A NEW RISK: THE CRASH OF BULLET-TRAINS

Experiences from the German ICE-accident on June 3, 1998

Gunnar J. Kuepper
Chief of Operations
Emergency and Disaster Management Inc.
Los Angeles, California US

"On June 3rd, 1998 a high-speed ICE train derailed and collided with a highway overpass in Eschede, northern Germany. The catastrophe occurred at a speed of 120mph and claimed the lives of 101 people. Another 108 people were mostly critically injured, and only 5 survived unhurt. 1,889 emergency workers with 400 vehicles and 39 helicopters responded in the first hours to the accident site in the remote town of 6,000 citizens. The salvage and body recovery operations took nearly a week. The media's presence and coverage by national and international representatives was unexpected and overwhelming.

This paper will describe impacts, challenges and demands on the affected town (Eschede), the county administration (City of Celle) as well as their communities. Their "real life" experience can be used as a blue print for emergency planning, especially in remote and rural areas.

INTRODUCTION

Since 1991, major cities in Germany have been connected by a system of high-speed trains, called ICE. ICE trains have transported more than 130 million passengers without serious accidents. Their top-speed can reach up to 175 miles per hour.

The train consists of two electric powered locomotives (one at the front, one at the end) and 12 passenger cars. The passenger capacity is 750 people. The length of the train is 410 meters (12,000 feet). Each passenger car is 95 feet long. The complete train weighs approximately 800 tons.

SAFTEY ASPECTS

ICE trains are inspected on a regular basis. According to a serious newsmagazine ("Der Spiegel") this specific train was audited by computer the night prior to the accident, as part of a regular maintenance schedule.

In a German high-speed train, every coach has two pivoting wheel assemblies or trucks, one on each end of the car. Every wheel assembly or truck has two fixed axles with one wheel on each end, that is four wheels per assembly. On top of each wheel is a metal sleeve. The sleeve is used for improving the passengers' comfort.

In the Inspection Center, 48 sound resonance sensors measure each wheel's outer diameter and the thickness of each sleeve. The diameter of every wheel is 93 cm. (3', 1" long). The sleeve is only 6 cm (2.28") thick, giving an overall outer diameter of 99 cm (39 inches). The acceptable tolerance is +/- 0.6 mm = 3/1000's of an inch. One wheel on the train that derailed showed a variance of 1.1 mm = 1/200's of an inch. The Safety engineers believed that this variance would cause some vibration and only affect the smoothness of ride. Even if it was clearly out of tolerance, it was not expected to be unsafe.

All procedures and performances associated with this accident are still under criminal investigation. There is no final report as of yet.

ACCIDENT SEQUENCE

The ICE-Train traveled at approximately 120mph through the rural and flat areas of Lower Saxon. About 3 miles prior to the crash site, a rear wheel of the first passenger car failed. The wheel rim or metal sleeve began to break off from the wheel. The remainder of the rim struck against the tracks. Some passengers in the first car could hear noises and felt vibrations beginning two minutes before the crash. However, there was no monitoring system to alert the engineer about the wheel failure.

The train traveled nearly 3 miles with the damaged wheel. Two hundred meters (200 yards) before a bridge, the train approached a track switch at a turnout. At this turnout the broken wheel rim, still hanging on the track brake, collided with a guide rail. As a result of the impact, the rear left wheels of passenger car no. 1 derailed.

One hundred and twenty yards later the derailed truck hit the next turnout switch. The derailed wheels caused the open switch point to close against the running rail lining. Passenger car no. 1 went straight through the switch, followed by car no. 2. The front wheels of car no. 3 followed as well, but the rear wheels diverted to the sliding track and derailed. This occurred 80 yards prior to the highway overpass.

The trailing end of passenger car no. 3 hit the concrete bridge and knocked out the support columns. This caused the 300-ton overpass to collapse, as the train was still running 50 meters per second. Car no. 3 and 4 were able to go through the falling bridge. The middle of car no. 5 was crushed by the collapsing bridge and torn apart. The rear end was buried under the 300 tons of concrete debris. Passenger car No. 6 turned sideways across the track in front of the barrier. The following six passenger cars no. 7 through 12, including the rear end locomotive, hit with full force (still 120 miles per hour) into the blockade. The unbelievable power pressed everything together and piled the train up in accordion fashion. Passenger cars no. 6 and 7 were partially buried and crushed by the bridge debris.

