U.S. Fire Administration/Technical Report Series

Chemical Fire in Apex, North Carolina

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FEMA

Department of Homeland Security
U.S. Fire Administration
Major Fire Investigations Program

The U.S. Fire Administration (USFA) develops reports on selected major fires throughout the country. The fires usually involve multiple deaths or a large loss of property, but the primary criterion for deciding to write a report is whether it will result in significant "lessons learned." In some cases these lessons bring to light new knowledge about fire--the effects of building construction or contents, human behavior in fire, and so forth. In other cases, the lessons are not new, but are serious enough to highlight once again because of another fire tragedy.

Under this project, USFA also develops special reports addressing a variety of issues that affect fire service such as homeland security and disaster preparedness, new technologies, training, fireground tactics, and firefighter safety and health.

The reports are sent to fire magazines and are distributed at national and regional fire meetings. The reports are available on request from USFA. Announcements of their availability are published widely in fire journals and newsletters.

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For reports on major fires and other critical incidents to which fire departments respond, USFA, which has no regulatory authority, sends an experienced fire investigator into a community only after having conferred with the local fire authorities to ensure that USFA's assistance and presence would support, not interfere, with any local review of the incident. The intent is to arrive after the dust settles so that a complete and objective review of all the important aspects of the incident can be made. Local authorities review USFA's report while it is in draft form. The USFA investigator or team is available to local authorities should they wish to request technical assistance for their own investigation.

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CHEMICAL FIRE IN APEX, NORTH CAROLINA (October 5-7, 2006)

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This is Report 163 of Investigation and Analysis of Major Fire Incidents and USFA's Technical Report Series Project conducted by Tri-Data, a Division of System Planning Corporation under Contract (GS-10-F0350M/HSFEEM-05-A-0363) to the DHS/USFA, and is available from the USFA Web page at http://www.usfa.dhs.gov

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We provide National leadership to foster a solid foundation for local fire and emergency services for prevention, preparedness and response.

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OVERVIEW

Apex, North Carolina, is a town of approximately 30,000 residents in the central part of the State and the fastest growing suburb in North Carolina. The town is located in Wake County south of the capital, Raleigh. This area of North Carolina is growing at the rate of two to three new residents every day in the expanding capital metropolitan area.

The town operates three fire stations with a combination career and volunteer system. There are 27 full-time employees, 12 part-time employees, and 15 volunteers in the Apex Fire Department (AFD). Minimum shift strength is eight, including a shift commander. The department staffs three engine companies, one tower ladder company, and other support equipment. The fire department provides fire suppression, rescue, first-responder emergency medical service (EMS), and operations-level hazardous materials (haz mat) response. The fire chief is also the town's emergency manager.

The Apex Police Department (APD) has an authorized strength of 51 sworn officers. APD is the agency that staffs the Public Safety Answering Point (PSAP) where 9-1-1 calls are received and responders are dispatched. The PSAP is located at police headquarters. Fire, EMS, and police are all dispatched from the PSAP. The city has a modern computer-assisted dispatch (CAD) and 800 mHz radio system. The typical patrol squad is staffed with eight or nine officers, including supervisors.

Emergency medical services are provided by Apex EMS, which is a city agency separate from the fire department. Originally formed in 1971 as the Apex Rescue Squad, Apex EMS no longer provides rescue or extrication services. Those services are provided by the fire department. EMS has 6 full-time employees, 20 part-time employees, and 15 volunteer members. The fleet of three ambulances and two support vehicles operates from two buildings: the first is the EMS station located in Apex; the second building has a paramedic-level ambulance and is located at the Fairview Fire Department 6 miles east of town on Highway 1010. The usual shift strength is two paramedic ambulances.

SITE OF THE FIRE

The Environmental Quality Company (EQ) operated a business that handled commercial hazardous waste at 1005 Investment Road. The original tenant of the facility was EnviroChem, which began operations in 1988 in what was then the "new" industrial park. EnviroChem operated the facility until 2002, when EQ took over. The company's business involved collecting, processing, and repackaging industrial waste for transport and proper disposal. EQ operates 12 other facilities in the United States and is based in Michigan. In 2005, the EQ plant in Romulus, Michigan, also suffered an explosion and fire, and approximately 2,000 people had to be evacuated.

