

ACDB5013 – Safety & Hazard Assessment

Risk Assessment & ALARP Justification

Risk assessment and ALARP justification statement covering the operation and firing of a 115mm large calibre weapon system in a trials environment.

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Part 1: Risk assessment for the firing of 115mm large calibre weapon system in a trials environment.

Reference Risk Matrix

v Likelihood/Severity >	Catastrophic	Critical	Marginal	Negligible
Frequent	A	A	A	B
Probable	A	A	B	C
Occasional	A	B	C	C
Remote	B	C	C	D
Improbable	C	C	D	D
Incredible	C	D	D	D

Task Highest Initial Risk Class: **A**

Task Highest Residual Risk Class: **C**

Likelihood Probabilities and Severity Consequences

Frequent – likely to occur more than 1 time in 1000 operations.	Catastrophic – Multiple employee fatalities, or single public fatality.
Probable – likely to occur between 1 in 1000 and 1 in 10,000 operations.	Critical – Single employee fatality or multiple employee injuries, or a serious public injury or multiple moderate public injuries.
Occasional – Likely to happen in between 1 in 10,000 and 1 in 100,000 operations.	Marginal – Single or multiple moderate employee injuries, or a single public moderate injury or several light public injuries.
Remote – Likely to happen in between 1 in 100,000 and 1 in a million operations.	Negligible – Any single mild injury or illness with no long term effects.
Improbable – Likely to happen in between 1 in a million and in 10 million times.	
Remote – Likely to happen less than 1 time in ten million operations.	

Risk Classes Explained

A	Unacceptable level of risk. Risk level must be reduced before any activities can commence or continue, without very exceptional circumstances.
B	Undesirable level of risk. Risk level should be reduced and activities can only commence or continue with justification from relevant authority.
C	Tolerable level of risk. Acceptable level of risk with provided proof that the risk is ALARP. Further controls should be applied if not ALARP.
D	Acceptable level of risk. Risk level is not necessarily ALARP, but the activity can commence without need for further mitigations.

This risk assessment details the key hazards that arise from the firing of a 115mm large calibre weapons system in a trials environment. Large calibre weapon systems are used in combat zones for a variety of reasons, and are required for use across a range of environments. As a result, the systems are heavy, mechanical plant with moving parts that pose a variety of hazards to the user, even in the controlled environment of a test and evaluation range. The addition of explosive articles to the system in the form of artillery shells adds a further set of hazards to a complex and high hazard environment.

This risk assessment will list the key credible hazards, the risk of the hazards materialising in to accidents if not suitably controlled, as well as listing all the controls and mitigations required during the activity to reduce the risk to a tolerable, ALARP level. These controls must be fully in place for the risk to be considered to be the level given in the residual risk column.

Hazard	Causes	Accident	Initial Risk	Controls/Mitigations	Residual Risk
1. Unplanned initiation of munitions during loading	Unplanned initiation due to the unintended input of shock, or due to exposure to flame or spark, or high levels of radiofrequency or electrostatic discharge (ESD).	Multiple fatalities and serious injuries caused by blast, heat and fragmentation effects of detonation.	Occasional Catastrophic Class A	- All trials begin with a specific brief delivered to all personnel, containing information on all credible hazards and which mitigations are in place. - Contraband combustible materials are to be kept out of the danger area at all times. - No munitions other than the specific munition required for the next firing is to be present at the weapon danger area to avoid sympathetic detonation. - Spark producing items are forbidden in areas where explosives are likely to be present. - Weapon system is subject to frequent electrical testing and the circuit is tested before any firings take place to search for electrical faults that could cause unintended ignition of a munition. - Munitions will not come in to contact with live electrical sources - If there is no requirement for the munition under test to be live,	Improbable Catastrophic Class C

