University of St Andrews

Chemical and biological safety – Part 2 – Biological and genetic modification safety

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University of St. Andrews

Guidance on Chemical and Biological Safety

Part 2 - Biological and Genetic Modification Safety

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Appendix 14 - UN2900 Infectious Substances Affecting Animals Assigned to Category A for Transport

1.0 Introduction

1.1 Preface

This booklet provides guidance on protecting workers, the public and the environment from risks. This guidance booklet also details the requirements of governing legislation for work with biological agents, genetically modified organisms (GMOs), animals and plants.

Work with biological agents, genetically modified organisms and larger eukaryotic organisms e.g. animals and plants, must comply with the requirements of the relevant legislation. Detailed guidance on compliance with relevant legislation can be found in the University Biosafety training programme found on the Moodle site at URL: https://moody.st-andrews.ac.uk/moodle/course/view.php?id=4340

Since current work in the University does not involve the deliberate release or marketing of GMOs, this guidance will concentrate on the contained use of GMOs. If any person needs advice on the regulations covering the deliberate release/marketing of GMOs they should contact the Director of Environmental Health and Safety Services (EHSS).

Health and safety legislation places emphasis on the assessment of risks. The underlying principles of risk assessment and implementation of control measures are defined under the Management of Health and Safety at Work Regulations (1999) (MHSWR). The MHSWR has a wide ranging requirement for assessing all risks within a workplace. Assessments made in compliance with COSHH and Genetically Modified Organisms (Contained Use) Regulations 2014 will satisfy the risk assessment requires of the MHSWR.

Additional guidance on safe working practices can be obtained from the Director of Environmental, Health and Safety Services.

2.0 Policy Statement

The following is the University of St Andrews Policy Statement with respect to work with biological agents and genetically modified organisms:

1. This University will comply, so far as is reasonably practicable, with all legislation and good practice guidance with regard to the storage, use and disposal of biological agents and genetically modified organisms.
2. The Office of the Principal has ultimate authority for regulating work with biological agents and genetically modified organisms
3. The Head of School/Unit has the responsibility for ensuring this Policy Statement is implemented within their School/Unit.
4. All supervisors of those working with biological agents, genetically modified organisms as well as hazardous substances are have a duty to ensure the workers under their control comply with all the local rules and guidances for such work.
5. All supervisors of those working with hazardous substances are have a duty to ensure the workers under their control comply with all the local rules and guidances for all such work.
6. Suitable and sufficient risk assessments for work should be undertaken for all non-genetically modified biological agents and the chemicals used in such experiments using the University's computerised COSHH risk assessment programme entitled 'CHARM'. All such risk assessments must be signed by all the workers it relates to,

the supervisor of the work and by a representative of the School/Unit for work with high risk hazardous substances

7. All work with biological agents and genetically modified organisms must be undertaken in appropriate containment facilities which relate to the ACDP categorisation of non-genetically modified organisms or facilities relating to the categorisation of genetically modified organisms.
8. The wearing of eye protection is mandatory in any laboratory working with hazardous chemicals, pathogenic organisms, high pressure systems and high vacuum systems as well as any laboratory with a mandatory wearing of eye protection sign.
9. All work in the category 3 containment laboratories must be approved by the Director of the Category 3 Laboratories prior to work starting
10. All work with category 3 non-genetically modified biological agents or genetically modified agents must be carried out in category 3 containment laboratories and must comply with the University's Category 3 Containment Laboratory – Code of Practice and Standard Operating Procedures.
11. All work on agents listed under the Specified Animal Pathogens (Scotland) Order 2009 (SAPO) must comply with the University Guidance on Work with Pathogens Regulated under the Specified Animal Pathogens (Scotland) Order 2009 (see URL: https://www.st-andrews.ac.uk/media/environmental-health-and-safety-services/SAPO-CoP-24-08-2015-FINAL.pdf)
12. All work with category 2 and above genetically modified organisms as well as agents listed in the SAPO legislation must receive approval by the HSE. All such applications must be done through the Director of Environmental Health and Safety Services.
13. There is a requirement to obtain a Home Office licence for all biological agents identified in Schedule 5 of the Anti-terrorism, Crime and Security Act 2001, Anti-terrorism, Crime and Security Act 2001 (Modification) Order 2007, The Part 7 of the Anti-Terrorism, Crime and Security Act 2001 (Extension to Animal Pathogens) Order 2007. All applications for such licences must be undertaken through the Director of Environmental, Health and Safety Services. have Home Office licence.
14. A suitably qualified University Biological Hazards Safety Adviser will be appointed to provide advice to staff and students as well as to the Office of the Principal on Biological Hazards issues
15. The University Biological Hazards Adviser will convene the University Chemical and Biological Hazards Management Group. This Group cannot be deemed quorate without the University Biological Hazards Adviser being present
16. The University Chemical and Biological Hazards Management Group will act as the University Genetic Modification Safety Committee as required by the Genetically Modified Organisms (Contained Use) Regulations 2014
17. A safety representative from each of the accredited Unions will be invited to the meetings of the Chemical and Biological Hazards Management Group.
18. A report of the Chemical and Biological Hazards Management Group meeting will be forwarded to the Vice Principal for Research for review by the Office of the Principal.
19. All workers with biological agents and genetically modified organisms will receive appropriate and proportionate training in the handling of such agents within their workplace
20. A specific detailed risk assessment will be undertaken for new and expectant mothers who may work with biological agents
21. All hazardous biological agents and genetically modified micro-organisms will be sterilized by an appropriate procedure to reduce the number of viable organisms by 10^5 or greater prior to their disposal
22. All accidents, near misses or medical conditions which are believed to be caused by hazardous substances will be reported to the Director of Environmental, Health and Safety Services.

23. Where it is believed that a worker has developed a medical issue or there is a potential for such a medical issue while working with a hazardous substance, the worker should obtain the advice of the University Occupational Health Adviser.
24. All Local Exhaust Ventilation equipment (LEV) controls like microbiological safety equipment must be tested every 14 months as a requirement of the Control of Substances Hazardous to Health Regulations 2002.
25. All workers should read the Moodle Biosafety training programme which can be found at URL: https://moody.st-andrews.ac.uk/moodle/course/view.php?id=4340
26. All waste items should be disposed of in accordance to the University guidance on such matters – see URL: https://www.st-andrews.ac.uk/media/environmental-health-and-safety-services/University%20Waste%20Guidance%202014-Modified-10-05-2016.pdf

3. The arrangements for managing the use of biological agents and genetically modified organisms

The structure of the management system for Health and Safety is given in the University 'Health and Safety Policy' (2017). This can be viewed at the following website: http://www.st-andrews.ac.uk/media/Approved HS Policy Final.pdf

3.1 University Chemical and Biological Hazards Management Group.

The Chemical and Biological Hazards Management Group fulfills, for the University, all of the legal requirements pertaining to the use of biological agents and genetically modified organisms. This Group will act as the University's Genetic Modification Safety Committee as required by the genetically Modified Organisms (Contained Use) Regulations 2014. Membership and remit of this Group is given in the University Health and Safety Policy (2017). The membership of this committee is given in Appendix 1

3.2 Head of School/Unit

The Head of the School/Unit is responsible for implementing the University Policy on controlling work with biological agents and genetically modified organisms, and to ensure suitable control measures are in place to monitor compliance with the University Policy. The Head may delegate specifically defined duties to other members of staff.

The Head of School/Unit is responsible for ensuring that:

- where necessary, ensure a local health and safety policy for work with biological agents is produced.
- where appropriate, ensure a School/Unit Health and Safety Committee is established, which the Head should be a member of, to serve as a consultative forum where matters of health and safety, including biological safety, can be discussed by representatives of all groups of staff within the School/Unit. Schools with multiple buildings should, in addition, appoint a Health and Safety Committee for each building;
- that suitable and sufficient risk assessments are carried out by Principal Investigators;
- appoint where necessary a biological safety supervisor;
- ensure that appropriate funding for health and safety matters is made available
- ensuring that a suitable policy for the selection, issue, use and maintenance of PPE is produced;
- that, where appropriate, a suitable health surveillance policy for employees is produced and implemented after consultation with the Occupational Health Adviser;

3.3 University Biological Hazards Adviser

Specialist advice on biological hazards is available from the University Biological Hazards Adviser. Communication with the University Biological Hazards Adviser should normally be through the Director of Environmental, Health and Safety Services. The remit for this post is given in Appendix 2.

3.4 School / Unit Biological Hazards Policies

The School/Unit Safety Policy should, include details on the identification and control of biological agents (genetically modified and non-genetically modified) within the School/Unit. In compliance with the School/Unit policy should ensure:

i) implementation of the University Policy on controlling biological agents and genetically modified organisms which requires that a suitable and sufficient risk assessment should be performed and signed by all relevant people before any work can be initiated;
ii) the systematic elimination or reduction of risks from biological agents and genetically modified organisms where reasonably practicable;
iii) the control of exposure to such agents by means other than Personal Protective Equipment (PPE);
iv) work with biological agents is carried out in suitable and appropriate containment facilities
v) that, where appropriate, a suitable maintenance regime is implemented for general and local exhaust ventilation systems (e.g. fume cupboards, microbiological safety cabinets);
vi) that, where appropriate, suitable guidance is produced for the selection, issue, use and maintenance of Personal Protective Equipment (PPE);
vii) where appropriate, that suitable health surveillance for employees is provided;
viii) that suitable and sufficient information, instruction, training and supervision in the use of hazardous substances is provided;
ix) that regular reviews of risk assessments are carried out;
x) that regular reviews of the School/Unit arrangements for the compliance are carried out.

3.5 Staff and Student Responsibilities

All staff and students should ensure they look after their own safety and the safety of others by ensuring that their actions or omissions do not put themselves or others at risk

As part of their training, all staff postgraduate and final year undergraduate students will be provided with appropriate training in biosafety risk assessments from Environmental, Health and Safety Services or their School/Unit.

3.6 Environmental, Health and Safety Services

EHSS will provide support to the University Biological Hazards Adviser, will administer the CHARM programme and will be involved in monitoring biosafety health and safety with inspections and audits with the University Biological Hazards Adviser

3.7 Intended audience

This policy and the attached guidance are intended for all members of staff at the University who use biological agents or genetically modified organisms as a requirement of their work activity

3.8 Where these Regulations apply

This policy and guidance is applicable for all Schools/Units within the University

1. 4Legislative and regulatory framework

This policy and guidance document has been produced to ensure compliance with the following legislation:

- ***Health and Safety at Work etc Act 1974*** – This is the enabling Act of Parliament which implements many of the health and safety legislation.

- ***Management of Health and Safety at Work Regulations 1999 –*** This provides general detail on the implementation of the Health and Safety at Work Act.

- ***Control of Substances Hazardous to Health (COSHH) Regulations (as amended) (2002) as amended***. These Regulations stipulate the need to carry out an assessment of the risks associated with work activities involving both chemical and biological substances and to implement appropriate control measures.

- ***Genetically Modified Organisms (Contained Use) Regulations 2014.*** These Regulations require a detailed assessment to be made of the risk that the genetically modified organism (GMO) poses to human health and to the environment. This regulation also requires that the appropriate control measures are implemented to prevent the release of the GMO into the environment.

- ***The Genetically Modified Organisms (Deliberate Release) (Scotland) Regulations 2002 (as amended).*** These regulations govern the deliberate release or marketing of GMOs and are designed to minimise the damage to the environment which may arise due to the release of the GMO. As the regulations are enacted via devolved government (i.e. via Environmental Protection legislation), there are separate regulations for Scotland and for England / Wales.

- ***Environmental Protection Act***. Section 108(1)(a) of this Act covers the environmental risks associated with work involving larger GMOs. It requires that anybody creating such a GMO, which is not an approved product or obtaining one from elsewhere, should carry out an assessment of environmental risks.

- ***Genetically Modified Organisms (Risk Assessment) (Records and Exemptons) Regulations 1996***. These require that the records of environmental risk assessments for GMOs, like those for micro-organisms, should be kept for 10 years.

- ***The Specified Animal Pathogens (Scotland) Order 2009 –*** This legislation controls the use of animal pathogens which may have significant effects on animal populations with potentially serious effects on agriculturally sensitive animal populations.

- ***The Medicines for Human Use (Clinical Trials) Regulations 2004 (as amended)*** This legislation controls gene therapy trials in humans

- ***Animals (Scientific Procedures) Act 1986.*** This Act requires that specific licences be obtained from the Home Office prior to the commencement of any work involving animals.

- ***Plant Health (Scotland) Order 2005.*** This Order deals with the control of Import and Exports of plants and plant materials in Scotland. There are similar Orders for England and Wales.

- ***Misuse of Dugs Act 1971 and Misuse of Drugs Regulations 2001 –*** This classifies compounds as 'Controlled Drugs' and requiring a specific licence for research with such substances.

Biological hazards regulations are enforced by:

- Health and Safety Executive
- Scottish Environment Protection Agency (SEPA)
- Home Office which licences the use of animals in experiments as well as controlled drugs and drug precursors

4.1 Relationship with existing University Policy, Procedures and Regulation

As noted throughout this Policy, compliance with the conditions set out here will on occasion also require observance of other University Policy and Regulations referred to herein.

5 Notifications to the Health and Safety Executive (HSE).

There is a legal requirement to notify the HSE of work with category 2.3 and 4 genetically modified organisms and work with certain pathogens. Guidance on the notification of work with pathogens is given in Section 2.1.4 and guidance on the notification of genetic modification projects is given in Section 4.1.5.

Note: All required notifications to the HSE **must** be made via the Director of Environmental, Health and Safety Services

6 Summary of the Risk Assessment Process.

When performing risk assessments you must identify the hazards present and the risk of the hazard injuring an employee. Guidance on biosafety risk assessments can be found on the Moodle site at URL: https://moody.st-andrews.ac.uk/moodle/course/view.php?id=4340 and also at URL: https://moody.st-andrews.ac.uk/moodle/course/view.php?id=3447 The definition of a hazard and a risk are:

Hazard - Is something with the potential to cause harm to man or the environment e.g. an infectious agent.

Risk - This is the probability that the harm from a particular hazard is realised e.g. the chance that the infectious agent will cause an infection and disease..

Once the hazards and risks have been identified, suitable control measures must be implemented to eliminate or, if that is not possible, minimise the risks to workers.

There are two risk assessment forms for work with biological agents. The first form is for Genetically Modified Organisms (GMOs) (see Appendix 7). The second form is for non-genetically modified biological agents and uses the University's electronic COSHH management system entitled CHARM (this can be found at the following website:

https://www.st-andrews.ac.uk/ehss/charm/home.htm

Details of the procedure to carry out a GMO risk assessment are given in the HSE guidance document entitled 'Guidance from the Scientific Advisory Committee on Genetic Modification' and can be found on the HSE website at the following URL:

http://www.hse.gov.uk/biosafety/gmo/acgm/acgmcomp/index.htm

Prior to any work with a non-GMO biological agent, a relevant COSHH risk assessment form **must** be completed using the University computerised COSHH Risk Management Programme entitled: ' CHARM' and signed by the worker(s) and the supervisor of the work. A risk assessment is only valid if it has been appropriately signed and dated. Specific information which will help in performing risk assessments on non-GMO biological agents is given in Section 2.1.3. Further guidance on this matter can be obtained from the Director of Environmental, Health and Safety Services.

7 Personal Protective Equipment

The Personal Protective Equipment at Work Regulations 1992 place a statutory requirement on the University to assess the risks of a work activity and if Personal Protective Equipment (PPE) is required to eliminate or minimise these risks then it must be supplied by the employer and worn by all persons within that work area.

Eye Protection

The wearing of eye protection is mandatory for all persons in any laboratory where any hazardous chemicals, biological agents, vacuum systems or high pressure systems are in use and also in any laboratory marked with an eye protection sign on the door. The protection must conform to British Standard for the type of eye protection required (see University Guidance entitled 'The Selection, Use and Maintenance of Personal Protective Equipment' URL: http://www.st-andrews.ac.uk/media/environmental-health-and-safety-services/health-and-safety/personal-protective-equipment/PPE-Policy-04-11-2008.pdf). All workmen and visitors must be provided with suitable eye protection before entering such laboratories.

Gloves

Gloves should be worn when handling pathogenic organisms

The type of hand protection issued under a risk assessment will depend on the properties of the gloves and substance you are using.

Glove selection - the following properties should be taken into account when selecting the type of glove to be used:

Degradation – the change in one or more physical properties of the glove upon contact with the chemical. This is usually reported in a chemical compatibility chart as E (excellent), G (good), F (fair), P (poor), NR (not recommended) or NT (not tested).

Breakthrough time – the time between initial contact of the chemical on the surface of the glove and the analytical detection of the chemical on the inside of the glove. Given on a chemical compatibility chart in minutes.

Permeation rate – the rate at which the chemical passes through the glove once breakthrough has occurred and equilibrium is reached. This is usually reported as 0 (if there is no breakthrough), Slow, Medium or Fast.

Type of Chemical	Natural Rubber	Nitrile	Neoprene (TM)	PVC	Butyl	Viton (TM)
Water miscible substances weak acids/alkalis	X	X	X	X	------	------
Oils	------	X	------	------	------	------
Chlorinated Hydrocarbons	------	------	------	------	------	X
Aromatic Solvents	------	------	------	------	------	X
Aliphatic Solvents	------	X	------	------	------	X
Strong Acids	------	------	------	------	X	-------
Strong Alkalis	------	------	X	------	------	------
PCBs	------	------	------	------	------	X

Detailed guidance on the use of Personal Protective Equipment can be found at the University Website - http://www.st-andrews.ac.uk/staff/policy/Healthandsafety/Publications/

Note: If any employee develops a sensitivity to gloves they should contact the Occupational Health Adviser as soon as practicable.

Respirators

Appropriate respiratory protective equipment (RPE) should be worn when handling substances which pose a risk when inhaled for example when working with animals which are known to cause allergic reactions. If RPE is issued then it must be 'Face Fitted' by a suitably trained person to ensure that it works effectively.

8. Laboratory waste bins and controlled waste

All waste produced within the University is classified as 'controlled waste' and must be disposed of in accordance with governing legislation. Detailed procedures for the disposal of waste items is given in the University guidance at URL: https://www.st-andrews.ac.uk/media/environmental-health-and-safety-services/University%20Waste%20Guidance%202014-Modified-10-05-2016.pdf

Hazardous waste, as defined by the 'Special Waste Amendment (Scotland) Regulations 2004', can only be disposed of by Specialist contractors. The arranging of the disposal of such Special Waste will be carried out by Environmental, Health and Safety Services.

