Des Falconer
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Urban Search and Rescue

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Introduction

In 1999, with the assistance of The Winston Churchill Memorial Trust of Australia, I was given the opportunity to study Urban Search and Rescue (US&R) in countries outside of Australia.

US&R involves the location and rescue of victims involved in a structural collapse. The type of structure that collapses and the mechanism that causes the collapse vary. Natural disasters such as earthquakes, landslides, floods, fires and cyclones; man-made disasters such as explosions - both accidental and deliberate - and faulty construction methods cause structures to collapse. High- and low-rise office complexes, apartment blocks, hospitals, houses, schools, bridges and monuments are amongst the vast type of structures that suffer damage and collapse during a disaster.

Australia is not immune from these disasters. A large part of our coastline is in a high-risk cyclone zone. In 1974 the country’s most damaging cyclone, Cyclone Tracy, struck the city of Darwin, an area considered to be of moderate cyclone risk.

Cyclone Tracy was devastating. Sixty five people were killed and 145 seriously injured as a direct result of the cyclone. Seventy per cent of Darwin’s houses suffered major structural failure.

In March this year, a section of the Western Australian coast was declared a natural disaster area in the wake of Cyclone Vance. The coastal town of Exmouth was hardest hit with some 100 homes destroyed and another 300 severely damaged by the 260km/h winds and torrential rain.

Although located in the middle of one of the Earth’s larger tectonic plates, earthquakes in Australia are widespread and reasonably common. Due to our position, Australia is prone to “intra-plate” earthquakes. These are different and poorly understood compared to the more familiar “plate-margin” type, common in the western parts of USA, Europe, South America and Asia.

Our first recorded earthquake was at Port Jackson in June 1788, when Governor Phillip reported, “the 22nd of this month we had a slight shock of an earthquake; it did not last more than 2 or 3 seconds. I felt the ground shake under me, and heard a noise that came from the southward, which I at first took for the report of guns fired at a great distance”.

In 1837, the first settlers in South Australia recorded, “there was a large rumbling noise that lasted 20 seconds. The earth shook and trembled. It was an earthquake”. Earthquakes were felt in the early days of Melbourne (1841), Hobart (1827) and Perth (1849).

According to the Australian Geological Survey Organisation, “As the population of the continent increases and buildings age, the significance of earthquakes as a natural hazard becomes more important”.

The Australian Seismological Centre estimates on average the Australian region experiences an earthquake of 5.6 magnitude or greater every 13 months. In the 40 years between 1954 and 1994 our total insured earthquake damage bill has been in excess of $2 billion.

It is worthwhile noting in 1941, Meeberrie, Western Australia, experienced an earthquake measuring 7.2 on the Richter Scale. Many of the major overseas earthquakes that cause widespread destruction and thousands of deaths are of a comparable magnitude. Fortunately, most of our larger earthquakes strike lightly populated areas.

One earthquake which did strike a populated region occurred in December 1989 in the New South Wales city of Newcastle. Previously considered a low seismic risk area the Newcastle earthquake had a magnitude of 5.6 on the Richter Scale. Thirteen lives were lost, 162 people hospitalised and a total of 70,000 buildings in the region damaged. After the earthquake 300 of these buildings had to be demolished: of these approximately 100 were homes. Insured losses reached $1 billion dollars ($1994) however the total estimated loss was approximately $4 billion.

Uncommon, but always an underlying threat, terrorist activity has occurred in Australia. In 1978, a bomb placed in a rubbish bin outside the Sydney Hilton Hotel exploded killing three people and seriously injuring seven others.

In July 1997, a landslide in the alpine village of Thredbo, New South Wales, caused the Carrinya Lodge to slide into the adjacent Bimbadeen Lodge. Nineteen people were trapped beneath tonnes of concrete and mud. A large scale operation to locate the trapped victims required rescue workers from several states and the Australian Capital Territory. Only one victim survived the landslide.

Since 1842, landslides in Australia have killed at least 74 people and damaged or destroyed over 200 buildings.
Organisations who provided assistance

Tokyo Fire Department, Japan.
Civil Defence Organisation, Turkey.
Turkish Embassy, Canberra.
Australian Embassy, Turkey.
Technical Help Works, Germany.
London Fire Brigade, England.
Northern Ireland Fire Brigade, Belfast.
Royal Ulster Constabulary, Belfast.
Fairfax County Fire Department, Virginia.
Montgomery County Fire Department, Maryland.
Miami Fire Department, Florida.
Miami-Dade Fire Department, Florida.
San Francisco Fire Department, California.
South San Francisco Fire Department, California.
Menlo Park Fire Department, California.
NASA Ames, California.
Australian Capital Territory Fire Brigade.
Emergency Management Australia (Mr Trevor Haines).
Melbourne Metropolitan Fire Brigade (Station Officer Mark O’Connor).

I would also like to thank my wife Sheree and children, Bradley and Simone for their support before, during and after my overseas study trip.
Background Information

All of the countries I visited - except Germany - have a recent history of structural collapse caused by natural disasters and/or bombings. It is almost certain these countries will be severely affected by future disasters. During the writing of this report Turkey suffered one of its most tragic natural disasters. On August 17, an earthquake measuring 7.4 on the Richter Scale struck Izmit, a town near the highly-populated city of Istanbul. The official death toll from the Turkish earthquake exceeds 15,000 and is expected to reach 20,000 when the missing and privately buried are taken into account. More than 24,000 people were treated for earthquake-related injuries.

I chose to study Technical Help Works (THW) in Germany because of their reputation to equip, train and respond an international search and rescue team to countries outside of Germany. A major component of their international team consists of volunteer rescuers. THW is a highly regarded organisation considered to be on the “cutting edge” of researching and developing technical search and rescue equipment and techniques.

The 1997 Thredbo landslide revealed that no single Australian organisation could be expected to cope with a major disaster involving persons trapped in a structural collapse. A medium-sized disaster in one of our more populated urban areas will most likely overwhelm city and state (or territory) resources. A major disaster will outstrip the country’s rescue capabilities.

Every country I visited has a disaster plan which includes receiving help from organisations outside their own city or state. Even the United States of America - a country highly prepared, substantially funded and well organised to provide US&R within and outside their own country - recognises the overwhelming effect of a major incident.

The USA federal disaster plan allows for (non-USA) international search and rescue teams to provide assistance to the USA if a disaster occurring on American soil outstrips American resources. Arrangements are in place to provide coordination, support and transportation to the non-American teams when they arrive in the USA. The American plan is so developed it even outlines the mechanism by which the international teams can claim financial reimbursement from the US Government.
Tokyo

Japan has a population of 125 million and an area of 370,000 square kilometres. In this century Japan has experienced at least 10 major earthquakes. In 1923, The Great Kanto Earthquake struck near the city of Tokyo. It claimed 140,000 lives. In 1995, 5,000 Kobe residents died as a direct result of The Great Hanshin-Awaji Earthquake; a further 300,000 people were injured and 100,000 homes destroyed.

A highly developed country with a robust economy, the Japanese population is able to dedicate considerable funding to earthquake preparedness and response.

Tokyo Fire Department

The city of Tokyo covers 1,750 square kilometres. Within this area lives a population of 11.5 million people and five million households.

Playing a leading role in Tokyo’s earthquake preparedness and response management, Tokyo Fire Department (TFD) has 18,000 personnel of which 17,500 are uniformed. As with nearly every aspect of the TFD, their headquarters at Otemachi is impressive: a modern, multi-storey building with commanding views. The entrance houses a decommissioned fire department helicopter (TFD’s first helicopter) and an excellent public relations section. The TFD has an annual budget of $3,163 million (all dollar values in this report are expressed in Australian dollars) which accounts for 3.7 per cent of the general account budget of the Tokyo Metropolitan Government.
Planning

Part of Tokyo Fire Department’s long range plan places a high priority on earthquake preparedness and response for members of the community and firefighters alike. As part of their approach to minimise earthquake damage TFD conducts the following measures:

- Collection and interpretation of earthquake data.
- Constant review of the TFD Earthquake Response Plan which integrates firefighting, rescue and emergency medical services.
- Strengthening of regional fire protection capabilities and local disaster volunteer organisations.
- Establishment of firefighting water sources in line with city planning.
- Promotion of measures to vitalise the Volunteer Fire Corps and strengthen their disaster response system.
- Construction of fire stations and living quarters of firefighters to enable quick response in times of disaster.

Projects

Included in Tokyo Fire Department’s 1998 – 1999 budget were the following main projects:

- Enhancement of heavy-duty trucks for a major earthquake.
- Training of neighbourhood emergency volunteers.
- Improvement of water sources for earthquake fires.
- Reinforcement of the information and communications system.
- Further development of the aerial fire appliance fleet for earthquake response.
- Improvement of earthquake preparedness equipment and tools.
- Improvement of earthquake resistiveness of fire department buildings.

Public Awareness

Another area of importance is the promotion of neighbourhood preparedness. A constant challenge, the TFD realises as time passes from the Great Hanshin-Awaji Earthquake of 1995, citizens of Tokyo gradually lose interest in disaster preparedness. (It’s interesting to note this complacency occurs in a high-risk earthquake country such as Japan as well as lower risk countries).

Statistics also show Tokyo has an ageing population and the number of fire/rescue victims is increasing among the elderly and handicapped. The fire department has adopted a broad ranging three-pronged approach to improve neighbourhood disaster preparedness. Their strategy is to: a) raise the disaster awareness of every citizen; b) develop the neighbourhood disaster preparedness system through close cooperation between residents and businesses; and c) make use of the mass media to promote disaster awareness.
The specific measures taken to achieve these objectives are:

- Raising disaster response capabilities of citizens; training women fire prevention organisations, junior fire departments and other community disaster organisations.
- Promotion of measures to protect the handicapped from disasters.
- Fire safety/protection education for building owners.
- Promotion of publicity and public hearing activities.

**TFD Response Capability**

For firefighting and rescue purposes, Tokyo is divided into nine districts. Each district has a district headquarters. Within the nine districts are 77 strategically located fire stations.

For those readers who enjoy statistics, the TFD has 1,772 pieces of fire apparatus which includes pumpers (486), rescue trucks (25), ambulances (192), robots with firefighting monitors (4), helicopters (6), fireboats (9), aerial ladders (83), foam trucks (67), firefighting squirts (6), floodlighting wagons (9), firefighting motorcycles (10), bulldozers (2), backhoes (2), cranes (2) and 10,000-litre water tankers (2).

In 1997 the TFD fought 7,025 fires which consumed a total floor area of 56,839 square metres and caused damage in excess of $214 million. Also that year, they conducted 10,010 rescues and responded to 14 structural collapses. Their ambulances attended 482,612 medical incidents.

Incoming emergency calls are received at one of two TFD communication & control centres (located in Chiyoda and Tachikawa). Vehicles, equipment and staff are dispatched to the emergency from the communication & control centre.

The Chiyoda and Tachikawa control centres can duplicate each other’s functions. This allows communication & control to remain functioning if one control centre is made redundant. As well as the standard uniformed staff found in most fire department communication & control rooms, each centre in Tokyo has a full-time doctor on duty to assist firefighter/paramedics with medical enquiries.

**Fire Rescue Task Force**

After the 1995 Kobe earthquake the TFD established the Fire Rescue Task Force. These units specialise in structural collapse incidents. A 20-member Fire Rescue Task Force comprises of three components: the Rescue Task Force, the Special Task Force and the Support Task Force. In total, the Fire Rescue Task Force has 17 appliances of which seven can be immediately responded to an incident: the type of appliance chosen depends on the type of incident.

The Kobe earthquake revealed two major problems which severely hindered initial firefighting and rescue operations. The first problem was a lack of water for
firefighting purposes - underground water supplies to fire hydrants were ruptured leaving firefighters helpless to attack the ensuing fires.

The second problem was the rescuers inability to access the affected areas. Many roads and thoroughfares became inaccessible because they were blocked by cars, fallen power poles, dislodged building facades and other debris. Several kilometres of roadway had to be cleared before fire personnel could perform any rescues.

With this in mind, the TFD designed the Fire Rescue Task Force to be as self-reliant as possible. Each Fire Rescue Task Force comprises of the following vehicles:

Rescue Truck II
Mounted on a 4-tonne chassis, Rescue Truck II is equipped with a winch, searchlight and generator as well as general rescue tools.

