



# European Network of P4 Laboratories (ENP4 Lab) Work Package 4. Report Checklist Biosafety and Biosecurity Harmonisation.

Lead partner: HPA

## 1. Background Summary

- 1.1. Access to high containment laboratories is essential to the better understanding of hazard group 4 pathogens and for maintaining the European capacity for early detection and intervention in the resulting human and animal diseases. Access is also needed to underpin the European emergency response capacity to incursions of exotic disease, whether this occurs naturally or as the result of terrorist activity. Currently, BSL4 facilities are limited to a few European countries. A European strategy for their continued provision that optimises opportunities for emergency, preparedness, response and collaboration, is therefore essential. However, high containment laboratories are complex, expensive facilities to build, maintain and operate demanding stringent interdisciplinary input from architects, designers, engineers, biosafety and biosecurity professionals and scientists. Undertaking such programmes requires robust project management and an understanding of maintaining the biosecurity and biosafety of working, storing and transporting high consequence pathogens while protecting the worker and community where such facilities are built.
- 1.2. In Europe, operational high containment laboratories are located in the UK, Germany, France, Italy, Sweden, Switzerland and Spain (animals only). Additional capacity is being planned or built in Austria, Germany and the Netherlands. In all the member states, their operation is governed by Directives from the EU as transposed into national law. There is therefore a generic legal framework for the design and maintenance of high containment facilities and for the designation of human and animal pathogens across Europe with some variations at local level.
- 1.3. Detailed and well developed guidance manuals relating to the design, building maintenance, commissioning of High containment facilities also form the basis of many decisions made by those contemplating the building of these laboratories. In addition, to the EU Directive **2000/54/EC**, other established documents referred to during this exercise have been based on the NIH BMBL, Canadian Biosafety, UK ACDP, WHO Biosafety manual.
- 1.4. The newly published CEN Laboratory Biorisk Standards (2008) have recently provided a working document for the management of biological risks and is compatible with the EN ISO 9001:2000 (Quality); EN ISO 14001:2004 (Environmental) and OHAS 18001:2007 (Occupational health

and Safety) management standards that integrate all such management systems of any organisation. Equally the WHO Laboratory biosecurity guidance (2006) also provides a generic approach to global guidance based on the formulating of a BSL-3 evaluation checklist.

- 1.5. Compliance of any Biosafety or Biosecurity needs have to be reviewed with national and local standards, regulations or guidelines which are of primary importance in any programme. Care has been taken during this exercise not to devise a 'checklist' system that conflicts with any legal requirements in member states.
- 1.6. There is no over-arching European strategy for the provision of high containment facilities, this being totally driven by the strategic requirements determined by each Member State. Memoranda of Understanding do exist between some Member States on the provision of essential back-up capacity during maintenance of their high containment facilities and to accommodate surge requirements during epidemic or emergency situations.
- 1.7. The rapid expansion of high containment facilities across the USA and those proposed within Europe have not been matched by the availability or provision of trained staff, the implication being that many of the facilities will either remain idle or will operate at a lower level of containment unless acceptable training programmes are developed that engender confidence by national officials and public. Expanding the construction of new BSL4 facilities, including laboratories on academic campuses and expansion of existing facilities has resulted in public concern, national reviews and enquiries into their safety and the qualifications of those working in them.
- 1.8. The European Network of P4 Laboratories (EURONET-P4) created in 2005, has successfully enhanced and maintained cooperation, communication and exchange of information between the medical, scientific, technical and biosafety professionals associated with European Bio-safety Level 4 laboratories. It also promotes harmonisation and standardisation of biosafety practices and diagnostic procedures and offers assistance to countries where new BSL-4 laboratories are being conceived, planned, constructed or commissioned.
- 1.9. The purpose of the current EuroNet P4 Biosafety and Bioscurity work package has taken into account current international and various national guidelines relating to biosafety, biosecurity and training requirements associated with the operation and management of Biosafety level 4 laboratories. This activity forms the basis of establishing a framework 'checklist' that underpins a workable and agreed measurable audit and guidance system. This 'checklist' system aims to provide the confidence that current and planned BSL 4 facilities comply with defined specific performance indicators and standards of essential systems that can be considered through the implementation of a robust European Audit system.

