Department for Communities & Local Government

CFRA
CHIEF FIRE & RESCUE ADVISER

Fire and Rescue Authorities Operational Guidance

GRAs
generic risk assessments

GRA 2.1
Rescues from confined spaces
2.1.4 collapsed structures

Generic Risk Assessment 2.1

Rescues from confined spaces

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April 2013

London: TSO

TSO
information & publishing solutions

Published by TSO (The Stationery Office) and available from:

Online
www.tsoshop.co.uk

Mail, Telephone, Fax & E-mail
TSO
PO Box 29, Norwich, NR3 1GN
Telephone orders/General enquiries: 0870 600 5522
Fax orders: 0870 600 5533
E-mail: customer.services@tso.co.uk
Textphone: 0870 240 3701

TSO@Blackwell and other Accredited Agents

Published with the permission of the Department for Communities and Local Government on behalf of Her Majesty's Stationery office.

ISBN 9780117540934

Any enquiries regarding this publication should be sent to us at
Dept for Communities & Local Government
Eland House
Bressenden Place
London
SW1E 5DU.

Printed in the United Kingdom by The Stationery Office

J002728426 C2 04/13 28651

Contents

SECTION 1

GRA 2.1 Rescues from confined spaces
2.1.4 collapsed stuctures

Scope

This generic risk assessment relates to the foreseeable hazards and risks associated with collapsed structure incidents attended by Fire and Rescue Authorities. It provides a starting point for Authorities to undertake their own assessments within the context of local conditions and existing organisational arrangements.

Depending upon the circumstances, buildings of the same class and type of construction may collapse in different ways. Collapsed structures may contain voids in which trapped persons can survive for comparatively long periods of time. To understand where these refuges may occur, it is necessary to be aware of the characteristics of various types of construction. Structures may be divided into the four classes below.

Framed buildings

The structural load in these buildings, ie the floors and roof, are supported by a skeleton or frame of steel or reinforced concrete. This type of construction is generally encountered in modern public buildings, eg office blocks and hospitals. Framed buildings have a greater resistance to collapse and structural failures tend to be more localised.

Unframed buildings

In these buildings the walls support all of the structural loads. This is the traditional form of construction in the United Kingdom. Walls support floors and roofs, and a traditional brick and joist structure is usual. If the load bearing walls fail along with columns or floor beams, the result can be an extensive collapse generating significant amounts of debris. Voids and spaces can be formed by the support of strong structural members, machinery and even furniture.

Structures other than buildings

Many structures lie outside the category of ‘buildings’, for example:

- bridges
- monuments
- tunnels

- piers
- railway infrastructure
- leisure facilities and stadia.

The collapse of such structures will require specific assessment, however, the principles contained within this generic risk assessment will still apply.

Temporary structures

Fire and Rescue Authorities must also consider the risk posed by temporary structures, for example:

- scaffolding
- fair grounds
- cranes
- temporary stands at events, particularly where large numbers of the public are present.

Buildings under construction or demolition also pose specific risks that Fire and Rescue Authorities will need to assess.

This generic risk assessment will be reviewed for its currency and accuracy three years from date of publication. The Operational Guidance Strategy Board will be responsible for commissioning the review and any decision for revision or amendment.

The Operational Guidance Strategy Board may decide that a full or partial review is required within this period.

Significant hazards

Environmental conditions – unsafe structures

Most structural collapses occur due to a loss of stability, in that the basic shape and integrity of the structure is significantly changed due to being subjected to a combination of forces. The newly altered structure/shape is less capable of supporting the forces and loads imposed upon it. The structure continues to change until it finds a new shape that is more stable. Structural collapse can follow a number of generic patterns, each with its own hazards and likely areas for survivors to be found. Collapse patterns can be categorised as: internal, external or total collapse.

INTERNAL COLLAPSE

Types of collapse in this category include:

PANCAKE COLLAPSE

There is a failure in load bearing walls or an upper floor fails and falls horizontally (or pancakes) on to the floor below. The added weight causes this and subsequent floors to fail and fall to a lower level (not always to ground level). Pancake collapse is sometimes referred to as progressive collapse and mistaken for total collapse.

LEAN TO COLLAPSE

A supporting wall, column or beam fails at one end. Triangular voids are created beneath and can offer refuge for occupants.

'V' COLLAPSE

Heavy loads from above cause a collapse at a given point of a floor level. The excess load causes the point to fail in the middle. This creates triangular voids that can act as safe havens.

TENT COLLAPSE

Structural supports fail near the outer walls but remain in-situ on the interior load-bearing element.

EXTERNAL COLLAPSE

Types of collapse in this category include:

90º ANGLE COLLAPSE

A wall falls outwards to a distance that is at least equal to its height. Debris will spread as the wall hits the ground.

CURTAIN FALL COLLAPSE

Much like a curtain cut loose at the top; walls collapse straight down and create a rubble pile near the base of the wall.

INWARD/OUTWARD COLLAPSE

Walls crack horizontally in the middle. The top half usually falls inwards and the lower half outwards.

TOTAL COLLAPSE

This is the most severe form of structural failure and occurs when all the floors have collapsed to the ground or basement level and all walls have collapsed onto the floors.