All waste must be put in the correct coloured bag. The relevant colour coding of bags is as follows:

- Yellow bags for clinical waste
- Blue bags or clear bags with biological hazard sign on it for biological material requiring autoclaving
- Red bags for chemically contaminated waste (e.g. gloves and weighing boats)
- Clear bags with a radioactive hazard sign on it for radioactive waste
- Yellow bag with red stripe on it for infectious waste contaminated with cytotoxic and/or cytostatic medicinal products
- Dustbin with purple strip - for oily rags and such workshop waste
- Black or Clear (with NO symbols on the bag) for domestic waste

Non- contaminated items of paper, plastic may be put in the re-cycling containers which should not located in the laboratory (contact the Environment Manager at Estates to determine what can and cannot be put into recycling bins). Certain types of glass can be put in the glass recycling bins. Borosilicate glass (e.g. QuikFit equipment) cannot be recycled and should be disposed of as waste.

Note - Do not put glass items or broken glass into domestic bins as these can cause cuts to cleaners. Broken glass should be kept in appropriate solid containers which will protect workers from cuts.

Domestic waste, dirty paper, plastic, rubber, wood and glass are exempt from certain requirements of the Controlled Waste Regulations and will be routinely collected by the Local Authority. These items may be placed in the bins provided for domestic waste in each laboratory and will be collected by the cleaners.

NOTE: No sharps (eg broken glass or syringe needles etc) can be put in domestic waste bins.

Each laboratory, however, must also have a container for items which are potentially contaminated with chemicals and thus not allowed to be put in the domestic waste bins. Such contaminated items include weighing boats, gloves and other items contaminated by trace quantities of chemicals. This waste should then be put in special containers (skips) for uplift by a special contractor. Such uplifts should be arranged through the Director of Environmental, Health and Safety Services. These items should never be put in skips uplifted by Fife Council.

Note: Sharps in the form of scalpels, syringes/needles should be put into a proper sharps container and uplifted by an appropriate contractor.

Laboratory controlled waste containers must be emptied regularly and never allowed to overflow. Under no circumstances must any item of glass, sharp metal or fine powder ever be put in a laboratory bin for domestic waste.

Where there are bottles with significant quantities of chemicals in them, these must be disposed of as 'Special waste' through a specialised contractor and arranged through the Director of Environmental, Health and Safety Services. Significant quantities of solid chemicals musty never be put to drain as a means of disposal.

Note: All empty bottles put out to recycling waste must be carefully washed to remove trace quantities of chemicals such that there is no detectable chemical smell, the label identifying any previous contents removed, tops must be removed from all bottles put out for disposal.

Guidance

9.0 Work with Biological Agents, Clinical Samples, Animals and Plants.

9.1 Biological Agents

9.1.1 Introduction.

All work with biological agents is governed by the COSHH Regulations. A biological agent is defined as 'micro-organisms (bacteria, viruses, fungi, microscopic parasites e.g. malaria, and microscopic infectious forms of larger parasites e.g. ova and infectious larval forms of helminths pathogenic to humans), cell cultures and human endoparasites, including any which have been genetically modified, which may cause infection, allergy, toxicity or otherwise create a hazard to human health and the environment'.

As biological agents may pose a risk to workers, to the general public and the environment, it is essential that suitable control measures, as required by a written risk assessment, are taken to prevent accidental release of any biological agents. These control measures include suitable and sufficient engineered control measures, a Laboratory Code of Practice, and as a last resort, appropriate personal protective equipment (PPE). Consideration must also given to the inactivation of any biological hazard before disposal.

Detailed guidance on assessing the risks of working with genetically modified organisms can be found in Section 4.1.4 of this guidance.

9.1.2 Hazards and Categorisation of Pathogens.

The hazards posed by biological agents to workers include infection, pathogenicity, release of toxins and allergic reactions. It is therefore essential that workers appreciate the risks to themselves as well as to others. The Advisory Committee on Dangerous Pathogens (ACDP) provides guidance on the safe use of pathogens. The ACDP publish a book entitled 'The Approved list of Biological Agents' which defines the hazard groups for biological agents. A copy of this book is available for view at the HSE website:

http://www.hse.gov.uk/pubns/misc208.pdf

A copy can also be viewed at the Environmental, Health and Safety Services office. The categories for biological agents can be obtained using the University computerised COSHH Risk Management System 'CHARM'.

Pathogens have been categorised by a National body (managed by the HSE) called the Advisory Committee on Dangerous Pathogens (ACDP) into four groups based on the inherent hazard of the organism. The term 'hazard' is intended to express the degree of pathogenicity of an organism and the term 'risk' expresses the probability that, in certain circumstances, the hazard will cause an infection. Judgment of the hazards of a pathogen are made on the basis of such factors as the severity of the disease it causes, the routes of infection and its virulence. This evaluation takes into account the existence of effective therapies, possibility of immunisation and the dose, route and site of infection.

NOTE: This categorisation of hazard does not allow for any additional risk to people who may be severely affected due to compromising factors e.g. pregnancy, compromised immunity or those allergic to the pathogen.

The four ACDP hazard groups are defined as follows:

Hazard Group 1 - Low Individual and Community Risk - This group of biological agents are unlikely to cause disease in healthy workers and is unlikely to spread to the community.

Hazard Group 2 - Moderate Individual Risk and Limited Community Risk - A biological agent that can cause human disease and may be a hazard to workers; it is unlikely to spread to the community and there is usually an effective prophylaxis or effective treatment available.

Hazard Group 3 - High Individual Risk and Moderate Community Risk - A biological agent that can cause a severe human disease and presents a serious hazard to workers; it may present a risk of spreading to the community, but there is usually an effective prophylaxis or treatment available.

Hazard Group 4 - High Individual Risk and High Community Risk - A biological agent that causes a severe human disease and is a serious hazard to workers; it is likely to spread to the community and there is usually no effective prophylaxis or treatment available.

NOTE 1: Work with category 3 pathogens can only be performed in the category 3 containment facilities in the Biomedical Sciences Research Complex (BSRC). Any work in this facility can only be performed if it has written approval by the **Director of the Category 3 Facilities** and the project ratified by the Chemical and Biological Hazards Management Group.

NOTE 2: ***Containment Level 4 -*** The University does not possess the necessary facilities to handle Hazard Group 4 pathogens and thus **NO WORK on Category 4 pathogens maybe undertaken at the University**. No details on such containment will be given in this guidance. If information on category 4 containment facilities is required, it may be obtained from the Director of Environmental, Health and Safety Services.

NOTE 3: The above groups are not exactly the same as the Category 1, 2, 3 and 4 groups defined in the Genetically Modified Organisms Regulations and should not be confused with these categories

9.1.3 **Risk Assessment of Work with Biological Agents**.

Work with a new biological agent cannot begin until a suitable and sufficient written risk assessment has been produced. Guidance on work with biological agents has been produced by the Health and Safety Executive and can be viewed on their website at the following address:

http://www.hse.gov.uk/biosafety/biologagents.pdf

A risk assessment should include the following details:

1. **The biological agents present**. This should include details of all possible contaminating agents e.g. contamination of cell cultures with virus (eg Epstein-Bar Virus transformed cell lines produce small quantities of viable virus from the cell line), or contamination of blood samples with Hepatitis B virus.

2. **The hazard group of the biological agent.** This can be found on the University computerised COSHH Risk Management System 'CHARM'. If the biological agent you are working with is not shown in this publication, you should seek advice from the Director of Environmental, Health and Safety Services.

3. **What form the biological agent is in.** Biological agents can exist in many forms for example as spores or cysts, which can be very resistant to disinfection procedures.

4. **The illness which the biological agent may cause.** This should include non-infectious illnesses e.g. allergic reactions and the effects of toxins.

5. **Where the biological agent is handled/stored and also how the agent may be transmitted.** This section should clearly define where the biological agent is stored and how it is used. It should also state possible routes of transmission e.g. airborne, through cuts, abrasions, ingestion, insect vectors etc.

6. **The likelihood of exposure and consequent disease.** This should include the identification of workers, who may be particularly susceptible, for example immuno-compromised employees.

7. **Whether the nature of the activity will permit substitution by a less hazardous agent.** In particular can non-pathogenic strains/mutants of the biological agent can be used.

8. **The control measures to be implemented**. The control measures should be prioritised as follows:

    i. Eliminate the risk if practicable;
    ii. If you cannot eliminate, then substitute with a less hazardous substance (e.g. less pathogenic mutant strains);
    iii. If you cannot substitute, then put in place appropriate engineering controls (e.g. work inside a microbiological safety cabinet);
    iv. Put in place appropriate laboratory Codes of Practices and appropriate Safe Operating Procedures;
    v. If none of the above control measures can adequately control the risks of the biological agents should Personal Protective Equipment (PPE) be issued.

The control measures should also include:

i). appropriate storage conditions;
ii) containment facilities required as part of the engineering solutions(see section 2.1.5);
iii) the method for inactivating the agent for disposal;
iv) means of limiting the number of persons exposed to the agent.

9. **Laboratory Code of Practice.** A Code of Practice appropriate for the level of risk must be prepared and approved by the School/Unit/Building Safety Committee before work

commences. A copy of the Code of Practice should be posted at the entrance to the work area. A standard Code of Practice is given as an example in Appendix 9. If it is necessary to modify the standard Code of Practice, a copy of the amended Code should be sent to the Director of Environmental, Health and Safety Services. There is a separate Code of Practice for work in Category 3 laboratories. All workers using such facilities should have read this Code of Practice and must under University regulations comply with this Code of Practice when entering such facilities.

10. **Treatment.** The risk assessment should include details of any effective therapies that are available for example immunisations, drugs to control infection etc.

11. **Health Surveillance.** Health surveillance maybe required. Specific procedures may be necessary to detect any adverse effects the biological agent may have on the health of workers. Advice on this matter is available from the Occupational Health Adviser (Ext. 2752).

Risk assessments for non-genetically modified biological agents should be performed using the CHARM programme for COSHH risk management.

A copy of the risk assessment must be signed by all relevant workers to show that they have read and understood the risks of the work and what control measures must be implemented.

Any necessary information, instruction, training and supervision which may be required for this work to be performed safely must be given to all relevant workers.

Further details on how to perform risk assessments on biological agents can be found in the HSE Publication 'Biological Agents: Managing the Risks in Laboratories and Healthcare Premises' (which can be found at the following URL: http://www.hse.gov.uk/biosafety/biologagents.pdf and 'COSHH: Approved Code of Practice' which may be viewed at URL: .

9.1.4 **Notification Procedures For Work With Non-Genetically Modified Biological Agents.**

HSE notification of category 2 and 3 GMO are made under the Genetically Modified Organisms (Contained Use) Regulations (see Section 4.1.6 of this Guidance.

The COSHH Regulations require that certain activities involving non-genetically modified biological agents should be notified to the HSE. These are:

i. Work with the following agents:
Work with any ACDP category 3 or 4 pathogen;
Bordella pertusis;
Corynebacterium diptheriae;
Neisseria meningitidis

ii. The HSE must be notified 30 days in advance of an intention to use, or store, an agent from a particular ACDP hazard group, other than group 1, for the first time. Workers intending to begin work with a hazard group 2 or 3 pathogen for the first time must contact the Director of EHSS for guidance before any such work may commence.

A record must be kept of all biological agents stored/used within a School/Unit. An annual update of the biological agents stored/used must be provided to the Chemical and Biological Hazards Management Group via the Director of Environmental, Health and Safety Services.

9.1.5 **Containment Requirements.**

The ACDP hazard group of a particular organism indicates the level of containment under which it must be handled. These levels of containment are regarded as appropriate for most laboratory scale uses of particular pathogens. The specific requirements for different containment facilities is given in Appendix 4.

NOTE: If there is a significant increase in the risk of infection to workers due to a particular work activity e.g. production of aerosols, it is the responsibility of the Project Supervisor to ensure that an appropriately higher level of containment is employed.

Details of the containment facility requirements can be found in the HSE document entitled entitled 'The Management, Design and Operation of Microbiological Containment Laboratories' (URL: http://www.hse.gov.uk/pubns/priced/microbiologyiac.pdf).

9.2 **Specified Animal Pathogens (Scotland) Order (SAPO) 2009**

The Specified Animal Pathogens (Scotland) Order (SAPO) 2009 governs the use of certain animal viruses which foreseeably could result in severe economic damage to the animal agricultural community. The list of Pathogens regulated by this legislation is given in Appendix 5. This list does change on a regular basis and thus the Principal Investigator must check with the Director of EHSS prior to beginning work on any pathogen which is believed may have an impact on animals. Approval of the use of such agents is now managed by the HSE on behalf of the Scottish government (see Guidance at URL: http://www.hse.gov.uk/pubns/priced/hsg280.pdf)

Due to the specific hazards associated with SAPO agents, guidance on the storage, use and disposal of SAPO agents is given in separate guidance document available from the Director of Environmental, Health and Safety Services.

The licence required to work with SAPO agents is held by the Vice-Principal – Research on behalf of the University. This is a change from previous guidance.

9.3 **Importation of Animal Pathogens**

The importation of animal pathogens from outside the European Union is regulated by the Importation of Animal Pathogens Order 1980 as amended. A licence for the importation of such agents must be obtained from the Scottish Executive. It is recommended that all such applications are made on behalf of the University by the Director of EHSS.

9.4 **Plants and Plant Pathogens**

Regulations covering experimentation with plants and/or plant viruses is enforced by the Scottish Executive / Department of the Environment, Food and Rural Affairs (DEFRA). There are extensive restrictions on the use of certain plant viruses, which foreseeably could result in severe economic damage to the agricultural community. Such work is restricted to higher containment facilities. Details of these regulations can be obtained from the Director of Environmental, Health and Safety Services. All work with Plant Viruses must be risk assessed using the HSE guidance (http://www.hse.gov.uk/biosafety/gmo/acgm/acgmcomp/index.htm) and checked with the Director of EHSS to ensure that the work complies with all other relevant legislation.

There is extensive legislation on regulating work with transgenic plants and genetically modified plants. As a consequence, all work with certain plant viruses and transgenic plants must be approved by the local School/Unit Health and Safety Committee and ratified by the Chemical and Biological Hazards Management Group. Guidance on working with genetically modified plants and plant viruses can be obtained at the following HSE website:

http://www.hse.gov.uk/biosafety/gmo/acgm/acgmcomp/part4.pdf

Information and guidance on these matters can be obtained from the Director of Environmental, Health and Safety Services.

9.5 **Anti-Terrorism, Crime and Security Act 2001 (as amended)**

The Anti-terrorism, Crime and Security Act 2001 as amended and the Part 7 of the Anti-Terrorism, Crime and Security Act 2001 (Extension to Animal Pathogens) Order 2007 requires the University to inform the Home Office and the local police if there is any work with specified pathogens (see Appendix 6 for the list of pathogens specified in this Act). The local police will recommend appropriate security measures for the storage, use and disposal of such pathogens.

The notification of the use of pathogens in this list will be carried out by the Director of Environmental, Health and Safety Services. No work with such pathogens can begin until the relevant authorities have been notified and the local police have inspected the facility or given their approval for the work to start. It is, therefore, vital that any Principal Investigator must notify the Director of EHSS of their wish to use these agents well in advance of the work beginning.

9.6 **Cell Lines**.

A COSHH risk assessment should be carried out on all work using cell lines as for any other work with a biological agent using the CHARM programme

All cell lines should be assessed for possible risks to employees before they are used. As many cell lines are human or primate in origin, it means they may carry adventitious human infectious agents and thus care should be taken when culturing them.

Laboratory workers **must not** cultivate cells from their own body. This is because if the cells are accidentally re-inoculated into the worker the *in vitro* transformed or genetic modification cells could result in malignant disease or expression of an unusually pharmacologically active protein causing disease in the worker.

Where work on a cell line may change the tropism for an infectious agent (eg inserting a receptor for a virus which does not usually infect a particular species), then as a precaution consideration should be given to reviewing the hazard category of the modified cell line as the potentially increased risk may make it necessary to increase the level of containment.

Certain permanent cell lines may have been transformed using viruses e.g. Epstein-Barr Virus (EBV). These cell lines may shed small numbers of viable virus particles when being cultured, exposing workers to the risk of infection with these viruses. It is therefore important that researchers identify this hazard in their risk assessment and put in place appropriate containment facilities are used when culturing these cell lines. Information on such transformed cells can be obtained from the manufacturer/supplier.

Assessment of the risks that specific cell lines pose should include the origin of the cell line, possible infectious agents (particularly any oncogenic viruses which may be present), any containment facilities required and the disinfection procedures required before disposal.

9.7 Clinical Samples.

Ethical approval must be obtained prior to work with human tissue can begin. All work with human tissue must comply with the Human Tissue (Scotland) Act 2006. All work with human samples must receive approval from the University Ethics Committee (UTREC - University Teaching and Research Ethics Committee) prior to the start of work (see https://www.st-andrews.ac.uk/utrec/)

All clinical samples should be treated as potentially infectious and hazardous, thus all operations should be performed within at least category 2 containment facilities (see section 2.1.5). Where there is evidence that a human tissue sample may be contaminated with a category 3 infectious agent, the sample should be work in category 3 containment unless there is good evidence that the infectious agent will pose limited risk to other workers.

NOTE: Samples which may be contaminated with category 4 pathogens cannot be worked at the University as we do not have the necessary containment facilities.

A written risk assessment of the foreseeable risks involved in working with specific clinical samples must be produced and signed by the Principal Investigator and made available to all relevant employees. This should include any clinical data provided which may be relevant to determine the risk to workers.

There should be a specific Code of Practice produced for collecting, processing and disposal of clinical samples which emphasizes the specific hazards of the samples (e.g. Hepatitis B infection from human blood samples). Personnel who work with clinical samples should receive the necessary information, instruction, training and supervision. Clinical samples should be stored securely. Any biological hazard associated with a particular clinical sample must be inactivated before disposal. It is essential that any sharps contaminated with clinical samples are stored in the appropriate sharps containers to be sent for incineration.

Researchers handling clinical samples must always have written consent of the patient to take their samples and to only undertake work described to the patient so they can give due consent to the work with their samples. This consent will also define what information can be passed to a third party.

Note: Contaminated sharps should be disposed of in designated containers and must never be mixed with domestic or other waste.

9.8 Work with Animals

9.8.1 Introduction

For any work on animals the Animals (Scientific Procedures) Act 1986 (ASPA) should be considered. The ASPA regulates procedures that are carried out on ‘protected animals’ for scientific or educational purposes that may cause pain, suffering, distress or lasting harm. All work must be approved by the University’s Animal Welfare and Ethics Committee (AWEC) prior to the work starting (http://www.st-andrews.ac.uk/staff/research/ethics/animalsinresearch/

If you are unsure if a procedure is regulated you must contact the relevant Named Animal Care and Welfare Officer (NACWO, Senior animal care technicians) or ask the Home Office Liaison Contact **PRIOR** to starting the work.