- 1.10. Providing an internationally accepted BSL4 facilities, based on the physical high containment infrastructure, is only part of the equation. Competent staff are also needed to operate and maintain the facilities. There is a legal requirement throughout Europe placed upon National Government sponsors and the founders of high containment laboratories, not only to protect these workers from the risk of exposure to dangerous pathogens but also to protect the public, environment and community from accidental releases. Suitable staff training and professional development programmes need to be available and a European strategy for coordinating and achieving this is increasingly necessary to convince the world community that they are built and managed to the highest standards.
- 1.11. This work package aims to be factual and identify the key and specific performance indicators in the form of a 'checklist' that will provide the basis for reviewing the biosafety and biosafety infrastructure related to biorisk management of BSL4 facilities. This cannot be done in isolation as it is also influenced by a number of regulatory and managerial frameworks that operate by various national authorities and these, in turn, have to be seen in a wider international, and particularly European, context. These issues therefore formed a strategic part of the overall audit construction.
- 1.12. The report work was commissioned by the Commission of the European Communities through the Institut Nazole perle Malattie Infettive IRCC('@Lazzro Spallanzani' (INML), Rome.
- 1.14. An ENP4 network auditing team members have been assembled and dates of the audit been selected.

## **2. Work Package Terms of Reference**

- 2.1. To create a checklist to be used as a standard evaluation tool for biosafety and biosecurity issues and minimum training requirements for new European P4 laboratories.
- 2.2. The developed tool will be used to perform biosafety and biosecurity audits to be offered to new or proposed BSL 4 laboratories.

## **3. Deliverables:**

- 3.1.D7: Biosafety and biosecurity checklist by spring 2009
- Checklist and 'pilot' audits organised
  - Audit team from network members been expressed willingness to participate.

### 3.2. Final report on biosafety and audit activity – October 2010

## 4. Considerations:

4.1. Five major points had to be addressed in order to make sure that the biosafety and biosecurity issues were meaningful, effective, and informative:

4.1.1. **Harmonisation:** the outcome needed to impact on how new facilities were going to be considered, designed, built, managed and on the selection and training of staff.

4.1.2. **Legislative issues:** although not relevant to normal activity of laboratories, there are international or national rules that have to be complied with and need to be considered in relation to the audit requirements.

4.1.3. **Definition of key performance indicators (standards?).** Imperative to identify those components of BSL4 facilities, staff training and management that are critical to the effective function of BSL4 facilities according to the highest standards of biosafety and biosecurity 'best practice'.

4.1.4. **Auditing criteria:** Determined the function and operation of auditing to aid future European BSL4 laboratory capacity.

4.1.5. **Review** of existing and established Biosafety and Biosafety guidelines and EU Directives that provide the basic information of the design, construction, commissioning and maintenance of BSL4 facilities.

4.2. Main issues addressed to defining a biosafety and biosecurity checklist and planned audit activities:

4.2.1. Define the terms 'checklist' and 'audit' to identify the specific performance indicators (standards?) critical to maintaining the operational capabilities of BSL4 facilities.

4.2.2. Critical areas or 'Specific Performance Indicators (standards?)' relevant to BSL4 laboratory should be the basis of the checklist and refer to the detailed Biosafety & Biosecurity Guidance Manuals available.

4.2.3. Infrastructure: defined scope, purpose of BSL4 infrastructure on the basis of existing proven facilities.

4.2.4. It is important to define and review operational management and support processes that underpin the critical functions of a BSL4 facility.

4.2.5. Identify the fundamental role of audits: not specific methodologies, but examination and implementation good working biosafety and biosecurity practice (hazard control,

existence of a positive safety culture), operations and support processes, management (does the facility fit the purpose for which it was intended?).