Earthquake Rescue Truck III
Earthquake Rescue Truck III is mounted on a 7-tonne, 4-wheel-drive chassis. This heavy rescue truck is equipped with a crane, winch, searchlight, generator, rescue tools, “TV Image Search System” (Type I and Type II) and a “Sound Detector System”.

Earthquake Rescue Truck IV
This truck can be transported on a cargo plane and is mounted on a 2-tonne, 4-wheel-drive truck chassis. As well as standard rescue equipment, a Type IV truck carries a “Life Search System”. The truck works in pairs.

Drag Shovel
There are two kinds of drag shovels – large and small. A drag shovel is equipped with a bucket, a turning grapple, a breaker and a crusher. Drag shovels travel on 25-tonne trucks. The 25-tonne transport truck also carries rescue equipment.

Bulldozer
Bulldozers are equipped with a multi-purpose bucket, a fork and an ordinary bucket. A bulldozer is transported on a 25-tonne truck.

Crane
Thirty-metre cranes are carried on 20-tonne trucks. Cranes are equipped with a hydraulic tug line, a grab bucket, hydraulic forcible entry tools and an earth drill.

Large Foam truck.
Housed on a 10-tonne chassis, the large foam truck has an A-1 Class pump, a 3,500 litre water tank, twin 800 litre foam tanks and a foam/water mixer.

Squirt
A two-section articulated boom with a nozzle, the squirt can reach up to 16.5 metres.

Smoke Ventilation/High Expansion Foam Truck
Designed to fight fires in underground shopping centres and cable tunnels, this vehicle has the capacity to exhaust smoke and discharge high-expansion foam.
Special Foam Truck
This unit consists of a carrier and a robot with monitor nozzles. Nicknamed “Rainbow 5” the remote-controlled robot is capable of removing obstacles. Rainbow 5 can discharge 5,000 litres of water or 3,000 litres of foam per minute.

Long Distance Water Supply Pumper and Hose Laying Wagon
Working as a unit, this combination can provide 3,500 litres per minute of water for a distance of up to two kilometres. This allows an alternative water supply to be used at an incident if city hydrant supplies are damaged or insufficient.

Special Ambulance
This ambulance is used as a 1st Aid station at mass casualty incidents. Its sides can be expanded to provide 40 square metres of covered area.

Ten-Tonne Water Tanker
Mounted on a 10-tonne truck chassis with pump, the stainless steel tank can provide 10,000 litres of water for firefighting and/or drinking.

Other US&R oriented equipment carried on these appliances includes machinery capable of concrete coring, cutting and crushing; a concrete reinforcing bar detection meter and a thermic lance. The “Sound Detector System” carried on Earthquake Rescue Truck III is an acoustic and seismic listening device. The two types of TV Image Search Systems are a standard camera (miniaturised and mounted on a telescopic pole) and fiberoptic. The “Life Search System” carried on Earthquake Rescue Truck IV uses a computer to analyse reflected electromagnetic waves. This system assists rescuers to detect trapped survivors at a building collapse incident.
At present there are two Fire Rescue Task Forces in Tokyo. The one I visited, in the southeastern 2nd District is located on Tokyo Bay. The other Fire Rescue Task Force is situated in the central 8th District. Both Fire Rescue Task Forces are staffed around-the-clock for the primary purpose of responding to a building collapse in Tokyo City. TFD’s long-term goal is to have a Fire Rescue Task Force in each of the city’s nine districts.
Standard Rescue Units

As well as the two highly specialised Fire Rescue Task Forces, 25 standard rescue units located throughout the nine fire districts carry equipment suitable for heavy rescue incidents. These standard rescue companies were established in 1971 and have evolved to meet the city’s needs. A high proportion of rescues performed by a standard rescue appliance involves motor vehicle accidents, industrial accidents, vertical (rope or high angle) rescue and confined space rescue. Firefighters who respond in these vehicles are cross-trained in all types of rescue, including structural collapse rescue.

I had the privilege of watching the crew of a standard rescue unit perform several fire and rescue drills at the Fukagawa fire station in the 7th District. The firefighters’ skills were excellent. After witnessing three or four drills my interpreter mentioned that the crew were conducting the drills at a much reduced speed for my benefit; to let me follow what they were doing.

“Nah, tell them I’ve seen a few drills in my time, even been involved in the odd one or two,” I heard myself say. “Go ahead, as fast as you like.”

The half-hour following those blurted words would still remain a mystery if my ever-gracious hosts hadn’t provided a written version of the drills (with “fireman-friendly” pictures included).

A standard rescue unit accompanies an ambulance to all medical calls. Vast tracts of Tokyo are forests of high-rise apartment blocks. Land in the city is at a premium. Living areas, by Australian standards are small and stairwells leading to apartment blocks are narrow. If a patient has to be “stretchered” out of an apartment to an ambulance it usually involves utilising the rescue squad and their expertise. (This type of incident is considered a medical call and not included in the fire department’s overall statistics of approximately 10,000 rescues per year).

In May 1993, the TFD responded many of its standard rescue units to the Hokkaido Earthquake. More recently, in January 1995, TFD sent these units to The Great Hanshin-Awaji Earthquake, and in December 1996, to landslides in the Nagano District.

A standard rescue unit responds with four firefighters. Included on the vehicle are: a thermal imaging camera, hydraulic cutting and spreading equipment (similar to the "Jaws of Life"), air, petrol and electric powered cutting tools, a jackhammer, a masonry drill, a line throwing gun and airbags used for lifting/spreading. Each standard rescue unit also carries a “TV Image Search System” and a “Sound Detector System”.
International Rescue

Japan’s international rescue team takes part in search and rescue operations in disaster-affected overseas countries.

Five hundred rescuers from 40 major Japanese fire departments are registered members of the international rescue team. Responding to international US&R incidents provides assistance and the latest technology to other nations. International response also allows Japanese rescuers to gain experience in surroundings they are likely to encounter at some future date in Japan.

While I was in Tokyo the TFD deployed a nine-member team to an earthquake in the South American country of Colombia. Including the Colombian earthquake, the TFD component of the international rescue team has responded to nine overseas missions.

The Japanese team sent to Colombia used commercial airlines to transport the rescuers and their limited cache of search and rescue equipment.

Volunteer Rescue Squads

There are 57 volunteer fire corps with 16,000 members in the 23 ku (wards) of Tokyo. Acting as an integral part of the TFD Earthquake Response Plan, the volunteer members are given duties to perform in the event of an earthquake. Trained in firefighting, rescue, flood control and 1st Aid, the volunteers work in close cooperation with full-time firefighters. As part of TFD’s disaster preparedness program, volunteer rescuers also instruct citizens in fire prevention, basic firefighting, rescue and 1st Aid on a regular basis.

The Earthquake Damage Estimation System

In 1994 the TFD developed the Earthquake Damage Estimation System (EDES). This system assesses damage in the early stages of an earthquake. Part of the EDES framework involves surveying the types of buildings in an area and their associated fire risks. The data is then developed into grid maps and made available to the public.

Factors such as electrical equipment, chemicals and other hazardous material, industrial furnaces and soil characteristics are taken into account during the assessment process. Research by the TFD has highlighted areas at a greater risk of fire immediately after an earthquake.

The TFD can then project the most likely route of fire spread. Included in the fire spread calculations are: type of building construction (timber, concrete, brick, etc.), separation distances between buildings, open spaces, storage of bulk flammable fuels, location and width of roads, reliable water sources and number of fire appliances pre-determined to respond to an area.
From the EDES study it is estimated if the 23 $ku$ area is directly hit by an earthquake, 824 fires will break out in Tokyo City. Of those, 149 will spread consuming an area of 96 square kilometres and 380,000 buildings.

This data allows the TFD to devise a disaster plan with seven focal points:

- Improvement of regional disaster preparedness.
- Prevention of fire outbreaks.
- Initial firefighting.
- Prevention of fire spread.
- Rescue and emergency medical services.
- Information management.
- Evacuation and post-quake safety measures.

Firefighting Water Sources

In the likely event that standard fire hydrant systems will be ruptured in future earthquakes, the TFD has established fire cisterns and underground water tanks. The location of these bulk water supplies is determined by overlaying a 250 x 250m grid pattern onto a map of high fire risk areas.

One-hundred-cubic-metre water tanks are installed in each of the grid squares. Areas considered strategically important have 1,500-cubic-metre cisterns installed in grid areas measuring 750 x 750m. For areas of less importance, 40-cubic-metre tanks are installed in each grid square.

As an incentive to install underground water tanks beneath all new commercial buildings, grants are offered to property developers, regardless of risk-factor rating.

Public Education

TFD Life Safety Learning Centres are located in Tachikawa, Ikebukuro and Honjo. Here, surrounded by modern interactive facilities, members of the public receive training in firefighting, 1st Aid, reporting emergencies to the authorities, hazard identification and smoke behaviour. Together with sight and sound, an earthquake simulator can generate earthquakes from 1 to 6 on the Richter Scale.
Turkey

In excess of 80 per cent of Turkey is classified as a high-risk earthquake zone and around 90 per cent of Turkey’s 65 million population live in this high-risk zone. Plagued by natural disasters, avalanches, landslides, floods and earthquakes are commonplace.

The Civil Defence Organisation

The Civil Defence Organisation is responsible for the preparedness and response phases of disasters nationwide.

Spawning from a military requirement for a civil defence capacity, a 1928 regulation called “Defence of the Areas Behind Battlefields Against the Air Attacks” provided the basis for the modern Civil Defence Organisation. In 1938, Law No 3502 put into effect the “Passive Protection Law” and remained current until 1959, when Law No 7126 gave Turkey today’s approach to civil defence.

The objectives of Law No 7126 are to:

- Secure the lives and belongings of the people during warfare.
- Save lives and belongings of the people during natural disasters.
- Preserve life and property in the event of a fire.
- Renew, repair and protect private and government institutes of vital importance.
- Build-up morale among civilians.

The Civil Defence Organisation comes under the Ministry of Internal Affairs and is divided into two sections: Provincial and Central.

Provincial

Turkey is made up of 81 provinces; each province has its own governor and local government. Provincial governors are required - within the limits of their given territory - to establish and maintain a local civil defence infrastructure. This includes the management and supply of equipment required during natural disasters, wars and large fires.

The Provincial arm of the Civil Defence Organisation consists of: province civil defence directorates, town civil defence directorates, town civil defence experts and chiefs of public and private establishments.

Central

The Central arm of the Civil Defence Organisation, located in Ankara, is made up of the General Directorate of Civil Defence, the Civil Defence College, the Warning and Alarm Centres and a Civil Defence Rescue Unit (CDRU).
The Civil Defence College

Established in 1960, the Civil Defence College trains teachers for Central and Provincial civil defence centres. CDRU recruits also receive their initial training at the college. The facility provides conferences and briefings as well as tactical and technical courses for senior officers. The Civil Defence College is located on the same grounds as the CDRU.

The training wing of the Civil Defence College has six classrooms, two lecture rooms, two libraries, a fallout shelter (for training citizens how to survive long periods in a fallout shelter), dormitories, a canteen and an emergency food centre (for mass food-preparation training). A partially damaged building, a totally collapsed building and a five-storey tower provide for US&R training.

Civil Defence Rescue Units

In 1959 the CDRU’s were staffed entirely by volunteers. In 40 years the organisation has grown to three full-time units – one unit located in each of the Turkish cities of Izmir, Istanbul and Ankara. The major growth period for the CDRU’s was during the mid-eighties and early nineties when Turkey suffered a series of tragic earthquakes.

For rescue purposes Turkey is divided into seven zones. It is envisaged by the year 2005 there will be four additional CDRU’s, one in each zone. The optimum number for a CDRU is 110 members. The unit I visited in Ankara presently has a team of 65. This number has been divided into five teams of eight rescuers. The remaining 25 members provide management and support functions. Over the next few years the Ankara team will be increased to 110.

Each member of a CDRU is trained in multiple disciplines. For example, a canine handling specialist could also be a competent heavy rigging specialist. The Ankara CDRU has two qualified search canines. According to the Turkish rescuers I spoke with, the search canines are their most successful piece of search “equipment”.