Sometime during the accident sequence, the front engine separated from the rest of the train. The locomotive had passed without any damage and came to a rest 2 miles ahead of the accident site. The stop was initiated by an automatic emergency braking system. Only then did the engineer realize the situation.

Car no. 1, 2 and 3 derailed and skidded along the tracks but didn’t fall over. Car no. 4 slid from the railroad embankment into a wooded area and fell on its side. Car no. 5 was torn up in the middle; the first part passed the overpass, while the rear part was buried under the debris.

This was the situation at 10:59AM in the remote town of Eschede (6,000 people, no industry, and no freeways).

RESPONSE AND RECOVERY OPERATIONS - OVERVIEW AND SUMMARY

The incident’s activities are divided into four phases:

Phase I - Wednesday from 11:00AM to 3:00PM:

dispatch emergency personnel and equipment, search and heavy rescue operations, extrication of trapped victims, triage-treatment-transport of the injured, and coordination of responding agencies (190 military personnel with heavy equipment and helicopters, 726 fire personnel with fire vehicles, 514 medical personnel with 19 EMS helicopters and 98 ambulances, at least 40 physicians)

Phase II - Wednesday from 3:00PM to Thursday 12:00PM:

secondary search operations, logistics, body recovery, dealing with the media and first press-conference, replacement of first responders, registration of fatalities, injured and uninjured train occupants, taking care of relatives and starting on-site stress debriefings.

Phase III and IV - Thursday June 4 at 12:00PM to Saturday June 6, 7:00AM:

body recovery, accident investigation, public relations (more than 200 journalists have arrived), dealing with high profile politicians at the site, logistics, collection of private baggage, salvage of the wreckage, search for body-parts

Friday June 5:

4 additional bodies were found and recovered. In the end, 96 bodies were recovered, many needing to be identified by dental or DNA records. The investigation proved that these persons died on initial impact.

Saturday June 6. at 7:00 AM: Command of the accident scene is passed over from fire to police.

EMERGENCY MEDICAL SERVICES ACTIVITIES

Emergency Medical Services (EMS) is organized by the county and provided by two private EMS companies. At that time, EMS had its own dispatching center, independent from the fire dispatch. The county of Celle has 7 full-time ALS ambulances (one of them stationed in the town of Eschede), 3 day-time BLS ambulances and 1 full-time emergency physician squad.

-In Germany, France, Belgium, Austria, plus some other countries, emergency physicians are part of the on-scene EMS. They are provided by the emergency departments of local hospitals and trauma centers. They go on-scene with an ALS ambulance or with a specially equipped medical squad vehicle.

The initial dispatch at 11:03 consisted of 5 ALS and 3 BLS ambulances, 1 emergency physician squad and 2 ambulance helicopters stationed in other counties.

Minutes later, the first paramedic that arrived on scene reported the extent of the catastrophe. The dispatcher then

- Asked other dispatch centers of neighboring counties for additional resources
- Alerted volunteer ambulance and EMT squads within the county
- Requested additional emergency physicians from the county hospital to the scene (within one hour, 14 physicians from that hospital had arrived) and
- Informed state headquarters of volunteer EMS organizations (i.e. Red Cross).

At 11:19, the medical director of the county EMS arrived on scene and assumed command as Medical Leader and organized all EMS activities.

EMS helicopters, volunteer organizations like the Red Cross, German and British military physicians and EMTs, and volunteer EMS squads were notified or heard about the catastrophe. They all rushed to the scene, sometimes units with their own agenda.

"Freelancing" is a cultural attitude of EMS. Ambulance units are generally used to work independently on a day-to-day basis. Their focus is to care for individual patients exclusively. Therefore, integrating EMS units within a larger incident command structure is always difficult and requires training.

Trauma teams (emergency/surgery physicians and skilled paramedics) came from the county hospital in Celle (15 miles away), the medical university in Hannover (40 miles away) and trauma centers in Hamburg (100 miles away).

At 12:05 PM Helicopters began to evacuate the most critically injured.