- 4.2.6. Training schemes and assessing competency in terms of selection, performance and continual professional development is critical to convincing national bodies and public that these European facilities are ensuring that biosafety and biosecurity working practices are being employed.

## 5. Proposed work plan and timelines:

5.1. Checklist completed May 2009

### 5.2. Pilot audit based on the checklist to be undertaken between autumn 2009 and spring 2010. Schedule of consenting Institutions;

- |              |  |                |
|--------------|--|----------------|
| 1. UK -      | Health Protection Agency, Centre Emergency, Preparedness and Response, Porton Down, Salisbury. | - Autumn 2009  |
| 2. Germany - | Phillips-Universitaet Marburg,   | - October 2009 |
| 3. Italy -   | L Spallanzani I.R.C.C.S  | -December 2009 |
| 4. France -  | Institut National de la sante et de la Recherche Medicale, Lyon                                | -February 2010 |
| 4. Germany - | Bernard-Nocht-Institute for Tropical Medicine Hamburg  | - April 2010   |
| 5. UK -      | Health Protection Agency, Centre for Infections, Colindale, London                             | -June 2010     |
| 6. Sweden -  | Swedish Institute for Infectious Disease Control   | Outstanding    |

*Note: This programme at the time of writing has experienced a set back through the European response to the Swine Flu pandemic and various national responses involving many of the network members and institutions.*

5.3. Pilot inspection teams will be drawn from experienced EuroNet P4 personnel;

- Dr Christopher Leculier, Lyon, France
- Dr Stephen Gunther & Dr Petre Emmerich, University Hamburg, Germany
- Dr Markus Eickman, University Marburg, Germany
- Dr Antonino DiCaro, Spallenzani, Italy
- Drs Graham Lloyd & Robin Gopal, Health Protection Agency, UK
- Ms Heather Sheeley President European Biosafety Association.

5.4. Finalise the 'pilot study' outputs, refine the checklist and submit final report Autumn 2010.

## 6. Organisational reviews and pilot audits.

6.1. All reviews to be overseen by the Project management team located at the Institut Nazole perle Malattie Infetitive IRCC 'Lazzro Spallanzani' (INML), Rome.

6.2. The Steering Committee was chaired by the project lead Dr Pollitano and the EuroNet workpackage leads formed a small independent Review Team that with independently review the pilot audits to amends, modify the auditing content, process if necessary and makes the final recommendations to the EU.

6.3. The pilot auditing team has been drawn from existing experienced operating European BSL4 facilities that includes biosafety professional representation from the European Biosafety Association and possibly WHO.

6.4. The work package lead had the freedom to operate independently of the Steering Committee and was responsible for producing the deliverables of the work package and was advised by experts from other CL4 facilities throughout Europe (Lyon, France;,, Hamburg, Munich, Germany; Stockholm, Sweden) and North America, CDC Atlanta, NIH Fort Detrick, Fort Collins Colorado), Johannesburg, South Africa, NIH Japan, NIH Winnipeg, Defence Science and Technology Laboratories (DSTL), the UK Health and Safety Executive (HSE) and the UK National Counter Terrorism Security Office (NaCTSO), WHO , ECDC, Global Health Security Action Group Laboratory Network, Global CL4 Users based in the US.

6.5. In addition, to the working scientists outlined from the above organisations with advice from biosafety and biosecurity professionals have also been obtained through the European, American, SE Asian Biosafety Association and WHO Biosafety Office.

## 7. Evaluating Biosafety Level 3 laboratories – Audit Sheet

### 7.1. Organisation and management structure

#### 7.1.1. Basic Guidance

8. **Audit aim:** *To identify Guidance/Regulatory or National Criteria are being followed documents in operating, commissioning, building or designing is/was currently based on what*

8.1. European:(Directives?).....

.....

8.2. National:(e.g.USA-BMML; UK-ACDP).....

.....

8.3. International:(e.g.WHO,BMML etc).....

.....