Causes of collapse

Often a collapse will be as a result of more than one mechanism, eg a building with a structural defect being subjected to a fire will increase the likelihood of failure and collapse. It is important that both the mechanism of structural failure and any indicative signs are identified as they may indicate if further collapses are possible. This information must be included in all risk assessments and may affect the rescue tactics employed. Reasons for structural collapse include, but are not limited to:

FIRE

The effects of a fire may weaken floors and supporting columns, push out walls through the expansion of steel beams, whilst water used in firefighting may increase the imposed load on a building. A steel structure although left standing after a fire can be significantly weakened.

EXPLOSION

This mechanism of collapse can be sub-divided into three main categories:

Category 1: Ignited gas or vapour explosion

Leaking gas can reach an ignition source and ignite with explosive force creating an over-pressure within the building.

Category 2: Explosion due to fire

Flammable substances (dust explosion, detonation, backdraught etc) involved in a fire can ignite with explosive force.

Category 3: Explosives

Can cause collapse or partial collapse of a structure as with the Grand Hotel bombing in Brighton or the bombing of the Murrah Building in Oklahoma City.

Explosives, when detonated, create a shockwave, consisting of highly compressed particles of air that cause most of the damage to structures. If the explosion originates from within the building the resultant over-pressure blows away floor, roof and wall panels and may even damage structural steel elements to an extent that a progressive collapse occurs.

In the case of an exterior explosion, the shockwave is reflected and amplified and then penetrates through openings, subjecting wall and floor surfaces to great pressures. The shock wave propels debris at very high velocity and, in a large explosion, may cause high intensity short duration ground shaking. In some cases of blast damage the building may collapse in an outward direction where debris will be spread over a wide area diminishing in density moving further away from the centre of the blast. In these circumstances there is the potential for casualties to be buried some distance away from the building.

STRUCTURAL DEFECTS

Inherent design defects can cause weaknesses to parts of a structure which may subsequently fail if stresses are applied, eg: fire, abnormal weather conditions or abnormal loading such as heavy machinery. A building under demolition or renovation may collapse if too many load bearing walls or floors are taken out without consideration to the effects on the other structural elements.

Equally, sub-standard materials used in construction or poor workmanship during the construction phase can result in a building that is substantially weaker than intended; increasing the likelihood of collapse should the building be exposed to additional forces.

GEOLOGICAL EFFECTS

Geological weakness may cause buildings to collapse through movement of the strata on which the foundations are laid, eg earthquakes, subsidence etc. This movement can place excessive stress on a structure overloading it and causing collapse.

Alternatively, the ground on which the building is constructed may weaken to such an extent that it is unable to support the weight of the building. Liquefaction, where the water content in the soil increases to such an extent that the soil loses all cohesiveness and strength and the building literally sinks into the ground, is the most common form of failure.

EXTREME WEATHER CONDITIONS

Mechanisms such as very high wind speeds may exceed the ‘designed limits’ of the building. Wind forces exert themselves on the exterior of a building; pressure on the windward face, suction on the leeward face, and lifting forces on the roof.

Severe flooding, particularly where the building is inundated by flowing water, causes similar pressure and can also act on the foundations.

Heavy rainfall may also cause flooding in confined spaces and air pressure can have an effect on the motion of gasses.

High winds may affect insecure building sections in precarious positions.

Wind and water can project items against the structure – further weakening it and increasing the likelihood of collapse. Snow and water lying on horizontal roof surfaces increases the imposed load on a structure and can be the cause of failure and collapse of the structure.

Severe weather conditions, such as ice, very low temperatures during snowfall or at nighttime, may increase the risk of hypothermia to casualaties.

TRANSPORT COLLISION

Many incidents have occurred where a form of transportation, eg: aircraft, road vehicle or train, has collided with a building or structure resulting in a partial or total collapse. The attack on the World Trade Centre in New York in 2001 demonstrates that this is not always as the result of an accident.

Associated hazards

Efforts to rescue casualties from a collapsed structure may expose rescuers to more dangers than are faced by those trapped within the structure. Rescue personnel must constantly observe all safety precautions to protect themselves from injury and be alert to any changes in conditions that may cause an additional threat to safety. They must also alert all team members of the dangers. The following are likely hazards that may be encountered at a collapsed structure incident:

MOVING/DEFECTIVE VEHICLES

The nature of structural collapse incidents may call for the provision of large numbers of front-line firefighting appliances in addition to specialist vehicles such as command and control units; urban search and rescue units; mass decontamination vehicles; high volume pumps.

It is essential that suitable and appropriate cordons and traffic management systems be employed at marshalling areas, rendezvous points and at the scene of operations to ensure the safety of personnel working within the inner cordon. Such vehicles may also include heavy plant, cranes etc that must only be operated by suitably qualified personnel in conjunction with an appointed assistant to guide and oversee operations.

LARGE NUMBERS OF PEOPLE

Depending on the nature and use of the structure concerned, large numbers of people may be exiting (or attempting to exit). As a consequence of their injuries and/or the stressful environment they find themselves in, these persons may be in an agitated or hostile state. Responding personnel must be mindful of this fact and assess the situation accordingly prior to the deployment of crews.