At 1:45 PM (Less than 3 hours after the accident) All but 1 of the more than 100 injured people were en route to hospital treatment by 60 ground ambulance transports and 27 helicopter transports. The patients were transported to 23 hospitals within a 100-mile radius, thereby avoiding patient overflow of any emergency room. Emergency physicians escorted and treated critical patients en route.

Considerations and Lessons Learned

Points that emerged from the EMS experience with the ICE accident included:

- Physician teams from regional trauma centers with a high-level of training and skills in triaging and treating mass casualties can be a beneficial factor.

- Work relations and knowledge of specialists' capabilities from other jurisdictions should be established. Standard procedures regarding their notification and transportation to accident location should be devised.

- Volunteer rescue and ambulance groups in rural and remote areas are an ideal resource in addition to the existing EMS.

FIRE - ACTIVITIES

The county of Celle has volunteer fire departments in every town and every city. The nearest career fire department is located in the city of Hannover, about 50 miles to the south. Volunteer fire departments have the same training and equipment like their paid colleagues.

The volunteer fire department of Eschede responded initially, as well as the county fire chief. After hearing the first radio reports, he requested the assistance of all fire departments in the county with rescue and extrication equipment, as well as mutual aid companies from neighboring counties. In addition, the paid fire departments of Hannover and Hildesheim responded, as well as the state fire college.

Seven hundred twenty-six fire personnel with 108 vehicles arrived in Eschede on the very first day. During this first day, their main tasks were:

- Rescue of injured survivors (often confined space and heavy rescue environments)

- Search for victims in buried and crushed cars

and in the following days:

- Recovery of bodies and body parts

- Support of salvage and train recovery operations.

- Lighting the accident site

- Escorting traffic and transporting incident personnel.

- Staffing and maintaining the fire command post.

Problems in Technical Rescue

Technical rescue operations were hampered due to the unidentifiable material/construction of modern high-speed trains. Pressurized windows were virtually unbreakable even with sledgehammers. Extrication tools like saws and the jaws-of-life slipped on the polished skin of passenger cars.

Even today, one year after the catastrophe, the German Railway Transportation provider (Deutsche Bundesbahn AG) does not provide any educational materials or training courses on technical rescue to fire and emergency services.

Heavy concrete sections of the collapsed bridge had buried at least two cars (nos.5 and 6). Parts of this debris weighted over 150 tons. To gain access to search the cars, heavy cranes had to be requested from private companies.

Considerations and Lessons Learned

Points that emerged from the first services experience with the ICE accident included:

- Make sure that your Emergency response teams are familiar with trains that run through your jurisdiction.

- Make sure that your Emergency response teams have adequate equipment to meet the hazards (i.e. A modern Diesel locomotive contains 2,500 gallons of Diesel fuel. In the case of a fire, an abundant amount of foam is necessary to extinguish this life threat. -Bourbonnais Township, Illinois-March 15, 1999) and their needs.

MILITARY

The German armed forces responded from nearby bases with 190 soldiers; of this, 56 EMTs and 28 physicians, 19 helicopters, 31 vehicles and 3 salvage- tanks.

One helicopter worked as a relay station/mobile control tower and coordinated all helicopter activities from civil EMS agencies, federal and state police, as well as military. All helicopters worked on a common VHF channel but often had no communication with the incident commander.

COORDINATION AND COMMAND

In the initial phase, coordination, command and control was mostly improvised. Incident Command System (ICS), as used in the US, is unknown in continental Europe.

The county fire chief and the county EMS director established a temporary command post at the scene. From there, they organized 2 necessary sectors for search and rescue, extrication, triage, and treatment and transport. The first sector (West) consisted of the cars no. 1-3 (derailed, but not overturned), car no. 4 (derailed, overturned and crashed from the embankment in a wooden area) and the front part of car no. 5 (mainly destroyed). The second sector (East) consisted of the collapsed bridge and crushed cars no. 5-12.

A unified command structure was established at 3:00PM (See annex 1). A final command base with facilities from fire, federal and state police, and for media relations was set about 500 yards away in a parking lot adjacent to public facilities.

Periodically, briefings occurred in a 1 or 2 hour term. All agencies involved in rescue and recovery operations participated. Decisions and assignments were handled as a team.

