

FIRE ADMINISTRATION

UNITED STATES

Confined Space Rescue on SS *Gem State*

November 19, 1990

Tacoma, WA



TECHNICAL RESCUE INCIDENT REPORT

Federal Emergency Management Agency



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This report is part of a series of reports on technical rescue incidents across the United States. Technical rescue has become increasingly recognized as an important element in integrated emergency response. Technical rescue generally includes the following rescue disciplines: confined space rescue, rope rescue, trench/collapse rescue, ice/water rescue, and agricultural and industrial rescue. The intent of these reports is to share information about recent technical rescue incidents with rescuers across the country. The investigation reports, such as this one, provide detailed information about the magnitude and nature of the incidents themselves; how the response to the incidents was carried out and managed; the impact of these incidents on emergency responders and the emergency response systems in the community; and the lessons learned. The U.S. Fire Administration greatly appreciates the cooperation and information it has received from the fire service, county and state officials, and other emergency responders while preparing these reports.

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Confined Space Rescue on *S.S. Gem State*
November 19, 1990
Tacoma, Washington

OVERVIEW

At 10:47 a.m. on November 19, 1990, the Tacoma Fire Department received a call to assist in the rescue of a victim who was unconscious from unknown circumstances on board the *S.S. Gem State*. This ship was an ocean-going freighter undergoing repairs at the Port of Tacoma. The victim was a civilian employee who had been working in the lower decks of the ship.

During the ensuing operations several firefighters were overcome by high levels of carbon monoxide, and were transported to the hospital.

After an investigation by the Washington State Department of Labor and Industries, the Tacoma Fire Department was cited for four “serious” violations. This report is an account of the initial response, search and rescue operations, the subsequent investigation, and the lessons learned by the Tacoma Fire Department.

History of Preparedness

In June 1989, the Tacoma Fire Department started to address the recognized need for specific confined space rescue training, and the supplied air respiratory systems that

would be required for that task. By August 1990, a training program had been developed with the help of the local distributor for a major fire breathing apparatus company.

While the training got underway, standard operating procedures (SOPs) were still being developed. Unfortunately, the *S.S. Gem State* Incident occurred before either the training or the SOPs could be finalized.

Acknowledgements

The authors would like to acknowledge the cooperation of the Tacoma, Washington, Fire Department, and the Washington State Department of Labor and Industries, and their representatives, for providing details of the initial response, and subsequent events and proceedings. All of their detailed analyses were crucial in providing the “lessons learned” of the incident, to be shared by all interested emergency services providers.

I. INITIAL RESPONSE

Tacoma Fire Communications received the call regarding a worker down in the ship at 10:47 a.m., November 19, 1990. The caller did not know the reason for the emergency.

The initial dispatch sent Engine 1 (E-1) and Rescue 1. The Lieutenant from E-1 realized the potential and requested a ladder truck.

At the scene, E-1 was told by bystanders that there was a man down for unknown reasons, possibly "bad air." Truck 1 (T-1) had now arrived at the scene as well.

The lieutenants from both E-1 and T-1 decided that E-1's crew and two firefighters from T-1 would board the ship and begin operations. The two other members of T-1's crew would stand by to haul additional equipment. E-1's crew took a medical kit, oxygen, and two SCBAs.

In order to reach the victim, the rescuers had to go up the gangway of one ship, across its deck, then cross a gangway to the *Gem State*, tied alongside. They then went to the fantail (rear) of the ship, where they believed the victim was lying on the deck.

The ship's crew indicated that the victim was actually one level below. Discussions with the crew left rescuers with a false sense of security about safety below the deck. Upon arriving at the next level down, they were told the victim was still one more deck below, in the rope locker. The crew stated that the victim had been working below with a gasoline-powered washer and had been overcome by fumes. The firefighters climbed through a hatch and climbed down a ladder to the rope locker level. In the rope locker they found several crewmen and a male victim. The victim was lying on the deck with a decreased level of consciousness. He was unable to assist in his own rescue.

The E-1 lieutenant advised the T-1 lieutenant that they would need additional personnel, supplied air systems, rope rescue gear and patient packaging equipment.

