

**Recovery from  
Terrorist CBR attack**

**London  
Underground**

**Module 5**

**Biological attack**

## **Module 5**

### **5.01 Introduction**

This module looks at the specific threat from biological contamination only, emanating from a terrorist event where platform & public access areas have been intentionally contaminated. The module excludes trackside decontamination which is found in module 4. Public or passenger decontamination is also excluded.

#### **Overview.**

The decontamination will be undertaken following total evacuation & isolation of the affected areas & local containment or removal of source materials where possible. *See modules 2 & 12*

### **5.02 Facility problems**

The natural ventilation & difficult access of the stations, especially section 12 deep level areas, pose various problems regarding decontamination. This includes the large areas involved together with the need for efficient & safe works. Typical problems include;

- Limited access from the street
- Limited electric outlets to public areas in terms of power supply
- Natural ventilation causing spread throughout the network
- Extensive Ceiling voids
- Substantial pre existing dirt & debris reservoirs in non visible areas
  
- **Initial Facility solutions**
- Utilise the natural but controlled ventilation to prevent leakage
- Utilise the substantial line power supply network

### **5.03 Hypothesis for clearance**

It must be assumed in the absence of proof to the contrary, that contamination would have spread via environmental & natural ventilation systems. Clearance will depend on substantial clearance protocol to be established.

There is therefore a reasonable requirement to either decontaminate or isolate all potentially affected areas. All decontamination should follow a protocol which results in compliance of clearance protocol. In any event, disturbed air sampling is essential. The decontamination protocol must therefore be designed to fulfil HSE clearance hypothesis which at present is unknown.

### **5.04 Specific Risk & Hazard assessment**

The hazard already established or considered will be seen as airborne. Therefore the air as a transport medium requires scrubbing to remove free floating contaminants.

### **5.05 Initial Response**

The affected station must where possible be contained to prevent contamination from the initial site travelling to secondary locations. This can be achieved by the erection of barriers to the entry & exit tunnel points. Inflatable balloons can quickly be installed with the aid of compressed air from either tanks or compressor. To reduce all potential exposure to the decon team a knockdown procedure will be followed to reduce or destroy all surface & accessible contaminate.

This takes the form of a thermal fog introduced by pulse jet equipment. The fog containing a compound of both wetting agents & hydrogen peroxide will be utilised. The hot fog will continuously expand to fill all voids & cool to condense where dwell & surface contact will be improved.

### **5.06 Chemical Efficacy**

While many toxic biocides are available most will create problems regarding residue or have intrinsic application problems such as temperature, humidity, or deactivation by organic material, (*dirt*). Equally extended dwell periods may be required to penetrate & denature contaminates. The procedures & materials provided in *modules 12 & 13* take these issues into account.

### **5.07 Primary Controls**

Due to the constant & continual air flow found in underground systems there is a requirement to prevent secondary contamination from occurring. This may be from the push, pull effects of trains within tunnel complex or from the venturi action of ventilation shafts. Substantial Negative air pressure with Heppa filtration coupled to sealing off flow routes is recommended. *See temporary shrink wrap.*

### **5.08 Secondary Controls**

There is a need to move & collect all loose & air transportable contaminated particulates. Laminar air movement is seen as the most effective solution to this, coupled to substantial collection & filtration devices..

### **5.09 Vacuum extraction**

Three methods of collection are envisaged.

1. The use of large Heppa air scrubbers located at the lowest point of the affected area. Power will be provided from the line network. Equipment delivered by train. (*module 12*)
2. A specially constructed train carriage module as described in module12.

### **Note.**

Train specific equipment must be engineered as a proactive measure & made available on any line or subsequent equipment manufactured for use on other lines where line transfer is impossible. This equipment is modified from existing rolling stock.

### **Laminar air movement**

Air will be forced from the uppermost accessible area to flow in laminar streams to be collected by the vacuum extraction. Turbulent air streams will be introduced to void or dead spots. (*See module 12.*) The air movement will be created either by water powered fans utilising water hydrant power, or electric fans installed at the station entrance & powered by mobile generators.