Circumstances of this nature may also have a detrimental effect on the initial information gathering process and create problems for the Incident Commander in obtaining the pertinent details from persons within the structure. Reference to site-specific risk information must be considered by way of assisting in verifying any information obtained by persons involved within the incident.

UNEVEN/SLIPPERY TERRAIN AND SURFACES

The nature of the working environment, coupled with environmental factors can give rise to potentially hazardous surfaces. Responding crews need to be mindful of the fact that visible surfaces may be unstable/slippery. In addition, other hazards such as excavations, potholes and trenches may be covered by debris.

FIRE/HEAT/SMOKE

In addition to the collapse element of the incident, responding crews will, in all likelihood be required to deal with fires and the associated by-products of combustion. Effective implementation of firefighting media and procedures must be considered in the initial phases of the incident to prevent further escalation and reduce the risk of fire spread, backdraught, flashovers, explosions etc.

FLAMMABLE/EXPLOSIVE ATMOSPHERES/HAZMATS

Flammable and explosive atmospheres may already exist in voids or may be created by leaking gas percolating through the debris and being ignited from unseen sources. Detectors for flammable and explosive atmospheres may be necessary. The contents of the structure may give rise to the presence of hazardous materials, therefore, the associated procedures and liaison with appropriate stakeholders and specialist officers may be required. Fire and Rescue Authority crews must also be aware of the potential for substances to combine and create additional further hazardous substances.

HEAVY DUST LOADS/AIRBORNE PARTICULATES

The nature of collapsed structure incidents will generate large quantities of dust; as a result of the collapse and/or as a consequence of search and rescue operations undertaken and the associated equipment utilised. Such dust may be inherently carcinogenic/hazardous and have the potential to travel off-site – particularly in inclement weather conditions. Consideration of the type and amount of such contaminants will inform the provision of appropriate personal protective equipment and respiratory protective equipment in addition to considerations for persons remote from the incident who may be affected by dust plumes.

DAMAGED UTILITIES

Gas, electricity and water services may be affected/damaged as a consequence of any structural collapse. This can create the potential for leaking gas, localised flooding and/or exposed electrical services to be present. Isolation of services must be considered in the early stages along with liaison with the appropriate agencies to provide advice and assistance. The list of utilities will depend on the building; a hospital for example may have piped steam / and/or oxygen. Unusual services such as these must be identified in the site-specific risk information and this must inform the Incident Commander.

UNSTABLE STRUCTURAL ELEMENTS

Search and rescue activities, movement of vehicles, use of equipment and secondary improvised explosive devices can all contribute to the potential for secondary collapse. Responding personnel must be mindful of the need to liaise with supporting agencies and Fire and Rescue Authority specialists in order to provide appropriate safe systems of work to enable operations to be undertaken in as controlled an environment as possible.

Provision of structural monitoring equipment can provide detail of structural movements. Shoring of such elements can reduce the risk of compromising fire and rescue personnel working in the vicinity.

EXPOSED SHARPS/PROTRUSIONS

Reinforcing bars within concrete and glass in windows/doors and similar openings may be exposed and create the potential for impalement injuries. Measures to identify and, if possible, remove such hazards must be implemented. If hazards of this nature cannot be removed, then the means to ensure sharps are covered and/or effectively highlighted must be employed.

MANUAL HANDLING ACTIVITIES

Such activities will include the provision and removal of equipment as well as the extrication of casualties. Appropriate training in manual-handling and team lifting techniques must be provided in addition to equipment that facilitates lifting and moving operations. Mechanical lifting aids must be utilised where appropriate and consideration must be given to the location of logistics areas/equipment dumps to reduce carrying distances as much as possible.

CASUALTY HANDLING ACTIVITIES

As well as the risk of musculoskeletal injuries resulting from inappropriate/incorrect manual-handling techniques; casualties may also expose fire and rescue personnel to bodily fluids as a result of their injuries. Fire and rescue personnel must be provided with inoculations as part of the service occupational health facility and adopt suitable procedures for casualty management purposes. Training and liaison with colleagues from hazardous area response teams and/or paramedic teams can assist in this process. Suitable personal protective equipment including gloves must also be utilised. Consideration must also be given to the potential for post-traumatic stress as a result of prolonged or profound exposure to victims of collapsed structure incidents.

CONFINED SPACES

Robust procedures need to be employed when working in confined spaces. Every effort must be made to obtain as much information about the environment as possible prior to committing personnel into such areas. Specified hazards as detailed in the *Confined Space Regulations* will dictate the nature and level of response. Fire and Rescue Authority crews can secure assistance from urban search and rescue, mines rescue service and mountain rescue teams.

WORKING AT HEIGHT

Only essential resources must be deployed at height and the provision of appropriate work positioning/fall arrest equipment provided. Fall zones for debris and/or equipment falling from height must be implemented, as must the requirement for all personnel to don the relevant personal protective equipment for the environment. Such equipment must include the provision of adequate head protection.