The E-1 lieutenant was told by the victim's co-workers that there was a second victim, just below, conscious but unable to get out. Again believing that victim number 2 was just one more deck down, two firefighters from E-1 went down in an attempt to locate him. Meanwhile the lieutenant from E-1 and the paramedic from Rescue 1 treated the first victim.

The two firefighters went through an extremely small hatch and down a 30-foot ladder. Since the hatch was so small, they took off their SCBAs, turnout coats and helmets. The SCBAs and an oxygen bottle were handed down from above.

As the two rescuers moved into the bilge area, the passages became more confined and this limited their ability to put the SCBAs back on. Instead they carried their packs in one hand while trying to keep the face piece in place. Hanging extension cords and ropes in the tight passages tore the masks from their faces several times.

After searching in the dark for approximately five minutes the two firefighters yelled up for further directions. The ship's workers directed them to follow the extension cords. After getting rope and more oxygen bottles, the two rescuers went to the top of the shaft alley. Hearing faint cries from below they finally climbed down to find victim number 2 wedged between the shaft alley and the side of the ship. This victim also had a decreased level of consciousness.

One firefighter attempted to get oxygen on the victim. However, due to the contour of the ship he had difficulty administering it. He then crawled along a narrow baffle beside the victim in an effort to turn the victim around for extrication.

Meanwhile above, the Lieutenant from E-1 and the paramedic from R-1 were trying to extricate victim number 1. With assistance from ship personnel, they rigged a

hauling system and raised the victim above deck. The victim was then transported to the hospital for evaluation, was treated and released. Every five minutes or so the E-1 lieutenant would yell down to the other firefighters to check their condition and progress.

Down below, one of the firefighters from E-1 was starting to feel the effects of the carbon monoxide exposure. Since victim number 2 was starting to respond more purposefully, the firefighter began using the oxygen on himself. A few minutes later the second firefighter from E-1 started to feel disoriented and told his partner that it was time to get out.

The firefighter from T-1 was moving between the rope locker up above and the landing below relaying equipment and messages. He yelled up to the lieutenant that he was feeling dizzy. The lieutenant ordered him out and the driver from T-1 down to replace him. The driver could see that the firefighter was disoriented and having trouble ascending the ladder. He assisted him back up to the rope locker before returning to the scene below.

As the firefighter tried to climb up the rope locker to the next deck, he collapsed. The lieutenant, along with the tiller-man from T-1, got to the man and helped him to the next deck above. The lieutenant then requested by radio that the T-1 lieutenant send more personnel and then returned to the rope lock to order the other personnel out.

Meanwhile, the driver and tillerman from T-1 had gone below to assist with the rescue effort. They ran into one of the E-1 firefighters who said his partner needed help below. They helped him up to the rope locker - the driver stayed to administer oxygen - while the tillerman went back down to assist with victim number 2. By the time the driver started back down, the tillerman had determined that the rescue effort wasn't working and that he and the E-1 firefighter needed to get out.

Listening through the hatch above, the E-1 lieutenant could hear the three men struggling below. Then he heard the first E-1 firefighter collapse behind him. He yelled

down an order for everyone to get out. The tillerman assisted the remaining firefighter from E-1 through the baffles and up to the rope locker.

E- 14 personnel now arrived on scene, and concentrated their initial efforts at getting all E-1 and T-1 personnel out from below. The lieutenant from E- 14 and his firefighters then went down to try to finish the rescue of victim number 2.

Again they were unable to don their SCBAs, and instead used the oxygen they had brought with them. T-1's driver attempted to ventilate the space using spare cylinders, and at the same time breathe himself directly from the valve of the cylinders.

The E-14 lieutenant found himself losing strength and coordination as he tried to negotiate the baffles to get to the victim, so he told the firefighter with him that it was time to get out. A paramedic from R-2 then assisted the T-1 driver and the members of E-14 out. The driver from T-1 noted that it had been 25 minutes from the time of his original entry to the time he got back up to the rope locker.

It was one hour and two minutes into the incident when a battalion chief arrived and assumed the role of operations officer. Meanwhile, another group from T-4 and E-8 made yet another attempt to reach victim number 2. Like the previous rescuers they couldn't wear their SCBAs. Further, they were not briefed on the specific location of victim number 2 and were unable to locate him. They finally made voice contact with the victim, but their air supply ran low and they had to retreat. While working his way to the shaft area, the lieutenant from T-4 had his mask ripped off several times.