				practice or drill rounds should be used in place. - Non-ferrous tools are the only tools permitted for assistance with loading. - No firings will take place when there is a significant risk of a thunderstorm developing. - No RF or ESD liable devices other than those specifically required and authorised for the trial are permitted in to the danger area. - Manual handling training is to be provided for all personnel anticipated to be lifting ammunition. - Trials must take place with first aid trained personnel on-site, including those trained for ballistic trauma injuries.	
2. Misfire or partial fire	Misfire or partial fire of munition due to a faulty weapon system, incorrect or damaged primer, incorrect loading, poor weapon maintenance or munition obsolescence.	Multiple fatalities and serious injuries caused by blast, heat and fragmentation effects of detonation, if munition detonates during its recovery. If munition does not detonate during recovery, burning injuries from hot munition, musculoskeletal injuries relating to poor manual handling, slips trips and	Occasional Catastrophic Class A	- All trials begin with a specific brief delivered to all personnel, containing information on all credible hazards and which mitigations are in place. - 30 minutes must be left after a misfire before inspecting, unloading or recovering misfired ammunition. - Only one person is to unload or inspect misfired or partially fired ammunition. All others must be clear of the weapon danger area. The person must be formally qualified to do so. - Inspector is to inform trials manager clearly and in detail to condition of	Improbable Catastrophic Class C

		fall and impact with the weapon system.		any misfired ammunition prior to reloading for firing. Any faults must be reported. - Anti-static clothing must be worn at all times during the inspection, recovery and reloading process. - Misfire procedures must be clearly laid out in the activity's process instruction, explaining what to look out for in each specific type of ammunition. - Trials must take place with first aid trained personnel on-site, including those trained for ballistic trauma injuries.	
3. Physical impact with weapon system or munition	Physical impact on the human body by the weapon system due to unauthorised persons in the weapon danger area, unintended movement of the weapon system – including unexpected closure of the breech mechanism - or poor special awareness.	Blunt trauma injuries to the head or body. Cuts, scrapes, sprains or fractures. Crushing injuries if in contact with moving parts.	Frequent Marginal Class A	- All trials begin with a specific brief delivered to all personnel, containing information on all credible hazards and which mitigations are in place. - Ensure that the number of personnel in the weapon danger area is reduced to the minimum number needed to operate safely. - Bump caps or hard hats must be worn when carrying out activities in the immediate vicinity of the weapon system, or any associated plant. - Ensure that the weapon is stabilised and not in a position to experience sudden or unintended movements. - Only those competent to do so are permitted to load or unload ammunition in to or out from a weapon system.	Probable Negligible Class C

				- All work must be supervised by a gun foreman. - Trials must take place with first aid trained personnel on-site, including those trained for ballistic trauma injuries. - Breech mechanism is to be chained and locked, and weapon system is to be locked away when not in use to prevent public access.	
4. Slips, trips and falls	Slips, trips and falls injuries due to protruding parts, unkempt cables or too many personnel in the weapon danger area.	Bumps, cuts, sprains, scrapes. Musculoskeletal injuries such as pulled muscles or twisted ankle.	Frequent Marginal Class A	- All trials begin with a specific brief delivered to all personnel, containing information on all credible hazards and which mitigations are in place. - Everybody has an explicit duty of care to undertake good housekeeping during the trial. Walkways, exits and the area immediately surrounding the weapon must be kept clear of obstructions, unkempt cables, protruding debris and any other likely trip hazards. - Report any spillages, such as that of oil or grease, immediately, and make sure spillages are cleared before continuing. - Ensure that personnel within the weapon danger area are reduced to as little as is necessary and safe to carry out the current task. - Trip hazards which cannot be eliminated, such as tied cables, must be clearly marked.	Occasional Marginal Class C

				- Personnel must be informed before any firings of slips, trips and fall hazards that could not be suitably mitigated to eliminate the risk. - Trials must take place with first aid trained personnel on-site, including those trained for ballistic trauma injuries.	
5. Manual handling	Manual handling injuries caused by poor manual handling practice, faulty or non-existent lifting aids, or lack of personnel to share the load.	Range of mild to severe musculoskeletal injuries, particularly to the arms, legs or back. If a heavy item is dropped, crushing injuries to hands, legs or feet.	Frequent Marginal Class A	- All trials begin with a specific brief delivered to all personnel, containing information on all credible hazards and which mitigations are in place. - Avoid any manual handling activities if possible to do so, utilising mechanical lifting aids. - If manual handling is unavoidable, seek the use of personal lifting aids such as belts, or make use of multiple personnel to move loads. - Only personnel competently trained in manual handling techniques should be doing so. - Always follow the principle of TILE (task, individual, load and environment). - Repetitive manual handling should be rotated among personnel to give personnel breaks from lifting. - Manual handling activities are to be conducted under supervision. - If someone does not feel able or comfortable with lifting a load, they must not do so. - Trials must take place with first aid trained personnel on-site, including	Occasional Marginal Class C