No work can start unless the University hold a Project Licence and a Personal Licence that have been issued by the Home Office. The project must detail any planned procedures and the personal licence must include the relevant categories to carry out the work. Any person wishing to obtain a personal licence must undertake an appropriately Home Office approved modular training course prior to starting work. Details of how to register for the courses and apply for these licences can be obtained from the University Home Office Liaison Contact (e-mail: holo@st-andrews.ac.uk).

The Act requires that all places where regulated procedures are undertaken on animals are carried out in licenced premises. These premises have restricted access and that the animals are regularly inspected by a named veterinary surgeon as well as Home Office Inspectors.

In certain circumstances, regulated procedures under the Act can be carried out in Places Other than Licenced Establishment. For example, procedures undertaken in fields, woods etc. In these cases, the Home Office will need prior notification when the work is due to start. You should contact the Home Office Liaison Officer (email: holo@st-andrews.ac.uk) prior to the work beginning to ensure the Act is being complied with.

The capture of wild animals for scientific purposes is also strictly regulated by legislation. If your project licence authorises the use of animals taken from the wild, you must ensure that such animals are captured by a competent person using a method which does not cause the animal avoidable pain, suffering, distress or lasting harm. To undertake such work, a licence for the capture of such animals must usually be applied for prior to the work starting. Information on the necessary approval procedures for such work can be obtained from the Home Office Liaison Officer (e-mail: holo) Director of Environmental, Health and Safety Services.

Work with animal pathogens regulated by the Specified Animal Pathogens (Scotland) Order 2009 must be notified to the HSE through the Director of EHSS prior to work starting (see Section 2.2).

All work with zoonotic pathogens on live animals must be notified to the Home Office Liaison Contact and Senior Animal Care technicians so they are aware of the potential risks to workers in the facilities.

9.8.2 Code of Practice

All animal house facilities work must include a written Code of Practice, which includes details on procedures required to be complied with by all users of the facility. No work in an animal house may begin until the relevant Senior Animal Care Technician has been provided, prior to the work starting, with a copy of:

- a formal study plan
- (for studies involving regulated procedures) a copy of the Home Office Project Licence and
- (for studies involving regulated procedures) a copy of the Home Office Personal Licence for the worker and
- a copy of the risk assessment for the work being proposed in the facility and
- a copy of the Standard Operating Procedure (SOP) for the work (if currently available SOPs do not cover the proposed work).

9.8.3 Hazards and Risk Assessments.

All work with animals should have a risk assessment performed and appropriately approved. When performing risk assessments all foreseeable significant hazards should be taken into account. The method for performing a risk assessment on work with animals may be based on the system used for assessing the risk of work with biological agents (see section 2.1.3).

The additional factors to be taken into account when performing a risk assessment of work with animals include:

i) Are there Home Office approved project and personal licences for procedures using animals?

ii) Are animals necessary for the experiment? If there are alternatives to using animals these must be used.

iii) Are the animals infected with any known human/animal pathogens? If so, what are the risks to workers in the facilities and/or the environment of accidentally released?

iv) What human diseases or environmental risks are associated with the animals? This will include non-infectious agents e.g. allergies and the production of toxins.

v) What are the routes of transmission of these diseases?

vi) Physical Risks: e.g. bites and needle stick injuries;

vii) Disposal of Toxic/Clinical waste. This will include protocols for the disposal of any hazardous/toxic/clinical waste which may be generated by the experimental procedure.

9.8.4 Containment Facilities For Animal Biohazards.

Animal house facilities and work within these facilities are governed by the Animals (Scientific Procedures) Act 1986 and other relevant legislation concerning biohazards.

The four principle aims of animal biohazard containment are:

i) To regulate and contain biohazards which may arise as a predicted result of an experimental procedure;

ii) To prevent the release of infectious agents that could arise from an experiment or be introduced accidentally into a colony of laboratory animals;

iii) To prevent the spread of dust, dander and excreta which may act as sensitising agents causing allergic responses (e.g. allergic asthma);

iv) To ensure that laboratory animals do not suffer any unnecessary pain,

9.8.4.1 Containment of Biological Hazards from Animals.

Laboratory animals could become hazardous or infectious for three reasons,

i) the result of experimental procedures
ii) the outbreak of an unwanted adventitious infection
iii) allergic responses.

Containment of the biological hazards from animals can be achieved by three means:

a. Containment Facilities

Animal house facilities should have an appropriate ventilation system providing approximately 20 air changes per hour. This level of ventilation will be affected by the level of dust produced by the animals. It is therefore vital that the stocking levels within individual rooms are not more than the ventilation system can manage. Guidance on this matter can be obtained from Estates.

Animals infected with pathogenic biological agents may require to be housed in specialised containment facilities. The appropriate animal biohazard containment facility requirements are detailed in the HSE publication 'Working safely with research animals: management of infection risks' (URL: http://www.hse.gov.uk/pubns/priced/animal-research.pdf - A copy of this document is available from the Director of EHSS). Guidance on animal biohazard containment facilities can be obtained from the Director of EHSS.

Where practicable, animals should be housed in Individually Ventilated Cages (IVCs) which have HEPA filtered air intakes and run at negative pressure to the room. This removes dust and dander from the atmosphere in the animal holding room, thus reducing the risk of allergic responses. When changing animal bedding, this should be done in a cage cleaning station which removes any dust which is generated. These units can be run at negative pressure to reduce the leakage of allergens to the atmosphere

b. Procedures

Containment can be achieved by carefully planned work practices. These work practices include measures designed to eliminate or, if not reasonably practicable, minimise exposure and the spread of infectious agents and/or allergens. These procedures should be detailed in the Animal House Laboratory Code of Practice. These procedures should be available to all relevant workers within the animal house.

The procedures must include means of minimising the generation of dust and dander which may cause allergic responses. Guidance on such procedures can be obtained from the HSE document entitled: 'Control of laboratory animal allergy (EH 76) (URL: http://www.hse.gov.uk/pubns/eh76.pdf) A copy of this document is available at Environmental, Health and Safety Services.

c. *Introduction of new stock*

To avoid introducing new infections into an animal colony, animals brought into the University should be acquired from approved UK suppliers (or approved UK institutions) who can guarantee that their stock is free from infection. The length of time animals should be acclimatized for is dependent on the type of work to be done however you should allow a minimum of 7days before use. This is may differ depending on species you would be advised to check out up to date documents to be sure.

The length of quarantine is dependent on the supplier, however, animals are usually quarantined for 14 days after arrival.

Animals should be routinely checked for infection and disease. Any animals suffering unnecessarily whether as the result of an experimental infection, or from an unwanted biohazard, should be humanely dispatched by an appropriately qualified and licensed member of staff.

No wild animals can be introduced to any animal facility without a detailed, suitable and sufficient risk assessment and approval from the Senior care technician (or Secure Facilities Manager) and if necessary the Home Office/Scottish heritage (if this is a wild animal brought into the facility). The potential risks of zoonotic infections and the spread of infections to animal colonies as well as the potential spread to the environment must be considered in detail before such animals are brought into the University facilities.

9.8.5 **Containment facilities for working with transgenic plants and certain plant viruses.**

There is extensive legislation on regulating work with transgenic plants and genetically modified plants. As a consequence, all work with certain plant viruses and transgenic plants must be approved by the local School/Unit Health and Safety Committee and ratified by the Chemical and Biological Hazards Sub-Committee. Guidance on working with genetically modified plants and plant viruses can be obtained at the following HSE website:

http://www.hse.gov.uk/biosafety/gmo/acgm/acgmcomp/part4.pdf

Information and guidance on these matters can be obtained from the Director of Environmental, Health and Safety Services.

1.9 Work with Arthropods

9.9.1 Introduction

Arthropods are a wide ranging group of invertebrate organisms which include insects, arachnids, or aquatic arthropods eg crabs and lobsters. The University has recently seen a significant and increasing amount of work with insects (e.g. *Drosophila melanogaster*) and other arthropods. There are specific hazards associated with each type of arthropod and it is vital that the hazards of each are fully understood by the researchers. The hazards can vary depending on the organisms and may include:

- Bites and stings from bees and some arachnids;
- Exposure to any potential zoonotic infections (examples of organisms that can survive in Drosophila URL: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3956501/)
- Potential release of genetically modified organisms (GMOs) into the environment;
- Exposure to potentially allergenic materials (see URL: http://flystocks.bio.indiana.edu/Fly_Work/culturing.htm http://www.sciencedirect.com/science/article/pii/0091674986903313)
- Physical defences (eg from marine arthropods like crabs)

To ensure the safety of laboratory workers as well as other staff and students at the University and to prevent possible harmful environmental effects of the work, it is important to have proportionate control measures in place which are relevant to the type of arthropod that researchers are using.

The control measures used to eliminate or minimise risks will vary depending on the type of organism. Thus the controls for Drosophila will vary from that used for marine arthropods like crabs and lobsters. It is therefore vital that workers understand what risks are associated with the particular organism.

9.9.2 Risks Associated with Arthropods

It is a legal requirement that an appropriate risk assessment is undertaken for all procedures which may have a significant risk to humans or the environment. All work with arthropods, which includes insects, arachnids and marine arthropods should identify any hazard these organisms pose and what control measures are required to eliminate or minimise the risks these organisms pose. All such risk assessments must be approved by the Supervisor of the project and also all the workers undertaking the activities.

Arthropods are a very large and wide-ranging phyla of arthropods ranging from very small inspects and arachnids to much larger aquatic arthropods like crabs and lobsters. The risks could include issues like:

- Stings and bites from some smaller insects eg bees, ticks, mites and scorpions;
- Much more serious venomous arthropods like tarantulas;
- Nips and pinches from larger aquatic decapods eg crabs and lobsters
- Allergic reactions to the arthropod or its sting
- Arthropods acting as a vector for a human pathogenic micro-organism

Risk assessments should clearly identify the hazards associated with this type of work, who may be harmed, the risks associated with the work and what control measures need to be implemented to minimise the risks associated with the work. This must include details of how the arthropods will be euthanized and how they are to be made safe for disposal. Guidance on risk assessing research with animals including arthropods can be found in the following Health and Safety Executive documents:

- Working Safely with Research Animals: Management of Infection Risk (see URL: http://www.hse.gov.uk/pUbns/priced/animal-research.pdf);
- Biological Agents: managing the Risks in Laboratories and Healthcare Premises (see URL: http://www.hse.gov.uk/biosafety/biologagents.pdf)

The risk assessment should also include details of specific hazards which may affect other workers at the University.

All chemical control measures which are used, e.g. disinfectants, must include some detail about the effectiveness of the chemicals (for low risk work, this can be the manufacturers information).

Work with genetically modified arthropods will come under the Genetically Modified Organisms (Contained Use) Regulations 2014. Such work with genetically modified arthropods (eg *Drosophila spp* or other insects or arachnids) must be approved by the University Chemical and Biological Hazards Management Group (see form at URL: http://www.st-andrews.ac.uk/media/environmental-health-and-safety-services/health-and-safety/chemical-and-biological-safety/Notification%20of%20Genetic%20Modification%20Project.rtf). Where the genetically modified arthropods which are more hazardous than the parent strain will then also have to be approved by the HSE which can take up to 45 days from submission.

It is therefore a requirement of the legislation to ensure there is adequate containment which is proportionate to the risk of the organisms to human health and the environment. Every effort must be undertaken to ensure there is no release of the genetically modified organism into the environment no matter how little risk is perceived from the organism.

Where an arthropod may act as a vector for a pathogenic micro-organism (eg mosquitos infected with *Plasmodium falciparum* thus may cause malaria), an assessment of the potential risk to workers and the public must be undertaken. This will include details of the genetically modified arthropod vector or pathogen or both. If there is a potential risk, then appropriate control measures must be put in place to avoid potential infection of workers and/or the public.

ISTR has produced guidance on working with arthropod vectors for human pathogens at URL: http://www.istr.org.uk/docs/guidance%20on%20the%20containment%20of%20infected%20arthropods%20%20V1%20August%202017.pdf .

Laboratories where work with arthropods is performed must have appropriate procedures for the storage and disposal of these organisms e.g. http://www.flyfacility.gen.cam.ac.uk/Flylab/houserules

9.9.3 Containment and Control Requirements

Other than during fieldwork or work in an apiary, all work with arthropods must be in specified laboratories, insectaries or aquaria. The door to these laboratories must display a Code of Practice or Standard Operating Procedure (SOPs) for those entering and working within the laboratory. Cleaning staff and trades staff should be warned of the hazards in these areas prior to starting work.

All work with genetically modified arthropods must be undertaken in controlled conditions which restrict the potential for escape. This is a requirement for genetically modified arthropods under the Genetically Modified Organisms (Contained Use) Regulations 2014. Further guidance on containment of arthropods which act as vectors for human/environmental pathogens can be found at URL: http://www.istr.org.uk/docs/guidance%20on%20the%20containment%20of%20infected%20arthropods%20%20V1%20August%202017.pdf

Each laboratory must have suitable and sufficient containment procedures in place which prevent escape of laboratory arthropods to the environment. The Health and Safety Executive guidance on working with arthropods is given in the document entitled: ' Working Safely with Research Animals; Management of Infection Risks (see URL: http://www.hse.gov.uk/pUbns/priced/animal-research.pdf).

Laboratories using terrestrial (ie those that crawl, jump or fly) arthropods should have the following control measures (or the equivalent):

- rooms should be insect-proof;
- ventilation inlets and outlets should be screened;
- consideration should be given to placing 'insectocutors' outside the laboratory – see Working safely with research animals: Management of infection risks (URL: http://www.hse.gov.uk/pUbns/priced/animal-research.pdf)
- measures should be taken to enable escaped arthropods to be easily detected and recaptured or destroyed;
- a laboratory sink should be provided with an adequate trap for waste; if there is a possibility that arthropods could escape through the trap, liquid waste should be treated before disposal (preferably by heat - see below);
- solid waste is most effectively treated by heat because it may harbour arthropods that may not be killed by chemical disinfectants or fumigants;
- insecticidal sprays may be necessary in an emergency;
- arthropods may be chilled to reduce their activity and minimise the risk of escape;
- for ticks and mites, containers should be kept over trays of oil;
- flying insects infected with agents in Hazard Groups 2, 3 or 4 should be kept in double cages (for example, a sleeved netting cage inside a clear substantial plastic bag) and both enclosures should be labelled;
- experimental cages/containers should be numbered and labelled or otherwise documented to indicate the hazard;
- at Containment Levels 3 and 4, flying or crawling arthropods should be kept in identified lots and each lot accounted for; they should also be handled in an appropriate containment device;

- laboratories receiving potentially infected arthropods for identification or examination, where the specimens are not known to be dead, should ensure that containers are opened in an appropriate safety cabinet or other safe form of enclosure;
- where practicable, a record should be made of the number of individual arthropods at the earliest practicable time, and each invertebrate should be accounted for as the work proceeds through to final fixation or disposal;
- where identification of flying or crawling arthropods alone is required, the container may be frozen at -20°C, or lower as necessary as some arthropods can withstand prolonged freezing, for 2 hours to kill them..

Please note that additional precautions may be necessary for genetically modified organisms, whether recommended by the Chemical and Biological Hazards Management Group, or imposed as a condition by a government agency. Guidance on what constitutes a GMO, how to assess risks of working with GMOs and good practices for containment of GMOs are available here:

http://www.hse.gov.uk/biosafety/gmo/acgm/acgmcomp/part5.pdf

Please note that additional precautions are necessary for work that involves species that pose a direct risk to public health and/or agriculture. Laboratories working at genetically modified arthropods at Hazard Levels greater than 1 will be required to obtain HSE approval prior to work commencing. Guidance on what arthropods meet these criteria are available here:

http://www.hse.gov.uk/biosafety/gmo/acgm/acgmcomp/

http://www.hse.gov.uk/pubns/priced/l29.pdf

http://www.who.int/csr/resources/publications/biosafety/en/Biosafety7.pdf

Where there is a proposal to work with deliberately released genetically modified arthropods into the environment, the requirements of the Genetically Modified Organisms (Deliberate Release) (Scotland) Regulations 2002 will need to be complied with. It is vital that any such application is made in due to time to obtain permission. It is vital that contact is made with the Chemical and Biological Hazards Management group as soon as practicable. It is vital that all practicable controls with regard to the potential harm of such organisms is contained in the risk assessment for the work.

9.9.4 Worker Safety

It is vital that the risk assessment for any work with arthropods also includes the safety of the workers. For example any work with marine arthropods on the coast line must take into account the risks to workers due to tide changes, access to the coastline etc.

If there is use of CO_2 for anaesthetisation for specific types of arthropods eg Drosophila, then this work must be carried out in a well ventilated area. If there is any restriction in the ventilation in this area, or if the size of the largest CO_2 cylinder would create a hazardous atmosphere in the event of a leak, then a CO_2 level or O_2 level electronic detection system must be installed.

Workers can become allergic to arthropod and/or the media used to maintain them as well as to their bites and stings

Any worker who shows the following symptoms:

- itchy eyes;
- sneezing, running or blocked nose;
- chest tightness with wheezing;
- itchy skin rash;
- swelling of lips, sometimes swelling of tongue

should notify their supervisor immediately and contact Occupational Health for medical advice.

9.9.5 Fieldwork

A suitable risk assessment needs to be done on fieldwork with arthropods. This will include any risks associated with getting to the relevant organisms (eg marine arthropods) as well as working on wild organisms (eg bees). Work with wild organisms should also take into account the possibility of injury due to the organism or injury due to stings/bites. Such work may not be close to emergency services thus consideration of medical / first aid requirements should be considered in the risk assessment. This is especially important when working with marine arthropods which are a significant distance from the coast. It is therefore vital that detailed assessment is undertaken where all relevant risks are considered and suitable control measures are implemented.

Where it is proposed to undertake work with deliberately released genetically modified organisms, then researchers will need to undertake a risk assessed under the Genetically Modified Organisms (Deliberate Release) (Scotland) Regulations 2002 (see URL: http://www.legislation.gov.uk/ssi/2002/541/contents/made). All such applications should be made to the University Chemical and Biological Hazards Management Group prior to any submission to the Scottish Government for approval. It should be noted that approval for such work can take a significant amount of time and thus any application must be made as early as possible.

9.9.6 Training

It is expected that researchers behave in a professional manner when using arthropods in their research. There are no legal restrictions on the use of arthropods at this time. It is, however, recommended that, morally, laboratories should have a culture of respect for all animal life, including arthropods. This includes using the most appropriate means of euthanizing the arthropod. This will vary depending on the organism, for example use of CO_2 for use with *Drosophila* but may be chilling certain aquatic arthropod species. It is recommended that individual laboratories train staff to minimize the number of organisms sacrificed during experiments and that all arthropods are dispatched in an appropriate manner. This should be part of the Standard Operating Procedures (SOP) for the work.