The facility was a two-building complex with an office and warehouse storage area in one building and a seven-bay hazardous waste storage area in the other building. The footprint of the whole complex was approximately 175 feet by 100 feet. There were parking aprons on both the north and south sides of the buildings. A truck tanker loading and unloading area was located to the immediate east of the hazardous waste storage area and included eight storage tanks. (See Figure 1.) The building was an unprotected steel structure and did not have a sprinkler system.

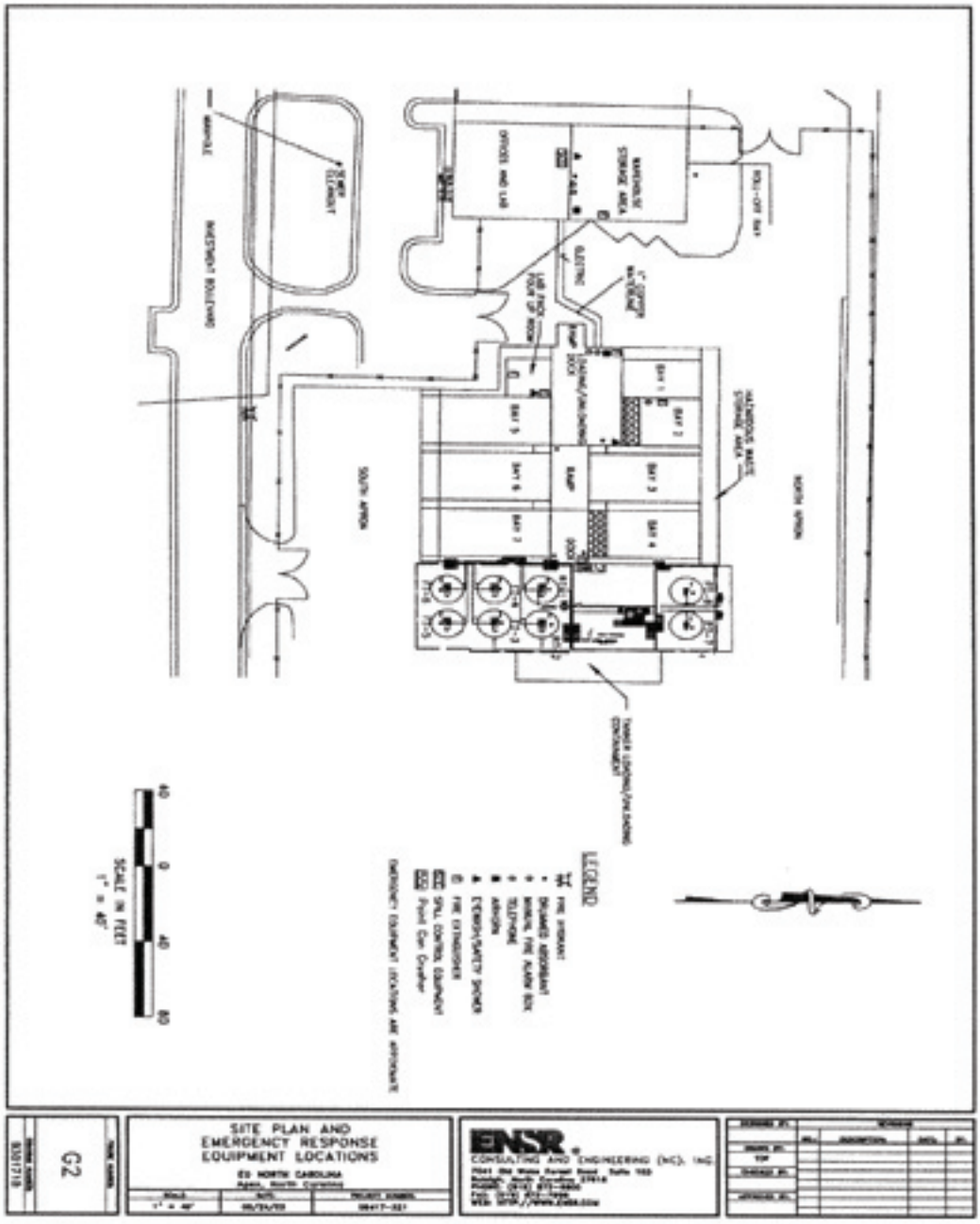

Figure 1. Site Plan and Emergency Response Equipment Locations.