Team members are recruited from two areas: career rescuers who apply for the position and surplus conscripted soldiers from the Turkish armed forces. After completing three months basic military training the surplus soldiers are assigned to a CDRU for a further 15 months.

The CDRU in Ankara has an administrative section, classrooms, outdoor training grounds, storage facilities, garages and search canines and their kennels.

It is common practice with a CDRU to send a modular component rather than the entire 65-member team to smaller incidents. The make-up of the reduced team depends on the incident but there are constants - a management component and a communications component - standard to all responses.
When I was at the CDRU in Ankara, they received a request to locate a missing avalanche victim in southern Turkey. The search team responded to the area consisted of eight persons and a canine.

**Training**

All CDRU rescuers undergo an initial one-year training period. The recruits study rescue equipment, search techniques, canine handling and advanced medical training. The medical training includes working in the accident trauma section of a local hospital.

Shoring, tunnelling, collapse structure void patterns, accessing voids, methods of rescuing victims from collapsed structures and localised and general debris removal are also covered in the initial training.

Architectural draftsmen are employed by the CDRU. After receiving core search and rescue skills the draftsmen then train in engineering, plumbing and electrical installations. Once qualified in those fields these specialists undergo structural engineering training. At present, the draftsmen are involved in a new project which entails cataloguing aerial photographs of existing Turkish buildings. When an earthquake occurs the affected area is then re-photographed and pre- and post-earthquake shots are analysed by a computer. The computer identifies individual components of a structure and their relationship to the collapsed building prior to its collapse.

Other team members are trained as Critical Incident Stress Management counsellors, specialising in Post Disaster Trauma for victims and rescuers.

A significant amount of the CDRU budget is spent on Nuclear Biological Chemical (NBC) preparedness. All recruits are given basic NBC competencies during their initial training period. A further 15-day course is provided at a later date by the Turkish military. The rescuers are issued with personal NBC kits. Included in these kits is a charcoal-lined chemical suit, a respiration mask and a pair of protective gloves.

**Vehicles and Equipment**

Karcher Decontain 3000
Mounted on a 6-tonne truck chassis, the Decontain 3000 is a mobile decontamination system which decontaminates people, land and equipment.

Karcher SC30
The SC30 is a sanitary container unit which provides on-site washing, showering and toilet facilities. This unit can be transported to an incident by air or land.
Karcher Waterclean 1000
Carried on a heavy-duty trailer, the Waterclean 1000 is a water purification system which independently treats radioactively, biologically or chemically contaminated water. The Waterclean 1000 can also produce drinking water from sea or brackish water.

Karcher TFL 25
Also carried on a purpose-built trailer, the TFL 25 is a mobile decontamination laundry capable of washing and drying about 25 kilograms of dry laundry per hour.

Heavy Rescue Unit
The heavy rescue unit is an 8-tonne covered truck which transports a variety of rescue tools, shoring and timber. Two of these vehicles are part of the fleet.

Light Rescue Unit
A light rescue unit consists of a 4-wheel-drive (Toyota Landcruiser style) and trailer combination. The unit carries hydraulic rescue tools, ropes, a generator, lighting, airbags, etc. There are four, light rescue units in the CDRU fleet. There are also three extra trailers which carry assorted air-inflated and standard style tents.

Ambulance
Fitted with standard, as well as NBC medical equipment, there are four ambulances in the fleet.

Large Field Canteen
The military-style large canteen is capable of feeding 1,000 people.
Small Field Canteen
The small canteen is for feeding members of the rescue team only.

Fully encapsulated chemical suits, chemical warfare gas detectors, ready-prepared syringes which contain a chemical warfare reversing agent and personal dosimeters (a device used to measure radiation) are general NBC pieces of apparatus also carried by a CDRU.

For cutting and breaching concrete, a CDRU uses jackhammers and concrete-cutting saws such as the Partner “Ringcutter” and the “Quickcut”. Limited by their lack of resources, the rescue unit relies on jackhammers to “core” concrete. The day I left Ankara the unit took delivery of a colour-monitor “SearchCam”.

Response

At Ankara, the entire cache of rescue vehicles and equipment is stored on-site at the Civil Defence College/CDRU complex. Rescuers and their families live in multi-storey apartments located near the complex.

When attending national disasters, a CDRU is expected to respond a basic team within 45 minutes of receiving an activation order. The team comprises of management, communications, light equipment, selected rescue personnel and a search canine and handler. A military base with an airwing is located 500 metres from the Ankara CDRU and military helicopters are used to transport the basic team. An agreement is also in place to use nearby police helicopters, if necessary.

Depending on distances, heavy equipment can be driven to the disaster or transported by the airforce. The heavy equipment can be responded by air within two hours on a weekday and four hours on the weekend. A full CDRU team can remain self-sufficient in the field for 10 days.

Provincial Services

By Turkish law, any citizen between the ages of 15 and 65, who is not serving in the military is obliged to “take the responsibilities given by the Civil Defence Organisation”.

Each of Turkey’s 81 provinces has a “main” town around which a municipality is zoned. As mentioned earlier, the municipality’s governor (Vali) represents the government in disaster planning. From 16 city or town institutions, such as health, police, education, communications, etc., a Disaster Service Group is formed. The Vali has the overall responsibility for ensuring disaster drills are held regularly. A government official from Ankara and a representative from the CDRU oversee the drills.

Public and private establishments form their own building protection group which consists of a manager, a firefighter, a nurse, a rescuer and a shelter chief.
In the event of a disaster, the Disaster Service Group acts immediately. The rescue team component of the Disaster Service Group conducts the initial rescues. As well as
performing rescues, members of the local rescue team conduct an assessment of the damaged area. This assessment involves dividing the collapse site into sectors, prioritizing buildings for number and likelihood of survivors and grading the difficulty of accessing potential survivors.

This information is transferred to the responding CDRU who, upon their arrival at the incident take charge of the rescue. The Vali remains the overall incident controller throughout the duration of the incident. Members of the local Disaster Service Group rescue team are integrated into CDRU teams. This provides invaluable local knowledge to the CDRU.

The Vali provides all heavy plant (cranes, bulldozers, etc.) required at the incident from his or her local resources. If demand exceeds local resources the Turkish Federal Government provides assistance. The Vali establishes a command and control centre at the affected area. At large-scale disasters a remote control centre is also established at the General Directorate Headquarters in Ankara. Communication between the two control centres is by telephone and/or citizens’ band radio.
Germany

The Federal Republic of Germany has a population of around 80 million people and is divided into 16 states.

Although not plagued by a multitude of natural disasters, one reason I visited Germany was to learn how the rescue organisation, Technisches Hilfswerk (THW), manages and trains their large percentage of volunteer staff. At present, THW has more than 44,000 active volunteer members, 17,000 reserve volunteers and 10,000 junior volunteers.

Technisches Hilfswerk

THW is a comprehensive and well-funded humanitarian and rescue organisation. A predecessor to the present day THW was founded during WWI. Upgraded during WWII and the Cold War, THW has developed over several decades to meet Germany’s changing needs and commitment to international humanitarian assistance.

The function of THW, as defined by German law, is to “provide technical relief in the sectors of civil defence, disaster relief and international humanitarian assistance. The main fields of activity are rescue, salvage and the rehabilitation of infrastructure (water, electricity, sewage)”.

Structure

THW is a federal organisation administered from the current German capital, Bonn. The organisation’s director and 120 of the 850 full-time staff are located at the Bonn headquarters. Independent of the states, THW comes under the Department of The Minister of Interior.

For rescue purposes, Germany is divided into eight zones. Smaller and less populated German states are amalgamated whilst the larger states stand alone. Within the eight zones are 66 strategically placed regional offices. Full-time employees staff the regional offices. The regions have then been geographically divided into 665 “town teams”, or sections. Voluntary commissioners manage the 665 sections. Each section has a depot where equipment is housed and training conducted.

Units and Equipment

Of the 44,000 active THW volunteers, around 32,400 are engaged in technical response. Operating out of the 665 sections are 810 technical platoons. Each platoon has 40 volunteer members. A technical platoon consists of one command squad module with four volunteers and three specialised modules, or units, each with 12 volunteers.
THW maintains the following specialised modular units throughout Germany:

- 1,620 Rescue and Salvage.
- 132 Debris Clearance.
- 66 Electricity Supply.
- 66 Command, Control and Communication.
- 66 Pumping and Sewage.
- 16 Temporary Bridge Construction.
- 264 General Infrastructure.
- 132 Boat and Pontoon.
- 66 Search and Detection.
- 66 Logistics.
- 32 Water Supply and Treatment.
- 16 Oil Pollution.
- 6 Rapid Deployment Search and Rescue.

Each unit is provided with the equipment it needs such as personnel transporters, trucks, generators, cranes, water treatment plants, etc. In total, THW has over 6,000 vehicles.

The modular approach adopted by THW appears to work well. Local risks are evaluated and modules specific to those risks are placed at a nearby section depot. Some of the modules, such as command squad units, are common to every section depot. Rescue and salvage modules are duplicated over several depots.

**Recruitment**

The majority of active THW volunteer members are young German men. Rather than serve compulsory military service, these young men have the option of joining THW as part-time volunteers for a seven-year period.

Those who do not want to, or cannot serve in the military may choose to transfer their conscription to another community-based volunteer organisation such as 1st Aid workers or volunteer firefighters. Females account for 3.2 per cent of the THW volunteer population.

When required for operational duties or training, statutory regulations ensure THW volunteers are released from their full-time employment at their normal pay rates. The German Federal Government reimburses employers’ costs.

Recognising that people may want to pursue other interests and will have limited spare time, THW offers the position of reserve volunteer to those men who have finished serving their mandatory seven-year period. The reserve status allows the skills and experience gained to remain within the organisation whilst placing no compulsory attendance restrictions on the reserve volunteer. Women are also eligible to become reserve volunteers.
Minimum enrolment age for active volunteers is 17 years. THW offers a “youth” or cadet status for children and teenagers between the ages of 10 and 16. Maximum retirement age from the ranks of active and reserve volunteer is 60 years, however, retirees may apply for the status of senior volunteer.

**Training**

In their first year, recruits must complete 120 hours of training and pass a written exam before being integrated into a platoon. This training provides standard skills in tool handling and equipment usage. Basic training is conducted at local or section level.

After their first year, volunteers then receive specialised unit training. This entails 100 hours over 12 months. The specialised training is also conducted at a local or section level. A volunteer’s professional background is considered when he or she is placed in a specialised unit. For example, volunteers in the electricity supply modules would generally come from an electrical engineering background.

Once a rescuer completes basic and specialised unit training, he or she can then progress to more advanced levels within the organisation. Advanced training is offered at THW’s two live-in training facilities: one in Hoya, near Bremen and the other in Neuhausen, near Stuttgart.

I stayed at the Hoya training facility where I received lectures from THW management and staff. Hoya is comfortable and well equipped. Constructed during WWII, the Hoya complex was first used as barracks for German military officers. Since then, Hoya has been upgraded, extended and refurbished. Students enjoy modern educational and recreational facilities including a bar, bowling alley, sauna, spa and exercise and common rooms.

I did note (my waistline included) the canteen food is plentiful, the classroom chairs comfortable and the view from large, double-glazed windows - of falling snowflakes - mesmerising. …luckily for me, a computer program automatically lowers the after-lunch temperature in each of the Hoya classrooms. This professional touch prevents drowsiness amongst the students and, no doubt, saved me from another embarrassing moment.

Hoya and Neuhausen offer management and technical courses. A one-week, 40-hour team leader course covers THW’s organisational structure, composition and tasks of units, operational management, Occupational Health & Safety, basic instructional techniques and human resource management. Successful participants in the team leader course may then advance to platoon leader training. This is a two-week, 80-hour course. Follow-up training is provided for all “live-in” courses.

At the Neuhausen complex THW’s international representatives receive training in foreign culture, project management and adapted technologies, logistics, health and hygiene services, psychological preparation and de-brief techniques.
Courses and course instructors are nationally accredited. Qualifications received from THW are recognised by educational authorities throughout Germany.