				those trained for ballistic trauma injuries.	
6. Hot and cold surfaces	Contact injuries after contact with hot and cold surfaces caused by regular operation of the gun or extreme weather conditions.	Contact with hot and cold surfaces causing hot or cold burn injuries, ranging from first to third degree.	Frequent Critical Class A	- All trials begin with a specific brief delivered to all personnel, containing information on all credible hazards and which mitigations are in place. - If ammunition has been conditioned to be hot or cold prior to firing, the appropriate PPE must be worn to protect arms, hands and body whilst handling and loading in to the gun – including gloves and long sleeved tops. - Gloves and long sleeved tops required when working in and around the gun barrel, which is prone to extreme high temperatures from repeated firings. - Do not touch surfaces likely to be hot or cold as a means of checking surface temperatures. - Trials must take place with first aid trained personnel on-site, including those trained for ballistic trauma injuries.	Occasional Marginal Class C
7. Exposure to COSHH substances and dangerous vapours	Exposure to COSHH substances and dangerous vapours caused by improper combustion during firing, regular maintenance and cleaning of the barrel requiring the use of solvents or poor ventilation in the trials area post-firing.	Exposure to hazardous substances and vapours causing a variety of short and long term injuries and illnesses, from corrosive burns and toxin ingestion to long term respiratory conditions and illnesses.	Frequent Critical Class A	- All trials begin with a specific brief delivered to all personnel, containing information on all credible hazards and which mitigations are in place. - All firings are to be conducted with all personnel under hard cover. Cover must not be broken until the area is safe from smoke vapours.	Occasional Marginal Class C

				- Firing activities are to be carried out in desirable weather conditions, with a prevailing wind in the direction of travel of the munition to carry smoke away from the trials area. - Trials area is open and well ventilated. - Any attempt to clear the gun bore must be delayed until smoke has visibly cleared, and gun bore cleaning is to be carried out by a single person, supervised remotely. - The use of cleaning materials, solvents, oils or greases is limited during a firing activity only to when absolutely necessary. - Where the use of solvents and other COSHH controlled cleaning fluids are required, users must wear appropriate mouth and nose coverings such as face masks. - Nitrile gloves are to be worn when using COSHH substances, or other oils and greases. - COSHH substances are locked away and strictly controlled by a register to avoid misuse. - Any spillages are to be immediately reported and relevant action taken. - Trials must take place with first aid trained personnel on-site, including those trained for ballistic trauma injuries. - Personnel exposed to harmful chemicals and substances are to be	
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				given frequent occupational health assessments. - All use of COSHH substances used in operations are to be controlled by a full COSHH assessment related to this activity. - When possible, use alternative, less harmful chemicals, when there is opportunity to do so. This is inclusive of COSHH substances and munition propellant charges.	
8. Exposure to noise	Noise exposure due to repeated, regular operation of the weapon system.	Overexposure to noise causing long and short term hearing damage.	Frequent Critical Class A	- All trials begin with a specific brief delivered to all personnel, containing information on all credible hazards and which mitigations are in place. - Personnel are to be under hard cover when firing takes place, and those in under cover areas inside designated hearing protection zones must wear ear defenders during firing. - Acoustic modelling forms part of a detailed trials plan. Where the acoustic levels are scheduled to pass 125dB locally, the activity cannot proceed. - Direct personnel likely to be exposed to noise levels above the Upper Exposure Level of 89dB are to undergo frequent occupational hearing assessments. - Trials must take place with first aid trained personnel on-site, including those trained for ballistic trauma injuries.	Occasional Marginal Class C

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Part 2: ALARP Justification Statement for Hazard 7 – Exposure to COSHH substances and dangerous smoke vapours.

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Activity Scope and Hazard Overview

As part of the routine operation and firing of a 115mm large calibre weapon system, exposure to harmful substances, vapours and smoke is a recurring, and potentially serious, hazard that has the potential to arise.

This ALARP justification statement assesses the hazard, the associated risks, the controls in place, and demonstrates that all necessary precautions and mitigations reduce the risk of the activity to one that is tolerable and ALARP, whilst demonstrating the impracticality of further controls.

Dangerous smokes and vapours, produced by the incomplete combustion of explosive materials during firing, can be carcinogenic and toxic. They will emerge from the routine firing of the gun during trials operations.