The immediate exposures included a gymnastics center that was quickly evacuated, a fuel oil company that had 400,000 gallons of diesel and heating oil on site, and a woodworking shop that carried paints, varnishes, and lacquers in excess of 1,000 gallons in its inventory.

The daily inventory of chemicals at the facility varied, so the company was not subject to the Comprehensive Environmental Response, Compensation, and Liability Act, (CERCLA) also known as the Superfund or the Superfund Amendment and Reauthorization Act (SARA Title III) regulations. The most significant implication of this distinction is that there was no requirement for Tier

II reporting. (Tier II reports document what chemical hazards are present and make this information available to the public.)

The AFD did conduct inspections of the premises, but the amounts, types, and forms of the chemicals on site changed constantly. Thus, on the day of the fire, the AFD would have had to obtain the daily manifest of the products on site to assess the hazard accurately. This manifest is required to be on site and available to response officials in the event of an emergency. Unfortunately, fire conditions prevented firefighters from accessing the area where the manifest, if it existed, would have been kept.

THE INCIDENT

At 9:38 p.m. on Thursday, October 5, 2006, the AFD was dispatched to a report of a chlorine odor near the intersection of Schiefflein Road and Investment Boulevard. AFD dispatched its standard response of two engines and a chief officer (shift commander). Because the regularly assigned shift commander was on leave, the chief of the department responded in his place.

Upon arrival 4 minutes later, at 9:42 p.m., Engine Company 3 reported a large vapor cloud and requested a second-alarm assignment. Crews then began an initial reconnaissance to determine the source of the cloud. The chief of the department arrived at 9:52 p.m., took command, and established the initial Incident Command Post (ICP) near the intersection of Schiefflein Road and Investment Boulevard. He began the process of evacuating the community, which ultimately involved 17,000 people.

The town's "Reverse 9-1-1 System" was activated as part of the notification and warning. This system sends prerecorded messages from the 9-1-1 center to threatened neighborhoods to provide emergency information such as evacuation or shelter-in-place instructions. Apex police officers began warning people downwind of the facility. They went door-to-door to inform people that they needed to leave. Regional Hazmat resources and the town's Emergency Operations Plan (EOP) were activated. The Hazmat resources included the Raleigh and Fayetteville Fire Departments' Hazmat response teams. By activating the plan, the town's Emergency Operations Center (EOC) at Fire Station 3 automatically was opened, and town officials had a location to coordinate the serial evacuations and shelter operations.

The initial fire companies conducted reconnaissance and were unable to determine the source of the release. As a second team approached the area, the fire burned through the roof of the building. A plume of unknown chemical vapors was venting from the structure, and the wind was carrying the plume away from the site into the surrounding community. Figures 2 and 3, (photos) were taken during the fire, and show the magnitude of the fire and the chemical plume that was being carried aloft.

Photo Courtesy of Apex Fire Department

Figure 2. Initial Explosion and Plume Cloud.

Photo Courtesy of Apex Fire Department

Figure 3. Secondary Explosion During Fire Operations.

At 10:12 p.m., a general alarm was sounded to recall the entire staff of the fire department. This recall included the remainder of the 27 full-time employees, 12 part-time employees, and 15 volunteers that staff the department. The ICP was relocated to a second location about a quarter of a mile away on Industrial Boulevard. This decision was based on changes in the wind direction that, in turn, caused the plume to move. The APD continued with the door-to-door notice to evacuate. Over the course of the evening and next day the remainder of the police department also was recalled for extended duty.