At 2:00PM, highly sophisticated communication vehicles and mobile command post arrived from the disaster management agency of a neighboring county. They were completely staffed with experienced incident command technicians and had set up by 3:00PM. Until then, communication was weak due to the lack of adequate equipment. The county fire chief as incident commander, worked from smaller command vehicles without fax or copy machines. There was no direct radio communication to the military and with some other agencies. Fire and EMS radio channels were jammed and cellular phone nets broke down completely.

A Problem with Functional Identification

Coordination was also hampered by unclear identification. Many EMS physicians were wearing uniform jackets with the functional identification label "medical leader" because they had this role in their own jurisdiction. The same happened for "Fire Chiefs" and vehicles marked as "Commander". Therefore, it was frequently difficult for arriving units to locate the Incident Commander or the EMS leader in order to receive assignments. Some units, especially EMS, did not even report to the incident commander.

Considerations and Lesson Learned

points that emerged from the coordination and command and control experience with the ICE accident included:

- Make sure command staff is easy recognizable and locatable. Colored vests with functional descriptions are the best way to make that happen. They can be worn over protective clothing and changed if necessary.

- The command post should be well marked (i.e. through a colored balloon, the industry provides even special balloons that are self-illuminated at night). Response Personnel and Equipment Initial Phase Wednesday, June 3, from 11AM to 3PM Personnel Vehicles Helicopters State & Local Police 85 20 1 Federal Police (BGS) 113 37 8 Fire 726 108 - EMS 91 22 13 Volunteer EMS Squads 423 102 - Military 190 34 17 Federal Volunteer Rescue & Salvage Organization (THW) 123 16 - Command Post (TEL) 25 5 - Others (i.e. cranes, railway company) 113 10 - TOTALS 1889 354 39.

FATALITY MANAGEMENT

A total of 103 persons died in the crash, 98 on initial impact and 5 later in the hospitals. Many bodies were so mutilated that they needed to be identified by specialists. For this reason, the district attorney requested an autopsy of every victim.

Bodies and body parts were recovered by volunteer fire and EMS personnel, put into body bags and transported to the Medical University of Hannover. This institution was the only facility within that region capable of handling the amount of victims.

It is still under discussion whether it was acceptable to let young volunteers accomplish this gruesome task of body/parts recovery. Unfortunately, Dmort teams are unknown in Germany. The author strongly believes that the amount of casualties and their injuries will have a traumatic impact on every recovery worker, one that cannot be erased by critical incident stress counseling. Such tasks should be fulfilled by experienced and prepared specialists.

Although Germany has no body recovery specialists, it does have a sophisticated federal expert team for body identification. It consists of specialists from the bureau of criminal investigation (BKA) and was founded in 1972. Since then, they have responded to the aftermath of 18 airplane crashes, explosions and terrorism incidents and have positively identified more than 1,100 bodies.

All deceased persons from the ICE-crash were finally identified on June 15, 1999 less than two weeks after the catastrophe.

Considerations and Lesson Learned

Points that emerged from the fatality management experience with the ICE accident included:

- A Mass Fatality program, including capable personnel and equipment, as well as refrigerated and secured facilities, should be part of the Disaster plan.<BR
- Procedures to ensure a dignified handling of bodies and body parts, including religious servants to give the last blessings.

LOGISTICS

1889 emergency responders on the first day and many others on the following days needed food, water and beverages, rehab areas restrooms and sanitation areas ground transportation including fuel space to meet and equipment to work means of communication Traffic Directions An efficient traffic direction system was organized from the early beginning. Police, local firefighters and public works awaited incoming fire and emergency vehicles from other cities and counties at a major highway intersection. The mutual aid services were then escorted to staging areas or the two established scene sectors.

Considerations and Lesson Learned

Points that emerged from the logistics experience with the ICE accident included:

- Access will often be a challenge even within city limits. To avoid congestion, it is essential to implement a traffic direction system as soon as possible (one way in, one way out).

DOCUMENTATION

Documentation was initially neglected. EMS focused on treatment and distribution of patients to hospitals/trauma centers adequate to their injuries. Unfortunately, nobody kept track of patients' names nor their destinations.

It took weeks to identify all fatalities due to the mutilations. Because nobody kept track of the survivors, many relatives could not receive information whether their beloved one was injured in a hospital or dead. The hospital location of surviving patients, especially the unconscious ones, could often not be realized.