The operations officer gathered all personnel topside to pass information and develop a specific rescue plan. All personnel were informed of the victim's exact location and a four-person team was assembled. Unnecessary extension cords and ropes were removed as much as possible to prevent entanglement. Electric smoke ejectors were used to attempt positive pressure ventilation.

After several attempts, the first firefighter with the four-man team reached the victim. He tried to free victim number 2 but discovered that his air was running low. He opted to make one last effort to free the victim and was able to pull him through the baffle hole.

Although he did not have his oxygen on, victim number 2 was now able to assist in his own rescue, and the other team members guided him up to safety. Once the victim was topside he was transported to a waiting ambulance. Victim number 2 was ultimately treated and released from the hospital.

The crews then took a break to organize the demobilization phase of the operation. Recovering the equipment left below was necessary to get back in service; however, the rescuers still faced the same problems as before. The SCBAs were suspended from ropes, while rescuers worked with face pieces in place. Some rescuers still had masks torn from their faces. Working as best they could under the difficult conditions, the rescuers were able to get the gear out and return all apparatus to service.

All of the 32 firefighters who had worked below deck were checked for CO levels at the hospital. Six had CO levels over 20, and one had a level of 26. He was kept overnight, while the six others were sent home for the remainder of the shift.

Shortly after the incident, the Department of Labor and Industries Division of Industrial Safety and Health conducted an investigation, resulting in the Tacoma Fire Department being cited for four “serious” violations:

- The first citation was for failure to use air-supplied respirators in hazardous atmospheres on the *S.S. Gem State*. The penalty was \$3,500.
- The second citation was for not instructing employees in safe procedures for entering confined spaces. The penalty assessed was \$2,100.

- The third citation was for an absence of written SOPs to protect employees assigned to perform rescue operations in confined spaces, including such subjects as the use of ventilation during such operations. The penalty was \$2,100.
- The fourth citation was for failure to conduct an evaluation of the atmosphere prior to entry in order to identify hazards. Department of Labor and Industries went on to state that such evaluations should be done by a competent person, in all locations and levels where employees might be exposed.

The Tacoma Fire Department appealed the citations, showing proof that reasonable attempts had been made to train and equip personnel for confined space rescues. The Department of Labor and Industries then reduced the fines to a total of \$1,750 and the Tacoma Fire Department agreed to abate all the cited violations.

II. LESSONS LEARNED

1. When responding to a below-grade rescue, a standard response should include haz-mat units, technical rescue units, and a command officer.
2. The Incident Command System should be utilized for confined space rescues, and proper rescue procedures for such circumstances should be employed.
3. A safety officer should be part of the initial ICS structure at the scene. This safety officer does not necessarily have to be a previous titled member of the department. Instead, that individual can be any appropriately trained rescuer who can ensure that proper policies are being followed, and who can assume responsibility for looking for existing and predictable hazards at the scene. The safety officer should have no other duties.
4. When sending personnel into a hazardous area, some accountability, or “passport,” should be employed and adhered to.
5. All hazards, including atmospheric, physical, and environmental, should be identified before entering a confined space.
6. Atmospheric testing can only be done correctly by a properly calibrated monitor operated by a trained technician.
7. After hazards have been identified, the incident commander must make a survivability judgment of the victim or victims, weighing the risks and benefits of the rescue attempt, before sending in any personnel.
8. Appropriately ventilate if an atmospheric hazard exists in the space.