In accordance with Apex's EOP, shelters were opened, and the EOC at Station 3 was activated. The first shelter was opened at the Community Center at 73 Hunter Street. Some residents who lived closest to the EQ facility were directed to shelter-in-place, that is, to stay indoors and shut down the heating, ventilation, and air conditioning (HVAC) systems to prevent outside air from coming indoors. That directive was given because those residents would have been evacuating **through** a toxic plume. It was determined to be safer to hold people indoors until the plume had passed.

Fire conditions prevented the reconnaissance teams from locating the daily manifest inside the structure. Since it was not possible to ascertain what chemicals were burning and what the plume might contain, the Incident Commander (IC) decided not to fight the fire. Instead, companies constructed a berm or dike to contain the liquid runoff that was starting to present near the edge of the EQ property. Companies arriving on subsequent alarms assisted with the evacuations. The fire department contacted the EQ Company and requested that a representative come to the scene. The EQ plant manager arrived on scene and reported that the fire involved pesticides, oxidizers, contaminated metals, flammable and combustible materials, lead, and sulfur. EQ also reported that they had requested a private firm specializing in chemical fires to respond. That response, however, did not arrive for 12 hours, because the firm was located in Arkansas.

Due to changing winds and the threat of explosions, at 10:35 p.m. the ICP again was moved several blocks away from the fire to the Crowne Plaza Hotel parking lot. As the winds continued to change, the ICP was moved two more times. The final move, at 5:30 a.m. on October 6, was to a shopping center parking lot to accommodate the space and logistical needs of the growing operation. As the plume moved, and the ICP moved, so did the shelter locations. The EOC itself had to be evacuated, and city government was essentially shut down while the elected officials relocated. Likewise, PSAP at police headquarters was abandoned and 9-1-1 calls had to be rerouted through Wake County.

The evacuation of police headquarters caused a problem, as police equipment, including some vehicles that were assigned to off-duty personnel, was left behind and had to be decontaminated after the operation. A mobile command vehicle was requested from Raleigh through mutual-aid agreements. CSX freight rail and Amtrak passenger service were shut down, as the rail line was affected by the plume. Requests to close the airspace over the fire were made to the Federal Aviation Administration (FAA).

A joint information center and media site was established near the ICP. Media briefings initially were held on the hour, and the media was credited with assisting in providing essential emergency public information regarding hazards, evacuation orders, and evacuation routes.

Throughout the night of October 5, evacuations continued with the cooperation of the school board which provided school buses and shelters for the evacuees. In a remarkable operation, Apex EMS coordinated with public transportation, schools, and the area EMS to evacuate 100 nursing home residents. None of the residents was ambulatory and all needed wheelchairs to be moved. The

patients were transported to three area hospitals: Western Wake, Wake Medical, and Rex Hospital, all in Wake County. This evacuation was completed in 4 hours with no injuries.

A Medical Branch was established that eventually included 16 EMS units, 2 buses, and 2 engine companies. Mutual-aid fire departments set up decontamination stations at the three area receiving hospitals. Three schools were used as shelters. Schools were closed Friday, as the town remained shut down. During the day on Friday, October 6, State and Federal support arrived. State law enforcement arrived to assist the Apex police with perimeter and traffic control. The North Carolina Department of Environment and Natural Resources (NCDENR) and the U.S. Environmental Protection Agency (EPA) assisted with air and water sampling to determine if there had been a runoff problem. None was reported as the NCDENR and EPA took more than 250,000 air and water samples.

By about 9 a.m. on Friday, October 6, 2006, the fires had died down enough to permit the Apex and the contract firefighters from EQ to begin offensive operations. By 5 p.m. Apex Fire Command was terminated, and the site was turned over to the EQ contract firefighters. The last of the fires was extinguished by 1 a.m. on Saturday, October 7.

The U.S. Chemical and Hazard Investigation Safety Board is conducting an investigation of the fire. Preliminary findings support the reports that incompatible chemicals were stored or somehow mixed together, and that a reaction occurred that caused the fire and explosions. The final report is available at http://www.csb.gov/index.cfm?folder=current_investigations &page=info&INV_ID=67

Figures 4 and 5 show the aftermath of the fire and how the chemicals were contained on site.