8.4. Other.....

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**9. Provide contact of person(s) with the following responsibilities**

9.1. Organisation chart or management structure.....

9.2. BLS4 laboratory manager.....

9.3. Access control system.....

9.4. Certification of workers requirements:.....

9.5. Autoclave and waste control:.....

9.6. Safety coordinator.....

9.7. Maintenance and facility & equipment:.....

9.8. Veterinary surgeon/representative (if animal work undertaken)

.....

**10. Site/laboratory certification**

10.1. Laboratory BSL4 certification.....

10.2. Biohazardous materials use authorisation.....

10.3. Site animal certification.....

10.4. WHO Collaboration Centre.....

## 11. Facilities and environment

**Audit aim:** To review the critical performance indicators (standards?) of BSL 4 infrastructure that are essential to laboratory design, building, commissioning and operational capability.

- 11.1. Conditions for site, facility and laboratory access.
- 11.2. Conditions for storage and access to Hazard group 4 agents.
- 11.3. Hazardous material storage conditions and monitoring.
- 11.4. Personnel authorisation and monitoring.
- 11.5. Access authorisation and control.
- 11.6. Transfer authorisation.

## 12. Conditions for BSL4 laboratory access and monitoring by;

- 12.1. Medical, Scientific and technical personnel
- 12.2. Maintenance engineers
- 12.3. Visitors
- 12.4. Emergency access

Table 1. Review of General Access requirements for CL4 facilities			
Item	Suited	Line	Laboratory Location and Access
1	●	●	Separated from public areas by door.
2	●	●	Access limited to authorized personnel.
3	●	●	Laboratory room doors to have appropriate signage (e.g., biohazard sign, containment level, contact information, entry requirements).
4	●	●	Size of door openings to allow passage of all anticipated equipment.
5	●	●	Doors to the containment laboratory lockable (this does not apply to areas within the containment laboratory).
6	●	●	Doors to provide restricted access by installation of a controlled access system (e.g., card key) or equivalent.
7	●	●	Electronic locking systems to be backed up with a physical key-lock system.
8	●	●	Office areas to be located outside of containment laboratory. Paperwork stations for data collection can be within containment laboratory provided they are located away from laboratory work areas.
10	●	●	Anteroom door(s) located between the clean and dirty change rooms not to be opened simultaneously with either the containment laboratory door or the clean change entry door. <i>(Interlock, visual or audible alarms, or protocols are all acceptable means.)</i>
11	●	●	Anteroom door(s) located between the clean and dirty change rooms not to be opened simultaneously with either the containment laboratory door or the clean change entry door (interlock only).
12	●	●	Interlocked doors, if present, to have manual overrides for emergency exit.

13	●	●	Entry to laboratory zone to be provided with clothing change areas separating personal and laboratory clothing dedicated to that zone (i.e., "clean" change area separated from "dirty" change area).
15	●		Entry to laboratory to be provided via anteroom with airtight doors (e.g., inflatable or compression seal);  CL4 laboratories using only a Class III BSC biological safety cabinet line, airtight doors are not required.
16	●		<b>Suited type facility (animal or laboratory):</b> Entry to hazard zone to be provided with a suit change area, a chemical shower on the containment barrier (i.e., between the laboratory and suit change area) and water shower on exit from the zone (i.e., between "dirty" and "clean" change areas); <b>Cabinet line facility:</b> for laboratories using only a Class III biological safety cabinet line, suit change area and chemical shower are not required).
17	●	●	Containment laboratories to be located in close proximity to supporting mechanical services to limit the amount of potentially contaminated services.
18	●	●	Ideally containment laboratories to be located away from external building envelope walls.