NOISE AND VIBRATION

Usually generated by rescue equipment and operations. Crew rotation is essential in order to reduce exposure, as is a robust means of monitoring and recording noise and vibration exposure. Suitably rated hearing protection must be provided and personnel must be encouraged to keep warm as this aids blood-flow and circulation which assists in reducing the effects of utilising vibration producing equipment.

IRRESPIRABLE ATMOSPHERES

Irrespirable atmospheres include areas which are oxygen deficient/enriched or which are contaminated by hazardous materials. Even when an atmosphere is considered to be safe it can quickly deteriorate and must be regularly monitored. It must also be remembered that exhaust fumes from appliances and portable pumps can make local atmospheres hazardous.

FLYING DEBRIS/SHARDS

Efforts to create access into a collapsed structure will necessitate the use of cutting equipment. Such operations will produce debris, sparks and dust which may create additional hazards if not appropriately managed. Damping down techniques can be employed to reduce hazards of this nature; but all equipment must be appropriately guarded and utilised by suitably trained personnel wearing the appropriate personal/respiratory protective equipment.

PROTRACTED OPERATIONS

Collapsed structure incidents are, by their nature, both time and resource intensive. Suitable provision of relief crews and rotation of activities on-site will reduce the effects of fatigue and provide a means for personnel to maintain effective operational response capability over prolonged periods.

LARGE NUMBERS OF PERSONNEL

This can create difficulties in identifying roles and responsibilities on the incident ground. As such, all fire and rescue personnel must be suitably donned in the appropriate personal protective equipment to make them readily identifiable. Where relevant, appropriate tabards that accord with the *Fire Service Manual for Incident Command* must also be employed. Robust cordon management procedures must also be adopted to reduce the risk of freelancing and personnel deploying into areas of the incident that they may not be trained or equipped to deal with.

Key control measures

Planning

Planning is key to enhancing the safety of firefighters and others likely to be affected by Fire and Rescue Authority operations. Each Fire and Rescue Authority's integrated risk management plan will set standards and identify the resources required to ensure safe systems of work are maintained.

Each Fire and Rescue Authority must assess the hazards and risks in their area relating to this generic risk assessment. The assessment must include other Fire and Rescue Authorities areas where 'cross border' arrangements make this appropriate.

Site-specific plans must be considered for locations where the hazards and risks are significant and plans must take into account and specify any variation from the normal operational capability of personnel, appliances and equipment. In particular, recognition must be given to the physical and psychological pressures that an operational incident may apply to fire and rescue personnel.

Site-specific plans must include:

- levels of response
- relevant standard operating procedures
- tactical considerations, including rendezvous points, appliance marshalling areas and access points
- identification and, where necessary, the formal notification to person(s) responsible for the site of any Fire and Rescue Authority operational limitations
- consideration of additional specialist resources, eg urban search and rescue teams.

Planning is underpinned by information gathering, much of which will be gained through inspections or visits by fire and rescue personnel – for example, those covered by section 7(2)d and 9(3)d of the *Fire and Rescue Services Act 2004*.

Information must also be gathered and used to review safe systems of work from sources both within and outside the Fire and Rescue Authority, including:

- fire safety audits
- incident de-briefs
- health and safety events
- local authorities
- local resilience fora.

Involving others in planning is an effective way to build good working relations with partner agencies and other interested parties, such as site owners.

Fire and Rescue Authorities must ensure systems are in place to record and regularly review risk information and that any new risks are identified and recorded as soon as practicable.

Fire and Rescue Authorities must ensure that the information gathered is treated as confidential, unless disclosure is made in the course of duty or is required for legal reasons.

Planning, along with risk assessments and any relevant guidance, must be the basis for the development of standard operating procedures and the provision of suitable equipment.

Fire and Rescue Authorities must consider the benefits of using consistent systems and formats to record information from all sources. Consideration must also be given to how timely access will be provided to information to support operational decision-making.

Information needs will vary in proportion to the size and nature of the incident. The capacity of fire and rescue personnel to assimilate information will vary in relation to the complexity of the incident. Therefore, arrangements may need to be flexible and be based on more than one system.

Further guidance on planning can be found in the national guidance manual, Fire and Rescue Service Operational Risk Information, Section 10, *The provision of operational information system (PORIS)*.

http://www.gov.uk/government/uploads/system/uploads/attachment_data/file/5914/2124406.p

Competence and training

When formulating a competence and training strategy, Fire and Rescue Authorities must consider the following points:

- Ensure that systematic risk assessments for this type of incident are suitable and sufficient and that those tasked with carrying out the assessment and developing procedures are competent
- Ensure that personnel are adequately trained to deal with hazards and risks associated with this generic risk assessment
- The level and nature of training undertaken must be shaped by an informed training needs analysis that takes account of Fire and Rescue Authority guidance on the competency framework, national occupational standards and any individual training needs
- Training and development programmes must:
  - follow the principles set out in national guidance documents
  - generally be structured so that they move from simple to more complex tasks and from lower to higher levels of risk

- typically, cover standard operational procedures as well as ensuring knowledge and understanding of equipment and the associated skills that will be required to use it
- consider the need for appropriate levels of assessment and provide for continuous professional development, to ensure maintenance of skills and to update personnel whenever there are changes to procedure or equipment, etc
- include personnel involved in other processes that support the emergency response, such as planners devising procedures and people procuring equipment
- consider liaison with Fire and Rescue Authority urban search and rescue teams and subject matter advisers.

