongly agreed 1 interviewee (14%) agreed	• 7 interviewees said that cellular phones were used during the exercise. • 3 interviewees were concerned about cellular calls being intercepted. • 1 interviewee had no concerns about using cellular phones. • 1 interviewee said that cellular coverage was poor (< 50%) in the small towns and rural areas.

Score	Question	Score Distributions	Comments
+12	#14 - On-scene laptops with a reachback capability to relevant databases are needed for a chemical terrorism event	5 interviewees (71%) strongly agreed. 2 interviewees (29%) agreed	• 1 interviewee said links to the Internet would be useful. • 4 interviewees said access to chemical information databases would be useful. • 2 interviewees said access to medical information for symptoms and treatment would be useful. • 2 interviewees said that access to property data (e.g., GIS data) would be useful. • 1 interviewee said that information on contaminant plume control and predictions of contaminant plume spread would be useful. • 1 interviewee pointed out that such systems would be valuable if they were reliable, but that additional technical personnel would be required to keep the systems operating.
+10	#12 - A real-time information management system for the Incident Commander is needed for a chemical terrorism event response.	4 interviewees (57%) strongly agreed. 2 interviewees (29%) agreed 1 interviewee (14%) had no opinion	• 4 interviewees said such a real-time system with computer displays would be useful in everyday work. • 1 interviewee said such a system would NOT be useful in everyday work. • 1 interviewee raised concerns about computer reliability problems. • 1 interviewee felt computer reliability problems were NOT a concern. • 1 interviewee felt a real-time management system would provide faster

Score	Question	Score Distributions	Comments
+9	#7 - Non-voice (fax image transmission, etc.) communications systems are needed for a chemical terrorism event.	3 interviewees (43%) strongly agreed. 3 interviewees (43%) agreed 1 interviewee (14%) had no opinion	• 3 interviewees said non-voice communications were used during the exercise while 4 interviewees said they were not. • 4 interviewees felt fax capability would be useful in everyday work. • 2 interviewees felt video imaging capability would be useful in everyday work
+8	#8 - Backup communications capabilities are needed for a chemical terrorism event	3 interviewees (43%) strongly agreed 2 interviewees (29%) agreed 1 interviewee (14%) had no opinion 1 interviewee (14%) no response	• 7 interviewees said backup systems were not used during the exercise, but the dominant reason was the primary systems worked well enough. • 1 interviewee stated backup systems weren't needed during the exercise. • 2 interviewees stated a backup system would be important for long duration events. • 1 interviewee stated a backup repeater would be useful.
+7	#9 - System limitations inhibited communications/interoperability between different agencies.	4 interviewees (57%) strongly agreed 1 interviewee (14%) disagreed 2 interviewees (29%) no response	• 1 interviewee stated there were no interoperability problems. • 3 interviewees stated a shortage of frequencies was a problem. • 3 interviewees stated that liaison issues with other departments and agencies produced problems. • 1 interviewee commented that they could only talk to other FD units over the radio.

Score	Question	Score Distributions	Comments
+7	#2 - Communications System performed adequately in the following areas: • Reliability • Clarity • Range • Endurance • Usability	Reliability: 1 interviewee (14%) strongly agreed. 6 interviewees (86%) agreed Clarity: 1 interviewee (14%) strongly agreed 4 interviewees (57%) agreed 2 interviewees (29%) disagreed Range: 1 interviewee (14%) strongly agreed 4 interviewees (57%) agreed 1 interviewee (14%) disagreed, 1 interviewee (14%) had no opinion Endurance: 3 interviewees (43%) strongly agreed. 4 interviewees (57%) agreed Usability: 3 interviewees (43%) strongly agreed 2 interviewees (28%) agreed 2 interviewees (29%) had no opinion.	• 3 interviewees stated performance was better than expected, but 2 of the 3 interviewees noted ranges were quite short. • 1 interviewee stated performance was about as expected. • 1 interviewee pointed out reaching remotes sites was difficult because of the transmission range. • 1 interviewee commented that transmission clarity was a problem. • 4 interviewees stated that headsets would be useful, leaving their hands free. None of the 4 interviewees had headsets during the exercise
+5	#1 - Communications system(s) performance during the exercise sufficiently supported your (first responder) operations	1 interviewee (14%) strongly agreed 4 interviewees (57%) agreed 1 interviewee (14%) disagreed 1 interviewee (14%) both agreed (voice was okay) and disagreed (fax was inadequate).	• 3 interviewees stated that communications performance was good ***initially.*** • 6 out of 7 interviewees identified the need for more frequencies, and 1 of those 6 interviewees specifically stated the need for radio trunking systems. • 1 interviewee stated the need for a larger command post