### 13. Design and operation conditions – critical safety performance indicators (standards?) *(Evidence provided by review of all associated and continual documentation)*

#### 13.1. Air balance – Primary Containment (i.e. Laboratory infrastructure, Cabinet line)

Item	Suited	Line	Table 2. Air Handling Systems Requirements Guidance
1	●		II BSCs to be tested in situ
2		●	Class III BSCs to be tested in situ in accordance with the and BS EN 12469-2000 <sup>(6)</sup> .
3	●		Interlocks (i.e., Class II Type B2 BSC internal cabinet supply fan and exhaust fan) to be tested <sup>7</sup> to ensure that internal supply fan shuts off whenever exhaust fan fails.
4	●	●	Alarms to be tested for detection of BSC and/or exhaust fan failure by simulation of alarm conditions.
5	●	●	Integrity of HEPA filters installed into supply as method of backdraft protection and exhaust ductwork to be tested <i>in situ</i> by particle challenge testing using scanning method.  Acceptance criteria: particle penetration not to exceed 0.01%.
6	●	●	Integrity of HEPA filter housings with inlet and outlet bubble tight dampers installed into supply ductwork, where HEPA filters are used as backdraft protection, and exhaust ductwork to be tested in situ by pressure decay test.  Acceptance criteria: rate of air leakage not to exceed 0.1% of housing vol/min at 1000 Pa (4 in. w.g.) minimum test pressure.
7	●	●	Supply ductwork, where backdraft protection is required on supply, and exhaust air ductwork located between containment perimeter and HEPA filter or bubble tight backdraft damper to be tested <i>in situ</i> by pressure decay.  Acceptance criteria: rate of air leakage not to exceed 0.1% duct vol/min at 1000 Pa (4 in. w.g.) minimum test pressure.
8	●	●	Supply and exhaust air ductwork between containment perimeter and HEPA filter or bubble tight backdraft damper to be tested <i>in situ</i> by pressure decay method Acceptance criteria: rate of air leakage not to exceed 0.1% duct vol/min at 1000 Pa (4 in. w.g.) minimum test pressure.
10	●	●	Pressurization relationships across adjacent areas to be verified (i.e., clean change to dirty change, dirty change to laboratory).  Acceptance criteria: inward directional airflow (under normal operations) to be visually

			demonstrated (e.g., by holding a smoke pencil at each door leading to adjacent areas).
11	●	●	Control systems to be tested for fail-safe operation by failure of system components, (i.e., exhaust fan failure, supply fan failure, power failure [where possible], BSC Class II or cabinet line exhaust failure). This is to include audible/visual alarm testing. Acceptance criteria: inward directional airflow. The sustained reversal of airflow across containment barrier is to be prevented.

### 13.2. Air balance – Secondary containment (i.e. Individual MSC Class 11, Individual BSL4 suits, animal isolators, down-draught post mortem tables)

Item	Suited	Line	Table 3. Heating, Ventilation and Air Conditioning (HVAC)
1	●	●	100% outside air to be supplied?
2	●	●	Directional inward airflow provided such that air will always flow towards areas of higher containment (e.g. 150 Pascal's????? differential).
3	●	●	Visual pressure differential monitoring devices to be provided at entry to containment laboratory.
4	●	?	Room pressure differential monitoring lines penetrating the containment barrier to be provided with filters of efficiency equal to that of HEPA filtration.
5	●	●	Alarm (visual or audible) to be provided in the laboratory and outside laboratory area (i.e., to warn others and maintenance personnel) to signal air handling systems failure.
6	●	●	Where determined necessary by a local risk assessment, supply air duct to be provided with backdraft protection (i.e., HEPA filter; bubble tight backdraft damper).
7	●	●	Supply air to be HEPA filtered.
8	●	●	Supply air system to be independent of other laboratory areas.
9	●	●	Supply air system to be interlocked (i.e., fans, dampers, electrical) with exhaust air system, to prevent sustained laboratory positive pressurization.
10	●	●	Exhaust air to be HEPA filtered.
11	●	●	Exhaust air to be passed through two stages of HEPA filtration.
12	●	●	HEPA filters installed into the supply and exhaust system to conform to national standards
13	●	●	<i>Supply HEPA filter housings to be designed to withstand structural change at applied pressure of 2500 Pa [10 in. w.g.]. North American Requirement</i>
14	●	●	<i>Where HEPA filters are used for backdraft protection in accordance with local risk assessment, supply HEPA filter housings to be designed to withstand structural change at applied pressure of 2500 Pa [10 in. w.g.]. North American Requirement</i>
15	●	●	Exhaust HEPA filter housings to be designed to withstand structural change at applied pressure of 2500 Pa [10 in. w.g.] and to be provided with a method of isolation and decontamination.
16	●	●	Exhaust air system to be independent of other laboratory areas.
17	●	●	Supply and exhaust systems located outside of containment to be accessible for repairs, maintenance, cleaning and inspection.
18	●	●	Supply air ductwork that is outside the containment perimeter (e.g., between containment perimeter and HEPA filter or bubble tight backdraft damper) to be sealed airtight
19	●	●	Where backdraft protection is required in accordance with local risk assessment, supply air ductwork that is outside the containment perimeter (e.g., between containment perimeter and HEPA filter or bubble tight backdraft damper) to be sealed airtight
20	●	●	Exhaust air ductwork that is outside the containment perimeter (e.g., between containment perimeter and HEPA filter or bubble tight backdraft damper) to be sealed airtight
21	●	●	Airflow control devices and duct sensors to be located downstream of the exhaust HEPA filter