Dangerous substances, controlled by 'The Control of Substances Hazardous to Health Regulations 2002' [1], are substances that, if in contact with the human body, through skin contact, ingestion, or inhalation, have the potential to do harm. Exposure to these substances will arise from regular non-firing activities during operation and firing, such as cleaning, where solvents will be used that are effective at breaking down explosive residues, and where cleaning activities produce large quantities of dust. These substances can often be corrosive or toxic. Lubricants and oils used for regular maintenance during operations are also controlled by COSHH 2002 because of the chemicals they contain. [2]

Note that COSHH regulations do not cover asbestos, lead or radioactive substances, as these are governed by their own regulations. [2].

Risk Overview

If personnel were to be overexposed to smoke from munition combustion, most of which contains harmful gases and chemicals, there is a significant risk of short and long term injury and illness, such as long-term respiratory conditions, internal burns or, potentially, cancers caused by carcinogens

inside the smoke. Some munitions even use carcinogenic and toxic tags as markers for the explosives, which provide another source of potential harm upon combustion.

The inevitability of the production of such harmful chemicals means that, without controls in place, personnel exposure to smoke from munitions firings is likely to occur frequently, in line with the definitions provided in the associated risk assessment, and the impact of the exposure to this hazard is likely to be critical, with the risk of serious injury and illness a distinct possibility.

The exposure of personnel to substances governed under COSHH 2002 regulations has the ability to cause serious illness and injury. According to the regulations, exposure relates to the uptake in to the body by means of inhalation, skin contact, injection or ingestion [3]. Many solvents used during the cleaning process have corrosive properties, owing to their ability to break down resilient residues. Many commercial lubricants used during operation of weapon systems also contain toxic and highly irritant chemicals that have the potential to cause respiratory issues or internal burning if inhaled.

Exposure to COSHH substances is likely to be commonplace during the operation and firing of a large calibre weapon system, as these operations form part and parcel of safe maintenance of serviceability of the system. The risks posed by these hazardous substances, therefore, are likely to arise frequently, with potentially critical consequences.

As a result of the frequency with which these risks are encountered, and the severity of them if left uncontrolled, the initial risk rating of this hazard is deemed to be Class A – unacceptable level of risk.

Controls

Legal duty is placed upon the employer to limit exposure to dangerous chemicals and substances through the COSHH Regulations. It declares this is to be done by ensuring that employees' exposure to COSHH controlled substances is prevented or, where not reasonably practicable¹, limited.

Where there is no possibility to fully prevent exposure, reasonably practicable control measures are required to be in place, with controls aligned with the Hierarchy of Controls model². [4]

In order to perform the functions of the activity defined previously, it is not reasonably practicable to completely eliminate all exposure to smoke and vapours produced by firing munitions from the system, or to eliminate the need to use solvents or lubricants to maintain the gun's serviceability. This means that the hazards cannot be fully eliminated, and so controls begin from a point of substituting the hazard for something less hazardous.

Controls are also guided by workplace limits, a table of legal exposure limits of working personnel to a standardised list of around 500 COSHH controlled substances. Employers have a legal obligation to ensure these levels are not breached as part of COSHH Regulations 2002. [5] [6]

Substitution Controls

- When possible, use alternative, less harmful chemicals, when there is opportunity to do so. This is inclusive of COSHH substances and munition propellant charges.
- The use of COSHH substances during firing operations is reduced only to when absolutely necessary, such as to clear large amounts of residue or to repair a gun jam.

¹ Reasonably practicable involves weighing a risk against the trouble, time and money needed to control it. Thus, ALARP describes the level to which HSE expect to see workplace risks controlled. [8]

² See appendix A for hierarchy of controls table and explanation.

Routine operations may not require the use of COSHH substances to assist with the task. If the gun is operating satisfactorily without any blockages or jams, then there is no need to use any harmful substances. Each activity is different, and it may not always be necessary to use explosive charges or cleaning chemicals or lubricants that are so harmful if there is no need to use them. These controls significantly reduces the repeated exposure of personnel to highly hazardous chemicals and gases.

Engineering Controls

- COSHH substances are locked away and controlled by a register when not in use.
- Firing activities take place in an open, well ventilated trials area.