Score	Question	Score Distributions	Comments
+4	#13 - An inter/intra-agency secure data communications system is needed for a chemical terrorism event.	2 interviewees (29%) strongly agreed 2 interviewees (29%) agreed 2 interviewees (29%) disagreed 1 interviewee (14%) had no opinion	• 2 interviewees felt such a system would help protect sensitive information. • 2 interviewees did not see a strong need for such a system. • 1 interviewee felt a Global Information System (GIS) would provide physical layout data. • 1 interviewee felt such a secure system would be useful in everyday work
+3	#3 - The communication system(s) performance significantly impacted the scenario outcome	3 interviewees (43%) strongly agreed 3 interviewees (43%) disagreed 1 interviewee (14%) had no opinion	• 3 interviewees stated there were no communications problems. • 1 interviewee said that training was a problem. • 1 interviewee said personnel shortages and not communications were the problem. • 2 interviewees mentioned lack of radio channels as a problem.
+2	#5 - Unique communication system capabilities are required for a chemical terrorism event	2 interviewees (29%) strongly agreed 1 interviewee (14%) agreed 3 interviewees (43%) disagreed 1 interviewee (14%) no response	• 1 interviewee stated no unique capabilities are needed. • 1 interviewee stated the need for fax capability. • 1 interviewee stated the need for an 800 MHz radio system (like that used by the State Police). • 1 interviewee stated a need for a CP communications van (see question #7). • 1 interviewee mentioned the need for solving liaison issues when there are separated command posts. • 2 interviewees stated the need for more Command Post radios.

Score	Question	Score Distributions	Comments
			• 1 interviewee stated the need for more frequencies. • 1 interviewee stated the need for secure communication lines. • 1 interviewee stated the need for an extra repeater for back-up. • 1 interviewee stated the need for a mobile repeater for backup.
+2	#6 - Encrypted or private communications systems are needed for a chemical terrorism event	2 interviewees (29%) strongly agreed 1 interviewee (14%) agreed and 3 interviewees (43%) disagreed, 1 interviewee (14%) had no opinion	• 6 interviewees said that encrypted systems were used during the exercise • 1 interviewee felt encrypted systems would NOT be useful in everyday work. • 3 interviewees felt encrypted systems would be useful in everyday work • 1 interviewee said encrypted systems would prevent terrorists from monitoring activity and triggering secondary devices when first responders are close to them.
-2	#4 - The communications system(s) performance would be notably different in an actual terrorist event from what was observed in the exercise.	1 interviewee (14%) strongly agreed 1 interviewee (14%) agreed 5 interviewees (71%) disagreed	• 4 interviewees said no problems would be expected in a real event. • 1 interviewee said performance would be worse because of the stress associated with a real event

Police Department

With 6 Police Department respondents, the scores range from a maximum of +12 for strongest agreement to –12 for strongest disagreement. These results are provided in Table A-2.