### **5.10 Decontamination**

Successful decontamination of biological agents depends on contact of a suitable agent or source removal. (cleaning). Three types of surfaces are considered for decontamination;

1. Hard non porous
2. Porous
3. Entrapped & soft finishes

In any event cleaning & source removal is always the most effective & sometimes the only method of decontamination.

#### **substrate**

- o Hard non porous include painted surfaces, laminates, glazed tiles, metallic finishes.
- o Stone, brickwork, concrete.
- o Fabrics, dirty surfaces, carpets etc.

#### **Level 1**

Clearly cleaning to such a large complex coupled to likely time constraints may make this impracticable. The application of either wet biocidal spray's, thermal or wet fogging techniques, coupled to foaming agents with prolonged dwell & contact time can however be considered. The relatively clean condition of most visible surfaces may facilitate this operation.

#### **Level 2**

Due to extensive pores & possible reservoirs these materials are best treated with foaming agents to prevent run off & allow adequate dwell periods.

#### **Level 3**

Soft & permeable materials should be considered for controlled waste disposal due to difficulty in decontamination & low values.

### **5.11 Void areas**

Where access is difficult or impossible, a temporary isolation, encapsulation or containment should be considered. This should take the form of an elastomeric film or encapsulate as described in (*section 13*) or physical barriers. Negative air pressure coupled to Heppa filtration are also considerations. This will enable the prompt clearance of contaminated areas but will require further & future decontamination under controlled conditions within an acceptable time frame.

### **5.12 Conclusion**

The requirement for urgent decontamination & public confidence in the safe re-commencement of service may depend on temporary measures to facilitate the reopening of stations. This may become a major concern where multiple sites are targeted or spread is confirmed. The limitations & availability of suitably trained & equipped decontamination teams may dictate the need for temporary solutions too.

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**Module 1**

**Risk & Hazard  
Assessments**

## **Overview.**

This assessment looks at the various component risk & hazard regarding possible contamination & clearance solutions coupled to the acceptable clearance risk of public safety.

From the initial incident a clear hypothesis of acceptable clearance must be established. From the scale of potential contamination & possible ongoing risk, total 100% clearance may not be possible, therefore due to the necessity of the network facilities being required a lesser acceptability may be required.

The following assessments considers the exposure to hazard & risk in various format.

### **1.00 Human risk**

- LU employees
- Passengers
- Decontamination team

The need for LU employees to be onsite during both evacuation & decontamination is essential. This is due to their ability to manage the evacuation & provide specific knowledge regarding the facility. In my opinion they are unlikely to be available, due to low calibre untrained or ill equipped confidence.

Passengers are likely to leave the scene whether affected or not, creating the potential; for secondary effects of cross contamination.

In any event the passenger exposure to contamination of the various potential weapons will result in casualties & in some events the prognosis for recovery is low. It is therefore essential to consider secondary exposure & subsequent health risks which would revolve around containment & decontamination.

Decontamination teams need to be fully equipped & on site quickly to prevent or control the potential for spread. The availability of even minor ppe, such as filter masks & disposable paper suits to don in the event of contaminated clothing being removed may be essential for post incident confidence of returning passengers.

### **1.01 Environmental risk**

- Apparent or visible risk
- Void or hidden
- Potential future risk.

Contamination may be in any form & may take days or weeks for effects to materialise. Clearly without an obvious incident there is possibility of attack being unknown to authorities, until symptoms develop. The requirement for total decontamination to allow stations or indeed the network to reopen may be impossible within acceptable time frames coupled to acceptable risk levels. Clearly a level of clearance may be required & this may be supported by the use of ppe by passengers following the re-opening of service. This need may be reduced due to continuing decontamination procedures out of hours during station closure or by the isolation or containment of possible contamination. There may be a potential for additional risk from transportable particulate becoming free & airborne at a later date. Therefore future controls, monitoring & passenger protective devices should be considered. This

may take the form of ppe or permanently installed Heppa air scrubbing equipment which should be passenger visible.