All staff who handle arthropods must be competent to do so and must have received appropriate training as well as must receiving suitable supervision. It is therefore a requirement that workers receive appropriate training in:

- SOP for work with arthropods,
- the handling of such arthropods,
- the best practice for anaesthetising arthropods,
- the appropriate systems for disposal of euthanized arthropods.
- procedures for working with arthropods that may cause physical harm (e.g. bees or tarantulas)
- what to do if significant numbers of arthropods escape
- where the arthropod may act as a vector for a pathogenic organisms, what disease these agents may possibly cause;
- potential injury due to nips and pinches from arthropods;
- how to report any medical conditions which may develop eg allergies

This training must be recorded for all workers.

Specific training in the handling of terrestrial arthropods during fieldwork should be required where appropriate. For example, workers handling bees in an apiary or during fieldwork should have

received suitable training eg attending a beekeeping course or tuition from an experienced beekeeper. All training should be recorded in writing.

9.9.7 Transport of Arthropods

Transport must be inside containers with at least 2 layers of physical containment which can withstand an approximate 2 metre drop or as appropriate according to the species.

9.9.8 Stocks of *Drosophila*

It is recommended that whenever reasonably practicable, all new stocks of terrestrial arthropods are quarantined appropriately for the relevant species eg. *Drosophila* should be kept in quarantine for 2 generations to ensure there is no inherent infection which will affect the colony with mites or micro-organisms. It is also recommended that stocks of arthropods are disposed of before adults become old. Older cultures have an increased risk of becoming infected with mites or mould (see URL: http://www.flyfacility.gen.cam.ac.uk/Flylab/houserules).

9.9.9 Disposal of insects or other arthropods and growth media

Terrestrial arthropods can be anaesthetised or killed with CO_2 in specific apiary gas tight containers or by freezing to -20ºC for 24 hours. Anaesthetisation with CO_2 should be undertaken in well ventilated laboratories in case of a leak of CO_2. See Worker Safety above.

It is then necessary to autoclave all biological material waste materials from the experiments including growth media. All such waste materials should be autoclaved at 120ºC at 15psi for 30 minutes. Following autoclaving, biological material and growth media can disposed through appropriate routes for waste disposal.

10.0 Allergic Reactions

10.1 Introduction

Animal dander, excreta and dust from cages can induce allergic responses in workers. It has been estimated that 15-30 % of all animal handlers develop allergies to animals and that as many as 10% develop allergic asthma. Symptoms can be provoked by inhalation of the allergen or by introduction of the allergen through a break in the skin caused by scratches or animal bites. The symptoms of allergic reactions include:

i) itchy eyes,
ii) sneezing, running or blocked nose,
iii) chest tightness with wheezing,
iv) itchy skin rash,
v) swelling of lips, sometimes swelling of the tongue as well.

Workers suffering any or all of these symptoms should contact the University's Occupational Health Service (Telephone: Ext. 2752 / 2750) immediately.

Note: All animal house employees undergo appropriate medical surveillance. It is the duty of the Principal Investigator to notify the Secure Facilities manager of all members of staff who may start work in any of these facilities and the manager will ensure that the Occupational Health Adviser is then notified.

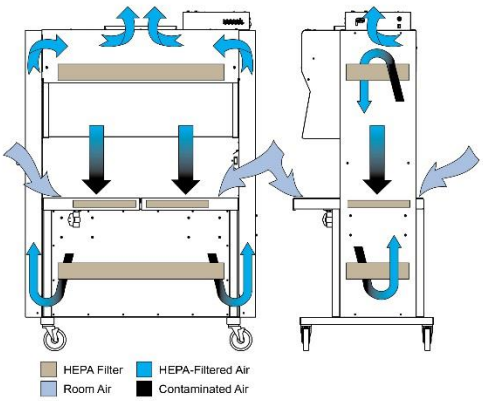
10.2 Control measures.

Animal house facilities should have an appropriate ventilation system providing approximately 20 air changes per hour. This level of ventilation will be affected by the level of dust produced by the animals. It is therefore vital that the stocking levels within individual rooms are not more than the ventilation system can manage. Guidance on this matter can be obtained from Estates.

It is vital that Standard Operating Procedures (SOPs) for work with animals are produced which detail the actions which should be taken to minimise the risk of allergic responses. It is the duty of the Secure Facilities Manager to ensure that appropriate SOPs have been produced and are being complied with. All SOPs must be complied with by all users of these facilities

Procedures and equipment should be provided to eliminate or, if this is not reasonably practicable, to minimise the release of allergens into the atmosphere of the animal house e.g. for cleaning cages. Where practicable, animals should be kept in Individually Ventilated Cages (IVCs) which remove particles of dust and dander thorough HEPA filters. The bedding from IVC cages should be removed and new bedding put into cages within a Cage Changing Station, which is at negative pressure to the outside and is like a Microbiological Safety Cabinet.

Fan example of a cage cleaning station and how the air flow works is given below:



Where IVCs cannot be used and for general facility cleaning, it is vital that dust and dander is not made airborne by sweeping etc. **It is forbidden to dry sweep** such facilities due to the risk of allergic reactions. Where practicable, such cleaning should be done using a HEPA filtered vacuum cleaner which will contain any allergens. If it is not practicable to vacuum clean, then any bedding and flooring should be 'damped down' with a water spray to reduce the amount of dust prior to sweeping up.

Respiratory Protective Equipment (RPE) should only be issued as a requirement of a written risk assessment and should be issued only if there is no other adequate control measure. Any RPE provided must be appropriate for the purpose. Where respiratory protective equipment is provided, it must be face fitted by a trained individual. Staff should be given appropriate instruction, information and training in the proper use of the relevant personal protective equipment. University guidance on Personal Protective Equipment can be found in the document entitled: 'The Selection, Use and Maintenance of Personal Protective Equipment' (URL: http://www.st-andrews.ac.uk/media/environmental-health-and-safety-services/health-and-safety/personal-protective-equipment/PPE-Policy-04-11-2008.pdf). Copies of this document are available from the Director of EHSS.

Further guidance concerning allergic reactions is given in the HSE Book entitled ‘Control of laboratory animal allergy’ (EH76) (ISBN 07176 2450 1) (URL: http://www.hse.gov.uk/pubns/eh76.pdf) which can be viewed at Environmental, Health and Safety Services.

11.0 Genetic Modification

11.1 Genetically Modified Organisms

11.1.1 Regulations.

Work with genetically modified organisms is governed by the following regulations:

i. ***Genetically Modified Organisms (Contained Use) Regulations 2014.*** These Regulations require a detailed assessment to be made of the risk that the genetically modified organism (GMO) poses to human health and to the environment. This regulation also requires that the appropriate control measures are implemented to prevent the release of the GMO into the environment.

ii. ***The Genetically Modified Organisms (Deliberate Release) (Scotland) Regulations 2002.*** These regulations govern the deliberate release or marketing of GMOs and are designed to minimise the damage to the environment which may arise due to the release of the GMO. As the regulations are enacted via devolved government (i.e. via Environmental Protection legislation), there are separate regulations for Scotland and for England / Wales.

iii. ***Environmental Protection Act***. Section 108(1)(a) of this Act covers the environmental risks associated with work involving larger GMOs. It requires that anybody creating such a GMO, which is not an approved product or obtaining one from elsewhere, should carry out an assessment of environmental risks.

iv. ***The Medicines for Human Use (Clinical Trials) Regulations 2004.*** This legislation controls gene therapy trials in humans

v. ***Genetically Modified Organisms (Risk Assessment) (Records and Exemptons) Regulations 1996***. These require that the records of environmental risk assessments for large GMOs, like those for micro-organisms, should be kept for 10 years.

As current work within this University does not involve the deliberate release of genetically modified organisms, this guidance will concentrate on the Genetically Modified Organisms (Contained Use) Regulations. Advice on the deliberate release of genetically modified organisms may be obtained from the Director of Environmental, Health and Safety Services.

Guidance on the 'Contained Use' regulations are given in the HSE publication entitled 'The Genetically Modified Organisms (Contained Use) Regulations 2014 – A Guidance on the Regulations' (URL: http://www.hse.gov.uk/pubns/priced/l29.pdf), a copy of which is available for view in Environmental, Health and Safety Services. Further information on this matter can be obtained from the Director of Environmental, Health and Safety Services.

11.1.2 **Definitions**

Genetic modification is defined in the Genetically Modified Organisms (Contained Use) Regulations 2014 as "the altering of the genetic material in that organism by a way that does not occur naturally by mating or natural recombination or both."

As the risk of genetic modification is the expression of the modified traits, a project is therefore deemed to be a genetic modification project when modified DNA is inserted into a cell/organism and may be expressed. It is the use of the genetically modified organism which is regulated not just the process of making the altered DNA.

Note: Work involving the insertion of modified DNA into host cells/organisms at institutions outwith this University, is also categorised as a genetic modification project. This has been deemed necessary as the risks are with the genetically modified traits of cells/organisms and not with the process of making or inserting the modified DNA.

11.1.3 **Classification of Genetic Modification Projects.**

The relevant legislation set the criteria for the classification of genetically modified biological agents. This is done in terms of the risk the organism poses to human health and/or to the environment and thus the necessary containment required to work with such modified cells/organisms (see Scientific Advisory Committee on Genetic Modification – Compendium of Guidance Sections 2 and 3 – URL: http://www.hse.gov.uk/biosafety/gmo/acgm/acgmcomp/). These categories are defined as follows:

Class 1 :	Work with organisms which require a minimum of category 1 containment facilities
Class 2:	Work with organisms which require a minimum of category 2 containment facilities
Class 3:	Work with organisms which require a minimum of category 3 containment facilities
Class 4:	Work with organisms which require a minimum of category 4 containment facilities.

NOTE: As the University does not have containment level 4 facilities such work will not be discussed further. Advice on category 4 containment facilities may be obtained from the Director of Environmental, Health and Safety Services.

11.1.4 **Risk Assessment of Genetic Modification projects**

A genetic modification project must not be started until an appropriate University GM1 risk assessment form (see Appendix 7) has been completed and 'Duly Approved' (see section 11.1.5). Details on how to perform a risk assessment on work with genetically modified organisms can be obtained from the HSE document entitled: 'The SACGM Compendium of guidance - Guidance from the Scientific Advisory Committee on Genetic Modification' which can be viewed at the following website:

http://www.hse.gov.uk/biosafety/gmo/acgm/acgmcomp/index.htm

Detailed University guidance on undertaking risk assessments on work with genetically modified organisms can be found at the following Moodle sites at URL: https://moody.st-andrews.ac.uk/moodle/course/view.php?id=4340 and also at URL: https://moody.st-andrews.ac.uk/moodle/course/view.php?id=3447

The University Genetic Modification Notification form (GM1) (see Appendix 7) acts as the University GM Risk Assessment form.

The genetic modification risk assessment produced by the Principal Investigator should include a background to the project which gives the main aims and purpose of the work.

The risk assessment should also include the following information:

- Details of the vector to be used. These details should be of the parent vector e.g. pUC19, pBR322, pET and **not** the specific plasmid name given with the modified gene inserted into it e.g. pAD4sac1VII. If it is a bacterial plasmid that is being used, then this section should include details of the genes that are involved in the transfer or mobilisation of DNA between organisms. These genes are called tra , mob, bom (sometimes called OriT or Mic). Plasmids which are tra^-, mob^- and bom^- are classed as 'Non-Mobilisable' plasmids (e.g. pUC19, pGEM vectors). Plasmids which are defective in one or more transfer functions and can only be mobilised by other elements which supply the missing functions are classed as 'Mobilisation Defective' and are often bom+, tra^- and mob^- (e.g. pBR322 or pET vectors). Vectors which are tra^+, bom^+ and mob^+ are classed as self-Mobilising Vectors (e.g. F Plasmid). A list of bacterial plasmid vectors and their mobilisation status is given in Appendix 8.

- Details of the host cells/organisms (including work with transgenic plants and animals) for the modified DNA, in particular the ACDP category of the organism. Where an organism is an auxotrophic disabled cell line, then details of the mutations which disable the cells should be provided where this is available. This information is available from the suppliers of such cell lines. The HSE has produced a list of cell lines which are classed as disabled or especially disabled. This list is given in Appendix 8.

- Details of the gene to be inserted and its biological function should be given in the risk assessment. Where the gene significantly alters the potential risk posed by the host cell to human health and/or the environment, then the category of the project will be increased. Where the inserted gene may affect the tropism of the organism, or express proteins which may significantly affect growth of cells (eg cytokines) or are oncogenes, then consideration should be given to these properties in the risk assessment. As a precautionary principle, work with such active genes should be considered to require a higher level of containment than is required for the parent organism.

The risk assessment should detail the control measures which need to be implemented to eliminate or minimise the risk posed to workers and/or the environment. This includes the procedures needed to inactivate the biological agents in the waste. Written evidence needs to be available to show a disinfectant procedure should reduce the titre of the host cells by at least 10^5 (see Section 13).

The risk assessment should be signed by all workers involved in the project. The genetic modification risk assessments must be made available to the relevant staff/students and this should include cleaners and maintenance staff who may be affected by the work. Any necessary information, instruction, training and supervision identified in the assessment should be provided by the School/Unit.

Where the accidental release of a genetically modified organism (GMO) could pose a significant risk to human health or the environment, a plan should be drawn up detailing the emergency

actions to be taken to minimise these risks. Emergency plans are only required for higher risk projects.

Note: The Director of EHSS must be notified of all accidents involving genetically modified organisms.

Note: All risk assessments will be kept by Environmental, Health and Safety Services for 10 years after the project has ceased.

11.1.5 **University Approval/Ratification Procedure For Genetic Modification Risk Assessments**.

Prior to the commencement of work on a genetic modification project(s), supervisors should ensure that appropriate risk assessments are produced and submitted for approval to the local School/ Unit Safety Committee. If the work is to be carried out in a building not managed by the local Health and Safety Committee, then the risk assessment form must also be signed by the Convenor of the Health and Safety Committee of the building where the work is to be carried out.

Where the genetic modification project requires Category 3 Containment Facilities, the risk assessment form **must** also be signed by the Director of the Category 3 Containment facilities that will be used.

All genetic manipulation projects which have been approved by the School/Unit Safety Committee must then be submitted, by the Project Superviser, to the Secretary of the Chemical and Biological Hazards Management Group, via the Deputy Director of EHSS (as Secretary of the Management Group), for ratification by the Management Group. In this booklet the above procedures for approval and ratification will be called 'duly approved'.

11.1.6 **Notification of work involving Genetic Modification.**

The Genetically Modified Organisms (Contained Use) Regulations 2014, requires the Health and Safety Executive (HSE) to be notified of all facilities where genetic modification work is carried out and of all category 2 and 3 genetic modification projects. The Project Supervisor must ensure that all genetic modification projects must be 'duly approved' (see section 11.1.5) and then submitted to the Director of Environmental, Health and Safety Services. All notifications to the HSE are carried out by the Director of Environmental, Health and Safety Services.

There are two types of notification required:

a) Notification of Intention to Use premises for Genetic Modification for the First Time
This is done by the Director of EHSS . The Principal Investigator should ensure that the premises that they intend to use are registered with the HSE by contacting the Director of EHSS

b) Notification of Class 2, 3 Genetic Modification Projects

NOTE: As the University does not have category 4 containment facilities, there can be no work with category 4 pathogens/GM organisms

The HSE does not need to be notified of Category 1 projects, though all such Category 1 projects **must be approved and ratified by the University prior to any work starting.**

All category 2 and 3 projects must be approved not only the University but also by the Health and Safety Executive. The HSE require the 'duly approved' risk assessment plus a HSE form called a CU2 form. This form is filled in by the Director of EHSS with the help of the Principal Investigator. All notifications of category 2 and 3 projects will be done by the Director of EHSS and must not be done by the Principal Investigator directly. There is a significant cost for applications to undertake category 2 or 3 projects thus all such projects should be discussed with the Director of EHSS, the Secretary to the Chemical and Biological Hazards Management Group and the University Biological Hazards Adviser long before submission.

For Category 2 projects, work will only be allowed to start when the HSE have formally acknowledged receipt of the application, but the HSE reserve the right to object to the work and thus stop the work within 45 days of receipt of the application.

For category 3 projects, work will only be allowed once the HSE has given its written consent which for the first application is up to 90 days after acknowledgement of receipt of the application but for subsequent applications is up to 45 after acknowledgement of receipt of the application.

As the University does not have any category 4 facilities, notification of such projects will not be discussed. If further information on this matter is required, the Principal Investigator should discuss the matter with the Director of EHSS.

11.2 **Transgenic Plants or Animals.**

The Chemical and Biological Hazards Management Group must be informed before any transgenic organisms can be produced or brought into the University. Transgenic organisms must not be produced within the University without the project being 'duly approved' by the University.

Genetic modification of animals or plants, where the transgenic animals or plants are as safe as the parental organism, require no advance notification to the HSE but the project must be 'duly approved' by the University. Workers are required to submit a risk assessment of the project for approval by the University.

Where the genetically modified animal or plant is 'not as safe as the parental organism', the HSE requires 45 days pre-notification and a notification fee is payable. Written approval from the HSE must be received prior to the commencement of the project.

Further guidance on this matter can be obtained from the Director of Environmental, Health and Safety Services.

12.0 MICROBIOLOGICAL SAFETY CABINETS AND CAGE CLEANING STATIONS

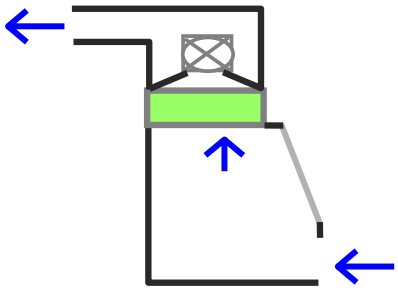
12.1 Definitions of Microbiological Cabinets and Cage Cleaning Stations

Microbiological safety cabinets are widely used for microbiological containment. The proper installation, location and maintenance of microbiological safety cabinets are critical to their performance. Reference should be made to the HSE Document entitled 'The Management, Design and Operation of Microbiological Containment Laboratories (URL: http://www.hse.gov.uk/pubns/priced/microbiologyiac.pdf) as well as the British Standard BS 5726: 2005 and BS EN 12469: 2000 for the specification, use, methods for testing the effectiveness of the cabinet, determining the level of protection and maintenance of cabinets.

Microbiological Safety Cabinets are considered to be 'Local Exhaust Ventilation' under the COSHH Regulations. As such they must be thoroughly examined and tested at least every 14 months by trained service personnel.