SEEBA

After gaining operational experience at a 1985 Mexico earthquake, THW established three rapid deployment search and rescue units. Named Schnell Einsatz Einheit Bergung Ausland (SEEBA), the objective of SEEBA is to provide national and international emergency assistance after earthquakes and other large-scale disasters. Although THW comes under the Minister of Interior, Germany’s Foreign Affairs Department can request SEEBA to respond to international incidents.

Registered with the International Search and Rescue Advisory Group of the United Nations, SEEBA has responded to 11 international missions. Whilst I was in Germany one of my instructors, Volker Wurm - an electronic listening device expert and long-time THW volunteer - had recently returned from a rescue mission in Colombia (THW provided a search and rescue component to the earthquake devastated South American country). In June 1999, Herr Wurm also headed a THW team sent to provide relief assistance to wartorn Kosovo.

SEEBA identifies its tasks at an incident as:

- Location and rescue of trapped or buried persons.
- Recovery of bodies and material assets.
- Advising local authorities and other assisting organisations.
- Providing technical assistance.
- Advice on follow-up measures.

SEEBA Modules

A SEEBA unit comprises of 70 volunteer THW specialists. A complete unit is made-up of one command squad module, one logistics squad module (including medical team) and three search and rescue team modules. The 70-person team has the ability to be boosted by local manpower.

A SEEBA command squad module consists of a team leader, a situation operator, a communications engineer, a technical leader and a technical consultant/liaison officer.

A logistics squad module consists of a logistics team leader, five logistics officers, an emergency doctor and four paramedics.

A search and rescue team module consists of a search and rescue team leader, a search (location of live victims) team of six persons and three search canines and 11 rescuers (extrication of victims). At least one member of the SEEBA unit has structural or civil engineering qualifications. Scientists experienced in seismology, geology and static calculation engineering are also attached to the SEEBA unit.
Ranging from a three person fact-finding team to the full 70-member task force, THW offers 17 modular options for equipment and personnel. All modules have equipment specific to their task. The transportation requirements of the modules are known and recorded. Most of the equipment is housed in light metal boxes which allows transport by military or conventional aeroplanes. Trailers and vehicles are designed and selected to meet air transport regulations.

The 17 modular options are costed on four-day and 10-day missions (excluding airfares). For example, a basic three person fact-finding module costs $8,800 for four days; $20,800 for 10 days. A full 70-member team costs $173,650 for four days; $433,000 for 10 days.

SEEBA teams are located near an international airport. These teams can respond from the airport within six hours of notification and remain self-sufficient for 10 days. This includes providing their own food, water, accommodation and medical and sanitary facilities.

**Search and Rescue Techniques**

SEEBA’s search team tactics revolve around a combination of search canines and electronic listening devices. In their experience, SEEBA nominates properly trained canines as the most reliable and successful search “tool”. The dogs are owned and trained by THW volunteers to the organisation’s specifications and requirements.

During the search for live victims of a structural collapse, ZEB Acoustic Ground Detectors (similar to the Uwe Beckmann models used in USA) are used in conjunction with the search dogs. THW had a large input into the ZEB’s design and specifications. Herr Wurm and other listening device specialists were involved in the early testing and evaluation of the ground detector. These specialised electronic acoustic/seismic listening devices cost around $15,200 per unit. THW has 72 ZEB detectors throughout Germany.
One innovation which may change THW’s search strategy is the PLS Radar System. For the past 18 months THW has worked on the PLS radar project with the radar’s manufacturer, German engineering company, Sirius. The PLS system is based on the principle of modulating an electromagnetic wave by the heartbeat and/or the breathing of a person buried alive.

THW has tested the radar system under variable conditions. Last year, at a collapse involving a water tower falling onto a building, the radar was able to detect the heartbeat of a dog trapped in the rubble. No human occupants survived the collapse.

Sirius literature describes radar penetration distances as 90 metres in open areas and 20 metres when penetrating walls. Sirius states the porpoise nature of demolished buildings allows the possibility to double and in some cases triple those distances. THW confirmed the radar’s ability to penetrate the rubble and noted on occasions during their experiments the radar was able to detect people behind the collapse or rubble pile they were searching.

Set-up time for the PLS radar is around 20 minutes. Using the PLS as the primary search tool, a collapse incident can be sectorised into appropriate sizes and widths.
The sectors which register a heartbeat or respiration are then searched using canines or electronic listening devices to localise the victim/s. The sectors which register no human activity are given a lower search priority. Whilst I was in Germany, THW was in the process of purchasing its first PLS radar. I believe one unit costs around $150,000.
Britain

The United Kingdom does not suffer many large-scale natural disasters which cause structural collapse. Instead, Britain experiences ongoing terrorism. Occurring mainly in Northern Ireland and parts of England, terrorist activity frequently involves the bombing of buildings, both occupied and unoccupied.

Two of the organisations I visited in Britain – London Fire Brigade and Northern Ireland Fire Brigade - are responsible in their respective jurisdictions for locating and rescuing victims following a structural collapse. Both fire brigades have experience in terrorist bombings. The Northern Ireland Fire Brigade would possibly be the most experienced rescue organisation worldwide in small- to medium-scale building collapse.

Considering this exposure, neither organisation has a specialised approach to US&R, preferring to rely on standard rescue equipment carried on fire appliances and “general purpose” fire rescue units.

London, England

The Greater London Area is 1,600 square kilometres and has a population of around 6.5 million. London rescue authorities consider a building collapse as a major incident and the information gained from their experience at major incidents can be applied to the study of US&R.

Five London organisations – London Fire Brigade, Metropolitan Police, City of London Police, British Transport Police and London Ambulance Service – form the London Emergency Services Liaison Panel (LESLP). One role of the LESLP group is to provide guidelines for the coordinated approach between emergency agencies at a major incident.

A major incident is defined as any emergency (including known or suspected acts of terrorism) that requires the implementation of special arrangements by one or all of the emergency services. A major incident will generally include some or all of the following features:

- Rescue and transportation of a large number of casualties.
- Involvement either directly or indirectly of large numbers of people.
- A large number of enquiries likely to be generated both from the public and the news media, usually made to police.
- The large-scale combined resources of the police, London Fire Brigade (LFB) and London Ambulance Service.
- The mobilisation and organisation of the emergency services and supporting services, for example, relevant local authority to cater for the threat of death, serious injury or homelessness to a large number of people.
A major incident may be declared by any officer of one of the emergency services who considers any of the above criteria has been satisfied.

Overseeing the emergency organisations is the Home Office, which comes under the direction of the British Home Secretary. The Home Office produces guidelines for dealing with disasters. These guidelines provide a framework within which the more detailed, individual emergency agencies can write their own response plans.

The following information contains some of the guidelines issued by the Home Office. It incorporates the best practices and lessons learned during the planning for, response to, and recovery from disasters during recent years.

**Initial Considerations**

The scene immediately after a disaster has struck is likely to be confused. To bring some order to this confusion it is important the emergency services establish control over the disaster area and also build up arrangements for coordinating the contributions to the response. Experience has shown that an effective response depends on good communications and mutual understanding.

It is generally accepted that the first member of the emergency services to arrive on the scene should not immediately become involved with rescue but should make a rapid assessment of the disaster and report back relevant information to his or her control room.

At the scene it is vital the emergency services establish control and coordination arrangements at the earliest stage. Each service needs to establish its own control arrangements but continuing liaison between the services throughout the response phase is essential. The underlying principle is that the police normally assume the management of overall coordination. This approach ensures that resources are used to best effect and avoids situations where, for example, resources may be called upon simultaneously by different agencies.

The management of the response to the disaster will normally be undertaken at one or more of three levels. These are:

**Operational Level**

The level at which work on the incident site or sites is undertaken.

**Tactical Level**

The level for more serious incidents at which the tactical commanders determine priorities in allocating resources and at which planning and coordination of all resources involved with the response is undertaken. Tactical command occurs from the incident control point in the vicinity of the disaster site.
Strategic Level

The level of management, infrequently needed, which establishes the strategic framework within which the tactical commanders will work. The strategic level of management is normally located away from the disaster site.

Arrangements which normally have to be made at the scene of a disaster include:

- Assigning the control of specific functions to one of the emergency services or other agency, taking into account the circumstances of the disaster and any statutory obligations.
- Setting up an inner cordon to secure the immediate scene and provide a measure of protection for personnel working within the area. An inner cordon also allows accountability for persons entering and leaving the scene.
- The location of a collection point for survivors before they are moved to a more formal reception centre; the location of casualty clearing stations to which the injured can be taken; an ambulance loading point for those who need to be transported to hospital; and the possible location of a helicopter landing site.
- The location of a rendezvous point for emergency services and other non-emergency services personnel. This point may be some distance from the scene in the event of a bomb incident.
- The location of internal traffic routes for the emergency services and other vehicles.
- The location of a body holding area.
- The location of a media liaison point.

Communications

Good communications are at the heart of an effective operation. Plans must be in place to supplement usual communication facilities. Be aware that upon arrival at the disaster scene the media will keep open channels on mobile telephones to ensure instant access to their editors. For this reason telephone communication restrictions may need to be invoked.

Senior Management Arrangements

Disasters can place considerable demands on the resources of the organisations called upon to respond, with consequent disruption to day-to-day activities. Senior management must have in place a contingency plan to deal with the twofold needs of a disaster and normal business requirements.
Disaster Victims

The care and treatment of those involved in a disaster lies at the heart of the operations. This applies to the care and treatment not only of those injured and traumatised and their relatives and friends, but to everyone involved in the emergency response who may be affected by the experience.

Survivors or casualties may not always be found near the disaster site. Some may suffer psychological injuries and wander off. It is therefore important to consider searching the surrounding area. Those who have survived a disaster uninjured (or with only minor injuries) may nevertheless be traumatised and suffering from shock. They will need to be treated with great sensitivity.

Survivors will often be able to provide crucial information about what happened and where other persons may be located, or where they were last seen.

Children

A special approach is needed if children are caught up in the disaster. The emotional affects on children are not always immediately obvious to parents or school staff. At times children find it difficult to confide their distress to adults, often because they know it will upset them. In some children the distress can last for months and may affect academic attainment. Be aware of the range of symptoms that children may show after a major trauma. Note any changes in behaviour. A number of key issues which must be considered are:

- The relay of accurate information to children as well as adults is vital.
- The families of children caught up in a tragedy need full and accurate information as quickly as possible.
- Formal debriefing meetings for both children and adults are an important part of the rehabilitation process.

The Voluntary Sector

Disasters can overstretch the resources of the emergency and local authority services and the value of additional support from the voluntary sector has been demonstrated on many occasions. In Britain, the authorities have divided the volunteer component into four categories:

- Established organisations such as Red Cross, St John’s Ambulance and the Salvation Army.
- Specialist skills such as cave rescue and mountain rescue groups; amateur radio operators.
- Individuals not necessarily in recognised voluntary organisations but who have particular skills, such as interpreters or religious representatives, whose help is offered or requested on the day.
- Organisations which specialise in providing emotional support.
Belfast, Northern Ireland

Northern Ireland has an area of 8,000 square kilometres and a population of 1.65 million.

The Emergency Planning Unit in Northern Ireland provides guidelines for the major emergency organisations. The three main emergency organisations are: Royal Ulster Constabulary, Northern Ireland Fire Brigade and Northern Ireland Ambulance Service.

The following information contained in the guidelines is generic to all major incidents. Given the political unrest in the country and the high incidence of terrorist activity over a long period of time, especially bombings, the guidelines have been tested repeatedly against real incidents.

Principles of Planning and Response

Northern Ireland uses an “Integrated Emergency Management” approach to incidents. Integration of emergency management arrangements encompasses a number of concepts, some of which overlap.

The principal emphasis in the development of any plan must be on the response to the incident and not the cause of the incident. There are an infinite number of possible emergency scenarios and it is impossible to plan for them all. However, incidents tend to result in a much smaller range of short- and long-term outcomes such as a need for evacuation, environmental pollution, a need to treat a large number of casualties or a need to make secure a damaged structure. By concentrating on planning to deal with outcomes, it is possible to respond to a very large range of incidents within the framework of a limited number of plans.