Lessons learned:

- To avoid pain and confusion and ensure safety (especially in criminal/terrorism events) names and hospital/shelter destinations must be documented from the very beginning. This task can be delegated to police or administrative personnel, if Fire and EMS workers are tied up with emergency operations. An EMS transportation officer/supervisor will be in charge for comprehensive documentation and should be designated as soon as possible.

- A program should be implemented that documents patients received by hospitals. Unconscious patients can be photographed and the pictures sent to the information facility of the command post.

POLICE ACTIVITIES

State/local police, as well as federal police (BGS) responded. State/local police were in charge of public safety, while federal police were in charge of the railroad track system, which is federal property. The railway provider, Deutsche Bundesbahn AG, is a private railway transportation provider using federal railroads.

In addition to standard police tasks (traffic control, restricting on-site access, documentation, criminal investigation, ETC), the police was also in charge of dealing with the media. The media was initially ordered to gather at the Eschede train station, about 1 mile away from the crash site. At this location, up to 7 police PIOs gave interviews and provided information for up to 250 media representatives. Later, this police division moved to a trailer at the command base, equipped with phone lines, faxes, PCs, etc. and continued the press work there.

MEDIA/PRESS RELATIONS

The county government was in charge of handling the media. Nearly 250 media representatives and camera teams showed up immediately after the news spread.

Consider:

- A public information officer (PIO) has to be assigned as soon as possible.
- A PIO in charge of a catastrophic event needs to be trained in dealing with a bulk of media representatives.
- There needs to be a clear agreement between all parties as to who will be disclosing which particular details during the different phases of the incident. Varying messages from different speakers (police, fire, government, railway provider, etc.) can cause negative publicity. In an initial press conference every agency should be involved with their PIO.
- Languages: a PJO with specific language skills must be available. An incident involving people with Latin American heritage will attract Spanish-speaking media, the crash of an Air-France plane will need French language skills, etc.

CRITICAL INCIDENT STRESS DEBRIEFING (CISD)

An organized CISD policy is not existent in Germany. Some local organizations have implemented individual projects in order to assist emergency responders, as well as victims and relatives. Due to:

- High number of victims (injured and dead) Traumatic and mutilation injuries of survivors Injured and deceased children
- Totally destroyed and mutilated bodies Accident location (remote areas with no multi-casualty experience) it was obvious that counseling was needed for:

Victims and their relatives Local volunteers EMS and fire personnel Police and Salvage workers On-scene consolations and psychological assistance was initially provided by a group of local pastors. A few days after the crash, an organized coordination program involving experts from different groups (i.e. Red Cross, volunteer EMS, clinic specialists, Fire Department Counselors) was established. They contacted Fire , EMS and police departments that had responded to the crash site and introduced the defusing, debriefing and counseling services. The program was quickly accepted and showed a tremendous need for this kind of post-traumatic stress management.

Consider:

- Critical Stress Debriefing and crises counseling need to be pre-planned as part of the standard Emergency Operations or Recovery Plan. It should become part of everyday Emergency Operations. Crisis counseling should cover: citizens and volunteers; EMS, Fire and Police Responders; victims and relatives.

- On-site Counselors must be part of the on-scene activities and work under the coordination and control of the Incident Commander. Freelancing of "independent" counselors must be avoided.

- On-scene crisis counselors must be certified and trained in on-scene stress debriefing and ICS.

- Counselors should be available on scene, especially for victims and relatives.

- Counselors should NOT intervene with emergency responders during their activities

COUNTY ADMINSTRATION OF CELLE

The county administrator was in charge of emergency management and operations, as required by state law. The county opened an information center (similar to an Emergency Operations Center-EOC) in the administration building soon after the accident. Their main focus was on gathering and providing information, as well as, logistical support for on-site activities. Phone lines were set up and staffed to provide information to the media, to relatives and to other governmental agencies. Even press releases were compiled and distributed from there via fax and mail.

In the first days, this information center had to be staffed 24 hours a day. A lack of experienced and trained personnel able to work in this pressuring environment was discovered. Due to the need of 24 hours a day staffing, and therefore, necessary replacements, it was a challenge to fill the positions needed.

The incident impacted most divisions of the county administration. It took sometime before everything went back to routine administrative work.