The keeping of a COSHH register, and the locking up of harmful substances at all times except for the specific times of requirement, ensures that personnel are not exposed to any COSHH controlled substances if there is no need for it, presenting a physical barrier between employees and the hazard. Having firing activities take place in a well-ventilated area means a much faster dissipation of dangerous smoke from firings.

Administrative Controls

The vast majority of controls identified in this ALARP justification can be classed as administrative controls.

- Firing activities and operations to be carried out in suitable weather conditions, where the prevailing wind is in the direction of firing to carry harmful smoke away from the firing area.
- Post-firing, the weapon system is not to be cleared until all visible smoke has dissipated from the area, and bore clearance is to be carried out by a single person, visually supervised remotely.
- Spillages and unintended release of COSHH controlled substances are to be immediately reported so that work can stop and clear-up can take place.
- Trials must take place with at least one suitably qualified first aider on-site.
- Personnel at risk of exposure to combustion products or to COSHH controlled substances are to undergo frequent occupational health assessments.
- All use of COSHH controlled substances during this activity are subject to a full COSHH assessment.
- All personnel are given a full brief explaining in detail the hazards and risks that arise during the activity, as well as all control measures and mitigations – and emergency procedures.

A strong, robust set of enforced and followed processes and systems of work has the ability to drastically reduce the frequency and severity of risks arising. Following the procedures and processes listed above will significantly reduce the possibility of any personnel up taking combustion chemicals in to their body thanks to the level of ventilation available. Health assessments provide a continuous and frequent picture of the health and exposure of personnel to hazards, which allows for constant monitoring and provides justification for further controls if required.

COSHH assessments and briefings instruct all employees on what to do to avoid exposure to hazards and risks when using COSHH controlled substances. First-aiders on site have the ability to mitigate long-term affects by providing immediate treatment to personnel when an incident occurs before emergency services arrive. Only having a single person attend to bore clearance reduces the impact of an incident to a single person to reduce the risk of multiple affected personnel, and supervision of the work taking place means that any incidents, including spillages and unintentional releases, can be immediately reported.

PPE Controls

As a last resort, all personnel involved in activities where COSHH controlled substances are present, including solvents and lubricants, are to wear nitrile gloves and protective face masks to prevent intake of chemicals.

Practicality Assessment of Further Controls

The controls put in to place as set out in the activity risk assessment reduces the risk class for this hazard from Class A – unacceptable, to Class C – tolerable if ALARP.

Many further controls are impracticable due to making the activity unviable, such as hazard elimination or stopping dynamic maintenance activities.

Further controls which had been considered as a means of reducing the risk further included the use of positive pressure breathing apparatus when operating with COSHH substances at the weapon system, or the automising of dynamic cleaning and maintenance tasks.

Using a Cost-Benefit Analysis augmentation on each of the two determines its practicability.

CBA Augmentation for further controls

Maximum number of personnel likely to be involved in the activity and therefore injured in a single incident: 2

Cost of apparatus: £100 - £400 each

Grossly Disproportionate Factor for injury type: 5 for moderate, 3 for slight

Value of Prevented Harm for a moderate injury: £10,000 for moderate, £500 for slight

Current risk severity: Single or two moderate injuries or illnesses, several slight illnesses or short term injuries

Life expectancy of mitigation: Maximum 5 years for masks, 25 years for robot

Likelihood: 2×10^{-5}

PPV Apparatus

Proportionate Cost = GDF x Number of Injuries x VPH x Likelihood x Mitigation Life Expectancy

Proportionate Cost for moderate injuries = $5 \times 2 \times £10,000 \times 2 \times 10^{-5} \times 5 = £10$

Proportionate Cost for minor injuries = $3 \times 20 \times 500 \times 1 \times 10^{-4} \times 5 = £15$

With a total proportionate cost of £25, the purchase of two PPV breathing apparatus at a total cost of £200 to £800 would be deemed **grossly disproportionate** and therefore not reasonably practicable alongside current controls.

Robotic Cleaning Equipment

Proportionate Cost = GDF x Number of Injuries x VPH x Likelihood x Mitigation Life Expectancy

Proportionate Cost for moderate injuries = $5 \times 2 \times £10,000 \times 2 \times 10^{-5} \times 25 = £50$

Proportionate Cost for minor injuries = $3 \times 20 \times 500 \times 1 \times 10^{-4} \times 25 = £75$

With a total proportionate cost of £125, the purchase of a robotic cleaning equipment at a cost of £500 to £1000 would be deemed **grossly disproportionate** and therefore not reasonably practicable alongside existing controls.