Command and control

The Incident Commander must be guided by the principles of the current national incident command system. Prior to committing personnel into any hazard area, the Incident Commander must take account of the actual information that is available at the time about the incident to make operational decisions in what are recognised as sometimes dangerous, fast-moving and emotionally charged environments.

Communication of new or changed risks must continue throughout the incident.

There must also be cognisance of the fact that a national Fire and Rescue Authority urban search and rescue capability with the personnel and equipment trained to respond to collapsed structure incidents is available. Such resources align with existing command and control protocols and follow a defined series of procedures in accordance with six distinct phases of a collapsed structure incident – referred to by the acronym REPEAT:

R	**RECONNAISSANCE AND INITIAL SCENE SURVEY** This phase is concerned with the identification of hazards, information gathering, and introduction of control measures, assessment of assistance and resources required and the application of the incident command system. This phase would normally be completed by the attending Fire and Rescue Authority pre-determined attendance, prior to the arrival of urban search and rescue resources but can be undertaken in conjunction with an urban search and rescue subject matter adviser if requested.
E	**ELIMINATION OF UTILITIES** This phase is concerned with the controlling and isolation where required of gas, water and electricity supplies to the incident location – as identified during the reconnaissance and initial scene survey phase.
P	**PRIMARY SURFACE SEARCH AND CASUALTY EXTRICATION** This phase is concerned with the prioritising and removal of any casualties immediately visible and accessible during the initial stages of an incident. The preference is to avoid the need to commit fire and rescue personnel to the rubble pile unless absolutely necessary. As such, efforts must be made to direct persons from the scene of the incident via a safe egress route. If it is deemed necessary by the Incident Commander to commit firefighters into the incident, they must proceed with caution as the removal/disturbance of any debris could cause areas to become unstable. Furthermore, personnel moving over a rubble pile may impact on persons buried deep within it. If personnel are committed, the minimum number required must be employed. In all instances, searches must be methodical to ensure all accessible areas are covered. If any doubt to the stability of the structure exists, Incident Commanders must refrain from committing personnel into the incident and await specialist urban search and rescue advice/intervention. This phase can also be carried out by the attending Fire and Rescue Authority pre-determined attendance (allowing for the controls discussed). As a minimum, fire and rescue personnel must gather information on the location of any trapped persons and pass this to the Incident Commander for dissemination to urban search and rescue resources on arrival.
E	**EXPLORATION OF VOIDS** This phase is concerned with the committing of urban search and rescue personnel into existing areas and areas created by the nature of the collapse. Such operations are conducted by specialist urban search and rescue personnel although host Fire and Rescue Authority personnel can assist in providing equipment to the scene of operations. The purpose of such tasks is to locate and extricate surviving casualties, prior to having to employ additional measures to create access/egress.
A	**ACCESS VIA SELECTIVE DEBRIS REMOVAL** This phase is concerned with specifically adopted tasks and operations implemented in order to create additional access/egress into a collapsed structure. Operations may include breeching and breaking of walls, removal of large slabs or elements of structure in order to gain access to trapped persons.
T	**TERMINATION OF THE INCIDENT** This phase is concerned with concluding an incident via the use of cranes and similar heavy plant machinery. Any debris removed during this phase must be removed vertically, so as to reduce the risk of disturbing any existing voids and creating further collapse. Consequently, any trapped persons still within the incident will have a greater chance of survival during this phase. Rescue teams must still be on standby during this phase in order to access any previously undiscovered voids. It is important to note that as far as is reasonably practicable, Incident Commanders must be satisfied that all has been done to ascertain that the area being cleared during this phase is clear of any trapped persons and that the debris being removed is done so in order to create better access to other areas, or to clear an incident. If any doubt exists as to the possibility of the presence of any trapped persons, measures must be taken to ensure the minimum amount of disturbance of the scene in order to safeguard anyone who may still be trapped below the surface.

In addition, the Incident Commander must be aware of the need to instigate and request command support from a variety of sources:

Safety Officers

The early appointment of one or more Safety Officer(s) will assist in supporting a tactical plan to address risks so they can be eliminated or reduced to an acceptable level.

A safety decision-making model must be used to brief Safety Officers regarding the nature of the incident, the allocated task and prevailing hazards and risks. The Incident Commander must confirm that the Safety Officer understands:

- their role and area of responsibility
- allocated tasks
- lines of communication
- current information about hazards and risks.

Those undertaking the Safety Officer role must:

- be competent to perform the role
- ensure fire and rescue personnel are wearing appropriate personal protective equipment/respiratory protective equipment
- monitor the physical condition of fire and rescue personnel and/or general or specific safety conditions at the incident, in accordance with their brief
- take any urgent corrective action required to ensure safety of personnel
- update the Incident Commander or senior safety officer regarding any change in circumstances
- not be engaged in any other aspect of operations, unless required to deal with a risk critical situation.