### **1.03 Contamination**

Chemical  
Biological  
Radiological

#### **Chemical**

Chemical attack may not be an issue for control or limitation due to it's effects which may be spontaneous or delayed. The various routes of body ingress, skin or inhalation make it's effects almost uncontrollable. Following an attack cleaning & decontamination should follow planned procedures & dispersal, dilution may reduce secondary effects although the primary or initial effects may be catastrophic. The quantity of agent coupled to access may be a limiting factor.

#### **Biological**

The type of agent may be critical in decontamination protocol. Two types are considered, transmittable or contagious or static such as spores. The former may be readily reduced by the evacuation of the premises although secondary infection is the major concern. This could result in epidemic & therefore control & containment followed by prophylactic care is essential. The means & mechanism of government measures are unknown to the author. The second risk is from dormant agents which may become active following ingestion or inhalation. Typically anthrax is considered.

Two risks are assumed, the primary affects of direct infection & the secondary risk from contaminated clothing & the possibility of affecting those not involved with the primary event.

Risk reduction procedures such as personal decontamination & prophylactic care are considered.

#### **Radiological**

While inhalation of irradiated particulate matter is the main concern the identification & subsequent decontamination is the easiest of all decontamination procedures. Affected persons will be confirmed by hospitals & again secondary irradiation by transportable particulates is a major concern. Removal of contaminated clothing at the scene is required & temporary lock down of contamination is required to prevent spread.

### **1.04 Clearance criteria**

Current  
Future

Passenger confidence in the safety of the network may be substantially reduced following an incident. Clearly there will be a priority requirement to prove

safety in the network use. This may be initiated from the observed response to any incident but subsequently from scientific independent evaluation of decontamination. The initial acceptable clearance may be issued however due to the potential for reservoirs hidden in ventilation systems, tunnels, cavities etc, the potential for re-contamination must be considered.

While ongoing works or indeed closure may be considered there will I believe be a requirement to re-open the network at the earliest possible, safe, opportunity. This may be dictated by government requirements but subsequent press or independent assessments may require ongoing monitoring to substantiate any safety statements.

### **Conclusion**

The potential hazard is high although the risk of attack may initially be assumed to be low. However in the event of any level of attack all assessments rise to the highest level. It is assumed that due to the potential of attack in any form or indeed at any location that government or local authority resources are low due to dilution from dispersal.. This may mean that due to delay, all risks become unmanageable & escalate. There is a clear need for contingency planning which should include the benefits of commercially available resources.

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**Module 8**

**Radiological  
Contamination Control**

## **8.00 Overview**

This module examines the control measures necessary to prevent the spread of radiological contamination following detonation of a dirty bomb. This module considers entrainment of contamination to station areas. Explosive devices internally are considered in module 3.

## **8.01 Typical incident**

A small explosive device with limited destructive potential is expected as the vector agent for distribution of contamination. In this outline, the explosion is considered externally of the station specifically & internal explosions are considered separately in module 3.

## **8.02 Health Hazard**

All radiation in its various forms is a health hazard, the proximity & dose to humans is the relevant factor in hazard assessment. Inhalation of radioactive particulate is in this particular event likely to result in lung cancer & little prophylactic care is possible, therefore prevention is essential if possible.

## **8.03 Hazard & Risk**

Respirable radioactive fallout of particulate matter is expected in the region of <15 micron. The fallout contamination in its various sizes is expected to remain airborne for some time due to both Brownian motion & transportation by air movement. Natural air movement will, where air speed is in excess of 5 mph dissipate the contamination & it is therefore essential to control & localise the particulate where possible.

This will result in a continuous risk to persons exposed. Secondary contamination vectors include the transportation by persons evacuating the hot zone from contaminated clothing. Risk reduction therefore depends on both personal decontamination & environmental control factors.