Emergency management arrangements should be integrated into an organisation’s everyday working and management structure. Emergency plans should build on routine arrangements. A plan which requires a response which is very different from how normal business is conducted or a reporting structure which is very different from the usual one used, requires a very high level of staff training and testing. In times of crisis people naturally cling to the procedures they know. Whatever the plan, everyone in the organisation who would contribute to the response must know what is expected of them and how they fit into the overall picture. They must be involved in tests, training and exercises.

The activities of different departments within an organisation should be integrated. Effective planning must identify the different contributions within an organisation and establish protocols in order to achieve an efficient and timely response.

Emergency arrangements need to be coordinated with other responding organisations. Major emergencies will almost always span physical and functional boundaries and they may encompass more and more organisations. Plans should include the capacity
to extend the level of response, either for emergencies on different scales or where an incident begins small but escalates into a much larger one.

**The Role of Management in Major Emergencies**

The role of management, especially senior management in an emergency should be:

- **Make sure the organisation is prepared.** Senior managers who set aims and objectives of the organisation should acknowledge the need to be prepared for an emergency and ensure sufficient funding and priority is allocated to the emergency planning and exercising functions.
- **Stay out of the way of direct service providers.** A manager with little recent operational experience should not interfere with the service delivery in an emergency situation. Training and exercises should have reassured management that those delivering the direct service are competent to do so.
- **Gather information.** As in day-to-day situations a manager needs to know what is going on in their own organisation and in other organisations. This information should be used to both brief senior management/directors/chief executives/ministers and to ensure information is provided to front line staff.
- **Provide resources.** Those directly delivering a response will require adequate and timely resources. These may be physical, such as machinery, manpower or money; or organisational, such as authority to make decisions or commit their organisation to a particular course of action.

**The Northern Ireland Fire Brigade**

There is no lack of building collapse rescue experience within the Northern Ireland Fire Brigade. Many of the longer serving fire officers I spoke with had lost count of the bombing and arson incidents they had attended in the span of their career.

During discussions with these officers, I discovered some of the difficulties encountered at bombing incidents. For example, in most instances, immediately after a bombing occurs members of the public will have already started some sort of search and rescue effort before the arrival of the fire service or police. It is recognised that these spontaneous rescuers will be emotional and angry, especially if the incident appears to be a terrorist-instigated bombing.

Rather than remove the members of the public and cause a volatile situation, the Northern Ireland Fire Brigade believes it is better to incorporate the spontaneous rescuers into the rescue activities, steering them towards tasks which present less personal danger to themselves. A need for sensitive but firm “people” skills is required. Another problem faced is the high probability of a secondary explosive device being “planted” at a bombing. The intent of a secondary device is to injure or kill rescuers.

The fire brigade has guidelines for attending suspected terrorist incidents. Fire crews work closely with the Royal Ulster Constabulary (RUC) and the military, especially
the Anti-Terrorist Branch and the Ammunition Technical Officer. In addition to the normal lifting and cutting equipment carried on fire appliances, the fire brigade may request specialist equipment from the military via the RUC. These include listening devices and specialised cutting equipment. The fire brigade has arrangements to procure via external sources, Acroprops, hammer drills and surcoats. Wherever possible, aerial appliances are used to overview the incident for operational tactics, location of casualties, limbs, etc.
United States of America

The United States of America (USA) has an area of 9.4 million square kilometres and a population of 260 million. The country is divided into 50 states and is one of the world’s wealthiest nations. An extremely diverse country, the USA suffers from a multitude of natural disasters and is subject to terrorist activity.

The heavily populated western coast of America lies above restless fault lines. Earthquake activity, especially in and around the state of California is frequent and causes much loss of life and damage to property.

Between the months of July and November hurricanes form in the northern hemisphere. Hurricanes lay waste to large tracts of populated regions, especially in Florida, North Carolina and the island state of Hawaii.

Every year, the United States records around 1,000 tornadoes. “Tornado Alley” runs through Texas, Oklahoma, Kansas and Missouri. One per cent of all thunderstorms in the USA produces a tornado. Of these, 79 per cent are weak, 20 per cent are strong and 1 per cent are violent.

To add to the country’s natural disaster woes, flooding, landslides and major bushfires are also regular occurrences.

In February 1993, a terrorist-instigated bomb blast caused massive destruction to the landmark World Trade Centre, New York. Six people died and 1,042 were injured. The explosion started a fire that sent smoke spiralling through the twin, 110-storey towers. It is estimated that 50,000 workers were evacuated from the World Trade Centre complex after the bombing.

In April 1995, another tragedy struck the United States. The population was shaken when the country experienced one of its worst terrorist attacks. One hundred and sixty eight people - including many children - lost their lives when the Alfred P. Murrah building in Oklahoma was bombed in an act of domestic terrorism.
The Development of Urban Search and Rescue

In the mid-1980’s, earthquakes in Mexico City (‘85), El Salvador (‘86) and Armenia (‘86) indicated to American authorities that a catastrophic event in the USA would overwhelm state and local resources. Then, in 1989, the Loma Prieta Earthquake and Hurricane Hugo highlighted the need for a national US&R capability.

A State of California study revealed the drain a major disaster would place on rescue resources. The study estimated that during a repeat of the Great Southern California Earthquake of 1857 some 250,000 hours of organised search and rescue (as opposed to spontaneous volunteer efforts) would be needed. The study equated this level of effort to employing 7,000 skilled search and rescue personnel operating around-the-clock in 12-hour shifts. A research paper, published by Arizona State University’s Office of Hazard Studies also revealed many earthquake deaths are not instantaneous and survival rates of victims trapped in collapsed structures do not decline rapidly during the first 24 hours after an event.

In late 1991, task force developmental grants were made through the Federal Emergency Management Agency (FEMA) to 25 of the 34 fire departments that had applied for equipment grants. The money was provided to increase the fire departments’ existing rescue capabilities. FEMA’s aim was to implement a national US&R response system: a framework for structuring existing emergency services personnel from the local level into integrated national disaster response task forces. Funding was based on each applicant’s technical score, geographical location and ability to equal the grant on a 50/50 cash match.

Originally, the placement of the national US&R response system concentrated heavily on the likelihood of earthquakes in the western region of the United States and hurricanes in the southern and eastern states. This saw the majority of initial successful applicants located on or near both coasts.

The 1995 bombing of the Alfred P. Murrah building in Oklahoma City manifested a significant void in central USA. At that time, there were only 12 operationally-ready task forces in the USA. The nearest operational team to Oklahoma City was located in Phoenix, Arizona, some 1,350 kilometres away. Since the Oklahoma bombing two additional task forces have been added in the central region, bringing the total number of teams to 27. The 27 teams encompass emergency service personnel from 18 states and 10 rescue zones. Approximately 4,850 personnel are rostered in the United States’ national US&R response system.
FEMA

Located in the national capital, Washington DC, FEMA is a taxpayer-funded, US Federal Government organisation.

When a disaster that overwhelms state and local capabilities strikes the USA, the affected state’s governor(s) may request - through FEMA - federal assistance. Once the President of the United States formally declares the incident a disaster, The Robert Stafford Disaster Relief Act is activated.

When this occurs, the US Federal Government mobilises resources and conducts activities to support state and local response disaster efforts. It does so under 12 Emergency Support Functions (ESF’s).

Each ESF is lead by a primary agency. The primary agency has been selected based on its legislative authorities, resources and capabilities in a particular functional area. FEMA is the primary agency for ESF-5 (Information & Planning) and ESF-9 (Urban Search & Rescue).

The 12 ESF agencies which can be activated by the Director of FEMA are:

ESF 1: Transportation - Department of Transportation.  
Provides civilian & military transportation support.

ESF 2: Communications - National Communications System.  
Provides telecommunications support.

Restores essential public services and facilities.

Detects & suppresses wildland, rural & urban fires.

ESF 5: Information & Planning – FEMA.  
Collects, analyses and disseminates information and develops plans.

ESF 6: Mass Care – American Red Cross.  
Manages & coordinates food, shelter and 1st Aid for victims.

ESF 7: Resource Support - General Services Administration.  
Provides equipment, materials, supplies & personnel for disaster operations.

ESF 8: Health & Medical Services – US Public Health Service.  
Provides assistance for public health & medical care needs.

ESF 9: US&R – FEMA  
Locates, extricates & provides initial medical treatment to collapsed structure victims.
   Supports federal response to actual or potential releases of oil and hazardous
   materials.

   Identifies food needs; ensures that food reaches areas affected by disaster.

   Restores power systems & fuel supplies.

Emergency Support Team

When a disaster occurs which requires national assistance, an Emergency Support
Team (EST) is formed. Consisting of a representative from the Emergency Support
Functions participating in the disaster assistance, the EST oversees the national level
response effort and coordinates activities between the Emergency Support Functions’
primary and support agencies. The EST operates from FEMA headquarters.

Task Forces

Each task force is sponsored by an individual fire department. A single task force may
be formed from several organisations located in the same geographical area.

An example is California Task Force III (CA-TF3) located in the southern region of
San Francisco Bay. CA-TF3 is sponsored and administered by Menlo Park Fire
Department, a fire department less than half the size of the ACT Fire Brigade.
Rescuers from Menlo Park Fire Department, nearby NASA Ames military base and
10 other fire departments located in the southern region of San Francisco Bay
combine to form CA-TF3. Another example is Florida Task Force 11 (FL-TF2)
sponsored by the Miami Fire Department. FL-TF2 draws its members from 27
organisations.

(Unlike Australia, where states and territories usually have one or two major fire
brigades to cover the entire state or territory, each town, city or county in the USA
tends to have its own autonomous fire department. This contributes to an existence of
more than 30,000 separate American fire departments).

FEMA and the national task force teams use the Incident Control System (ICS), a
disaster management system widely adopted by the Australian fire service.
Task Force Capabilities

A task force is designed to provide the following capabilities at an incident involving a collapsed structure(s):

- Physical, canine and electronic search.
- Rescue operations in various types of structures.
- Advanced life support treatment and medicine.
- Structural integrity assessments.
- Stabilisation of damaged structures to allow for casualty rescue.
- Hazardous materials assessments.
- Coordination with heavy equipment operations.
- Communications.
- Technical documentation development.
- Liaison.
- Incident action planning.

Task Force Structure

A full task force has 62 members. This allows two teams of 31 rescuers to operate 12-hour shifts for 24-hour operational periods. Each task force must be completely self-sufficient in the field for a period of up to 72 hours. No task force will be deployed at an incident for longer than 10 days’ duration.

Each position on a task force is three-deep. A sponsoring agency has 186 trained operators to fill the 62 positions. This allows for vacations, sick leave, and other forms of non-availability.

Primarily, a task force performs the functions of search and rescue for trapped victims and medical care for task force members and trapped victims. In order to operate in this manner, task forces are divided into five components. Task force members are cross-trained in two areas, eg, search camera operator and rigging specialist. The individual team components and primary functions are outlined below:

Management Team
Composition: Task force leader.
Safety officer.
Planning officer.
Functions: Provides overall management and coordination of task force operations, including planning and safety oversight.

Search Team
Composition: Canine specialists and search canines.
Technical search specialists.
Functions Utilises canines and technical/electronic search to locate trapped victims.
**Rescue Team**

**Composition:** Rescue specialists organised into four squads with leader and five specialists.

**Functions:** Performs extrication of trapped victims. Skilled in cutting, shoring, lifting and breaching steel and reinforced concrete.

**Medical Team**

**Composition:** Physicians and medical specialists at paramedic or equivalent level.

**Functions:** Provides pre-hospital and emergency care for task force members and crush syndrome/confined space medicine for rescued victims.

**Technical Team**

**Composition:** Structural engineers, hazardous materials specialists, heavy equipment and rigging specialists, technical information specialists, communication specialists, logistics specialists.

**Functions:** Provides support to the overall search and rescue mission to include: hazards evaluation, structural integrity assessments, heavy equipment rigging, communications, logistical support.

**International Assistance**

Of the 27 US&R task force teams, two respond internationally as well as nationally. Fairfax County in Virginia and Miami-Dade in Florida are contracted by the Office of Foreign Disaster Assistance (OFDA) to provide a US&R service to countries outside the USA. Generally, Miami-Dade responds into South America and Fairfax County covers Europe and Africa. Miami-Dade, through OFDA is also involved in training in Asia. Both international task force teams responded to the August 1999 earthquake in Turkey and September 1999 earthquake in Taiwan.