			and upstream of the supply bubble tight backdraft damper or HEPA filter, or if located upstream, duct penetrations to be sealed.
22	●	●	Bubble tight backdraft dampers and HEPA filters to be located in close proximity to the containment perimeter.

### 13.3. Building management and emergency alarm systems

### 13.4. Integrity of BSL4 facility (i.e. Air tightness, water tight)

Item	Suited	Line	Table 4: Room Integrity – Guidance Notes
1	●	●	Integrity of containment surfaces to be tested visually and with a smoke pencil or other visual aid. Inspect floors, walls, and ceiling for cracks, chips and wear. Verify integrity of wall/floor and wall/ceiling joints.  Acceptance criteria: to confirm the integrity of all penetrations (i.e., equipment, services, etc.) and seals (i.e., around doors, windows, autoclaves, etc.) on the containment barrier.
2	●	●	Integrity of containment to be tested by pressure decay testing.  Acceptance criteria: two consecutive tests with a minimum of 250 Pa (1 in. w.g.) loss of pressure from an initial 500 Pa (2 in. w.g.) over a 20 minute period <small>North American Standard</small> .

- 13.5. Integrity of MSC cabinet (i.e. individual, cabinet line of flexible animal husbandry isolators, post mortem tables)
- 13.6. Integrity of PPE (i.e. Personal suits, Respirators) – Effectiveness monitoring and planned preventative maintenance programme,
- 13.7. Room and MSC cabinet HEPA filter performance and planned preventative maintenance programme (i.e. Supply and Exit)
- 13.8. Waste treatment operation, monitoring and planned preventative maintenance programme
- 13.9. High containment autoclave operation, monitoring and planned preventative maintenance programme.

Item	Suited	Line	Table 5: Containment Perimeter Requirements
2	●	●	Double-door barrier autoclave with bioseal to be located on containment barrier; body of autoclave to be preferably located outside of containment for ease of maintenance
4	●	●	Barrier autoclave to be equipped with interlocking doors, and visual or audible alarms to prevent both doors from opening at the same time.
5	●	●	Integrated high security autoclave with bioseal to be located on containment barrier and integrated with cabinet line; body of autoclave to be preferably located outside of containment for ease of maintenance
6	●	●	For materials that cannot be autoclaved (e.g., heat sensitive equipment, samples, film) other proven technologies for waste treatment (e.g., incineration, chemical, or gas) to be provided at containment barrier.
7	●	●	All penetrations to be sealed with nonshrinking sealant at containment barrier.
8	●	●	All conduit and wiring penetrating cabinet line to be sealed with nonshrinking sealant at the containment barrier.
9	●	●	Windows positioned on containment barrier to be sealed in place; window glazing material to provide required level of security.