Table A-2

Police Department Survey Results

Score	Question	Score Distributions	Comments
+12	#10 - Cellular phones are needed for a chemical terrorism event.	6 interviewees (100%) strongly agreed.	• 6 interviewees said that cellular phones were used during the exercise. • 4 interviewees were concerned about overloading the phone system. • 1 interviewee was concerned about cellular calls being intercepted. • 1 interviewee had no concerns about using cellular phones.
+12	#11 - A command post/ communications vehicle is needed for a chemical terrorism event.	6 interviewees (100%) strongly agreed.	• 3 interviewees said such a CP would be useful in everyday work for major events. • 1 interviewee said that every good-sized department should have a CP vehicle
+11	#14 - On-scene laptops with a reachback capability to relevant databases are needed for a chemical terrorism event.	5 interviewees (83%) strongly agreed 1 interviewee (17%) agreed	• 4 interviewees said this would be useful all the time. • 1 interviewee said access to chemical information databases would be useful.

Score	Question	Score Distributions	Comments
+9	#7 - Non-voice (fax image transmission, etc.) communications systems are needed for a chemical terrorism event	3 interviewees (50%) strongly agreed 3 interviewees (50%) agreed	• 6 interviewees said non-voice communications were not used during the exercise. • 1 interviewee felt that non-voice communications would be used in a real terrorist event.
+9	#12 - A real-time information management system for the Incident Commander is needed for a chemical terrorism event	5 interviewees (83%) strongly agreed 1 interviewee (17%) disagreed.	• 4 interviewees said such a real-time system with computer displays would be useful in everyday work. • 1 interviewee said such a system would NOT be useful in everyday work. • 1 interviewee felt that the IC would most likely not use such a system. • 1 interviewee felt that having access to map programs to provide a better picture of the incident scene would be beneficial.
+9	#13 - An inter/intra-agency secure data communications system is needed for a chemical terrorism event.	5 interviewees (83%) strongly agreed 1 interviewee (17%) disagreed	• 2 interviewees felt such a secure system would be useful in everyday work. • 1 interviewee felt it is only needed for a long-term event. • 1 interviewee felt it is only needed for a mass casualty incident

Score	Question	Score Distributions	Comments
+8	#8 - Backup communications capabilities are needed for a chemical terrorism event.	2 interviewees (33%) strongly agreed. 4 interviewees (67%) agreed	• 3 interviewees said backup systems were used during the exercise. • 1 interviewee stated backup systems weren't needed during the exercise. • 1 interviewee stated a backup system would be important for long duration events. • 1 interviewee stated that cell phones could serve as a backup to the radios. • 1 interviewee stated that the Rockingham County communications van could serve as a backup to dispatch.
+6.6	#2 - Communications System performed adequately in the following areas: • Reliability • Clarity • Range • Endurance • Usability	Reliability: 3 interviewees (50%) strongly agreed. 1 interviewee (16%) agreed 2 interviewees (34%) disagreed Clarity: 3 interviewee (50%) strongly agreed 1 interviewee (16%) agreed 2 interviewees (34%) disagreed Range: 3 interviewees (50%) strongly agreed 1 interviewee (17%) agreed 1 interviewee (17%) disagreed, 1 interviewee (17%) strongly disagreed Endurance: 4 interviewees (67%) strongly agreed. 1 interviewee (17%) agreed 1 interviewee (17%) disagreed Usability: 5 interviewees (83%)strongly agreed 1 interviewee (17%) agreed	• 1 interviewee commented that transmission clarity was a problem. • 1 interviewee said that the radios could bleed into one another because of the close ranges. • 1 interviewee stated performance was about as expected. • 1 interviewee stated performance was better than expected

