Operation Tunnel:
Confined-Space Operations Within the Tunnels of Chicago

By Captain David Noble and Captain James Allen

In the spring of 2003, the 863d Engineer Battalion (Combat) (Heavy) commander decided to start analyzing hot-topic current events surrounding global military operations, focusing on urban environments. Taking into account the actions in Baghdad, urban terrorist actions, and the potential for future city-oriented engagements, he realized that construction engineers might be called on to conduct specific underground missions within the tunnels of major cities, which is reminiscent of the tunnel rats of the 1960s in Vietnam. However, there was no established military training on how to conduct effective underground operations. Being a United States Army Reserve (USAR) officer in a USAR battalion, he not only had civilian experience but also was supported by a battalion staff filled with civil engineers that were required by civilian and state industry to be trained on confined-space operations. With this knowledge and the drive to cover all the possible scenarios that a construction engineer might face, the com-mander gave the order for the battalion to initiate a mission training plan to create a platoon of engineers capable of conducting effective underground operations (with all the safety and combat considerations involved).

Operational Concept

Operation Tunnel, as it was titled early in the military decision-making process, was a unique planning experience, since there was no established military guidance for such a mission. It was the same as creating military

While underground, soldiers conducted radio operations and tested night vision goggles.

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Soldiers and members of the Office of Emergency Management conduct a joint tunnel inspection.

operations on urbanized terrain training for the first time; a team would have to analyze enemy tactics, after-action reviews, and planning considerations in a post-Cold War scenario. The planning and execution focused on four major areas:

- Confined-space training and duties/responsibilities
- Combat considerations in an underground environment
- Equipment and operations
- A tunnel exercise within the Chicago tunnel system (Operation Tunnel)

The original plan allowed for 6 months from start to finish. With the initiative of the battalion staff and the determination of the command and battalion Operations and Training Officer (S3), the mission was ultimately executed within 5 months. However, the road to success was paved with many obstacles. This was expected, since it was the first time for not only the battalion but also for the support agencies to perform this type of mission.

Confined-Space Training

Using an established format from the civilian sector, which had been proven by state and local agencies, the battalion had the basis for a training plan. The training concept took into consideration many factors that civilian engineers had faced and proved to work. The overall objective was to provide familiarization to soldiers in case an operation of this type might be required. Associated hazards with confined-space operations, entry-and-rescue procedures, and personal protective equipment were only some of the objectives identified. The battalion commander identified confined space as an area that is large enough or so configured that a soldier can enter and perform work with limited or restricted means of entry or exit and is not designed for continuous military occupancy.

A basic four-soldier team was developed to identify key areas of emphasis for underground operations. This team included the following:

Entry Supervisor. The entry supervisor was the overall officer in charge of the operation and provided command and control for the team. He recognized the effects of exposure to hazards that were reasonably expected to be present and performed the duties and responsibilities identified in Air Force Occupational Safety and Health (AFOSH) Standard 91-25.[1]

Entrant. An entrant was anyone who entered the area of operation (actually went into the tunnel). There could be multiple entrants during a mission. Each was briefed on his specific function, focus, and area of responsibility and the

Remnants of old warning signs and hauling equipment still remain in the

toxic effects and symptoms of exposure. He was trained to detect atmos-pheric conditions and report physical and atmospheric hazards to the attendant.

Attendant. The attendant maintained an accurate account of all personnel who entered the underground area. Functioning primarily as the entrance guard and staying outside the tunnel or confined space, he also communicated with anyone in the underground area where the operation was conducted. He had the authority to order all entrants out of the area and to keep unauthorized personnel out of the work area.

Rescue Operator. The rescue operator provided medical and rescue support in case of an accident or injury. He maintained retrieval and rescue equipment, was trained in combat lifesaver skills, and typically waited with the attendant outside of the tunnel in case of an emergency.

Soldiers use an air monitor to test the atmospheric conditions at the entrance of the tunnel system.

Certain criteria had to be met before entering the area of operation, in this case a tunnel. The entry supervisor conducted a preentry briefing with all entrants. Precombat checks and inspections were conducted on all mission-specific and personal protective equipment. The attendant and the first entrant had to establish acceptable entry conditions. The entrant conducted initial air sampling as he entered the tunnel. The attendant was in position from start to finish. Communication was established between the entry supervisor, the attendant, and the entrant, with strict orders that if communication was broken, the entrant would return to the attendant. Once these criteria were met, the entry supervisor reported all actions to the higher headquarters.

Combat Considerations

Confined-space operations have multiple hazards that must be considered, some visible (physical) and some nonvisible (atmospheric). Physical hazards include the following:

- Unguarded machine parts
- Heat
- Exposed electrical circuits
- Slipping and falling
- Engulfments
- Entrapments
- Noise
- Vibration
- Poor lighting
- Wildlife

Atmospheric hazards include the following:

- Oxygen richness/deficiency
- Combustibility
- Flammability
- Explosibility
- Toxic gases
- Dust, vapors, and mist

During planning, all these hazards were briefed in the same manner as any other risk management procedure. These potential risks were part of the mission, and risk assessments were created to capture them with ways identified to counter and continue the mission should any of them occur.