FEMA may request to have non-American US&R teams operate at a disaster in the United States. The request for overseas assistance is made to the United Nation’s, Department of Humanitarian Affairs. If overseas teams are used in the USA, they will be afforded the same logistical support and will be expected to operate within the same framework as FEMA national task forces.

**Incident Support Teams**

FEMA has developed the Incident Support Team (IST) to identify the need for, and maximise the speed with which task forces can be requested, mobilised and utilised. An IST does not directly manage state or local disaster response activities. The aim of an IST is to provide US&R related management, support and coordination for the incoming task forces.
Once an incident is declared a disaster, FEMA responds an IST to the disaster location. Although FEMA determines the size and composition of each IST on an individual “disaster needs” basis, an initial IST typically consists of 18 personnel.

Upon arrival at the incident the IST makes contact with the local jurisdiction and begins initial planning and resource support. The IST also identifies a base for operations, an area in which task force equipment and personnel are housed for the duration of their involvement. Major incidents will most likely warrant extra IST personnel, therefore, the team can be expanded with additional positions to support the task forces when needed. Depending on the size and scope of the disaster this may require an organisation of around 53 personnel to dual-staff all positions.

Another important role of the IST is to develop a signed agreement with the incident’s jurisdiction. The agreement details all mission objectives prior to the arrival of ESF-9 assets. This clearly delineates the scope and parameters of the task forces’ operations.

The IST communicates between FEMA headquarters in Washington and a temporary office established at or near the disaster site. The IST conducts situation/needs assessments and provides technical assistance, support and advice about US&R issues to public officials at federal, state and local levels.

The IST must be able to operate around-the-clock; remain self-sufficient at an incident for at least 72 hours and be capable of deploying advance team personnel within two hours of activation.

**Rapid Needs Assessment Team**

ESF-9 assets can also be utilised as part of a Rapid Needs Assessment Team. The Rapid Needs Assessment Team provides a field assessment immediately following a disaster. Developed by FEMA, the Rapid Needs Assessment Team responds to incidents which will likely result in federal assistance being provided to the affected states. This allows valuable information gathering prior to the incident being officially declared a disaster.

The Rapid Needs Assessment Team is a “pre-designated team tasked with making accurate assessments of the immediate resources required to save lives, prevent further human suffering and mitigate additional property damage”.

The Rapid Needs Assessment Team is based around a medical specialist (ESF-8), an infrastructure specialist (ESF-3) and a hazardous materials specialist (ESF-10). Specialists from other disciplines can be included if required.

**Funding**

In 1991, FEMA provided the nation’s newly formed task force teams a total of $2,677,612 on a 50/50 cash-match basis. In 1992, each team received $15,350 on a 75/25 cash-match basis. After 1992 there was no cash-match requirement but it is
recognised by all parties that sponsoring fire departments commit a substantial financial contribution to the national US&R program. The fire chiefs and senior officers of participating fire departments I visited believe the investment is worthwhile. They see the skills attached to the US&R teams as an extension of the skills and service they already provide their respective communities. The fire chiefs recognise that the US&R program greatly enhances those skills as well as providing improved morale, leadership training and team building.

Between 1991 and 1996 the national task force teams received in total $6.75 million of federal funding. The most any individual team received from FEMA in that period was a total of $344,325 or $57,400 per annum. The average was $271,500 or $45,250 per team, per year.

The two task force teams which respond internationally as well as nationally (Miami-Dade and Fairfax County) receive OFDA and FEMA funding. Miami-Dade estimates one-third of their running costs comes from OFDA, one-third from FEMA, and one-third from Miami-Dade Fire Department.

I also noted that many individuals involved in the US&R program contribute a portion of their free time without monetary remuneration.

When deployed to an incident within the USA, all task force team members are contracted employees of FEMA. Federal funds are used to pay the sponsoring fire departments (or relative organisations) for the rescuers’ operational time. Any expenses due to backfilling are included. FEMA also provides injury and liability insurance for rescuers during training sessions and deployment. Training costs are borne in a similar way: FEMA paying travel and living expenses where necessary.

A 62-member US&R task force on deployment costs an average of $120,500 per day. This includes salaries, benefits and backfilling costs.

Training

The responsibility for training is shared by federal, state and local governments. FEMA administers the federal portion of the training. Federally sponsored training, or functional training concentrates on the development of advanced skills not normally found in affected communities.

FEMA has developed eight functional skills acquisition courses which are delivered on an annual or biannual schedule. For example, logistics officers attend national logistics courses conducted by logistics experts. Another example is the structural engineers’ specialised training which is presented by structural collapse experts who are also structural engineers. Course participants are flown to the host town or city for the live-in courses. Up until recently, these courses were provided by an organisation called NASAR on a “sole source contract”. Training is now provided by the open tendering process.
State and local US&R training covers skills acquisition and maintenance at entry and intermediate levels. Some fire departments, such as Fairfax County, Montgomery County and Miami-Dade have sites dedicated to structural collapse training. Miami-Dade has a team consisting of five fire officers which administers and coordinates the Miami-Dade Task Force on a daily basis.

Some of the task forces I visited have adopted Tuesday as a structured training day (I was told Tuesday is the quietest weekday in America, hence, a good day for training). US&R team members are able to program technical rescue training into the Tuesday training schedule. The fire officers I spoke with, especially those involved in presenting the training, believe this approach to technical training is successful.

As well as the structured Tuesday training days - where firefighters from different areas or city zones are brought together (usually at a training complex) to train - less formal, but just as important training is held on a daily basis at individual fire stations.

**Equipment**

Task forces must fulfil the requirements of the FEMA equipment or cache list. A complete cache is valued at approximately $1.8 million. A component of the equipment is US&R-specific, but much of the rescue equipment on the list is common to fire services generally. Cache equipment broken, lost (on a mission or during a training exercise) or expended is replaced by FEMA.

Surplus USA military equipment may be acquired for a nominal cost by registered task forces before the surplus equipment goes to auction. I visited a surplus military
warehouse in Miami with fire officers from Florida Task Forces I & II. The range of equipment at the warehouse was comprehensive and reasonably modern. Most task forces acquire some equipment - from storage boxes to forklifts and small cranes - by this method.

**Cache Management**

The overall effectiveness of an operation is greatly dependent on the prompt availability of the tools, equipment and supplies in the task force cache. A complete cache is large and diverse. The cache is physically taxing and time consuming to move, set-up and organise. Task forces have their cache tools, equipment and supplies pre-packaged and wherever possible palletised in modular form.

The logistics officer has primary responsibility for property accountability and resource tracking during the mobilisation, mission operations and demobilisation phases. This position distributes, maintains and accounts for all the tools and equipment for the task force.

Various task forces employ different methods to achieve cache management. Fairfax County and many other task forces have a barcode on each piece of equipment and each rescuer has a barcode on his or her helmet. A computer database and scanner allows equipment to be logged to an individual. This process can take less than a minute.

Montgomery County has identified deficiencies in the barcode system: barcodes can be scratched or accidentally removed; a computer malfunction can render the system unusable. Instead, Montgomery County uses the “T” card system familiar to most Australian fire brigades.

Drugs, and other items which require storage at a reduced temperature are kept in fridges (Miami-Dade has an entire section of their considerable storage area refrigerated). Limited shelf-life items are routinely replaced as part of the cache’s maintenance program.

Most of the equipment is stored in colour-coded containers and the containers stored on military pallets (military pallets measure 2.64m x 2.13m and carry a maximum of 3.4 tonnes). Due to their light weight and strength, aluminium containers are the most popular type of container but a variety of materials – including timber and plastic (polythene) - are used. The polythene containers have the added advantage of folding down to less than 300mm in height. A weight limit is applied to individual, fully stowed containers to ensure they can be moved by hand.

Caches are divided into five separate elements and colour coded: rescue (red), medical (blue), technical (yellow), communications (green) and logistics (white). Each container has the inventory number of the container, unit name, weight of the container and contents of the container stencilled on its lid and two adjacent sides.

Packaging of tools and equipment makes handling during transport more efficient and allows task forces to adopt a “kit” concept. For example, instead of filling a lighting container with floodlights only until the weight limit is reached, a single lighting
container includes all the necessary components to place floodlights in service at a worksite. A floodlighting container has floodlights, tripods, stands, spare bulbs and extension leads. The kit concept is applied to all categories of tools and equipment.
Each task force has determined the most efficient configuration to load containers onto each pallet and in turn each pallet onto a truck. This configuration is then recorded in schematic diagram form.

An entire cache of equipment weighs around 27,000 kgs. The load limit for personal, carry-on gear per team member is 30 kgs and 45 kgs for each canine and associated canine support equipment.

Notification

There are four types of notification notices issued by FEMA to task forces:

Advisory Notice

Upon the occurrence of a significant disaster (such as an earthquake) or the possibility of an impending event (such as a hurricane), FEMA may issue an advisory notice of
the event to all US&R task forces. Included in the advisory notice is all appropriate information related to the event such as type of event, location, weather conditions, etc.

**Alert Notice**

Should information indicate that US&R resources have a probability of being requested within the next 24 hours, FEMA may issue an alert notice to certain or all US&R task forces. Relative information pertaining to the event is also included in the alert notice. The alert notice is used to notify the task forces which may be activated but an alert notice is not a directive to mobilise. The alert notice will authorise a specific amount of funds allocated to the sponsoring agency for administrative expenses. An alert notice allows the sponsoring agency to prepare for a (potentially imminent) full task force activation. The alert notice may be verbal followed by written confirmation, normally within 12 hours.

**Activation Order**

If it is determined the disaster will require US&R resources, FEMA will select task forces to be activated. FEMA will contact the sponsoring agency and the respective state to determine the availability of the alerted task force for federal service. The task force in conjunction with the state may decline the mission if, in their opinion, there is a need or potential need for the task force in the state or home jurisdiction. Once the task force accepts the mission FEMA will issue an activation order. Sponsoring agencies accepting the mission are expected to be able to field all necessary personnel, supplies and equipment and report to their designated point of departure within six hours of the activation order.

**Demobilisation Order**

When an alert notice has been issued and subsequent information indicates that mobilisation of US&R task forces is not warranted, FEMA will issue a written demobilisation order through the state to sponsoring agencies. After an activation, a demobilisation of the activation may occur at any time during the mobilisation process.

**Task Force Rotation System**

In order for all task forces to be considered fairly for deployment, FEMA has developed a rotation system. The rotation system removes subjectivity in task force activations and enables task forces to know when they are most likely to be activated.

The rotation schedule is based upon a monthly calendar rotation and divides the task forces into three regions. Each task force rotates monthly within their region from first-to-respond through to ninth-to-respond.

Following an incident which requires US&R assets, FEMA will initially activate the number of task forces it deems necessary for the incident. The first three task forces utilised will be the three located geographically closest to, but outside the affected
state. Any task forces within the affected state will be deemed to be state resources until the state releases their use to FEMA.

If additional task forces are required beyond the first three geographically-located task forces, FEMA refers to the rotation schedule, using the first-to-respond from the incident region then moving to the first-to-respond from the other two regions and continuing until the incident is mitigated or until all task forces have been used.

**Transportation**

Depending on the travel distance to the disaster, task forces may deploy by air or ground transportation. If the incident is further than 800 kilometres from an activated task force, the task force will be flown to the disaster. If the incident is less than 800 kilometres, the task force will use ground transportation.

The Department of Defense is the primary provider of air transport to task forces. As well as being at the disposal of the US government, the military is experienced in transporting unusual and unique loads, including compressed gas cylinders, hazardous materials and fuel.

When transporting a task force cache, aircraft loadmasters require the equipment to be grouped on pallets. The pallets are loaded and positioned on the plane depending on their classification. Hazardous materials are packed onto a single pallet and placed at the rear of the aircraft. Should an in-flight emergency arise the hazardous materials can be the first load jettisoned out of the rear of the plane.
Within the constraints imposed by the loadmaster’s requirements, consideration needs to be given to segregating and loading tools, equipment and supplies needed early in the mission. A selected combination of technical and rescue gear receives priority. These two categories interrelate, allowing victims to be located and rescued in the first few hours of the task force’s arrival. Pre-determined communication equipment should also accompany the first priority shipment. Personal equipment is not considered essential (all personnel maintain a small personal kit, or daypack in which they keep personal and safety gear with them at all times).