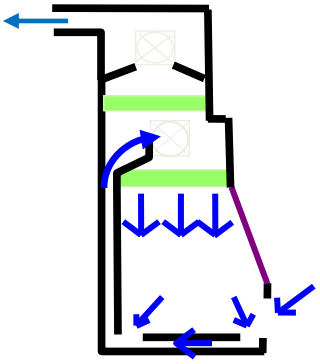
There are three classes of microbiological safety cabinet:

- **Class I Safety Cabinet -** Class I cabinets are open-fronted, negative pressure, HEPA filtered exhaust for personal protection which can be used for all but Hazard Group 4 pathogens. Potentially infectious aerosols are contained due to the inflow of air into the cabinet and by the exhaust HEPA filter.



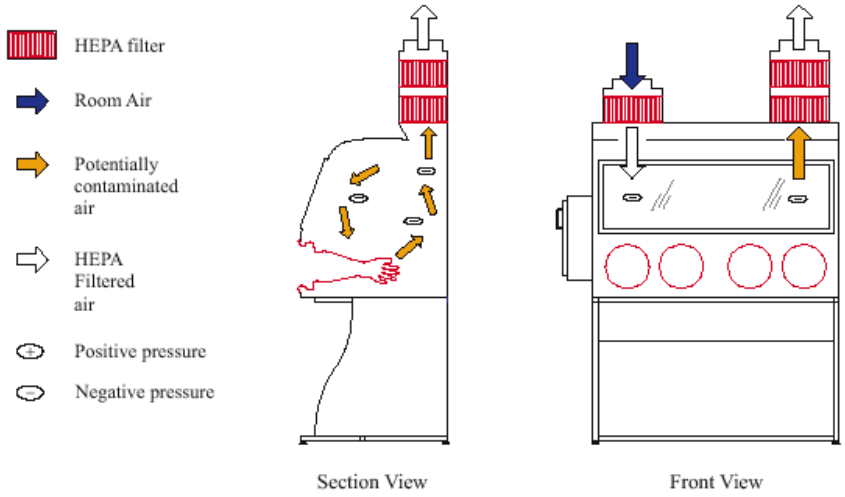
The filtered air is normally discharged into the atmosphere but in exceptional circumstances it is possible to recycle the air in the laboratory provided it has been passed through two HEPA filters and the procedure has HSE approval.

- **Class II Safety Cabinet -** Class II cabinets re-circulate some HEPA filtered air, exhaust some to the atmosphere via HEPA filters and take in fresh air through the working aperture.

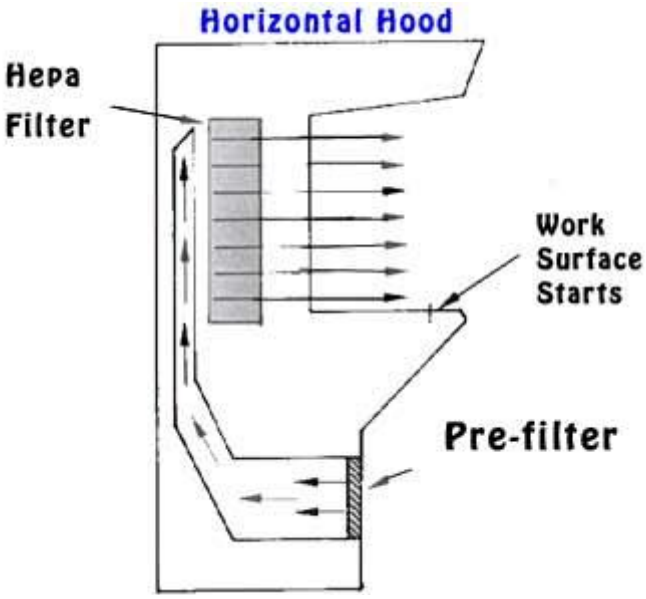


The air flow around the front of a Class 2 cabinet is very delicately balanced and easily disturbed and thus if the cabinet is badly sited and/or set up, it may not provide the protection required.

- **Class III Safety Cabinet -** Class III cabinets separate the operator from the work by a physical barrier e.g. by gloves mechanically attached to the cabinet. The escape of any airborne particles is prevented by a HEPA filtered exhaust system. There is an inlet filter that provides sterile air to flush the interior.



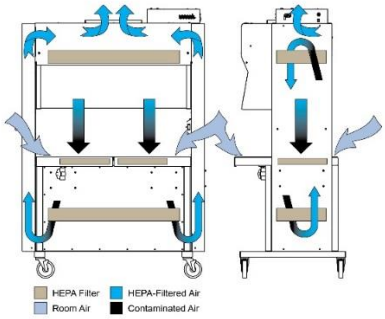
NOTE: Microbiological safety cabinets should not be confused with other **laminar flow** cabinets, in particular with horizontal laminar outflow cabinets which direct air towards the operator. Laminar flow cabinets must not be used for handling infectious, toxic or sensitising materials.



The Class of Microbiological Safety Cabinet does NOT correlate with a level of containment and is not related to the containment required for specific categories of ACDP pathogen - ie Class 2 cabinets are not required for Category 2 pathogens.

Cage cleaning stations are local exhaust ventilation systems which are designed to minimise exposure of workers to animal allergens. These systems are used when animal bedding in cages are changed and for other relevant procedures. As these systems are classed as local exhaust ventilation (LEV), it means they must be examined and maintained every 14 months as a requirement of the COSHH regulations.

Fan example of a cage cleaning station and how the air flow works is given below:



12.2 **Proper Use and Maintenance of Safety Cabinets**

Laboratory personnel must be given suitable information, instruction, training and supervision in the correct use and maintenance of microbiological safety cabinets to ensure they and others are adequately protected. Such cabinets only provide protection against pathogens if the air flow within the cabinet is inward flowing. Any disturbance to the designed air flow can lead to leakage of aerosols of pathogens. Further guidance on the correct usage of microbiological safety cabinets can be found at the Moodle site URL: https://moody.st-andrews.ac.uk/moodle/course/view.php?id=4340)

All cabinets should be kept as free from equipment as much as possible and the working surfaces should be disinfected after use (see section 13.0). The wire grids protecting the pre-filters should be regularly examined and disinfected. Ultra-violet lamps are ineffective for disinfecting surfaces; if UV lamps are fitted they must **not** be turned on during the use of the cabinet. Guidance on the use of UV-lamps is given in the University publication 'Local Rules for Work with Non-Ionising Radiations - Part 2 Ultra-Violet Radiation' which is available from Environmental, Health and Safety Services.

Audible and visible warning systems monitoring airflow should be examined periodically to ensure they are functioning correctly. If such an alarm is activated, it should be assumed there is a fault with the safety cabinet and it should not be used until it has been checked by an engineer.

Maintenance of safety cabinets can only be performed after they have been suitably disinfected (see section 13.2.2) and a 'Decontamination Certificate' has been issued by the School/Building/Unit Safety Co-ordinator. An example of a Certificate is given in Appendix 10.

Advice on technical matters involving microbiological safety cabinets and cage cleaning stations can be obtained from the Director of Environmental, Health and Safety Services.

13.0 **DISINFECTION, STERILISATION AND FUMIGATION**

There is no one procedure which is suitable for disinfection of all types of pathogen. Autoclaves are very effective against bacteria and viruses but due to their limited size are not appropriate where there is large volumes to disinfect. The chemical disinfectants react in different ways such that they are effective against some organisms but not others. Some organisms, eg bacterial spores are very resistant to most procedures.

The Health and Safety Executive state that any disinfection procedure should reduce the titre of viable organisms by 10^5. It is should be determined from the data issued by the manufacturer or by personal experimental data which disinfectant will work against the organism they are working with and this data put into the risk assessment.

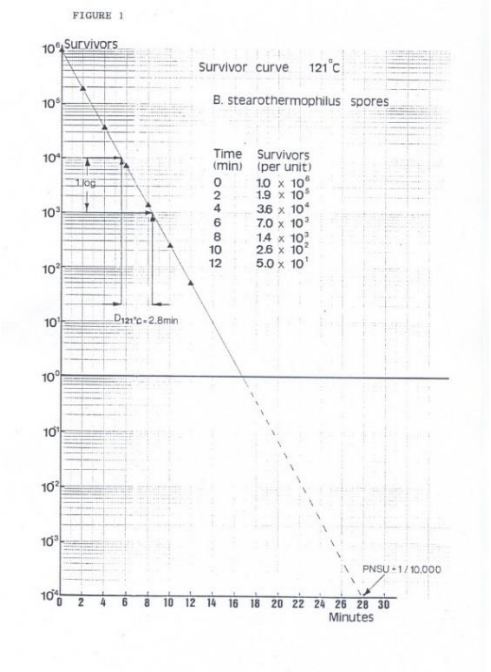
Where a reduction in titre of 10^5 of the culture will not be sufficient to reduce the risk of infection from the pathogen from the experiment, then it may require the waste is autoclaved and then sent away for incineration to ensure there is minimal risk to workers and the public/environment.

NOTE - Work with Category 3 organisms requires more detailed evidence to show that the disinfectant works in the system being used and that nothing in that system will interfere with the disinfection process.

13.1 **Autoclaves.**

Autoclaves generate steam at 120^{o}C or higher while under pressure of 15psi. Autoclaving is the preferred means of inactivating biological agents as it achieves a higher degree of inactivation and is more reliable than chemical disinfectants (many chemical disinfectants are inactivated by other agents for example by proteins).

Autoclaving reduces the number of viable cells exponentially, thus the process will never eliminate all organisms. The effectiveness of autoclaves is measures by the time and temperature it takes to reduce the number of viable organisms by 90% - This is called the D value eg



In this example – Start with 1 x 10^6
Baccilus stearothermophilus spores.

90% reduction = 1 x10^5 organisms left at 121oC at 5 minutes

D_{121} = 5 minutes

Examples of D Values for Specific Organisms

Table 4.3 *Microbial heat resistance*

Vegetative organisms ($z \sim 5$ °C)	*D* (mins)	
Salmonella sp.	D_{65}	0.02–0.25
Salmonella Senftenberg	D_{65}	0.8–1.0
Staphylococcus aureus	D_{65}	0.2–2.0
Escherichia coli	D_{65}	0.1
Yeasts and moulds	D_{65}	0.5–3.0
Listeria monocytogenes	D_{60}	5.0–8.3
Campylobacter jejuni	D_{55}	1.1
Bacterial Endospores	D_{121}	
($z \sim 10$ °C)		
B. stearothermophilus		4–5
C. thermosaccharolyticum		3–4
Desulfotomaculum nigrificans		2–3
B. coagulans		0.1
C. botulinum types A & B		0.1–0.2
C. sporogenes		0.1–1.5
C. botulinum type E	D_{80}	0.1–3.0
	D_{110}	< 1 second

Autoclaves are deemed Pressure Systems under the Pressure Systems Regulations 2000 and thus are required to be inspected by a Competent Person under a Scheme of Work. This is usually done through Estates and thus all autoclaves must be registered with Estates.

NOTE: This is not a maintenance inspection. Maintenance of autoclaves is the responsibility of the School/Unit.

Autoclaves should have regular maintenance which is organised by the School/Unit.

The School/Unit should produce and implement a Code of Practice for the Use and Maintenance of Autoclaves . A specimen Code of Practice is given in Appendix 11. Maintenance of autoclaves should not commence without a 'Decontamination Certificate' signed by the School/Building/Unit Safety Co-ordinator. A specimen Certificate is given in Appendix 12. All normal operations and maintenance should be recorded in a log book and archived centrally.

A regular check on the temperature inside autoclaves should be made using e.g. a thermocouple. A written record should be kept and archived centrally.

Staff and Training - Only persons who have received the appropriate training (which must be recorded) are permitted to use autoclaves. All staff involved should receive instruction on the basic microbiology of hygiene so that they can appreciate potential hazards. Although maintenance may be contracted out, in practice there will always be routine tasks which may be undertaken by laboratory or local maintenance staff. These personnel must receive adequate training and their staff records should be endorsed accordingly. It is recommended that training be provided for all concerned with the operation and maintenance of laboratory autoclaves.

Further guidance on the use of autoclaves can be obtained in the HSE Guidance Note PM73 "Safety Requirements for Autoclaves" (URL: http://www.hse.gov.uk/pubns/guidance/pm73.pdf). A copy of this guidance note is available for viewing at the HSE website and at Environmental, Health and Safety Services.

13.2 **Chemical Disinfection Procedures**

The purpose of disinfection is to render an infectious agent non-viable. The Health and Safety Executive require that if chemical disinfectants are to be used, then there must be written validated evidence that they are effective. This may be evidence provided by the supplier, or published data or by personal experimentation (details of the experiments to show effectiveness must be kept). The effectiveness of the disinfectant will depend on the type of pathogen (e.g. ACDP Category 4 pathogens require a greater level of inactivation as the consequences of escape of such a pathogen would be much greater than an ACDP Category 1 pathogen) or the state that the pathogen is in (e.g. spores are much harder to inactivate than eukaryotic cell lines). Thus the risk assessment for the work will determine the type of disinfectant which can be used and the required reduction in pathogen titre. The HSE have recommended that for category 1 and 2 pathogens there should be a reduction in titre of viable organisms by 10^5 at the very least.

The following chemicals are used for disinfection:

Disinfectant	Mode of action	Organisms and Forms affected by Chemical Disinfectant	Items which inactivate the Chemical Disinfectant
Alcohol – ethanol and iso-propanyl alcohol	Denatures protein	Effective, albeit slowly, against vegetative bacteria and lipid containing viruses. **NOT EFFECTIVE against** spores, fungi and non-lipid containing viruses.	Alcohol takes a significant amount of time to be effective - Problem with evapouration of the agent
Chlorine (hypochlorite, Chloros etc)	Inactivation by chlorine can result from a number of factors: oxidation of sulfhydryl enzymes and amino acids; ring chlorination of amino acids; loss of intracellular contents;	Hypochlorites are suitable disinfectants for vegetative bacteria (including mycobacteria), spores, fungi and both lipid containing and non-lipid containing viruses depending on the concentration of chlorine	Inactivated by small quantities of organic matter
Formaldehyde	Alkylates the amino and sulfhydral groups of proteins and ring nitrogen atoms of purine bases	Effective against vegetative bacteria (including mycobacteria), spores, fungi and both lipid and non-lipid containing viruses	Aldehydes are active in the presence of protein and are not inactivated by natural or man-made substances or detergents - **NOTE: Gluteraldehyde is a known sensitiser.**
Gluteraldehyde	Alkylation of sulfhydryl, hydroxyl, carboxyl, and amino groups of microorganisms		

Disinfectant	Mode of action	Organisms and Forms affected by Chemical Disinfectant	Items which inactivate the Chemical Disinfectant
Hydrogen Peroxide	Hydrogen peroxide works by producing destructive hydroxyl free radicals that can attack membrane lipids, DNA, and other essential cell components.	Contact supplier for details	Contact supplier for details
Iodine and Iodophors	Disruption of protein and nucleic acid structure and synthesis	Contact supplier for details	Contact supplier for details
Ortho-phthalaldehyde (OPA) which contains 0.55% 1,2-benzenedicarboxaldehyde (OPA).	OPA and glutaraldehyde interact with amino acids, proteins, and microorganisms.	Contact supplier for details	Contact supplier for details
Peracetic acid and peracetic acid + H_2O_2 mixture	Denatures proteins, disrupts the cell wall permeability, and oxidizes sulfhydryl and sulfur bonds in proteins, enzymes, and other metabolites	Contact supplier for details	Contact supplier for details
Phenolics	High concentrations, phenol acts by penetrating and disrupting the cell wall and precipitating the cell proteins.	Effective against vegetative bacteria and against lipid containing viruses	Not affected by organic matter. Doesn't attack metallic items

W.A. Rutala, D. J. Weber, and the Healthcare Infection Control Practices Advisory Committee (HICPAC) - http://www.cdc.gov/hicpac/pdf/guidelines/Disinfection_Nov_2008.pdf

Clear Soluble Phenolics - These are not greatly inactivated by organic matter and do not attack metals. They are effective against vegetative bacteria and against lipid containing viruses. They should be used in general microbiology, for discard jars and for disinfecting benches. Use all phenolics at the manufacturers' recommended dilutions. Do not store diluted disinfectants.

Examples of phenolic disinfectants are 'Clearsol' , 'Printol' , 'Stericol' 'Sudol' .

Peroxysulfates - These are disinfectants like hypochlorites which act as a strong oxidiser of biological materials. These substances do not contain any chlorine though. These compounds are therefore much less corrosive than hypochlorites and are less sensitive to inactivation by proteinaceous materials than hypochlorites (though they are inactivated by high concentrations of such materials).

Example of a peroxysulfate compound is Virkon.

Hypochlorites - These disinfectants are usually inactivated by organic matter and attack metals to varying degrees. Hypochlorites are suitable disinfectants for vegetative bacteria (including mycobacteria), spores, fungi and both lipid containing and non-lipid containing viruses depending on the concentration of chlorine.

Note: Hypochlorites must never be used on centrifuges or moving parts of machinery or metal surfaces.

As hypochlorites are easily inactivated by protein they should not be used for highly proteinaceous material. They may be used in virology for virus samples, small quantities of blood, discard jars, pipette holders and for surface disinfection. 'Chloros' and 'Domestos' contain nominally 100,000 ppm of available chlorine but many bleaches contain 50,000 ppm or less. 'Chloros' and Domestos' should be used as follows:

General use	1% v/v (1,000 ppm available chlorine)
Pipette jars	2.5% v/v (2,500 ppm available chlorine)
Blood spillage	10% v/v (10,000 ppm available chlorine).

Hypochlorites are compatible with anionic and non-ionic detergents but not with cationic detergents such as quaternary ammonium compounds (e.g. cetrimide). The activity of the hypochlorite should be regularly tested e.g. with starch iodide paper, which turns blue-black in the presence of hypochlorite.

Examples of hypochlorite disinfectants are 'Chloros', 'Domestos', 'Milton'.

Alcohols - Ethanol and propan-2-ol at concentrations of 70-80% are effective, albeit slowly, against vegetative bacteria and lipid containing viruses . They are not effective against spores, fungi and non-lipid containing viruses. These solutions are very useful for disinfecting surfaces. It should be noted that 70% propan-2-ol is much more effective than 70% ethanol

Quaternary Ammonium Compounds - These are cationic detergents which are effective against vegetative bacteria, lipid containing viruses and some fungi but are not effective against mycobacteria, spores and non-lipid containing viruses. These compounds are inactivated by protein, by a variety of natural and plastic materials and by non-ionic detergents. These compounds have limited use for disinfection within the laboratory due to inactivation but as they are non-corroding they are good for cleaning metallic surfaces.

Example of a quaternary ammonium disinfectant is 'Cetrimide'.

Aldehydes - Aldehydes are toxic substances and should only be used as disinfectants in special situations. They are effective against vegetative bacteria (including mycobacteria), spores, fungi and both lipid and non-lipid containing viruses. Aldehydes are active in the presence of protein and are not inactivated by natural or man-made substances or detergents.