Equipment and Operations

The entire concept for this operation ultimately involved specific equipment that would be required to detect potential environmental hazards and to protect the soldiers during execution. The following equipment was required to enter the tunnel:

Air Monitor. The US Army has no identified air detection equipment as part of the modified table of organization and equipment within a combat heavy engineer battalion. However, since construction operations and foundation work play a heavy part in urban repair, such equipment would prove necessary for mission completion. For Operation Tunnel, one of the several agreements between the USAR and the city of Chicago involved the Chicago Office of Research and Development allowing the battalion to have access to an air monitor. During execution, the soldiers trained with a GasTech® GT-402 air monitor. The table below shows the four major atmospheric conditions that the GasTech GT-402 detects.

GasTech GT-402 Monitoring Capability

Element	Warning	Alarm
LEL/ppm	10%	50%
Oxygen	23.50%	19.50%
Hydrogen sulfide	10 ppm	15 ppm
Carbon monoxide	25 ppm	200 ppm

Legend:
LEL = lower explosive level
ppm = parts per million

Fall Arrest System. This system would be required for a vertical entry, which was covered during briefings. However, a horizontal entry was used for this operation, thus eliminating the need for this equipment.

Ventilation Equipment. Due to the unknown amount of breathable air, ventilation equipment is recom-mended for prolonged periods in confined spaces. There are methods to circulate breath-able air, while at the same time diluting or flushing out atmospheric hazards.

Lighting System. Special lighting was required because of the dust particles underground. Normal flashlights are not recommended due to their unstable reaction when turned on. An easy alternative is a chem-light. There are also special flashlights available in the civilian market, which are used by virtually every gas and sewage facility in the country.

Communications Equipment. During our mission, we used Single-Channel Ground-to-Air Radio Systems (SINCGARS) to maintain constant contact. Cell phones and other alternative means of communication are dangerous, because they can create an electrical spark that could ignite combustibles or flammables, causing an explosion.

Body Harness and Lifelines. Based on the severity of the area of operation, lifelines connected to the entrants could be used to maintain physical contact. An easy alternative would be to use 550 parachute cord.

Working Winch. Mainly used by the rescue operator, this device would connect to the lifeline and extract entrants mechanically during a vertical extraction.

Operation Tunnel

On 13 September 2003, at the battalion headquarters in a Chicago suburb, soldiers from all four companies and a complement of the battalion staff gathered for the tunnel exercise. The instruction focused on confined-space operations, the battalion confined-space standard operating procedure, operation of the air monitor, and a safety brief. Those trained included two civilian representatives from the 88th Regional Readiness Command Safety Office, who had been part of the planning process since Day One. Recognizing this as a new type of training with no established policies or procedures, the safety personnel monitored our training and execution and provided insight when applicable. They recognized the need for the air monitor, special lighting equipment, and rescue personnel. After accepting our risk assessment and level of detail in the training modules, they gave the final approval for execution.

Safety was not the only consideration during the planning process for this mission: legal considerations nearly cancelled the entire operation. Representatives from the city of Chicago, the USAR Center Legal Assistance, and the 88th Legal Assistance Office meticulously identified all the legal implications if an accident were to occur. A military operation within city limits, focusing on training that was "opportunity training" at best, posed a high risk for all involved. Ultimately, it was recognized at the eleventh hour (with the 88th Safety Office, a guide from the city of Chicago, and a thorough training plan) that this mission would be a success.

Soldiers travel through part of the tunnel, prepared to conduct Operation Tunnel.

Twenty-four soldiers (five solders from four companies and four from the battalion) convoyed to Chicago City Hall, where they established the entry supervisor, the entrants, the attendant, and the rescue operator. At that same time, the Chicago Office for Emergency Management was conducting similar training and reviewing underground schematics, which is a periodic requirement for that organization. So the two groups, ranging upwards of 50 people, proceeded together to tour the tunnels.

Before entering the tunnel, certain entry procedures had to be met. First, the entrant with the air monitor had to test air concentrations outside the entrance. In this case, the entrance involved a secured door, much like a submarine hatch. Once opened, the entrant had to test the air at the opening and then on the other side. Fortunately, the GasTech GT-402 is capable of continuous operations and beeps when toxic levels are high. For vertical entry, the entrant with the air monitor must test atmospheric conditions in 3-foot increments. The air monitor used for Operation Tunnel came with a 30-foot extension hose. As the hose was lowered, the fact that the hose (no matter what the altitude) was still 30 feet long had to be considered, so the same planning factors (based on 10 seconds per foot for air to travel through the hose) had to be considered. Whether a hose is 6 or 16 feet underground, 5 minutes must be allowed per test (10 seconds x 30 feet = 300 seconds or 5 minutes).

Conclusion

The soldiers from the 863d Engineer Battalion traveled 5 miles through the tunnels, which covered only 2 percent of the overall tunnel system, then exited and completed their mission. Although this was valuable training, it was only familiarization training. No one was validated or certified to conduct confined-space operations. However, the soldiers can now appreciate the inner workings of such a mission and will be better prepared if they are called on to conduct this type of operation in the rebuilding of other nations.

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Captain Allen was the civil engineer for the 863d Engineer Battalion. He is currently deployed overseas in support of Operation Iraqi Freedom with the 980th Engineer Battalion.

Endnote

[1]AFOSH Standard 91-25. *Confined Spaces*. 1 February 1998, Paragraph 2-13.