COMMUNITY IMPACT (TOWN OF ESCHEDE)

The town mayor arrived at the site 10 minutes after the accident. He saw many residents assisting victims and supporting the efforts of Emergency Responders. The mayor realized that the primary task for the city government would be to logistically support Emergency Response and Recovery Operations. The magnitude of the incident required space, first of all. Public facilities (city hall, a public works garage, a school with two gymnasiums) were in one location, about 500 yards away from the accident site.

School sessions were cancelled and students were transported home by buses. Gymnasiums were initially prepared by city workers for the admission and treatment of injured persons. Due to the fact that all injured passengers were en route to hospitals within 3 hours, the hall was later used for responding personnel.

Immediately after the accident, locals rushed to the scene to help, comfort and assist the accident victims. There were no bystanders. Other residents went to city hall to assist in logistical operations like food preparation.

Spectators/Disaster tourism

After a couple of hours, a wide perimeter was set up with restricted access ensured by police check points. This procedure continued during the recovery, salvage and investigation operation for more than a week. The barriers prevented voyeurs from reaching the crash site.

After police finally vacated the site, streams of onlookers flocked into town. They not only visited the crash site, but also approached locals on the streets. They even had the audacity to ring houses with a barrage of questions regarding the catastrophe for the already beleaguered residents.

Street Linkage

The accident destroyed a highway overpass. The collapsed bridge was the only paved road that provided access to the town's surrounding neighborhoods. The only other link to public streets led through a three-mile stretch of an unpaved forest track. The need of repair of this access route with loose gravel was determined the day of the accident and subsequently a contractor was hired to enable temporary use by cars.

Even today, more than one year after the catastrophe, the people of the affected neighborhoods still have to use the temporary access route. Plans have been made rebuild the bridge, but construction has not yet begun.

Conclusions:

Since April 25, 1853, train disasters have become common. On that day, the first train catastrophe occurred near Chicago, Illinois. In the 2 train collision, 21 people were killed.

Since than the U.S. and other parts of the world encounter train crashes in densely populated (i.e. Chicago Oct. 30,1972) as well as in remote (i.e. Kingman, Arizona Aug. 9, 1997; Bourbonnais Township, Illinois, March 15, 1999) and nearly inaccessible (i.e. Mobile, Alabama Sept. 22, 1993) areas.

They can occur in bad weather conditions (snow, fog) with no possibility to use helicopters in dark and rainy nights, and in cold temperatures. Train accidents have always been very challenging for emergency management. They can combine Search, Limited Access, Fire & Explosion, Hazards and Hazmats, Heavy Rescue, Confined Space, Extrication, Water Rescue and Multi Casualty Incidents all in one.

High-Speed/ Bullet Trains were first implemented in Japan (Shinkansen) in 1964. The latest bullet train there has a capacity of nearly 1,300 passengers and travels as fast as 177mph. It can be expected that these "Supertrains" will also run in the U.S. in the near future.

The German ICE-Crash is the first of its kind in history. Like the first passenger jet crash, it was unexpected and opened a new era of transportation disasters. Its devastating effects will soon become a new venture for emergency planners and managers.

REFERENCES:

Huels E., Oestern H.-J. et al. Die ICE-Katastrophe von Eschede. Berlin:Springer Verlag 1999

Koebl, Irene "ICE-Unglueck Eschede: Gesamteinsatz". Brandschutz 6 (1999), pp. 521-548

Kuepper, Gunnar J. "150 Years of Train Disaster" 9-1-1MAGAZINE Sept./Oct. Issue (1999)

Lange, Claus "ICE-Unglueck Eschede: Technische Rettung" Brandschutz 6 (1999), pp. 549-556

Latsch, Gunther et al. "Heimsuchung im High-Tech-Land". Der Spiegel 24 (1998), pp. 22-34

Preuss, Erich Eschede 10 Uhr 59. Munich: GersMond Verlag 1998

NOTES

1. Gunnar J. Kuepper is Chief of Operations with Emergency and Disaster Management Inc. This independent agency advises private, industrial and governmental organizations worldwide in state-of-the-art emergency and crisis handling. Gunnar J. Kuepper is a member of numerous professional and Disaster Relief Organizations (ARFFwg, IAFC, IAEM, NFPA, Advisory Board of the Los Angeles NSC, WADEM, etc.) and serves on the Technical Committee of NFPA 1600 "Disaster Management".