The role of a Safety Officer can be carried out by any of the Fire and Rescue Authority roles, but the complexity of the task, size of the incident and scope of responsibility must be considered by the Incident Commander when determining the supervisory level required.

Safety Officers must wear nationally recognised identification to indicate that they are undertaking the Safety Officer role.

Fire and Rescue Authorities must ensure that training and other measures (such as aide-memoires) are in place and available to support those staff liable to undertake this role.

Urban Search and Rescue Subject Matter Adviser

Urban Search and Rescue Subject Matter Advisers (SMAs) are personnel from Fire and Rescue Authorities who have been identified as having the relevant skills and knowledge to enable them to provide tactical advice and operational planning assistance to an Incident Commander and/or the nominated support officers at Silver or Bronze levels at

incidents involving structural collapse. Such personnel may also offer support and detailed capability advice as part of the *National Coordination and Advisory Framework* in response to level 4 (major) incidents.

The Incident Commander must consider:

- requests for urban search and rescue teams and local authority building control officers
- establishing safe cordons around the site to control operations
- briefings for all crews on hazards and control measures
- designating areas for emergency teams/reliefs etc
- requests for specialist personnel from the national urban search and rescue capability
- liaison with other agencies.

Personal protective equipment

Fire and Rescue Authorities must ensure that all personal protective equipment provided is fit for purpose and meets all required safety standards. When choosing suitable protective garments, the standard of clothing worn beneath the specialist personal protective equipment must also be taken into account. Consideration must also be given to the selection of suitable sizes and gender specific requirements.

Personal protective equipment must also take account of the need for rescuers to be visible against the operational background including night working and for the Incident Commander and other managerial and functional roles (defined in the national incident command system) to be distinguishable.

All fire and rescue personnel must use appropriate levels of Fire and Rescue Authority provided personal protective equipment and respiratory protective equipment as determined by the safe system of work.

Post-incident considerations

The following measures must be considered to assist in eliminating or removing risks, as appropriate to the nature and scale of the incident:

- Any safety event, near misses, personal injuries, exposure to hazardous substances etc must be recorded, reported and investigated in accordance with legislative requirements
- Arrangements must be in place to either remove all contamination from personal protective equipment or ensure its safe and appropriate disposal. Checks must also be made to ensure the equipment maintains the required levels of integrity
- Occupational health to conduct any post incident follow up as dictated by local policies and procedures

- Conduct a debrief to identify and record lessons learned from the incident. Debriefs will range in size, complexity and formality and be proportionate to the incident and in accordance with Fire and Rescue Authority procedures
- Consider any changes to procedures, safe systems of work, equipment etc following the outcomes from the debrief and/or safety investigations
- Consider reviewing site-specific risk information or the need to add detail as part of future emergency planning protocols
- Consider arranging for staff to make a contemporaneous written record of their actions. This information may be used to assist in any internal or external investigations or enquiries that follow any incident eg Coroner's Court, public enquiry, etc
- Staff to be supported and monitored to check for adverse effects. Provision of counselling may also be required.

Technical references	
1	Urban Search and Rescue in Collapsed Structures (International Fire Service Training Association)
2	Structural Collapse and Urban Search and Rescue Operations
3	First Addition – Fire Protection Publication
4	Fire & Rescue Service Circular 55-2004 8 December 2004
5	Fire & Rescue Service Circular 69/2008 23 December 2008

SECTION 2 – Summary of Generic Risk Assessment 2.1

Rescues from confined spaces
2.1.4 collapsed structures

Initial response activities

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
1.1	Responding to incident	Moving vehicles/other road users Defective vehicle	Impact/collision with other road users and/or traffic furniture	Fire and rescue personnel Other emergency personnel Public	Information, instruction and training for emergency response drivers Local procedures for emergency response Appropriate road speed for the conditions Appropriate use of visible and audible warning devices Assistance from partner agencies/Police Service with traffic control GRA 1.1 Emergency response and arrival at the scene.

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
1.2	Initial attendance	Large crowds and/ or groups of hostile persons	Public disorder and/or violent and aggressive actions towards responding crews	Fire and rescue personnel Other emergency personnel	Fire and Rescue Authorities' procedures for civil disturbances Dynamic risk assessment of the situation and need for response Police Service to assist with crowd management Clearly defined cordons Appropriate personal protective equipment including helmets and visors.
1.3	Personnel dismounting vehicles	Vehicle layout, steps, doors etc	Slips, trips and falls Impact with vehicles and/or vehicle furniture	Fire and rescue personnel	Fire and Rescue Authorities' risk assessment policies, procedures and supervision Consideration to location and parking of vehicles on arrival.
1.4	Positioning vehicles	Vehicles/demountable units in close proximity to persons within the outer cordon	Impact/collision with service vehicles	Fire and rescue personnel Other emergency personnel Public	Vehicle manoeuvres to be supervised by driver's assistant Fire and Rescue Authorities' policies and procedures for reversing of appliances and/or slow manoeuvre activities Safety Officers.