Note: Gluteraldehyde is a known sensitiser and can cause serious respiratory diseases. It should not normally be used as a disinfectant. Alternatives to gluteraldehyde include Peracetic acid (tradename: NU-CIDEX, Johnson and Johnson Medical).

Formaldehyde gas is widely used for fumigation of Microbiological Safety Cabinets and for rooms. Safe entry into a room being sterilised with formaldehyde gas can only take place when the concentration of formaldehyde is less than 2 ppm. Formaldehyde solution (Formalin) is too toxic and is too severe an irritant to be used as a disinfectant. For details on the use of formaldehyde see sections 6.3.1 and section 6.3.2.

It should be noted that formaldehyde is to be classified as a Category 1b carcinogen in January 2016 (see URL: http://content.govdelivery.com/accounts/UKHSE/bulletins/1116d71). As a consequence the risk assessment for the use of formaldehyde as a fumigant should consider the carcinogenic properties of formaldehyde.

	Active Against						
Disinfectant type	Vegetative bacteria	Bacterial spores	Fungi	Enveloped viruses	Non-enveloped viruses	Myco-bacteria	TSE and prion agents
Phenolic	+	-	+	+	2	+	-
Hypo-chlorites	+	+	1	+	+	1	+
Alcohols	+	-	-	+	+	+	-
Aldehydes	+	+	+	+	+	+	-
Surface-active agents	+	-	1	2	2	-	-
Peroxygen compounds	+	+	+	+	+	+	-

+ Generally effective
- Generally ineffective
1 Limited activity
2 Depends on the virus

Note: the specific activity of a particular disinfectant must be assessed on a case by case basis.

13.3 **Fumigation**

For disinfecting large spaces or pieces of equipment (eg category 3 containment laboratory or microbiological safety cabinets, it is necessary to use a fumigation method. Guidance on fumigations is given in the HSE document entitled 'Fumigation - Health and safety guidance for employers and technicians carrying out fumigation operations' (URL: http://www.hse.gov.uk/pubns/priced/hsg251.pdf).

There are two main fumigation systems which are widely used in laboratories and for microbiological safety cabinets. These involve the use of:

- Formaldehyde gas
- Hydrogen Peroxide gas.

These systems have been tested against each other and both are found to similar effectiveness (see Alan J. Beswick*, J. Farrant, C. Makison, J. Gawn, G. Frost, B. Crook, and J. Pride; **Applied Biosafety 16 139-157 (2011) - http://www.absa.org/abj/abj/111603Beswick.pdf**).

It is recommended that the fumigant that is used will work against the types of organisms being used in the laboratory/Microbiological Safety Cabinet. This is of particular importance when using resistant forms of cells eg spores.

It should be noted that formaldehyde is to be classified as a Category 1b carcinogen in January 2016 (see URL: http://content.govdelivery.com/accounts/UKHSE/bulletins/1116d71). As a consequence the risk assessment for the use of formaldehyde as a fumigant should consider the carcinogenic properties of formaldehyde.

13.3.1 **Fumigation of Microbiological Safety Cabinets.**

The standard methods for disinfecting microbiological safety cabinets are as follows:

Method A - Laycock's Fumigator - This is a prepared fumigator kit containing paraformaldehyde and potassium permanganate. The addition of water to the mixed components causes formaldehyde vapour to be released after 1-2 mins. The cabinet should be sealed before the vapour is released.

Method B - Place 25 ml of formalin BP into a vapouriser, if available, or into a beaker on a hot plate. Close the cabinet and boil away the formalin. A thermostatically-controlled heater and time switch may be used if a vapouriser is not available.

In both cases the cabinet is left sealed overnight. Next morning switch on the fan and open the front sealing on the cabinet to allow a flow of air to remove any residual formaldehyde vapour. Remove the door and re-test the airflow before use.

Other techniques for fumigating microbiological safety cabinets use hydrogen peroxide instead of formaldehyde as it is less toxic to humans. Tests suggest it is as effective as formaldehyde though much more expensive

13.3.2 **Fumigation of Rooms.**

Fumigation should only be done by appropriately qualified personnel.

Any room that is to be fumigated should be sealable, gastight (this includes doors, ceilings and wall joints), lockable and also have a vent to the atmosphere (e.g. a safety cabinet).

Note: If at any time there is a leak of formaldehyde from the room, the building must be evacuated.

The room should also have a facility to measure the formaldehyde levels both at the time of fumigation and during venting. A gas detector tube system may be used to monitor formaldehyde levels. Once the reaction has started, the room should be rapidly sealed and locked. The levels of formaldehyde should be measured after 30 minutes.

Suitable warning signs should be placed on the door to the room stating that 'Fumigation with formaldehyde is taking place and that entry is forbidden till the level of formaldehyde is less than 1 ppm' should be displayed during fumigation.

The room should then be left sealed overnight. Forced air venting to the outside atmosphere should be initiated via a timing device. The room should not be opened till the levels of formaldehyde are less than 1 ppm. In the event of failure of the system venting formaldehyde into the atmosphere, the following emergency procedure must be adhered to:

EMERGENCY PROCEDURE

i) The rooms in the vicinity of the fumigated room must be cleared.

ii) Only trained personnel wearing Respiratory Protective Equipment may open the door to the room and initiate venting of the formaldehyde to the atmosphere.

iii) The concentrations of formaldehyde must then be monitored in this room and surrounding rooms.

iv) When the concentration of formaldehyde in the fumigated and surrounding rooms is less than 1 ppm, staff/students may re-occupy the rooms.

Further guidance on fumigation procedures can be obtained from the HSE Guidance Note on Fumigation (CS22), which is available for view at Environmental, Health and Safety Services.

Rooms may also be fumigated using hydrogen peroxide systems.

Before using any fumigation system, you should check that the compound that you propose to use reduces the biological agent by 10^5 fold as a minimum standard.

14 Transport of Pathogens

Then transport of pathogens comes under the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009. This enacts into UK law the European guidance on transport by road (ADR) (see URL: http://www.unece.org/trans/danger/publi/adr/adr2015/15contentse.html). This details very specifically the packaging and labelling requirements for hazardous substances including pathogens. Only those trained in the packaging of biologically hazardous materials can undertake this process.

If pathogens are being transported by air or by sea they need to comply with the relevant guidances on these modes of transport ie. IATA guidance for air transport and the IMDG for maritime transport.

14.1 Training

All those who will be transporting pathogens by road, air or by sea should receive the appropriate level of training to ensure the items are properly packaged and what labelling has to be on packaging and what the procedures are for prior notification of recipients.

If a research group wishes to send items abroad then it is vital that such personnel are also trained in the specific requirements of the airline transport restriction. Also, personnel should be aware of security issues thus transport of some pathogens will be restricted because of this.

Guidance on such training can be obtained from the Director of EHSS.

14.2 Categorisation of Pathogens for Transport

The ADR and thus by definition the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009, have categorised pathogens into two categories:

- Category A Pathogens – These are pathogens which could potentially cause a significant human disease or animal disease (see Appendix 13 and 14 for a list of Category A pathogens);
- Category B pathogens – Pathogens which are not Category A

Guidance on the packaging of Category A pathogens can be found at URL: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/287775/guidance-note-17.pdf

All packages with pathogens should be inspected by a person trained in the transport of pathogens and approved for sending.

It is important that such a person is involved in the signing of the courier transport sheets.

14.3 Transporting Pathogens Abroad

It is very important that any packages destined for abroad must meet the recipient country's regulations otherwise the package and be refused entry and destroyed.

You must also make sure that the couriers and shippers of the packages (eg airlines) are aware of the contents of the package and what to do in the event of the package leaking.

14.4 Labelling of the Packages Containing Pathogens

All packages must meet the international standards for transport labelling. If in doubt, ask a person who has received the appropriate level of training or the Director of EHSS.

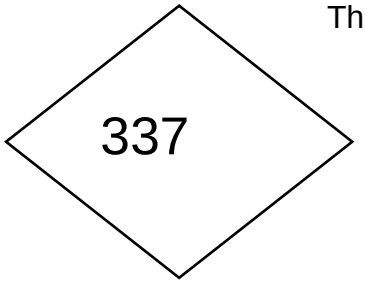
The package should show the appropriate transport diamond for the contents of the package (thus there may be more than 1 label if the sample is sent in dry ice for example). It should also have details of the sender and recipient on the package with contact details.

It is important that the following is observed:

- For Transport Category A pathogens the following symbol is on the package:

This shows the presence of a Category A pathogen within the package. This label should not be put on packages with Category B pathogens

- Category Pathogens should use a blank diamond to show the UN number for the type of pathogen present eg.



This sign is the UN number for Category B pathogens.

14.5 Receipt of Packages With Pathogens

Only packages which a recipient is expecting should be opened. Before opening any package, make sure you know what the contents are and that you ordered (or asked for).

When packages are delivered, they must be taken to the named person (or their nominated Depute) named as the recipient as soon as practicable. The package should never be left for any significant time or given to a person who does not have the appropriate training (eg secretaries).

Packages should only be opened in appropriate conditions eg if a Category 3 pathogen has been sent it must be opened in the microbiological safety cabinets in the category 3 containment laboratory.

It is very important to open the package carefully and the right way up (especially if the contents are liquid). The sample should then be put in appropriate storage as soon as practicable.

If there is any evidence of leakage of the sample from the package, the package should be immediately treated with an appropriate disinfectant. You should not try to rescue such samples as there is a potential for infection. If the sample that has leaked is a Category A pathogen you should inform the Director of EHSS as soon as practicable as there is a potential that workers at the courier company may have been infected.

14.6 Accident / Incident Reporting

All incidents involving the transport of pathogens should be reported to the Director of EHSS through the accident report form (URL: http://www.st-andrews.ac.uk/media/environmental-health-and-safety-services/health-and-safety/accidents/Accident-Rep-Form.doc) or if the incident involved a significant pathogen (Transport Category A pathogen or an ACDP Category 3 Pathogen), the Director of the Category 3 Containment Laboratories and the Director of EHSS should be informed by the fastest possible means.

15 Training

All staff using pathogens should receive an appropriate level of training prior to using such agents.

All new workers at the University should undergo the University Health and Safety Induction Moodle course which can be found at URL: https://moody.st-andrews.ac.uk/moodle/course/view.php?id=2864

All workers using pathogens should also undergo the University Biosafety Moodle course and undertake the associated test which cna be found at URL: https://moody.st-andrews.ac.uk/moodle/course/view.php?id=4340

The Principle Investigator should also give all necessary training for working with specific organisms prior to a worker starting. There should be a regular monitoring of the standards of workers and where necessary, remedial training should be provided.

It should be noted that workers who wish to use the Category 3 Containment Laboratories will need to receive further specialist training from the Director of the Category 3 Laboratories and the manager of these facilities. Records of such training will be kept by the Director of the Category 3 Laboratories.

Training in associated areas of work to be undertaken should also be undertaken and records kept of all such training eg use of radioactive materials – Moodle Site URL: https://moody.st-andrews.ac.uk/moodle/course/view.php?id=2905 etc .

Where there is no formal training, it is the responsibility of the Principle Investigator to provide such training and keep a record of this training.

Appendix 1

Membership of the Chemical and Biological Management Group

1. University Biological Hazards Adviser - Convenor of the Management Group
2. University Chemical Hazards Adviser
3. Director of Environmental, Health and Safety Services
4. Director of Category 3 Laboratories
5. School of Biology Representative
6. School of Chemistry Representative
7. School of Medicine Representative
8. School of Psychology Representative
9. UCU Representative
10. UNITE Representative
11. UNISON representative
12. Deputy Director OF EHSS- Secretary to the Management Group.

Appendix 2

University of St. Andrews

Duties of the University Biological Hazards Adviser

The Adviser will be Convenor of the Chemical and Biological Hazards Management Group and will submit a Report of the meetings of this Management Group to the Office of the Principal. The Chemical and Biological Hazards Management Group serves as the Genetic Modification Safety Committee as required by the Genetically Modified Organisms (Contained Use) Regulations 2014.

The duties of the Adviser will include:

1. ensuring that the remit of the Chemical and Biological Hazards Management Group is implemented;

2. providing professional advice to the University on matters of biological health and safety;

3. following a programme of continued professional development so that the standard of professional expertise is sustained;

4. liasing with School/Unit Safety Co-ordinators and other health and safety staff and with members of the Office of the Principal over the implementation of the University Health and Safety Policy as it relates to biological health and safety;

5. co-operating with specialists inside and outside the University on biological health and safety matters;

6. advising University staff in charge of the design and construction of new buildings and the modification of existing buildings on matters affecting biological health and safety;

7. where necessary, co-operating with the University's Occupational Health Service in the provision of occupational health surveillance and monitoring;

8. advising on:

    - biological waste disposal;
    - the preparation of schemes of work and local rules;
    - biological risk assessments;
    - the acquisition of any required licence or authorisations;
    - in consultation with the University Occupational Health Service, maintaining a list of workers under the Genetically Modified Organisms (Contained Use) Regulations 2014;

9. overseeing and co-ordinating the provision of central biological health and safety training;

10. keeping staff aware of the problems of biological health and safety and their responsibilities for the health and safety of those who work or study under or with them;

11. undertaking or assisting with periodic inspections of University premises where a biological health and safety input is required;

12. auditing and monitoring School/Unit biological health and safety arrangements;

13. investigating any major microbiological emergency or accident, instigating any remedial action, compiling accident data and co-operating with University staff responsible for insurance and related matters;

14. liasing with the various relevant enforcement authorities and co-ordinating their visits and inspections;

15. representing the interests of the University at meetings of bodies whose activities may influence health and safety at the University;

16. such other health and safety duties that may, with mutual agreement, be assigned by the University

Appendix 3

University of St. Andrews

The Duties of a School/Unit Biological Safety Supervisor.

The terms of reference for a School / Unit Biological Safety Supervisor are as follows:

- To provide advice on biological health and safety matters to the Head of the School/Unit and all relevant personnel within the School/Unit;
- To ensure the School/Unit complies with governing legislation and Local Rules;
- To liase with the University Biological Safety Adviser as required;
- To keep a file of the current projects which have been approved by the Chemical and Biological Hazards Management Group and to supply a copy of each approved project to the Project Supervisor;
- To supply the Director of Environmental, Health and Safety Services, whenever requested, with a summary of the current School/Unit projects involving the use of genetically modified organisms and/or holdings of biological agents;
- To draw up and issue ‘Systems of Work’ for work with biological agents after consultation with the project supervisor;
- To ensure that the requisite certificates, warning signs and notices are posted;
- In the event of an accident which may involve exposure to a biological agent, contamination or significant release or loss of biological agents, the School / Unit should take immediate measures as he/she deems necessary and to inform the Head of the School/Unit, Director OF EHSS and the University Biological Safety Adviser as a matter of urgency.

Appendix 4

ACDP Containment Facilities Requirements

ACDP Containment Level 1 - This level applies to the handling of hazard group 1 pathogens. Level 1 containment does not require any special design features beyond those suitable for a conventional well designed and functional laboratory. Containment cabinets are not required. Work may be carried out on an open bench top and containment is achieved by the use of good microbiological techniques and practices. All laboratory personnel should receive appropriate training in good microbiological techniques and any other relevant information, instruction, training and supervision.

Level 1 containment is achieved by:

- A laboratory Code of Practice should be produced and posted in a prominent position within the laboratory.
- The laboratory should be easy to clean. Bench surfaces should be impervious to water and resistant to acids, alkalis, solvents and disinfectants.
- Effective disinfectants should be available for immediate use in the event of a spillage.
- If the laboratory is mechanically ventilated, it is preferable to maintain an inward flow of air while work is in progress by extracting room air to the atmosphere.
- All procedures should be performed so as to minimise the production of aerosols.
- The laboratory door should be shut when work is in progress.
- Laboratory coats or gowns should be worn in the laboratory and removed when leaving the laboratory suite.
- Personal Protective Equipment, including protective clothing, must be:

  i) only be issued as a requirement of a risk assessment;
  ii). stored in a well defined place
  iii) checked and cleaned at suitable intervals
  iv) when discovered to be defective, it must be repaired or replaced before further use.
- Personal protective Equipment which may be contaminated by biological agents must be:

  i) removed before leaving the working area.
  ii) kept apart from uncontaminated clothing.
  iii) decontaminated and cleaned or, if necessary, destroyed.
- Eating, chewing, drinking, taking medication, smoking, storing of food and applying cosmetics is forbidden.
- Mouth pipetting is strictly forbidden.
- The laboratory should contain a basin or sink that can be used specifically for hand washing.
- Hands should be decontaminated immediately when contamination is suspected and before leaving the laboratory.
- Bench tops should be cleaned after use.
- Used glassware and other materials awaiting disinfection should be stored in a safe manner. Where re-usable pipettes are used these should be completely immersed in disinfectant.
- Contaminated materials whether for recycling or disposal should be stored and transported in robust and leakproof containers without spillage.
- Waste sharps should be stored in specifically designed leakproof containers.
- All waste material, if not to be incinerated, should be rendered non-viable before disposal.
- Accidents and Near-miss/Dangerous Occurrences **must** be reported to the Director of EHSS on the appropriate form. The form is available from School/Building/Unit Safety Co-ordinator or from Environmental, Health and Safety Services website at the following address:

http://www.st-andrews.ac.uk/media/Accident-Rep-Form.rtf

ACDP Containment Level 2 - This level of containment is required for hazard group 2 pathogens. Laboratory personnel must receive appropriate training in good microbiological techniques and given any other relevant information, instruction, training and supervision before handling hazard group 2 pathogens.

Containment level 2 is achieved by following the standards:

- A specific laboratory Code of Practice must be produced and displayed in a prominent position within containment level 2 laboratories.
- Access to the laboratory should be restricted to authorised personnel only.
- The laboratory should be located away from public areas and general offices.
- There must be specified disinfection procedures.
- If the laboratory is mechanically ventilated, it must be maintained at an air pressure negative to atmosphere while the work is in progress.
- Bench surfaces must be impervious to water, easy to clean and resistant to acids, alkalis, solvents and disinfectants.
- There must be safe storage of biological agents.
- There must be access to an incinerator for the disposal of infected animal carcasses.
- There should be adequate space (24 m^3) in the laboratory for each worker.
- The laboratory door (preferably self-closing doors) should be closed when work is in progress.
- Laboratory coats or gowns, which should be side or back fastening, should be worn and then removed when leaving the laboratory suite. Separate storage (e.g. pegs), apart from that provided for personal clothing, should be provided in the laboratory suite.
- Personal Protective Equipment, including protective clothing, must be:

  i) only issued as a requirement of a written risk assessment;

  ii). stored in a well defined place

  iii) checked and cleaned at suitable intervals

  iv) when discovered to be defective, it must be repaired or replaced before further use.
- Personal protective Equipment which may be contaminated by biological agents must be:

  i) removed on leaving the working area.

  ii) kept apart from uncontaminated clothing.

  iii) decontaminated and cleaned or if necessary, destroyed.
- Eating, chewing, drinking, taking medication, smoking, storing of food and applying cosmetics is forbidden.
- Mouth pipetting is strictly forbidden.
- Bench surfaces should be regularly decontaminated according to the pattern of work.
- Procedures likely to give rise to infectious aerosols should be performed in a class I microbiological safety cabinet (BS EN 12469: 2000 or unit with equivalent protection factor or performance) (see Section 5.0), isolator or be otherwise suitably contained. Safety cabinets should exhaust to the outside air or to the laboratory through a HEPA filtered system. Some other types of equipment may provide adequate containment in their own right but must be verified. All local exhaust ventilation systems **must** be inspected and maintained every 14 months as required by relevant legislation.
- The laboratory should contain a wash basin specifically for hand washing located near the laboratory exit. Taps should be of a type that can be operated without being touched by hand.