Photo Courtesy of Apex Fire Department

Figure 4. Aftermath of the Apex Fire.

Photo Courtesy of Apex Fire Department

Figure 5. Containers of Chemicals from the Apex Fire.

By the time the incident demobilized, approximately 17,000 people had been evacuated from their homes due to the threat posed by the chemical plume. There were no fatalities. Thirty civilians sought medical treatment for respiratory distress and skin irritation. Twelve police officers and one firefighter were treated for respiratory difficulties that were consistent with exposure to "tear gas."

At this point, on October 6 at 5 p.m., the Apex police took responsibility for coordinating traffic control to allow reentry to the evacuated areas. The reentry was conducted in phases, with traffic controls that allowed only people with proper identification to enter their neighborhoods. Figure 5 shows the areas that were evacuated and timeframes for allowing people to return to their homes.

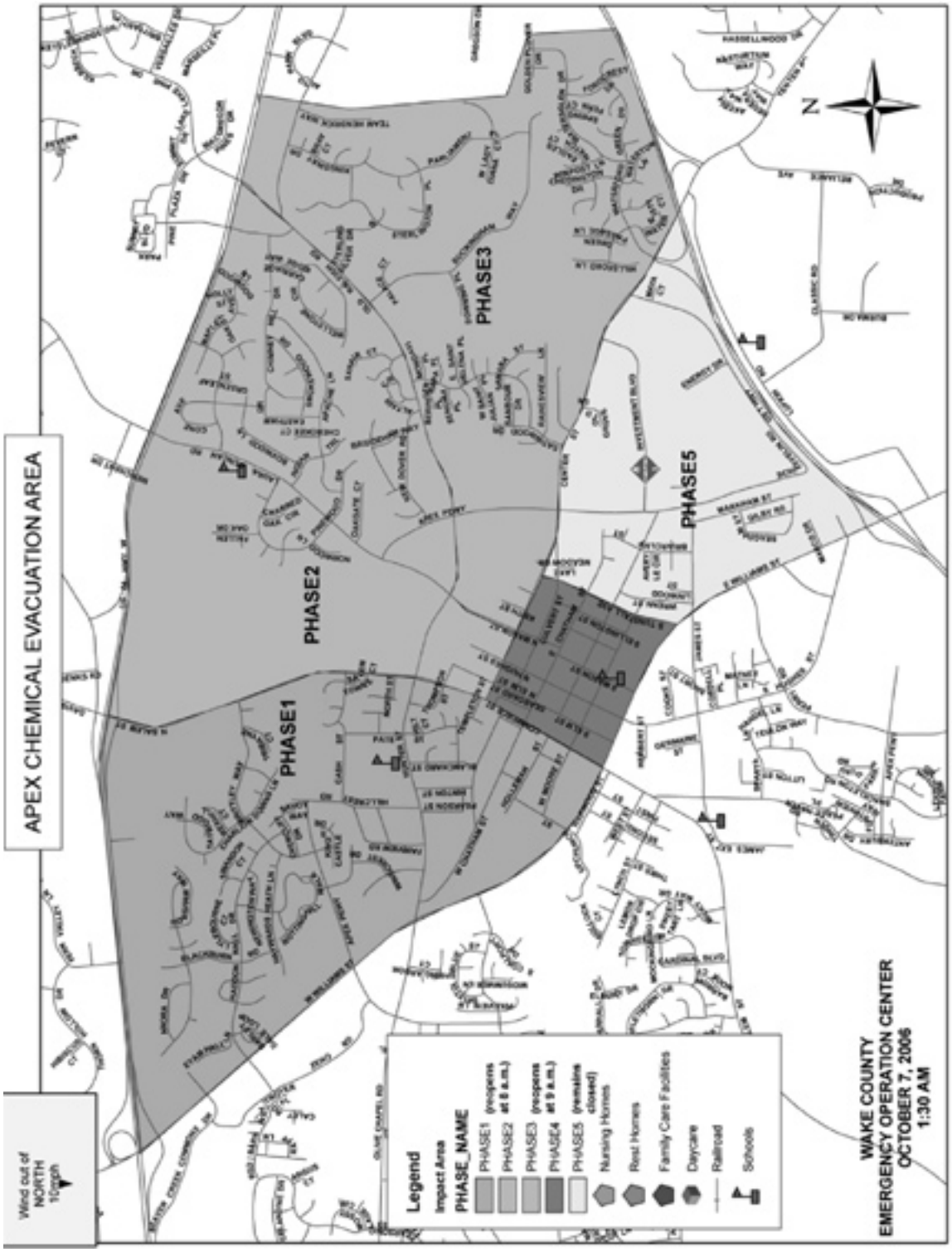

Figure 6. Apex Chemical Evacuation Area.

EMERGENCY OPERATIONS PLAN AND SUCCESS OF UNIFIED COMMAND

From every account and after-action report, including the town's report, this potentially devastating situation was handled with the highest levels of skill and expertise. The multiagency cooperation was virtually a textbook application of Unified Command and the National Incident Management System (NIMS). What contributed to the town's excellent and coordinated response? What can be learned from the EQ plant fire?

The key element contributing to the success of operations was that Apex had a very well-defined plan that was practiced routinely. They made a commitment to train to the plan, and when they had an incident they used the plan as a foundation for the response. Apex was prepared to evacuate the town in large part because police, fire, EMS, public works, and elected officials all participate in federally required biannual exercises for the Shearon Harris Nuclear Power Plant, located 10 miles from the town. Communities within 50 miles of a commercial nuclear reactor are required to plan for evacuation, emergency public information, sheltering, and other protective actions. Instructions on what to do in case of an emergency are routinely sent to the public via mailings with water and tax bills.