Civilian carriers may provide air transportation, but their capability is limited and their rules restrictive. Moving via a civilian carrier also requires a task force to reconfigure equipment and pallets for loading. Due to non-military regulations, in many instances two commercial aircraft are required to move an entire task force - one aircraft for personnel and one aircraft for cargo and equipment.

Florida Task Force 1 (FL-TF1), sponsored by Miami-Dade Fire Department has its cache stored in a large warehouse adjacent to a military airport. The warehouse, situated less than 50 metres from the landing strip, allows quick loading if travelling by plane. Most of the other task forces I visited have their US&R semi-trailers partially loaded to save time in the event of a deployment.

Peter Smalley (one of the driving forces behind FL-TF2) responded with a small search and rescue team to Papua New Guinea (PNG) in 1998. Over 2,000 people were killed when a tsunami struck PNG’s northern coast in 1998. Over 2,000 people were killed when a tsunami struck PNG’s northern coast. Peter’s search and rescue team was neither FEMA nor OFDA instigated and comprised of skilled and experienced volunteers offering their time and expertise. Peter told me that Qantas was able to fly the team and their limited cache of equipment from the United States to Australia at short notice. The Australian military also assisted the American rescue effort in PNG.

Work Period Scheduling Rotations

One of the most important strategic considerations for the task force leader and team managers (the rescue team manager, in particular) is how to deploy the task force personnel at the start of mission operations.

In general, it is felt when a task force arrives at the assigned location the most advantageous approach is to commit all task force personnel to the initial requirements such as setting-up at the base of operations, structures triage (prioritizing which buildings are to be searched and in which order), building marking (identifying safe entry points, hazards, etc.), equipment cache set-up, search and reconnaissance activities, etc.

The importance of locating live victims as early as possible after a building collapse - coupled with the capability a 62-person task force offers - substantiates this total commitment of personnel at the outset. An early review of present and anticipated search and rescue opportunities will determine the benefits of a full-scale commitment of resources at the start of the incident. Depending upon the general conditions present, it may be most appropriate to attempt the following guidelines:
- First 8 - 12 hours of operations: all personnel committed to task force set-up, structures triage and search and rescue operations.
- Next 4 - 6 hours of operations: half the personnel are relieved for eating/sleeping.
- Subsequent 12 hours of operational period: half the task force works; the other half rests, eats and sleeps.

Consideration should also be given to available daylight. Productivity may be increased and rescuer accidents reduced if the task force splits the daylight hours. For example, if the first shift is run from midday to midnight and the second shift run from midnight to midday, each half of the task force works part of their shift in natural lighting. As the task force moves into alternating 12-hour periods, there should be a one- to two-hour overlap of the shifts to allow for briefings and debriefings. In this case each person would work a 13- or 14-hour shift and have a 10- or 11-hour break.

**Operational Phases**

The operational period at a major US&R incident is divided into five distinct phases. At times it may be necessary for a task force to begin rescue operations in one of the middle phases. It is likely that local emergency response personnel will have completed the first two phases prior to the arrival of a task force.

**Phase One:**

Assessment of the collapse area. The area is searched for possible victims (surface and/or buried) and an evaluation of the structure's stability and potential danger to rescue personnel is performed. All utilities must be evaluated and shut down.

**Phase Two:**

Removal of all surface victims as quickly and safely as possible. Care must be taken during this phase to ensure rescuers do not become victims.

**Phase Three:**

Search and rescue of victims from accessible void spaces. All voids and accessible spaces created as a result of the collapse must be searched and explored for viable victims. An audible call out system can be used during this phase. Only trained canine or specially trained personnel should be used in voids and accessible spaces.

**Phase Four:**

Selected debris removal to locate and rescue victims. Special tools and techniques may be necessary after locating a victim.

**Phase Five:**

General debris removal. Usually conducted after all known victims have been removed.
In concert with the above phases, search operations may occur in two modalities: a hasty search to quickly detect the presence of survivors (usually conducted at Phases Two and Three); and the more time consuming extensive grid search to pinpoint the survivor’s exact location (usually conducted during Phases Three and Four).

The most perplexing strategic decisions will probably involve choices between multiple rescue opportunities that surpass the rescue resources of a task force. In this situation task force management should prioritise rescue opportunities.

Personnel safety and the benefit for the maximum number of people should be the guiding principles. This would involve factoring in victim(s) viability, degree of difficulty and duration of rescue; the possible end results of rescue efforts (a single rescue operation yielding two or more victims) and safety considerations for rescuers.

Rescue Team Integration in Search Activities.

The success of the search component of a search and rescue operation can be greatly enhanced if members of the rescue team assist the canine and technical search personnel with search and reconnaissance activities.

This may include safety assessments of the site, gaining access to voids and other difficult areas and conducting physical search operations. Search personnel may be most effective using electronic viewing equipment (search cameras, fiberoptics, etc.) in conjunction with concrete (hole) corers to pinpoint the exact location of victims. This combination can also be used for general void searches within collapsed buildings. Experience has shown success with rescue personnel drilling an array or series of holes in a floor or wall. Following the path of the rescuers, a technical search specialist equipped with a search camera can then use the holes to make a quick assessment of the area.

Interdiscipline Coordination

It is important that task force disciplines are included throughout the operation. Consideration should be given to the non-search and rescue component of the team to ensure their expertise is not underutilized.

Structure specialists (engineers) must be involved in ongoing rescue extrication operations, especially those involving significant cutting, breaching, moving and lifting. The officer-in-charge of rescue should request structural assessment assistance in the development of the rescue plan and receive periodic reviews during the course of operations. Architects and builders involved in the design and construction of a structure which has collapsed can also provide valuable information.

Hazardous material specialists should assist search and rescue personnel with the initial site analysis prior to search or rescue operations.
Heavy equipment and rigging specialists can provide recommendations during operations involving cranes and heavy lifting. It is equally important that these specialists act as a liaison between the rescue squads conducting the rescue and non-task force equipment operators (crane drivers, etc.) who may not fully understand the tactics involved.

Medical specialists provide medical assessment, intervention and stabilisation. These elements are essential to the eventual survival of entrapped victims. Rescuers must allow medical team members access to the victim as soon as safely possible. This may require temporary cessation of rescue operations but the benefits of early medical intervention and stabilisation of victims greatly offsets any time lost. Medical personnel are also responsible for monitoring other task force members for excessive critical incident stress, exhaustion, adequate water intake and treating any injuries that require intervention.

Technical information specialists should document significant aspects of a rescue. This may include both still and video photography of operations.

At times the rescue team may have to integrate the services of non-task force personnel into ongoing operations. These include local utilities personnel (gas, electricity, water), law enforcement officers and military and civilian volunteers. The assistance of these persons should not be overlooked when needed.

**Search Tactics**

Search resources used in the urban disaster environment are divided into three categories: physical, technical and canine. The following list outlines the current tactics for locating trapped victims and their corresponding advantages and disadvantages. No single tactic is sufficiently effective on its own to ensure that a complete search has been conducted.

<table>
<thead>
<tr>
<th>Tactical Operation</th>
<th>Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Void Search</td>
<td>Does not necessarily require specialists, canine or sophisticated electronic equipment. People can be trained quickly (and supervised by task force personnel) to support the effort.</td>
</tr>
<tr>
<td>Audible Call Out/Knocking Method</td>
<td>Same as above. Personnel can inform victim of expected response. This procedure can be modified and used in conjunction with listening devices.</td>
</tr>
</tbody>
</table>
### Electronic Viewing Devices
Provides the general position and condition of the victim. Can be used to verify other search tactics prior to commencing rescue operations.

### Infrared/Thermal Imaging
Equipment is sometimes readily available with responding local organisations. Some models are cheaper than most electronic listening devices. Can be used to survey large, open, dark areas.

### Electronic Listening Devices
Able to cover larger search areas and sometimes triangulate on victim’s position. Only equipment capable of picking up faint noises and vibrations. Can be used in conjunction with other search devices to verify find.

### Search Canines
Can search large areas in a short period of time. Can traverse or gain access to voids and other opportunity sources. Can work in unsafe areas.

### Tactical Operation

<table>
<thead>
<tr>
<th>Equipment/Method</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Void Search</td>
<td>Limited access to all voids in (visual/vocal) building. Proximity required is dangerous to search personnel.</td>
</tr>
<tr>
<td>Audible Call Out/Knocking Method</td>
<td>Unconscious or physically weak person cannot be detected.</td>
</tr>
<tr>
<td>Electronic Viewing Devices</td>
<td>Extended or inaccessible voids (observation holes) cannot be viewed due to the flexible nature of the fibreoptic cable and limited light source. Limited penetration of the equipment.</td>
</tr>
<tr>
<td>Infrared/Thermal Imaging</td>
<td>Units cannot detect heat differential through solid mediums. Sources of heat other than persons buried under debris</td>
</tr>
</tbody>
</table>
are also indicated. This can cause confusion.

Electronic Listening Devices

Unconscious person cannot be detected. Ambient site noise is intrusive. Victim must create a recognisable sound pattern. Range is limited (acoustic – 8m, seismic – 25m).

Search Canines

Extent of operation is limited. Performance may vary re: handler/canine capabilities.

Search Canines

According to a FEMA training manual, “A handler and Advanced Certified dog in top form is probably the single best search tool available in the urban disaster environment”.

Most task force canine handlers are not career emergency service responders. Although I did meet some canine handlers who are full-time firefighters, the vast majority of canine owner/handlers come from diverse backgrounds and professions outside of the emergency services.

FEMA has a (disaster) search canine program in place. Disaster search canine teams (a search canine and its handler) are certified at two levels – Type 1 (advanced) and Type 11 (basic). Evaluators assess each canine/handler team for their readiness to become part of a task force. In addition to a practical test, handlers must also pass a written test (some of the dogs I saw put through their paces could probably pass the written test, as well). Once a canine/handler team has passed the Type 11 evaluation it is eligible to take Type 1 evaluation. The canine/handler teams are recertified every two years.
Some task forces have a separate area in their US&R training complex dedicated to canine/handler training. The dogs and their handlers are required to train as an individual team and as part of the overall US&R search team. Canine handlers receive instruction in several US&R disciplines.

Canine search tactics usually involve a unit comprising of two canine/handler teams and one overhead coordinator. The overhead coordinator monitors site safety and coordinates and manages the search. It is preferable if two separate canine teams are deployed early in the mission. In many instances, the initial canine search can usually provide the most rapid assessment. A sweep of an area can be used to determine any indication of victims. After an initial period of operation, the two teams are rotated into rest cycles and used alternatively for extended, continuous operations.

The individuals staffing the overhead position must be fully trained in that function. The overhead coordinator ensures that accessible areas are not overlooked and each specific site or sector is properly searched. Should either of the canine/handler teams indicate a find, the overhead coordinator will pull that team away from the find.
location. The handler involved in the find mentally notes the exact location of the
find. The area is not physically marked at that time.

The overhead coordinator then directs the second canine/handler team into the same
general area. Should the second team indicate a find in the same location, the area is
marked with survey tape. The overhead coordinator passes this information to the task
force leader for subsequent action. The canine/handler search team then continues
searching for other victims.

**Electronic Search**

State-of-the-art electronic listening devices allow search teams to “access” previously
inaccessible areas. In some cases a victim’s scent may not reach the surface making
detection by the canine/handler team unlikely.

Technical search specialists within a task force use the acoustic/seismic listening
devices as their primary tool. All available technical search specialists are deployed
early in the mission. After that initial period the specialists are rotated into rest cycles
for extended operations.

Electronic search operations are more site-specific and longer in duration than canine
search operations. Other task force personnel (preferably rescue personnel) should
assist the technical search specialists and also act in the overhead function to ensure
overall safety.