Score	Question	Score Distributions	Comments
+5	#6 - Encrypted or private communications systems are needed for a chemical terrorism event	3 interviewees (50%) strongly agreed 1 interviewee (17%) disagreed, 2 interviewees (33%) had no opinion	• 4 interviewees said that encrypted systems were not used during the exercise. • 2 interviewees said that that capability did not exist. • 2 interviewees said that private communications are used more by detectives during their investigations. • 1 interviewee stated, "All agencies should have this." • 1 interviewee felt that cell phones made this unnecessary
+4	#1 - Communications system(s) performance during the exercise sufficiently supported your (first responder) operations.	2 interviewees (33%) strongly agreed 1 interviewee (17%) agreed 2 interviewees (33%)both agreed (voice was okay) and disagreed (fax was inadequate) 1 interviewee (17%) disagreed	• 1 interviewee felt that intra-agency communications was good, but inter-agency was not in the beginning • 1 interviewee felt that communications performance was satisfactory initially, but as more respondents got on the radios, they became overloaded. • 2 interviewees felt that performance was good throughout. • 2 interviewees identified the need for more frequencies, and 1 of those specifically stated the need for a trunked radio system
+3	#9 - System limitations inhibited communications/interoperability between different agencies	2 interviewees (33%) strongly agreed 2 interviewees (33%) agreed 1 interviewee (17%) disagreed, 1 interviewee (17%) strongly disagreed.	• 2 interviewees stated there he found it extremely difficult to talk directly to other agencies; it was necessary to go through dispatch or the command post. • 2 interviewees felt that interagency communications at the local level were successfully achieved. • 2 interviewees stated that liaison issues with federal agencies were difficult

Score	Question	Score Distributions	Comments
+1	#5 - Unique communication system capabilities are required for a chemical terrorism event	1 interviewee (17%)strongly agreed 2 interviewees (33%) agreed 1 interviewee (17%) disagreed, 1 interviewee (17%) strongly disagreed 1 interviewee (17%) had no opinion	• 1 interviewee felt that communications are needed with every field unit in order to ensure overall coordination. • 1 interviewee stated no unique capabilities are needed. • 1 interviewee stated that better radio coverage would be needed and recommended a nationwide common frequency that could be set aside for such an event so all agencies could communicate. • 1 interviewee felt that that better communication capabilities are needed to communicate with the federal agencies instead of having to rely on cell phones.
0	#3 - The communication system(s) performance significantly impacted the scenario outcome.	1 interviewee (17%) strongly agreed 1 interviewee (17%) agreed 1 interviewee (17%) disagreed 1 interviewee (17%) strongly disagreed 2 interviewees (33%) had no opinion	• 1 interviewee felt that communications performance did not impact the outcome because of the incident location. • 2 interviewees felt that communications impacted the outcome in a positive way
-1	#4 - The communications system(s) performance would be notably different in an actual terrorist event from what was observed in the exercise.	2 interviewees (33%) strongly agreed 1 interviewee (17%) disagreed 2 interviewees (33%) strongly disagreed 1 interviewee (17%) had no opinion	• 1 interviewee felt that performance would be exactly the same during a real event. • 1 interviewee said performance would be better because they would have been using the primary channel.

Dispatch

There were 3 respondents from Dispatch; therefore the scores for these results range from +6 for strongest agreement to –6 for strongest disagreement. These results are presented in Table A-3.

Table A-3

Dispatch Survey Results

Score	Question	Score Distributions	Comments
+5	#8 - Backup communications capabilities are needed for a chemical terrorism event.	2 interviewees (67%) strongly agreed 1 interviewee (33%) agreed	• All 3 interviewees said no backup systems were used during the exercise.
+4	#1 - Communications system(s) performance during the exercise sufficiently supported your (first responder) operations.	1 interviewee (33%) strongly agreed 2 interviewees (67%) agreed	• 1 interviewee felt that encrypted radios would have been good for all officers involved. • 1 interviewee felt that being able to more freely assign mutual aid companies would be an improvement. • 1 interviewee stated the need for secure communications between the command staff and dispatch. • 1 interviewee felt that additional consoles in Dispatch were needed