Having applied a cost-benefit analysis to the two features most likely to eliminate or significantly reduce risk and found applying the measures to be grossly disproportionate, there is satisfaction that the risks of the activity specified have been demonstrably reduced to ALARP, and therefore the

risk level is tolerable in line with The Management of Health and Safety at Work Regulations 1999.
[7]

Conclusion

Combining the comprehensive controls put in place to reduce the risk rating of this activity from Class A to Class C, including the implementation of a fully functioning safe system of work, compliant procedures and clear instructions on reducing and mitigating risk, ensuring compliance with all relevant UK legislation, including COSHH Regulations 2002 and MHSWR 1999, as well as demonstrating through cost-benefit analysis' that further controls designed to completely eliminate the residual risk would be grossly disproportionate, it can be stated with confidence that all reasonably practicable measures to reduce, control and mitigate the risks associated the activity have been taken, and therefore it is appropriate to say that the risk level of this activity is now ALARP.

References

- [1] UK Statutory Instrument 2002 No. 2677, "The Control of Substances Hazardous to Health Regulations 2002," legislation.gov.uk, 31 12 2020. [Online]. Available: <https://www.legislation.gov.uk/uksi/2002/2677/contents>. [Accessed 10 07 2025].
- [2] Health & Safety Executive, "What is a 'substance hazardous to health'?", Health & Safety Executive, [Online]. Available: <https://www.hse.gov.uk/coshh/basics/substance.htm>. [Accessed 01 07 2025].
- [3] Health & Safety Executive, "Workplace Exposure Limits," Health & Safety Executive, [Online]. Available: <https://www.hse.gov.uk/coshh/basics/exposurelimits.htm>. [Accessed 13 07 2025].
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- [6] Health & Safety Executive, "Workplace exposure limits," Health & Safety Executive, [Online]. Available: <https://www.hse.gov.uk/coshh/basics/exposurelimits.htm>. [Accessed 10 07 2025].
- [7] UK Statutory Instrument 1999 No. 3242, "The Management of Health and Safety at Work Regulations 1999," legislation.gov.uk, [Online]. Available: <https://www.legislation.gov.uk/uksi/1999/3242/regulation/3/made>. [Accessed 16 07 2025].
- [8] Health & Safety Executive, "ALARP: As Low As Reasonably Practicable," Health & Safety Executive, [Online]. Available: <https://www.hse.gov.uk/comah/alarp.htm>. [Accessed 02 07 2025].

Appendix A: Hierarchy of Controls

The following table explains the hierarchy of control model used for managing and controlling risks associated with hazardous activities.

Control Stage	Explanation
Elimination	Total elimination of the hazard.
Substitution	Replacing the hazard with something less hazardous.
Engineering Controls	Isolation of people from the hazard using preventative measures such as barriers, increasing ventilation, or guards.
Safe Systems of Work	A robust set of procedures, including thorough training regimes, to maximise competencies.
PPE	Wearing of personal protective equipment.

When controlling risk, controls and mitigations should give priority to those which eliminate the hazard, working down the table until PPE requirements, which act as a last resort control.

Appendix B: Relevant legislation governing this hazardous activity.

Whilst not all directly referenced in this statement, all of the following legislation has governed the method in which this hazardous activity is carried out, and has influenced the controls and procedures put in place to ensure safety and compliance, so far as is reasonably practicable.

- *Control of Substances Hazardous to Health (COSHH) Regulations 2002*
- *Health and Safety at Work Act 1974*
- *Management of Health and Safety at Work Regulations 1998*
- *Personal Protective Equipment at Work Regulations 1992*
- *Workplace (Health, Safety and Welfare) Regulations 1992*
- *Provision and Use of Workplace Equipment Regulations (PUWER) 1998*

Appendix C: Abbreviations

The following is a list of all abbreviations used in this statement:

- ALARP: As low as reasonably practicable
- COSHH: Control of Substances Hazardous to Health
- GDF: Grossly Disproportionate Factor
- MHSWR: Management of Health and Safety at Work Regulations
- PPE: Personal Protective Equipment
- VPH: Value of Prevented Harm