Reconnaissance and initial scene survey

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
2.1	Movement around incident ground	Uneven/slippery surfaces	Slips, trips and falls	Fire and rescue personnel Other emergency personnel	Fire and Rescue Authorities' dynamic risk assessment policies, procedures and supervision Scene lighting Safety Officers Personal protective equipment to include suitable footwear for the conditions.
2.2	Assessment of scene	Fire/heat/smoke Presence of hazardous materials Heavy dust loads	Irrespirable atmospheres Secondary fires/ explosions Backdraught/flashover	Fire and rescue personnel Other emergency personnel Public	Information, instruction and training in breathing apparatus and associated procedures. Suitable cordons to be established Fire and Rescue Authorities' standard operating procedures for firefighting and associated operations Hazardous materials/chemical, biological, radiological, nuclear, explosive procedures and guidance Fire and Rescue Authorities' personal/ respiratory protective equipment to consider breathing apparatus/airline/respirators.

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
2.3	Information gathering	Incorrect/insufficient information obtained Casualties	Ineffective/inappropriate tactics employed Fire and rescue personnel self deploying	Fire and rescue personnel	Site specific risk information CHALETs messages to act as aid memoire Dynamic risk assessment and analytical risk assessment procedures Full brief to all crews prior to deployment in to the incident.

Elimination of utilities

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
3.1	Isolating services/utilities	Leaking gas Exposed electrical services Leaking water	Asphyxiation Irrespirable atmosphere Secondary fires/ explosion if ignition source present Excavations/openings being covered	Fire and rescue personnel Other emergency personnel Public	Site-specific risk information Full brief to all crews prior to deployment in to the incident Controlled movement of personnel.
					Dynamic risk assessment and analytical risk assessment procedures Fire and Rescue Authorities' standard operating procedures for firefighting and associated operations Use of gas monitoring equipment Provision and use of self-contained breathing apparatus/airline if appropriate.

Primary surface search and casualty extrication

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
4.1	Movement on or around the rubble pile/scene of operations	Uneven/slippery surfaces Heavy dust loads Moving or displaced rubble/structural members Exposed sections of rebar, glass and similar penetrative elements of construction	Slips, trips and falls Irrespirable atmosphere/asphyxiation Secondary collapse Impalement injuries	Fire and rescue personnel Other emergency personnel Public	Information, instruction and training in collapsed structure incidents Safe access/egress routes to be identified and clearly marked Liaison with on scene specialist assistance, eg urban search and rescue teams/urban search and rescue subject matter advisers; structural engineers Exposed elements to be removed or clearly marked Coordinated movement of personnel Consider use of sharps protection equipment Use of building scene assessment equipment Provision of shoring equipment Pre-determined evacuation signal Safety Officers Fire and Rescue Authorities' personal/respiratory protective equipment to consider self-contained breathing apparatus/airline/respirators.

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
4.2	Provision of equipment to scene of operations	Manual handling activities	Musculoskeletal injuries	Fire and rescue personnel	Information, instruction and training in manual handling procedures and assessment Team lifting operations to be employed where appropriate Consideration to type and amount of equipment required to facilitate rescue operations Forward logistics areas/equipment dumps to be suitably located to minimise carrying distances Consider use of mechanical lifting aids where appropriate Rotation of personnel to reduce fatigue.

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
4.3	Extrication of casualties from the scene of operations	Manual handling activities Presence of bodily fluids Presence of sharps within medical equipment Agitated/distressed casualties Multiple casualties	Musculoskeletal injuries Biohazard contamination/infection Verbal/physical assault to personnel Prolonged/repeated exposure to traumatic situations Post-traumatic stress	Fire and rescue personnel Other emergency personnel Public	Information, instruction and training in manual handling procedures and assessment Team lifting operations to be employed where appropriate Information, instruction and training in first aid and casualty handling procedures Hazardous area response team personnel/ paramedics to provide clinical care and assessment Appropriate inoculations, eg tetanus, hepatitis B Fire and Rescue Authorities' biohazard equipment and procedures Emergency decontamination procedures Consider use of mechanical lifting aids/ stretchers where appropriate Rotation of personnel to reduce fatigue Training/liaison with hazardous area response team/paramedic personnel Personal protective equipment No fire and rescue personnel to administer injections/drugs to casualties Rescue teams to consist of at least two personnel Occupational health provision

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
					Post incident debriefs Monitoring and recording of incident exposure levels Provision of post incident counselling.
4.4	Scene monitoring	Secondary collapse Heavy dust loads	Entrapment injuries Fatalities	Fire and rescue personnel Other emergency personnel	Structural monitoring equipment Liaison with on scene specialist assistance, eg urban search and rescue teams/urban search and rescue subject matter advisers; structural engineers Fire and Rescue Authorities' personal/ respiratory protective equipment to consider self-contained breathing apparatus/airline/ respirators Periodic updates on status to be recorded.

Exploration of voids

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
5.1	Provision of equipment to scene of operations	Manual handling activities	Musculoskeletal injuries	Fire and rescue personnel Other emergency personnel	Refer to controls at 4.2.
5.2	Technical search operations	Large numbers of personnel	Inability to triangulate casualty locations	Public	Use of urban search and rescue canine search teams Audio/visual technical search equipment Only essential personnel to be within scene of operations.