Score	Question	Score Distributions	Comments
+4	#6 - Encrypted or private communications systems are needed for a chemical terrorism event.	1 interviewee (33%) strongly agreed 2 interviewees (67%) agreed	• All 3 interviewees said that encrypted systems were not used during the exercise. • All 3 stated there was limited availability of encrypted radios; there were none in Dispatch. • 2 interviewees said that secure communications should be used to assist in investigations and the passing of sensitive data
+4	#9 - System limitations inhibited communications/interoperability between different agencies.	1 interviewee (33%)strongly agreed. 2 interviewees (67%) agreed	• 1 interviewee stated there some of the responding ambulance and fire apparatus did not have or could not communicate on the Portsmouth FD channels. • 1 interviewee stated that there was no communication link between dispatch and outside agencies and no real link between the fire and police command posts. • 1 interviewee felt that the new Computer aided dispatch (CAD) program was difficult to use for mutual aid.
+4	#13 - An inter/intra-agency secure data communications system is needed for a chemical terrorism event.	2 interviewees (67%) strongly agreed 1 interviewee (33%) had no opinion.	• 1 interviewee felt such a secure system would be beneficial to the police. • 1 interviewee felt a secure system would be useful for any event as a way to pass information between departments
+4	#14 - On-scene laptops with a reachback capability to relevant databases are needed for a chemical terrorism event	1 interviewee (33%) strongly agreed. 2 interviewees (67%) agreed	• 1 interviewee felt that laptops would provide data quickly to the scene instead of tying up the radios. • 1 interviewee felt that this would be more secure.

Score	Question	Score Distributions	Comments
+3	#11 - A command post/communications vehicle is needed for a chemical terrorism event.	1 interviewee (33%) strongly agreed 1 interviewee (33%) agreed 1 interviewee (33%) had no opinion.	• 1 interviewee felt that a CP duplicated the functions of dispatch. • 2 interviewees said such a CP would be useful in any critical incident.
+3	#12 - A real-time information management system for the Incident Commander is needed for a chemical terrorism event.	1 interviewee (33%) strongly agreed 1 interviewee (33%) agreed 1 interviewee (33%) had no opinion.	• 2 interviewees felt that it would provide the IC the most current information on the situation.
+2	#4 - The communications system(s) performance would be notably different in an actual terrorist event from what was observed in the exercise.	1 interviewee (33%)strongly agreed 1 interviewee (33%) agreed 1 interviewee (33%) disagreed	• 1 interviewee felt that performance would be different because of communications overload with calls from the general public. • 1 interviewee felt there would be no difference
+2	#5 - Unique communication system capabilities are required for a chemical terrorism event	1 interviewee (33%) strongly agreed 1 interviewee (33%) agreed 1 interviewee (33%) disagreed	• 2 interviewees felt that encrypted radios would be required to transmit sensitive information.
+1.8	#2 - Communications System performed adequately in the following areas: • Reliability • Clarity • Range • Endurance • Usability	Reliability: 3 interviewees (100%) agreed. Clarity: 2 interviewees (67%) agreed. 1 interviewee (33%) disagreed Range: 1 interviewee (33%) agreed. 1 interviewee (33%) disagreed 1 interviewee (33%) strongly disagreed Endurance: 1 interviewee (33%) strongly agreed. 2 interviewees (67%) agreed Usability: 3 interviewees (100%) agreed.	• 1 interviewee stated that since a non-repeater secondary channel was used, it was difficult to communicate between venues. • 1 interviewee stated that dispatch had difficult picking up transmissions because of the limited range of the radios.

Score	Question	Score Distributions	Comments
+1	#7 - Non-voice (fax image transmission, etc.) communications systems are needed for a chemical terrorism event.	1 interviewee (33%) strongly agreed 1 interviewee (33%) agreed 1 interviewee (33%) strongly disagreed	• 2 interviewees said non-voice communications were used during the exercise. • 1 interviewee felt that no one would monitor a fax machine during a terrorist event. • 1 interviewee felt that this capability would allow command staff to pass photos of suspects and other information
+1	#10 - Cellular phones are needed for a chemical terrorism event.	2 interviewees (67%) agreed 1 interviewee (33%) disagreed	• 3 interviewees said that cellular phones were used during the exercise. • 2 interviewees were concerned about overloading the phone system during an actual event. • 2 interviewees was concerned about the security of cellular phones
0	#3 - The communication system(s) performance significantly impacted the scenario outcome	1 interviewee (33%) agreed 1 interviewee (33%) disagreed, 1 interviewee (33%) had no opinion	• 1 interviewee felt that communications impacted the outcome in a positive way.