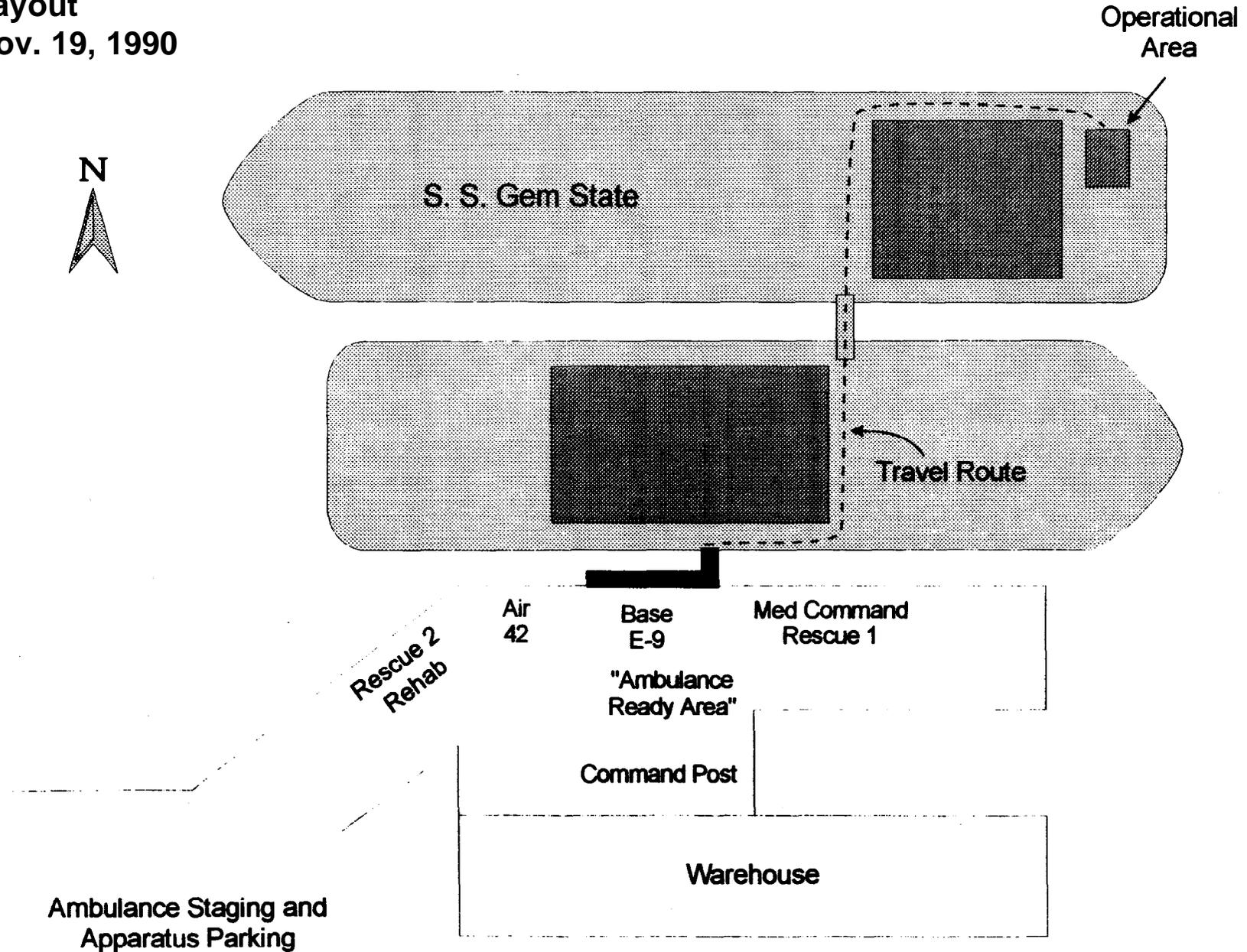
9. Prior to the start of rescue operations, a primary and backup rescue plan must be determined and implemented.
10. Assign an entry team and a back-up team to assist in the rescue of the entry team.
11. The plan should include a diagram of the space, and if possible, the specific location of the victim or victims.
12. All personnel in a contaminated atmosphere should wear respiratory protection at all times.
13. Upon determining that there is a victim, a treatment area outside the operations area should be established.
14. A “rehab” area should be established, and crews rotated out frequently for rest, water, and food if necessary.
15. Confined space personnel should be trained to recognize the signs and symptoms of exposure to hazardous atmospheres, and trained how to respond.
16. Confined space rescues frequently require the use of rope rescue skills, and rescuers should be trained accordingly.

Appendix A

S.S. Gem State Incident Layout

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**S. S. Gem State Incident
Layout
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**Cross Section
Viewed from
Rear of Ship**