The entire town of Apex is within the Emergency Planning Zone (EPZ) for the Harris facility. Under the plans for the power plant, the town is designated for evacuation in the event of an emergency at the Harris facility, since Apex is so close to the reactor. This is the typical response if a plant declares a Site Area Emergency or General Emergency, (types of emergency designation which are unique to the nuclear power industry). For more information regarding emergency planning and operations for communities near commercial reactors see the Nuclear Regulatory Agency Web site and click on Emergency Classifications (www.nrc.gov/about-nrc/emerg-preparedness.html). It was due to the frequent and ongoing planning and exercise program for the nuclear power plant that a climate and culture of cooperation had been firmly established among the town and surrounding agencies. All of the key players knew each other and knew each others' capabilities.

Apex's 20-year emergency plan originally was designed for the purpose of meeting Federal requirements related to the nuclear power plant. However, as a result of a January 2002 ice storm, the EOP was revised to become an all-hazards plan, which included provisions for shelters, as part of the overall plans annex for evacuation. The shelters are located in schools and staffed by the American Red Cross. By taking a hazard-specific plan and expanding it to an all-hazards plan, the base of cooperation and coordination was expanded.

Another factor in Apex's success was that they applied the NIMS during the incident. Apex aggressively applied NIMS training and made it available to all city agencies. The police and fire departments required all personnel to complete the Federal Emergency Management Agency (FEMA) independent study programs IS-100, *Introduction to the Incident Command System*, IS-200, *ICS for Single Resources and Initial Action Incidents*, IS-700, *National Incident Management System*, *An Introduction* and IS-800, *The National Response Plan*, An Introduction. The fire department provided instructors to the other city agencies for their ICS programs. Public works and other city agency members also completed the IS-700 and IS-800 courses.

The fire department also did something the study team found unique. The fire chief requires the shift commander to prepare and complete an I-204 form from NIMS at the beginning of every shift. This form is an assignment listing and is a fundamental part of a written Incident Action Plan (IAP). Large incidents such as major chemical fires require written IAPs. By requiring the shift commander to have an I-204 completed in advance, the formal written IAP process had already been set

in motion at the time of the fire. While every IC has a plan, and those plans are given out verbally on emergencies, the transitional time between oral and written plans can be reduced if some of the documentation is begun ahead of time. Certainly this practice helped the Apex Fire Department move from a local response to one that involved many mutual-aid agencies.