- Disposable gloves should be worn when handling infectious material. When gloves are worn they should be disposed of before handling items likely to be touched by others e.g. telephones, paperwork etc.. Computer keyboards and where practicable other equipment controls should have removable flexible covers that can be adequately disinfected.
- Hands should be decontaminated immediately if contamination is suspected, after handling infectious materials and before leaving the laboratory.
- An autoclave for the sterilisation of waste materials should be readily accessible in the same building as the laboratory.
- Materials for autoclaving should be transported to the autoclave in robust containers without spillage.
- There should be a means for the safe collection, storage and disposal of waste.
- Contaminated waste should be suitably labeled before removal for incineration.
- Used glassware and other materials awaiting sterilization before recycling should be stored in a safe manner. Pipettes, if placed in disinfectant, should be totally immersed.
- Accidents and Near-miss/Dangerous Occurrences must be reported to the Director of EHSS on the appropriate form. The form is available from School/Building/Unit Safety Co-ordinator or from Environmental, Health and Safety Services website at the following address:

http://www.st-andrews.ac.uk/media/Accident-Rep-Form.rtf

Laboratory staff are responsible for ensuring that the facility is safe for routine cleaning. Cleaning staff should be instructed to only clean the floors in category 2 containment facilities. Service and cleaning personnel who enter the facility must be informed of the potential hazards they may encounter.

Containment laboratories and equipment should be thoroughly cleaned by laboratory staff at regular intervals. Procedures for effective disinfection are given in section 6.0.

Note: Laboratory staff must not use the standard equipment of the cleaning personnel as this equipment is provided for their use only.

Containment Level 3 - Work on Category 3 pathogens or Category 3 Genetic Modification projects can only be carried out in containment level 3 facilities. Only written risk assessments for work with category 3 pathogens or genetically modified organisms which has been approved, in writing, by the Director of the Category 3 Containment Facility and by the Chemical and Biological Hazards Management Group can be undertaken in that facility.

All workers who wish to use this facility **must** undergo the specialised training programme for working in this facility **prior to starting work in the facility**. A record of this training will be kept by the category 3 facility manager. All other necessary information, instruction, training and supervision for work in this facility will be carried out by the Manager of the Category 3 Facility. All workers **MUST COMPLY** with the Standard Operating Procedure (SOP) for the facility. Failure to comply with the SOP will mean that further access to the facility will be denied. Any accident or near-miss in this facility **must** reported to the Director of EHSS as a matter of urgency.

A copy of the SOP for this containment facility may be obtained from the Director or Manager of the Category 3 facility.

Access to equipment used in this facility by maintenance workers can only be allowed using a 'Permit to Work' system which has been authorised by the Director of the Facility or the Manager of the Facility. Access will only be allowed once the facility has been suitably disinfected.

Containment Level 4 - As the University does not possess the necessary facilities to handle Hazard Group 4 pathogens no details on such containment will be given in this guidance. If information on category 4 containment facilities is required, it may be obtained from the Director of Environmental, Health and Safety Services.

Appendix 5

University of St. Andrews

Pathogens Requiring a Licence Under the Specified Animal Pathogens (Scotland) Order 2009 (SAPO)

Specified animal pathogens listed in Part I of the Schedule to the Specified Animal Pathogens (Scotland) Order 2009 are:

African horse sickness virus
African swine fever virus
Aujeszky's disease virus
Avian influenza viruses which are:
(a) uncharacterised; or
(b) Type A viruses which have an intravenous pathogenicity index in six week old chickens of greater than 1.2; or
(c) Type A viruses H5 or H7 subtype for which nucleotide sequencing has demonstrated multiple basic amino acids at the cleavage site of haemagglutinin
Babesia bovis, B. bigemina and B. caballi
Bacillus anthracis
Bluetongue virus
Bovine leucosis virus
Brucella abortus
Brucella melitensis
Brucella ovis
Brucella suis
Burkholderia mallei
Classical swine fever virus
Cochliomya hominivorax
Eastern and Western equine encephalomyelitis viruses
Echinococcus multilocularis and Echincoccus granulosus
Ehrlichia ruminantium
Equine infectious anaemia virus
Foot and mouth disease virus
Hendra disease virus
Histoplasma farciminosum
Japanese encephalitis virus
Lumpy skin disease virus
Mycoplasma agalactiae
Mycoplasma capricolum sub species capripneumoniae
Mycoplasma mycoides sub species mycoides SC and mycoides LC variants
Mycoplasma mycoides var capri
Newcastle disease (avian paramyxovirus type 1) viruses which are –
(a) uncharacterised, or
(b) have an intracerebral pathogenicity index in one-day-old chicks of 0.4 or more, when not less than 10 million 50% egg infectious doses (EID_{50}) are administered to each bird in the test.
Nipah disease virus
Porcine reproductive and respiratory syndrome (PRRS) virus genptype 2

Peste des petits ruminants virus
Rabies virus and all viruses of the genus Lyssavirus

Rift Valley Fever virus
Rinderpest virus
St Louis equine encephalomyelitis virus
Sheep and goat pox virus
Swine vesicular disease virus
Teschen disease virus
Theileria annulata
Theileria equi
Theileria parva
Trichinella spiralis
Trypanosoma brucei, T. congolense, T. equiperdum, T. evansi, T. simiae, and T. vivax
Venezuelan equine encephalomyelitis virus
Vesicular stomatitis virus
West Nile virus

The specified animal pathogen listed in Part II of the Schedule to the Order is:

The live virus causing viral haemorrhagic disease of rabbits.

Appendix 6

Pathogens Listed in Schedule 5 of the Anti-Terrorism, Crime and Security Act 2001 as amended And The Part 7 of the Anti-terrorism, Crime and Security Act 2001 (Extension to Animal Pathogens) Order 2007

Animal Pathogens

African horse sickness virus
African swine fever virus
Bluetongue virus
Classical swine fever virus
Contagious bovine pleuropneumonia
Foot and mouth disease virus
Goat pox virus
Hendra virus (Equine morbillivirus)
Highly pathogenic avian influenza (HPAI) as defined in Annex I(2) of Council Directive 2005/94/EC[2]
Lumpy skin disease virus
Newcastle disease virus
Peste des petits ruminants virus
Rift Valley fever virus
Rabies and rabies-related Lyssaviruses
Rinderpest virus
Sheep pox virus
Swine vesicular disease virus
Vesicular stomatitis virus

Notes
Any reference in this Schedule to a micro-organism includes—

(a) intact micro-organisms;
(b) micro-organisms which have been genetically modified by any means, but retain the ability to cause serious harm to animal health;
(c) any nucleic acid derived from a micro-organism listed in this Schedule (synthetic or naturally derived, contiguous or fragmented, in host chromosomes or in expression vectors) that can encode infectious or replication competent forms of any of the listed micro-organisms;
(d) any nucleic acid sequence derived from the micro-organism which when inserted into any other living organism alters or enhances that organism's ability to cause serious harm to animal health.".

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The Schedule 5 to the Anti-terrorism, Crime and Security Act 2001 (Modification) Order 2007

VIRUSES (Human Pathogens)
Chikungunya virus
Congo-crimean haemorrhagic fever virus
Dengue fever virus
Dobrava/Belgrade virus
Eastern equine encephalitis virus
Ebola virus
Everglades virus
Getah virus

Guanarito virus
Hantaan virus
Hendra virus (Equine morbillivirus)
Herpes simiae (B virus)
Influenza viruses (pandemic strains)
Japanese encephalitis virus
Junin virus
Kyasanur Forest virus
Lassa fever virus
Louping ill virus
Lymphocytic choriomeningitis virus
Machupo virus
Marburg virus
Mayaro virus
Middleburg virus
Mobala virus
Monkey pox virus
Mucambo virus
Murray Valley encephalitis virus
Ndumu virus
Nipah virus
Omsk haemorrhagic fever virus
Polio virus
Powassan virus
Rabies virus
Rocio virus
Rift Valley fever virus
Sabia virus
Sagiyama virus
Sin Nombre virus
St Louis encephalitis virus
Tick-borne encephalitis virus (Russian Spring-Summer encephalitis virus)
Variola virus
Venezuelan equine encephalitis virus
West Nile fever virus.
Western equine encephalitis virus
Yellow fever virus

RICKETTSIAE (Human Pathogens)

Coxiella burnetii
Rickettsia prowazeki
Rickettsia rickettsii
Rickettsia typhi (mooseri).

BACTERIA (Human Pathogens)

Bacillus anthracis
Brucella abortus
Brucella canis
Brucella melitensis

Brucella suis
Burkholderia mallei (Pseudomonas mallei)
Burkholderia pseudomallei (Pseudomonas pseudomallei)
Chlamydophila psittaci
Clostridium botulinum
Clostridium perfringens
Enterohaemorrhagic Escherichia coli, serotype 0157 and verotoxin producing strains
Francisella tularensis
Multiple-drug resistant Salmonella paratyphi
Mycobacterium tuberculosis
Salmonella paratyphi A, B, C
Salmonella typhi
Shigella boydii
Shigella dysenteriae
Shigella flexneri.
Vibrio cholerae
Yersinia pestis

Fungi **(Human Pathogens)**

Cladophialophora bantiana
Cryptococcus neoformans.

TOXINS (Human Toxins)

Abrin
Botulinum toxins
Clostridium perfringens epsilon toxin
Clostridium perfringens enterotoxin.
Conotoxin
Modeccin toxin
Ricin
Saxitoxin
Shiga toxin and shiga–like toxins
Staphylococcal enterotoxins
Tetrodotoxin
Viscum Album Lectin 1 (Viscumin)
Volkensin toxin.

Notes

1. Any reference to a micro-organism in this list includes:

(a) intact micro-organisms;
(b) micro-organisms which have been genetically modified by any means, but retain the ability to cause serious harm to human health;
(c) any nucleic acid deriving from a micro-organism listed in this Schedule (synthetic or naturally derived, contiguous or fragmented, in host chromosomes or in expression vectors) that can encode infectious or replication competent forms of any of the listed micro-organisms;
(d) any nucleic acid sequence derived from the micro-organism which when inserted into any other living organism alters or enhances that organism's ability to cause serious harm to human health.

2. Any reference in this Schedule to a toxin includes:

(a) any nucleic acid sequence coding for the toxin, and

(b) any genetically modified micro-organism containing any such sequence.

3. Any reference in this Schedule to a toxin excludes any non-toxigenic subunit.".

Appendix 7

University of St. Andrews

Notification of Genetic Modification Project

(**N.B.** A GM1 Form should be completed for each Distinct Project Undertaken)

1. School / Building .....

2. Name of Project Leader .....

3. Title of Project:

4. Name(s) and Signatures of other Worker(s) Involved
(Including their status e.g. PhD Student, Graduate Research Assistant etc.)

Name(s) **Signature(s)**

....

....

5. Name and Signature of Project Supervisor

Name ……..... **Signature** ..... **Date** …….

6. Approval of the Project by the School / Unit Safety Committee
Signed on behalf of the School / Building Safety Committee

Name ……..... **Signature** ..... **Date** …….

7. If the work is to be undertaken in a different building from the Approving Local Safety Committee, then the Convenor or Secretary of the School/Building Health and Safety Committee of the building where the work is to be carried should also Approve the project

Name ……..... **Signature** ..... **Date** …….

8. If the work requires Category 3 Containment Facilities, then the work must also be Approved by the Director of the Category 3 Containment Laboratory

Name ……..... **Signature** ..... **Date** …….

9. Ratification of the Project by the Chemical and Biological Hazards Management Group
Signed on behalf of the Chemical and Biological Hazards Management Group (which acts as the Genetic Modification Safety Committee for the University)

Name ……..... **Signature** ..... **Date** …….

The Genetically Modified Organisms (Contained Use) Regulations 2000, requires that all genetic modification projects must be assessed for the risk to human health and to the environment. This form (GM1) should be used to record your risk assessment. To perform a risk assessment you should identify the hazards associated with the procedures, determine the probability that the hazards will cause harm to human health or the environment (i.e. the risks) and then detail the control measures necessary to minimise the risks to human health and the environment.

You should complete each section putting in as much detail as is practicable.

A genetic modification procedure is defined by the ACGM as:

a. Recombinant techniques consisting of the formation of new combinations of genetic material by the insertion of nucleic acid molecules, produced by whatever the means outside an organism, into any virus, bacterial plasmid or other vector system and their incorporation into a host organism in which they do not naturally occur but in which they are capable of continued propagation;

b. Techniques involving the direct introduction into an organism of heritable material prepared outside the organism including micro-injection, macro-injection and micro-encapsulation;

c. Cell fusion or hybridisation techniques where live cells with new combinations of heritable genetic material are formed through the fusion of two or more cells by means of methods that do not occur naturally.

This University deem other procedures to be classed as Genetic Modification projects. These include:

i. Use of an organism with modified DNA, even though the organism has not been created at this University;
ii. The generation of transgenic animals/plants using modified DNA as defined by the ACGM (in (a));
iii. Site directed mutagenesis.

Techniques not considered to result in genetic modification include:

a. *in vitro* fertilisation;
b. Natural processes including conjugation, transduction, or transformation;
c. Polyploidy induction.

Techniques for which the Genetic Modified Organisms (Contained Use) Regulations 2000 do not apply are:

a. Random mutagenesis (e.g. by chemicals like methyl nitroso-urea);
b. Cell fusion (including protoplast fusion) or prokaryote species which can exchange genetic material through homologous recombination;
c. Cell fusion (including protoplast fusion) of cells of any eukaryotic species, including production of hybridomas and plant cell fusions.

Work With Animals

NOTE: All work with genetically modified animals requires a Home Office Personal **AND** Project licence. All projects using genetically modified animals or infection of animals with genetically modified micro-organisms **MUST be approved** by the Chemical and Biological Hazards Management Group **AND** by the management of the animal welfare facilities **as well as** approval by the Home Office (Contact the University Home Office Liaison Officer - e-mail: holo@st-andrews.ac.uk)

Background to Project

NOTE: You should include a detailed background to the project here (e.g. using the Abstract from the original grant application). It is important to provide as much background as reasonably practicable so that the University's Chemical and Biological Hazards Management Group (which acts as the University's Genetic Modification Safety Committee) can have an informed judgement of the project.

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Risk Assessment

NOTE: It is important to provide as much detail as practicable so that the University's Chemical and Biological Hazards Management Group (which acts as the University's Genetic Modification Safety Committee) can have an informed judgement about the project. This Management Group will not 'Ratify' a project unless enough detail about the project has been provided.

(a) Details of the Genetically Modified Constructs

(i) List of recipient strain(s)

Cover the name of the strain of micro-organis(s) and/or animals and/or plants should be provded, as well as the name of the wild-type organism from which it is derived and the extent to which it is disabled.

(ii) If a micro-organism, what other organism(s) (e.g. animals, plants) will the recipient strain infect

(iii) List of vector(s)

Cover names and any disabling mutations.

(iv) List of genes to be inserted and function of inserted gene(s)

In doing this genes should be identified in such a way that an outside reviewer will have a general idea of their function i.e. providing a three-letter name may not be sufficient. Where the function of a gene is unknown, it may help to provide details of any known homologues.

(b) Hazards to Human Health

(i) Hazards associated with the recipient organism (e.g. bacterial host or viral vector, animal, plant etc)

Factors to consider include whether the recipient microorganism is listed in ACDP hazard groups 2, 3 or 4. Other relevant factors may be the microorganism's mode of transmission, disease symptoms, host range, and tissue tropism as well as an indication as to whether vaccines or chemotherapeutic agents are available. Information should also be provided on any disabling mutations and whether there is any possibility of any disabling mutations being complemented or reverting. If an animal or plant, are these organisms inherently dangerous (e.g. toxic plants, production of allergens etc)

(ii) Hazards arising directly from the inserted gene product (e.g. cloning of a toxin gene or oncogene)

Consideration should be given to whether the inserted DNA encodes a toxin, an oncogenic protein, an allergen, a modulator of growth or differentiation (hormone or cytokine) or any other protein, which may result in potentially harmful biological activity. Where the function of the inserted gene is unknown, it may help to describe the function of any known homologues. Please note that even a normal human gene may be harmful if overexpressed, especially if the overexpression is in tissues that do not normally express the protein.

(iii) Hazards arising from the alteration of existing traits (e.g. alteration of pathogenicity, host range, tissue tropism, mode of transmission or host immune response)

One factor to consider is whether the inserted gene encodes a pathogenicity determinant, such as an adhesin, a penetration factor or a surface component providing resistance to host defence mechanisms. Another important consideration is whether the inserted gene encodes a surface component, envelope protein or capsid protein that might bind to a different receptor to that used by the recipient microorganism. Consideration should also be given to whether the inserted DNA (or the plasmid sequence) encodes resistance to a drug or antibiotic that might be used for the treatment of a laboratory-acquired infection. If an animal or plant, will the inserted gene affect the tropism of human pathogens, will the modified organism act as a new 'reservoir' for a human pathogen etc.

(iv) The potential hazards of sequences within the genetically modified organism being transferred to related organisms

Factors to consider include whether widespread dissemination of the inserted gene as a result, for example, of either gene transfer or recombination of the GMM with a wild-type microorganism, would be a matter of concern. If this is the case an important consideration will be whether, in the event of a breach of containment could the genetically modified organism could survive in the environment for long enough for such a gene transfer to take place.

(v) Any other relevant information.

(c) Assignment of a Provisional Containment Level that is Adequate to Protect Against Hazards to Human Health

This step will involve considering the containment level necessary to control the risk of the recipient organism (e.g. the ACDP Hazard Group of the recipient microorganism) and making a judgment about whether the modification will result in the genetically modified organism being more hazardous, less hazardous, or about the same.