## **8.04 Objective**

Particulate matter will eventually settle & fall naturally, however its re launch must be prevented. Where particulates are airborne they must where possible be encouraged to fall to prevent inhalation. Radioactive particulate is readily identified by electronic counters but decontamination would be a long & laborious procedure & therefore control is essential to allow for planned action within acceptable time frames.

## **8.05 External Protocol**

### **a. external operations**

It is imperative that airborne contamination is brought down as quickly as possible. Rain may be a simple measure & the RAF may be required to instigate precipitation by cloud seeding to the upper atmosphere.

This would effectively wash the air. Falling radioactive particulate may therefore be washed into local drains which may be controlled by the waste water authority. This is seen as a trade off as drain contamination is preferable to human effects & is a problem which would materialise in any event.

Following this initial measure the streets & lower buildings must be washed by fire hoses.

The removal of all contamination is impossible & therefore containment is required to prevent re release of particulate following drying & air movement.

### **b. external controls**

Low pressure spray of a temporary lock down solution must be applied to all surfaces to encapsulate particulate. This solution must enable both effective lock in but be readily removable to enable future decontamination procedures. Liquid, water borne PVA should be introduced into the fire hose following the initial washing down. Application should ideally be from above & the use of building dry & wet risers in the locale should be considered with application through windows & roof access.

## **8.06 Station Internal protocol**

### **Overview**

Two types of control are envisaged either immediate or delayed, this may be dictated by the severity of the incident. Components of the assessment include passenger presence (c) or post evacuation. (d) section 8.07.

### **Passenger transience**

While the safety of passengers is paramount the reality is that without respiratory protection they may have already been exposed to inhaleable radiological particulate & therefore may be later casualties. Clearly there is need for passengers to be equipped with disposable particulate masks, issued prior to the event, (location)

either by train or station staff. Where this is considered un-acceptable for various reasons, substitute action must be considered either to reduce exposure or contamination spread.

### **8.07 Controls**

(c) As passengers evacuating an incident are unlikely to be controllable, limitation to exposure must be provided where possible. This can be accomplished by the use of wet fogging techniques to reduce the air loading of particulates. (*see modules 12 –13*)

(d) The application of a water or solvent based encapsulate which will continue to attract & trap particulate. This can be enhanced by the use of ionisation equipment which at low cost could be installed either pre or post incident. Air borne contamination reduction can also be increased with the use of Heppa or other air scrubbing techniques as previously described in other modules.

### **8.08 Conclusion**

The release of a dirty bomb would represent a significant health hazard from inhalation over a large area & for a long duration. The immediate & substantial response from the unified action of all possible sources must be considered to prevent the spread of contamination. Typically airborne contamination may travel hundreds of miles although possibly limited by content. Radioactive contamination is relatively easy to identify for decontamination purposes, the significant potential must be limited by urgent lock down & encapsulation procedures. This will provide limitation of the contaminated area & enable planned, controlled decontamination.

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**Introduction & reference  
document**

## **Introduction**

This document forms part of a series of possible solutions to the London underground system following the deliberate release of CBR *Chemical Biological or Radiological* agents. With the likely release of CBR contaminants at some point of time, the modules outline various contingency & response actions. The reality that those exposed to CBR incidents may be either casualties or terminally affected has been identified & exposure risk reduction is seen as paramount importance to control or limit exposure & secondary affects. The significant importance of the transport infrastructure is identified & subsequent controls to minimise closure & the need for decontamination is considered. The document is an overview only as the author has no access to official information or possible plans.

## **Module Set**

1. Risk & hazard Assessments
2. Isolated contamination & control procedures
3. Track & tunnel isolation & control
4. Track & tunnel decontamination
5. Platform & Public access areas control
6. Platform & public areas decontamination
7. Radiological decontamination specific
8. Radiological spread control procedures
9. Chemical incident decontamination
10. PPE & decontamination of employees
11. Clearance & public acceptance
12. Special equipment requirements
13. Chemical products utilised
14. Waste disposal