LESSONS LEARNED

The Apex, North Carolina, incident is proof that preplanning and interagency training result in a positive emergency incident response outcome. Emergency agencies in Apex and Wake County, as well as the State of North Carolina and Federal agencies successfully mitigated this potentially deadly incident of October 5 and 6, 2006, with no life loss and only minor exposure issues.

Key factors contributing to success in the management of this incident:

POSITIVE INCIDENT FACTORS

1. Interagency coordination and cooperation improved functionality of responders.

The responding departments and personnel were known to each other before this incident because they attended regular meetings, seminars, and exercises together. This familiarity lessened the time needed to change from group functionality to a single-team operation, and brought about a quicker reaction to the ever-changing incident.

The actual blueprint for this type of response had been developed and rehearsed several times well in advance of the incident. Personnel and organizations knew their roles and responsibilities, as well as those of other personnel and agencies. Responders followed the EOP and Standard Operating Procedures (SOPs), but, most importantly, a Unified Command structure was initiated with the first-arriving unit and maintained throughout the entire incident.

2. The entire operation was able to adapt to the frequently changing conditions.

All three public safety agencies, police, fire, and EMS, as well as the rest of the town's employees demonstrated a high level of cooperation and competence when they responded to the EQ chemical plant fire and subsequent evacuation.

Weather worsened, and high wind conditions and changes occurred in the fire/plume cloud progression. These meteorological changes placed stress on the emergency plan, and decisions were made by Incident Command to adjust the response to meet the problems created. The ICP was moved successfully four times during the operation, which may have been a tactical problem; however, these relocations were well organized. The police station and Apex 9-1-1 dispatch were evacuated without any major interruptions in services. AFD Station #3 and the EOC also were evacuated on very short notice.

3. Tactical decisions were made efficiently and effectively.

Overall the Wake County communications system was very effective, and adapted well to the changing situation, including the shut down and relocation of Apex 9-1-1 dispatch. Although there were enough radio frequencies available to handle the incident effectively, not all emergency personnel

had the same communications equipment. Personnel even relied on their own creativity, including personal cell phones and multiple handheld radios, patched with the equipment to keep key communications flowing.

The use of North Carolina State Patrol and other outside police agencies for traffic control at key locations in and near Apex was very effective and likely averted some problems. Citizens tended to cooperate with the evacuation and traffic controls more fully because higher levels of law enforcement authority were in place for security and scene control. Additionally, the outside agency officers could get to their assigned locations easily, since the major locations were at key intersections and landmarks.

The decision by the Apex fire chief to require shift supervisors to use the IAP as a daily shift planning and accountability tool provided familiarity with this instrument. This when an actual emergency occurred, the IAP was not a point of confusion for AFD personnel.

4. *The Public Information Officer (PIO) was very effective.*

Though there were some problems early on, placing the media in an area near the Incident Command staff was essential in maintaining a good working relationship with the press. Additionally, holding hourly media updates and always reporting at least one new topic or item kept news resources busy and averted attempts at freelancing. Since the media were occupied with reporting the official updates, they were less inclined to seek out stories from unauthorized sources. This mechanism also provided citizens with current and accurate information and kept them from wandering into the incident area for personal curiosity.

5. *Evacuation was well planned.*

Since Apex is within the EPZ for the Shearon Harris Nuclear Plant, the town is required to plan and test evacuation systems for the facility. Having this mechanism in place meant citizens of Apex knew and accepted the possibility of a community-wide evacuation. Routes were already in place, and the process was understood, which significantly reduced confusion during the actual evacuation process. All communities, whether located near a nuclear power plant or not, can plan for a successful evacuation and major incident response.