(d) Identification of Any Hazards to the Environment

(i) Hazards associated with the recipient organism (e.g. bacterial host, viral vector animal, plant)

Factors to consider include whether the recipient microorganism is capable of infecting any plants, animals or insects in the environment and whether there is any possibility of any disabling mutations being complemented or reverting. In particular it should be ascertained whether the recipient microorganism is a pathogen that is controlled by DEFRA. If it is an animal or plant, are these organisms inherently hazardous to any population in the environment. List all such groups even though they may not exist in the UK

(ii) Hazards arising directly from the inserted gene product

Consideration should be given to whether the inserted DNA encodes a toxin, an oncogenic protein, an allergen, a modulator of growth or differentiation (hormone or cytokine) or any other protein, which may result in potentially harmful biological activity. Where the function of the inserted gene is unknown, it may help to describe the function of any known homologues. Please note that even a normal gene may be harmful if overexpressed, especially if the overexpression is in tissues that do not normally express the protein. You should also indicate if the protein produced by the gene may affect other organisms in the environment (e.g. expression of antibiotics etc)

(iii) Hazards arising from the alteration of existing traits (e.g. alteration of pathogenicity, host range or tissue tropism)

One factor to consider is whether the inserted sequence encodes a pathogenicity determinant, such as an adhesin, a penetration factor or a surface component providing resistance to host defense mechanisms. Another important consideration is whether the inserted gene encodes a surface component, envelope protein or capsid protein that might bind to a different receptor to that used by recipient microorganism. If an animal or plant, will the modified organism act as a 'reservoir' for an organism that would not have been present in that species before.

(iv) The potential hazards of sequences within the genetically modified organism being transferred to related organisms

Factors to consider include whether widespread dissemination of the inserted gene as a result, for example, of either gene transfer or recombination of the genetically modified micro-organisms with a wild-type micro-organism, would be a matter of concern. If an animal or plant, what would happen if wild type organisms organisms mated with the genetically modified version (e.g. escape of plant pollen, escape of fish eggs/sperm etc). If this is the case an important consideration will be whether, in the event of a breach of containment the organism could survive in the environment for long enough for such a gene transfer to take place.

(v) Any other relevant information.

(e) Who is at Risk

You should identify all those at risk. This should include the support services who may have access to the laboratories e.g. cleaners, maintenance staff etc. You should also clearly identify those who may be at especial risk e.g. pregnant women, immune compromised workers etc.

(f) Control Measures Required to Minimise the Risks of the Work

(i) What level of containment facilities and procedures will be required for this work?

Details of the physical and procedures requirements for different levels of containment can be obtained in the SACGM Compendium of Guidance - Guidance from the Scientific Advisory Committee on Genetic Modification (website: http://www.hse.gov.uk/biosafety/gmo/acgm/acgmcomp/index.htm)

All workers should be informed on how to obtain these details of these containment requirements.

(ii)Are any of the work procedures likely to generate aerosols?

If so, should the work be undertaken in a safety cabinet or isolator?

(iii) How will waste materials be disposed of?

Include both solid and liquid laboratory waste and waste from experiments with infected animals.

(iv) Will it be necessary to use sharps?

Does work involve glass Pasteur pipettes?

(v) If the work involves the experimental infection of animals is it known whether the animal will shed the GMM?

(vi) If the work involves the experimental infection of plants what is known about the likely route of transmission of the GMM?

For example, is the microorganism insect-borne or carried in run-off water? This will have important implications for the type of glasshouse used.

(vii) In the case of organisms whose multiplication involves a complex life-cycle will the work involve the propagation of organisms that are in stages in that life-cycle that are particularly hazardous?

Examples include the propagation of the infective stages of parasites or the release of spores from fungi. Consideration should be given to all potential routes of transmission including those that might not be used naturally.

(viii) Have any disinfectants been validated under the actual conditions of use?

For example, if disinfectant is being used for the treatment of virus in tissue culture medium, is it known that the disinfectant is effective in the presence of high levels of protein?

(ix) Does the nature of this work preclude it being undertaken by any workers who have a serious skin condition (e.g. eczema) or other health problems that might make them more susceptible to infection (e.g. some kind of immunological defect)?

(x) Will workers require any vaccinations or health surveillance?

(g) Consideration of whether there is a need to assign additional measures over and above the provisional level of containment.

Additional measures may be necessary in any of the following circumstances:

(i) to take full account of any properties of the GMM that may be hazardous to human health.
(ii) to protect the environment.
(iii) to provide additional safeguards for particular work procedures.

Part 3. Final assignment of containment measures and risk class

The following aspects of this project are assigned to class 1.

The following aspects of this project are assigned to class 2.

The following aspects of this project are assigned to class 3.

The following aspects of this project are assigned to class 4.

Appendix 8

List of Classified Vectors and Host Cells

Vectors

ACGM Classified as 'Non-Mobilisable' bacterial plasmid vectors

pAT153
pACYC184
pBR327
pBR328
pUC series
pBluescript II
pMTL20
pBS
pGEM
pGEMEX
pGEMZf
pUR222
pUCBM
pSP64
pEX series
pCAT series
pT3/T7
pEUK-C1
pEUK-C2
pMAM
pDR720
pRIT2T
pRIT5
pMSG
pSP18
pSP19
pSP6/T3
pSP6/T7
pXT1
pSUb
pEMBL 18
pEMBL 19
pSELECT

Not yet ACGM classified but provisionally classified at St-Andrews as 'Non-Mobilisable' bacterial plasmid vectors

PQE
pREP (InVitrogen) series
pCEP (InVitrogen) series
pCDNA (InVitrogen) series
pGEX
pUHD-10
pMR101 (+ derivatives)
pZeoSV2(+)
pVL1392
pVL1993
pCRII
pRC/CMV-neo
pRSET
pCR1000
pCR2000

ACGM classified as 'Mobilisation Defective' bacterial plasmid vectors

pBR322
pBR325
pACYC177
p15A
pROK-1
pKK233-2
pKK338-1
pNOS
pET
pBTac1
pBTac-2
pBTrp2
pBTrp56
pKC-30
pKT279
pKT280
pHSV-106
pKT287
pFB series
pNO1523
pSVL
pKSV-10
pGA482
pGA580
RP4-1

Not yet ACGM classified but provisionally classified at St. Andrews as 'Mobilisation Defective' bacterial plasmid vectors

pTH1010R

ACGM classified as 'Self-Mobilisable' bacterial vectors

F RP4 RSF1010
ColE1
Not yet classified by the ACGM but provisionally classified at St. Andrews as 'Self-Mobilisable' bacterial vectors

PRK2013 (from Tim Hirst) ?

ACGM classified as 'Non-mobilisable' Cosmid vectors

pHC79 pWE15,16 Super Cos1
pAA113 pAA113-X pAA113-M

Yeast Vectors

ACGM Classified as 'Non-Mobilisable' Yeast vectors
-Integration vectors (e.g. Yip vectors)

YRp, YCp, YIp, YARp, YPp, YXp, YHp, YAC
YEp, YCp, YARp, YPp, YXp, YHp.

Bacteriophage Vectors

ACGM classified as 'Non-Mobilisable' the following bacteriophage vectors.

Charon
λgt10 (and derivatives e.g. λGEM 2, 4 etc.)
λgtWES
λEMBL3, 4 (and derivatives e.g. λGEM 11, 12 etc.)
λgt11 (and derivatives λZAP, λDASHII, λFIX)
M13 (In a host containing a tra- F plasmid)

Bacterial Hosts.

ACGM Classified as Disabled Host Cells (K-12 E. coli derivatives)

AG1	LE392	DH20*	
BW313		NM554	DH21*
CES201	N99	NM522*	
CPLK	N4830	PLK-F'*	
C600	NM538	SRB*	
DH1	NM5329	SURE™ *	
DH5	P2392	XL-1 Blue *	
HB101	PLK-A	Y1088	
INV1	PLK-F'*	Y1089	
JM83	RR1	Y1090	
JM101	SCS1	BMH 71-18	
JM103	TB1		
JM105	TG2		
JM107	XS127		
JM109	MC1061-P3		
JM110	71-18*		
K808	BB4*		
KW251	CSH18*		

* = These strains of E. coli may mobilise plasmids by F and thus require an increase in the Access Factor.

ACGM Classified as 'Status Unclear'

E. coli

BL21 BL21 (DE3)

BL-21 has now been shown to be a disabled host which cannot infect humans (An investigation into the pathogenic properties of Escherichia coli strains BLR, BL21, DH5α and EQ1. Chart, H., et al Journal of Applied Microbiology 2000, Vol: **89**, p1048-1058)

Disabled Hosts not yet appearing on the ACGM list

E. coli

TOP10

ACGM classified as Disabled Hosts of Salmonella typhimurium

BRD509	BRD915	BRD917
SL3261	SL3235	TA2657

ACGM classified as Disabled Hosts of Vibrio

Vibrio sp. 60 (Wild type – but the University of St. Andrews does not believe this strain of vibrio will colonise humans)

Other Bacterial Hosts

Rhizobium spp. (Inc. Bradyrhizobium) (Especially Disabled Host – non-pathogenic)

Fungal Hosts.

Yeast cells

Saccharomyces cerevisae (Especially Disabled Hosts – non-pathogenic)
Schizosaccharomyces pombe (Especially Disabled Hosts – non-pathogenic)
Pichia pastori (Disabled Host)

Other Fungal Hosts

Aspergillus oryzae (Especially Disabled Host – non-pathogenic)

For other fungal hosts – please ask for guidance

Eukaryotic Cell Lines

All eukaryotic cell lines are especially disabled provided the cells are unable to colonise the worker (i.e. are not from the worker) and contain no adventitious agents which are potentially harmful.

APPENDIX 9

UNIVERSITY OF ST ANDREWS

Specimen Laboratory Code of Practice for Biological Work at Containment Levels 1 or 2

(The Code of Practice must be posted in a conspicuous place near the laboratory entrance)

SCHOOL/BUILDING/UNIT .....

CODE OF PRACTICE FOR BIOLOGICAL WORK

Location: Rooms xxx, yyy

Biohazard Hazard/Containment Level Number: (1, 2)
(As agreed by the Chemical & Biological Hazards Management Group)

To comply with the Regulations, all persons working in this Laboratory should be familiar with the contents of the University booklet entitled "Guidance on Chemical and Biological Safety - Part 2 Biological and Genetic Modification Safety" and with the School/Building/Unit Health and Safety Handbook. Before embarking on work with potentially hazardous substances, laboratory personnel should have the necessary information, instruction and training to enable them to pursue their work in a manner which is safe for themselves and for others.

1. Casual visitors should not enter except by invitation from a competent person, who has particular knowledge of the work of the laboratory.
2. The laboratory door should be closed when work is in progress.
3. Laboratory coats, of appropriate type, should be worn at all times.
4. Eating, chewing, drinking, smoking, storage of food and applying of cosmetics are forbidden within the laboratory.
5. Mouth pipetting is not permitted.
6. All procedures must be performed so as to minimise the production of aerosols. Any procedure likely to produce aerosols should be performed in a microbiological safety cabinet of appropriate type. (Type to be stated).
7. The work area must be kept clean and tidy. Bench tops should be cleaned and disinfected with an appropriate biocidal agent after use.
8. Work with radioactive isotopes must be limited to within the areas indicated by Radioactive Hazard Tape. Radioactive waste should be stored in marked containers and removed to the room or site set aside for disposal. The levels of radioactivity permitted in these areas are displayed.
9. Contaminated glassware should be disinfected by complete immersion in an appropriate disinfectantsolution or otherwise sterilised. Fresh solutions should be prepared as necessary and at least each week.
10. Contaminated plastics should be placed in the bin marked "Biohazards" for autoclaving.
11. Non-contaminated waste should be put in the unmarked bins.
12. All sharps should be placed in the "Sharps" bin for later disposal.
13. Contaminated waste should be autoclaved separately from other materials.
14. Spills should be treated immediately with an appropriate disinfectant (*state disinfectant*) and/or absorbent paper as appropriate.
15. Hands must be disinfected or washed immediately when contamination is suspected and also before leaving the laboratory.

16. Accidents or incidents which could lead to injury or infection should be reported immediately to the laboratory supervisor and recorded in the book kept for the purpose. (Give location of record book).

APPENDIX 10

UNIVERSITY OF ST ANDREWS

MICROBIOLOGICAL SAFETY CABINET
DECONTAMINATION CERTIFICATE

SCHOOL/BUILDING/UNIT .....

This is to certify that the microbiological safety cabinet

type/number .....

situated in

location .....

is safe to handle.

All the equipment has been cleaned and disinfected prior to the commencement of maintenance work. The equipment is free from infection and other hazards.

Date: .....

Signed: .....
(Laboratory Supervisor)

Signed: .....
(School/Unit Safety Co-ordinator or
School/Unit Biological Hazards Supervisor)

APPENDIX 11

UNIVERSITY OF ST ANDREWS

Specimen Laboratory Code of Practice for Use and Maintenance of Autoclaves

(The Code of Practice must be posted in a conspicuous place near the autoclave)

SCHOOL/BUILDING/UNIT.....

CODE OF PRACTICE FOR USE AND MAINTENANCE OF AUTOCLAVES

(State rooms serviced and the Hazard/Containment levels of the work).....

Autoclave type and serial number: .....

Only trained operators are permitted to use the autoclave. All persons delivering material to, or using, the autoclave should be familiar with the contents of the University booklet entitled "Guidance on Chemical and Biological Safety - Part 2 Biological and Genetic Modification Safety" and with the School/Building/Unit Health and Safety Handbook.

Operational Risks:

1. The autoclave is only to be used by trained operators.
2. Each operating cycle of the autoclave should be noted in the "Autoclave Process Record".
3. Contaminated waste should be autoclaved separately from other materials.
4. Any faults or abnormalities should be recorded in the "Maintenance Log" and reported to the Departmental Biological Hazards Officer for remedial action to be taken.
5. MAINTENANCE:
   Regular maintenance is essential for the continued efficiency and safety of laboratory autoclaves. The following maintenance schedule must be followed:

   a) *Daily Maintenace:*
   The steam pressure from the supply must be checked;
   The chamber and all internal fittings must be cleaned;
   The door seal must be cleaned with a damp cloth and examined to ensure that it is in good condition with no cuts or abrasions;
   Visual checks must be made for steam and water leaks.

   b) *Weekly Maintenance:*
   The operation of the indicator lamps must be checked;
   During an operating cycle, the temperature gauge and pressure gauge must be checked;
   Each laboratory should possess a temperature indicator with thermocouple probes, or alternative, for the temperature checks.
   The results of these checks must be reported in the "Maintenance Log" and any faults reported to the Laboratory supervisor.

   c) *Annual Maintenance and Inspection:*
   The autoclave is to be checked annually by a maintenance/service engineer; before the engineer can commence work on the autoclave a Decontamination Certificate must be issued stating that the equipment is safe to handle (i.e. free from infection and other hazards); these are obtained from the School/Unit Safety Co-ordinator or School/Unit Biological Hazards Supervisor.

Further guidance on the use of autoclaves can be obtained in the HSE Guidance Note PM73 "Safety Requirements for Autoclaves". A copy of this guidance note is available for viewing at Environmental, Health and Safety Services.

APPENDIX 12

UNIVERSITY OF ST ANDREWS

AUTOCLAVE DECONTAMINATION CERTIFICATE

SCHOOL/BUILDING/UNIT .....

This is to certify that the autoclave

type/number .....

situated in

location.....

and ancillary equipment, are safe to handle.

All the equipment has been cleaned and disinfected prior to the commencement of maintenance work. The equipment is free from infection and other hazards.

Date: .....

Signed: .....
(Laboratory Supervisor)

Signed: .....
(School/Unit Safety Co-ordinator or
School/Unit Biological Hazards Supervisor)

Appendix 13

INDICATIVE EXAMPLES OF INFECTIOUS SUBSTANCES ASSIGNED TO CATEGORY A These entries are for infectious substances carried in any form, unless otherwise indicated.

Note: The following list is not exhaustive. Infectious substances, including those containing new or emerging pathogens, which do not appear in the following list but which meet the same criteria, must be transported as a Category A infectious substance. In addition, if there is doubt as to whether or not a pathogen falls within this category it must be transported as a Category A infectious substance.

Bacillus anthracis (cultures only)
Brucella abortus (cultures only)
Brucella melitensis (cultures only)
Brucella suis (cultures only)
Burkholderia mallei - Pseudomonas mallei – Glanders (cultures only)
Burkholderia pseudomallei – Pseudomonas pseudomallei (cultures only)
Chlamydia psittaci - avian strains (cultures only)
Clostridium botulinum (cultures only)
Coccidioides immitis (cultures only)
Coxiella burnetii (cultures only)
Crimean-Congo haemorrhagic fever virus
Dengue virus (cultures only)
Eastern equine encephalitis virus (cultures only)
Escherichia coli, verotoxigenic (cultures only)
Ebola virus
Flexal virus Francisella tularensis (cultures only)
Guanarito virus
Hantaan virus
Hantavirus causing haemorrhagic fever with renal syndrome
Hendra virus
Hepatitis B virus (cultures only)
Herpes B virus (cultures only)
Human immunodeficiency virus (cultures only)
Highly pathogenic avian influenza virus (cultures only)
Japanese Encephalitis virus (cultures only)
Junin virus
Kyasanur Forest disease virus
Lassa virus Machupo virus
Marburg virus Monkeypox virus
Mycobacterium tuberculosis (cultures only)
Nipah virus
Omsk haemorrhagic fever virus
Poliovirus (cultures only)
Rabies virus (cultures only)
Rickettsia prowazekii (cultures only)
Rickettsia rickettsii (cultures only)
Rift Valley fever virus (cultures only)
Russian spring-summer encephalitis virus (cultures only)
Sabia virus
Shigella dysenteriae type 1 (cultures only)
Tick-borne encephalitis virus (cultures only)
Variola virus
Venezuelan equine encephalitis virus (cultures only)
West Nile virus (cultures only)
Yellow fever virus (cultures only)
Yersinia pestis (cultures only)

Appendix 14

UN 2900 INFECTIOUS SUBSTANCE AFFECTING ANIMALS ONLY

African swine fever virus (cultures only)
Avian paramyxovirus Type 1 - Velogenic
Newcastle disease virus (cultures only)
Classical swine fever virus (cultures only)
Foot and mouth disease virus (cultures only)
Lumpy skin disease virus (cultures only)
Mycoplasma mycoides - Contagious bovine pleuropneumonia (cultures only)
Peste des petits ruminants virus (cultures only)
Rinderpest virus (cultures only)
Sheep-pox virus (cultures only)
Goatpox virus (cultures only)
Swine vesicular disease virus (cultures only)
Vesicular stomatitis virus (cultures only)

Version number	Purpose / changes	Document status	Author of changes, role and school / unit	Date
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