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
5.3	Accessing confined spaces	Toxic/flammable vapours Free flowing liquids/ solids Oxygen deficiency/ enrichment Extreme temperatures Fire/explosion	Entrapment injuries Drowning Asphyxiation Heat exhaustion/heat stress Hypothermia Claustrophobia	Fire and rescue personnel Other emergency personnel Public	Fire and Rescue Authorities' training and procedures for confined space operations Urban search and rescue procedures for confined space operations Provision and use of gas monitoring equipment Ventilation equipment Safety officers and/or designated supervisory officers to oversee confined space operations Effective communications Only essential personnel to be committed in to confined spaces Liaison with on scene specialist assistance, eg urban search and rescue teams/urban search and rescue subject matter advisers; structural engineers Rescue teams to consist of at least two personnel.

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
5.4	Working at height	Falls from height Falling equipment/debris	Fatalities Impalement injuries Impact injuries	Fire and rescue personnel Other emergency personnel Public	Fire and Rescue Authorities' training and procedures for working at height operations Safety Officers and/or designated supervisory officers to oversee working at height operations Effective communications Only essential personnel to be committed to work at height Only essential equipment to be taken aloft Fall zones to be clearly identified and appropriately cordoned Lanyards for equipment.
5.5	Extrication of casualties from the scene of operations	Manual handling activities Presence of bodily fluids Presence of sharps within medical equipment Agitated/distressed casualties	Musculoskeletal injuries. Biohazard contamination/infection Verbal/physical assault to personnel	Fire and rescue personnel Other emergency personnel	Refer to controls at 4.3.

Access via selective debris removal

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
6.1	Provision of equipment to scene of operations	Manual handling activities	Musculoskeletal injuries	Fire and rescue personnel Other emergency personnel	Refer to controls at 4.2.
6.2	Breeching and breaking/ space creation operations	Heavy dust loads Noise Vibration Moving structural members Moving parts on equipment Flying shards/debris cast off from equipment and structural members Electrical services Suspended structural elements Irrespirable atmospheres due to presence of hazmats; leaking gas and/or oxygen enrichment/ deficiency.	Respiratory distress/ asphyxiation Noise induced hearing disorders Inability to hear warning/ evacuation signals Hand arm vibration syndrome Secondary collapse Entanglement Cuts/contusions Electrocution Entrapment/crush injuries	Fire and rescue personnel	Information, instruction and training in specialist equipment use Rotation of crews to reduce exposure Noise and vibration management systems to record exposure levels and duration Safety Officers Use of building scene assessment equipment Liaison with on scene specialist assistance, eg urban search and rescue teams/urban search and rescue subject matter advisers; structural engineers Provision of shoring equipment Pre-determined evacuation signal Fire and Rescue Authorities' personal/ respiratory protective equipment to consider self-contained breathing apparatus/airline/ respirators Monitoring equipment to locate concealed/ buried cables Provision and use of gas monitoring equipment.

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
6.3	Extrication of casualties from the scene of operations	Manual handling activities Presence of bodily fluids Presence of sharps within medical equipment Agitated/distressed casualties Multiple casualties	Musculoskeletal injuries. Biohazard contamination/infection Verbal/physical assault to personnel Prolonged/repeated exposure to traumatic situations Post-traumatic stress	Fire and rescue personnel Other emergency personnel Public	Refer to controls at 4.2.
6.4	Accessing confined spaces	Toxic/flammable vapours Free flowing liquids/ solids Oxygen deficiency/ enrichment Extreme temperatures Fire/explosion	Entrapment injuries Drowning Asphyxiation Heat exhaustion/heat stress Hypothermia Claustrophobia	Fire and rescue personnel Other emergency personnel Public	Refer to controls at 5.3.
6.5	Working at height	Falls from height Falling equipment/debris	Fatalities Impalement injuries Impact injuries	Fire and rescue personnel Other emergency personnel Public	Refer to controls at 5.4.

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
6.6	Deployment of specialist resources/personnel	None specialist crews freelancing with specialist equipment	Injuries to personnel	Fire and rescue personnel	Only appropriately trained and competent personnel to operate specialist equipment; eg hot cutting; breeching and breaking; shoring; chainsaws; technical search equipment Any specialist teams to accord with Fire and Rescue Authority incident command system principles and operations overseen by the Incident Commander or appointed delegate.
6.7	Protracted incident	Prolonged/repeated deployment of personnel	Fatigue Heat exhaustion Heat stress Stress	Fire and rescue personnel	Rotate and/or relieve crews.

Termination of incident

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
7.1	Deployment of heavy plant/machinery to clear rubble	Moving vehicles Suspended structural elements	Impact/collision with other road users and/or traffic furniture Secondary collapse	Fire and rescue personnel Other emergency personnel Public	Vehicle routes, movements and activities to be appropriately supervised Lifting operations to be assessed, planned and supervised.

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
7.2	Making up equipment	Uneven/slippery surfaces Manual handling activities	Slips, trips and falls Musculoskeletal injuries	Fire and rescue personnel Other emergency personnel	Fire and Rescue Authorities' dynamic risk assessment policies, procedures and supervision Scene lighting Safety Officers Personal protective equipment to include suitable footwear for the conditions Refer to controls at 4.2.