The acoustic/seismic search involves placing an array of two or more pick-up probes
around the perimeter, sector or void areas of a building. A bullhorn or hailing device
can be used to give directions to any conscious victim trapped within the structure.
The victim should be directed to make repetitive sound (i.e., “keep knocking five
times”). The repetitive series will provide the operator with an identifiable sound to
detect. The general area must be made as quiet as possible during this operation.

In the same manner as the canine find, the second technical search specialist (or other
task force member fully skilled in acoustic/seismic devices) should be used to confirm
any find. Should the second operator confirm the find the position is marked with
survey tape. This information is passed to the task force leader for subsequent action.
The technical search specialist then continues with his/her assignment.

**Electronic Viewing Devices**

Electronic viewing equipment provides another capability for the task force’s search
function. This equipment can be quite effective at pinpointing the exact location of
victims. It may also be used for general void searches within collapsed buildings.

Search cameras and fibreoptic equipment are simple to use once personnel are fully
trained in their operation. The most difficult aspect to master is the determination of
which direction one is viewing when the instrument is inserted into a drill hole or void
opening. This requires consistent training. Due to the visual indication of a victim, no secondary confirmation of a find is required.

Montgomery County Fire Department (MD-TF1) has an excellent US&R training facility. Part of the complex contains mock rooms which simulate a house and an office (loungeroom, bedroom, reception area). The rooms are only 1.2 metres high and covered with a plywood ceiling. A series of holes drilled in the ceiling allows the team’s search and fibreoptic camera operators to train in (reasonably) realistic surroundings. The plywood ceiling is removable, allowing the rooms to be reconfigured easily and new items added and new scenarios created.

Physical Search

Immediately following a structural collapse it is the spontaneous volunteer, local bystander and even the walking wounded who rush in to conduct a physical search, especially if victims are visible. This form of rescue is uncoordinated, inefficient and may leave some areas unsearched and other areas searched repeatedly. Untrained spontaneous volunteer rescuers can be placed at a high risk of serious injury or even death.

An example of this occurred at the 1995 Oklahoma bombing where a passing-by, off-duty nurse rushed to the assistance of lightly trapped surface victims. Her brave attempt added to the tragedy when she was struck and killed by a computer falling from several floors above.

Most effective during daylight hours, a coordinated and planned physical search allows personnel to be deployed efficiently over and around a collapse site. These personnel can make separate visual assessments in voids and confined space areas for
any indication of victims. They may be used in a coordinated fashion as an array of
listeners. A bullhorn or hailing device should be used to provide direction to trapped
victims. The area is made quiet in an attempt to pinpoint the location of any noise.
This type of operation is less exacting than those using electronic listening devices,
but in disasters involving limited resources and/or widespread destruction, a planned
physical search can be an invaluable search and rescue tactic.

Search Considerations

A combination of physical, canine and electronic search tactics allows task force
supervisors to better establish priorities and focus resources on the most important
rescue activities.

Incoming task forces arriving at an area severely affected by a large-scale incident
could be faced with large numbers of persons trapped beneath the rubble. Some may
still be alive and many simple rescues already accomplished by the local people.

Trained rescuers will have the resources to deal with the most difficult of rescues. It is
always important to establish whether or not the team is involved in a live victim
rescue since body removal should not be conducted while other live victims might
still be saved.

Large Scale Prioritisation

One of the initial decisions a US&R task force may have to make is what area should
be searched first. This consideration usually deals with larger geographical areas
involving several separate structures although it can also involve a single structure,
especially those with multiple uses. Prior experience shows there are two general
strategies that can be used to decide how to deploy task force resources.

The first is to sectorise the affected area. Depending on the size of the damaged area
and the search resources available, an area may be sectorised by city blocks or other
easily definable features. The available search resources are then divided and
allocated to each sector for search operations.

The second, a more practical method in most cases, is to determine the search
priorities in terms of the type of occupancies affected. Those presenting the highest
likelihood of survivors and number of potential victims would receive attention first.
Using this method, a building “ triage” is conducted. Sectorising still occurs, but in a
more localised manner.

Search and Reconnaissance Teams

The design of a FEMA US&R task force allows for two search and reconnaissance
teams. When a task force begins operations both teams can be deployed. A full task
force search and reconnaissance team is staffed as follows:
<table>
<thead>
<tr>
<th>Role</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search team manager</td>
<td>Functions as team supervisor. Sketches and records information. Relays details and recommendations back to task force leader.</td>
</tr>
<tr>
<td>Canine search specialist</td>
<td>Conducts canine search operations and secondary verification of alerts.</td>
</tr>
<tr>
<td>Technical search specialist</td>
<td>Conducts electronic search operations including acoustic/seismic listening devices and/or electronic viewing equipment.</td>
</tr>
<tr>
<td>Medical specialist</td>
<td>Provides medical treatment for located victims and/or search and reconnaissance team members.</td>
</tr>
<tr>
<td>Structures specialist</td>
<td>Provides analysis and advice regarding structure stability, shoring and stabilisation.</td>
</tr>
<tr>
<td>Hazardous materials specialist</td>
<td>Assesses, identifies and marks hazardous materials present. Monitors atmosphere in and around voids and confined spaces.</td>
</tr>
<tr>
<td>Rescue specialist</td>
<td>Provide assistance to the search and reconnaissance team including drilling/breaching for electronic viewing equipment.</td>
</tr>
</tbody>
</table>
The search and reconnaissance team is tasked with general area search, reconnaissance and evaluation. This includes a structure triage and physically marking each structure with predetermined symbols.

The viability of surviving victims is also assessed. The atmosphere is monitored for lack of oxygen and dangerous gases. Any hazardous material is identified and flagged. Site and personal hazards, such as overhanging building components, structural instability and secondary collapse zones are identified and recorded.

A sketch of the general area is made and all significant issues are noted. This information, along with recommended priorities is relayed to the task force leader.

Medical Component

The task force medical team is organised, staffed and equipped to provide sophisticated and possibly prolonged out-of-hospital specialised emergency medical care throughout the course of a mission. The medical team’s major role is treating victims directly involved in the structural collapse. The medical personnel are also responsible for minimising health risks, intervention in extended incident stress syndrome and limited treatment of hazardous material exposures for task force personnel. In addition, the medical personnel must be capable of providing treatment to the search canines.

The medical team consists of two physicians and four paramedics. Most of the physicians selected have a background in emergency medicine and/or surgery. The physicians also take courses in confined space medicine and crush syndrome. Fire departments provide the paramedics. (In the USA, firefighters have the dual role of firefighters/paramedics. Ambulances belong to the various fire departments nationwide). One advantage of this system is that many of the fire department team members not assigned to a medical role have paramedic and patient care qualifications.

The medical equipment component of a task force’s cache provides medical treatment for the 62-member task force as well as victims encountered at the site. Based on research and past experiences, the quantity of equipment and drugs in the cache provides for treating 10 critical cases, 15 moderate cases and 25 minor cases.
Neighbourhood Emergency Response Teams

The Californian city of San Francisco has a history of powerful earthquakes. The US Geological Survey predicts there is a 67 per cent chance the San Francisco Bay Area will be struck by a major earthquake within the next 30 years.

Like many other high risk areas in the US, San Francisco has adopted a proactive stance towards disaster preparedness. One example of this is the Neighbourhood Emergency Response Team (NERT).

Implemented in 1990, the NERT program is sponsored and conducted by the San Francisco Fire Department. Community organisations, government agencies, private enterprise and individuals are targeted to participate in NERT training. Since the program’s inception, over 9,000 San Francisco residents have been involved in NERT training. The San Francisco Fire Department can provide the training in three languages – English, Spanish and Cantonese.

The goal of the NERT program is to “help the citizens of San Francisco to be self-sufficient following a major disaster by developing multi-functional teams that are cross trained in basic survival skills”. NERT training – taught by firefighters - consists of six classes. Each class is 2.5 hours in length.

Class 1 - Earthquake Awareness

- Earthquake type, magnitude, history and probability.
- How to prepare before it happens.
- What to do when the shaking starts.

Class 2 – Disaster Skills

- When and how to shut off gas, water, electricity.
- Fire extinguishers.
- Hazardous materials awareness.

Class 3 - Disaster Medicine

- Disaster medicine.
- Triage: how to decide who to treat and when.
- Care of minor injuries.

Class 4 – Light Search & Rescue

- Building damage recognition.
- Light search and rescue techniques.
- Lifting heavy objects with mechanical advantage.
Class 5 – Team Organisation

- Team organisation and management.
- The city’s disaster plan.
- Disaster psychology.
- Tabletop exercise.

Class 6 – Hands-On Training

- Extinguishing fires.
- Treating injured victims.
- Extricating a victim trapped by heavy timbers.
- Interior search for missing persons.
- Exterior building damage assessment.
- Award of Achievement.

As well as their initial training program, NERT members undergo refresher drills twice per year (April and October). Community groups, government agencies and members of the public receive NERT training and associated literature and equipment free-of-charge. Private enterprise is charged a total of $4,625.00 to conduct the six classes. A maximum of 60 students can be trained per class and the cost includes a manual, individual identification, a helmet, a vest and a graduation certificate for each student. The charge is formulated on a cost-recovery basis.

San Francisco is divided into 12 districts. In the event of a disaster occurring, a pre-determined fire station in each district becomes the district’s incident control point. The fire department’s on-duty battalion chief is designated as the district incident controller. Police officers assigned to a district report to their pre-determined fire station.

The overall commander for the disaster is the city mayor. He or she, in liaison with the police chief and fire chief, form an Emergency Management Team. The Emergency Management Team is located at an Emergency Command Centre (ECC) remote from the fire stations.

After the earthquake or disaster each district fire station provides a damage report to the ECC. From this information the Emergency Management Team develops a disaster strategy.

NERT members also assemble at their district fire stations. Part of their role in a disaster is to visit their district’s vulnerable population. A disaster register provided by the Department of Public Health lists members of the community with special needs (aged, handicapped, medical requirements, etc.).

History shows a strong spontaneous volunteer capability will become available after a disaster. With the NERT program these spontaneous volunteers are directed to specific sites where they are formed into disaster assistance teams. Trained NERT members supervise the teams. Communications within the NERT network is via citizens’ band radio.
During my stay in the San Francisco I had the opportunity to attend a lecture (Class 6, Hands-On Training) delivered to a community group and a biannual major exercise. From my observations, both of these could be transferred to the Australian scene.
Conclusion

Australia’s history shows a need for an Urban Search & Rescue capability. Each of the past three decades has produced a memorable natural disaster and each natural disaster has caused multiple loss of lives and a heavy financial burden.

I believe a variation of the United States model would best suit Australia. Existing rescue organisations can already provide much the expertise and necessary equipment however, the sheer magnitude of properly maintaining a three-deep, 62-member team cannot be underestimated.

Locally, the ACT can provide a smaller, modular team. This team could stand-alone or – when required – become part of a larger US&R national team.

To be fully successful, US&R in Australia requires Federal Government support in the form of funding and coordination.

Although we still have much to learn, we are moving forward. Today we know more about US&R than we did yesterday – a positive sign.
Recommendations

(1) The ACT Fire Brigade develops a technical rescue training complex in Canberra where a broad range of rescue training can be combined.

(2) The ACT Fire Brigade/Emergency Services Bureau develops a modular search and rescue team. This team could be responded to assist at incidents outside of the ACT, where required. The team should consist of around 10 persons. The make-up of a 10-person team should be: Team Leader, Hazmat/Safety, Search & Rescue/Medical, Communications/Logistics. Each position should be three-deep and each team member cross-trained in multiple disciplines.

(3) Familiarisation training take place between the ACT Fire Brigade and relevant interstate rescue organisations on an annual basis.

(4) ACT Fire Brigade members undergo a bomb-awareness course from police or military experts.

(5) Undertake further study of the Tokyo Fire Department’s Earthquake Damage Estimation System and apply a similar system locally and nationally.

(6) A local register is developed listing trauma doctors, structural engineers, surveyors, architects, trained search canines & handlers, etc., who volunteer to provide their services in the event of a disaster. As a minimum these persons should receive basic US&R training and annual refresher training.

(7) A local register is developed listing resources such as cranes and similar heavy machinery.

(8) The Emergency Services Bureau adopt pertinent sections of the NERT program, for example, SES volunteers visit special needs members of the community immediately after a disaster.