6. *Incident Action Plans were used routinely by the IC.*

The Planning Section provided Incident Command with an IAP for each 12-hour segment of the incident, as well as a second IAP for the next consecutive 12-hour segment. Continuous updating kept a current and future plan in place at all times, even though the Planning Section was short-staffed, which could be resolved by developing a two-team Planning Section for long-duration incidents. Additionally, AFD personnel had been using an IAP daily for shift staffing and assignment. This familiarity with the document and the process virtually eliminated any problems with line personnel during the incident.

7. *Training is the most critical part of successful incident mitigation.*

Training is the single most important component of emergency incident response. Emergency personnel respond to a real situation in the same way they are trained. If poorly trained, a fragmented,

ill-planned, and inadequate response is the most likely outcome. If well-trained, a multiagency, well-structured, and complete response will be delivered. Apex was well-trained, and this incident was an example of a successful outcome; however, a high level of interagency training still is necessary to maintain this proficiency.

Apex and Wake County strive to be "NIMS functional not just NIMS compliant." This desire to be NIMS functional means a continuous commitment to training. Areas to focus training efforts toward include evacuation of special-needs populations, redundancy of key positions, parts of the information system (IS), resource tracking, and continuity of operations.

AREAS FOR IMPROVEMENT

While the successful outcome of the Apex, North Carolina, incident is a testimony to multi-jurisdictional planning and training, there were some lessons learned about what can be improved to make any future emergency incidents even more effective.

1. *Special-needs population evacuation was not well-planned.*

Special-needs populations present a significant risk for emergency evacuation scenarios. The number of special-needs citizens in special care facilities and mainstreamed into daily society is increasing across America. Planning whether to shelter in place or evacuate these persons is the cause for major concern at all levels of emergency management. Emergency plans must address this. In Apex the special-needs evacuation was planned and executed ad hoc at the time of the incident. A clear, concise plan for special-needs populations in emergencies should be part of the county plan.

2. *Remote Staging Area was not identified and used.*

A Staging Area for reserve and undeployed personnel and equipment should be established well away from the potential exposure or contamination areas. The rapidly changing plume cloud in Apex traveled over 2 miles across the center of the community, due to an unexpected change of wind direction and an air inversion. The exposure of many later-needed pieces of equipment and the evacuation of the communications center could have been disastrous to the final outcome of this incident.

Though not used in Apex, implementing the military model of one-third of resources held in reserve and two-thirds deployed at an emergency situation would provide adequate personnel and equipment for continuous operation at any long-duration operation during an emergency. Military leaders have used this operational deployment system for decades and understand the consequences of inadequate reserves and improper placement of reserve caches better than anyone.

3. *Geographic Information Systems and Computer-Aided Design should be functions of the Planning Section.*

A lack of local GIS and CAD information at the ICP in Apex decreased potential effectiveness of some tactical decisions, specifically, accurate maps and up-to-date personal contact information.

Integrate the GIS and CAD functions of local government into the Planning Section of the Local Emergency Plan. It is also a wise idea to use the local IS department in the Planning Section as well.

The ability to generate accurate and well-detailed mapping of the incident is critical to good plan-

ning. The IS personnel can access all electronic data stored by the jurisdiction, and the possibilities of uses for such information cannot be anticipated fully in advance of an emergency.

4. *Public information functions must be well-placed and effective.*

Though the PIO function was cited earlier in this report as an overall success, there were some areas for improvement of this key function. The PIO section should be attached to the Command function or at least be very close to the Command area. PIO is a critical function, which provides information to the media, and a single source of reliable information is critical to successful incident management.

The PIO staff should be technically knowledgeable and able to communicate basic technological information concisely to public and media. In Apex this function was handled by the mayor, and his communication skills greatly aided in positive interaction with the media. However, the North Carolina State and U.S. Federal agencies did not use the unified PIO set up by local agencies. This created instances of misinformation during critical times, including confusion as to who had incident access and the current status of the emergency operations.

The PIO operations struggled in the early stages of this incident due to their remote location, but greatly improved by being repositioned near Command. Future plans are being modified to bring PIO more closely into the key functions of leadership and establish the media area as close to Command as is practical. This should enhance the functionality of PIO greatly.