13.10. Incinerator and plant function, operation and planned preventative maintenance programme

13.11. Effluent treatment plant functional operation criteria and planned preventive maintenance programme.

13.12. Personnel chemical shower plant operation and planned preventative maintenance programme

Item	Suited	Line	Table 6: Laboratory service (i.e. water, drains, gas, electricity and safety equipment
2	●	●	Hand washing sinks to be located near the point of exit from the laboratory or in anteroom. Not applicable to CL4 suit laboratories.
3		●	Hand washing sinks to be provided with "hands-free" capability.
4	●	●	BSCs and other primary containment devices to be provided.
9	●	●	Domestic water branch piping serving laboratory area(s) to be provided with backflow prevention, and isolation valve, to be located in close proximity to the containment barrier.
11	●	●	Drain lines and associated piping (including autoclave condensate) to be separated from areas of lower containment and to be connected to an effluent sterilization system.
12	●	●	Drains connected to effluent sterilization to be sloped towards sterilization system to ensure gravity flow; consideration should be given to the installation of valves to isolate sections of piping for <i>in situ</i> decontamination; the effluent sterilization system (e.g., piping, valves, tank) to be heat and chemical resistant consistent with application.
13	●	●	Autoclave condensate drain to have a closed connection.
14	●	●	Drainage traps to be provided to required deep seal depth in consideration of air pressure differentials.
15	●	●	Floor drains not to be provided, except when essential (e.g., body shower).
16	●		Plumbing vent lines (including effluent sterilization system) to be provided with filter of efficiency equivalent to that of HEPA and provided with a means of isolation and decontamination.
18	●	●	Compressed gas cylinder(s) to be located outside the laboratory.
19	●	●	Laboratory supply gas piping (e.g., carbon dioxide, compressed air) to be provided with backflow prevention.
21	●		Compressed breathing air to be provided to positive-pressure personal protective equipment (i.e., for connection to the air hose of suits), equipped with breathing air compressors and back-up cylinders (sufficient for 30 minutes per person); air hose connections to be provided in all areas where suits are worn, including chemical shower and suit change room.
		●	Emergency PPE required
22	●	●	Emergency lighting to be provided.
23	●	●	Life safety systems, lighting, HVAC systems, BSCs, security systems and other essential equipment to be supported with emergency back-up power.
24	●	●	Circuit breakers to be located outside biocontainment area.
26	●	●	Laboratory to be equipped with a communication system between containment area and outside support area.
27	●	●	System (e.g., fax, computer) to be provided for electronic transfer of information and data from laboratory area to outside laboratory perimeter. (Note: paperwork from the containment laboratory may be removed after appropriate decontamination, i.e., autoclaving, irradiation, microwaving; such practices are generally not recommended for use on a routine basis).
28	●	●	Work area to be monitored (e.g., closed circuit TV) from outside laboratory

## 14. Equipment, information systems and materials

### 14.1 Requirement for planned preventative maintenance, calibration and certification records

Item	Suited	Line	Laboratory Equipment and Services Requirements
1	●	●	Operation of water supply backflow preventers to be verified
2	●	●	Backflow prevention for other services (e.g., gases) to be verified to ensure that system will operate as specified.
3	●		Compressed breathing air and systems to be verified. Systems to be verified for switchover to backup system and to test the response of the alarm.
4	●		Operation of positive-pressure personal protective equipment (i.e., suit) to be tested to ensure that the suit will operate as specified.
5	●		Water and chemical shower systems to be tested to ensure that systems will operate as specified and to test the response of the (CL4) disinfectant tank low level alarm.
6		●	Water shower systems to be tested to ensure that systems will operate as specified and to test the response of the (CL4) effluent tank low level alarm.
6	●	●	Standby power and UPS systems to be tested under appropriate load conditions to ensure that the systems will operate as specified.
7	●	●	Operation of interlocking doors to be verified to ensure that doors cannot be opened at the same time.
8	●	●	Operation of security systems (e.g., controlled access, closed circuit TV) to be verified to ensure that the system will operate as specified.
9	●	●	Operation of communication and electronic paper transfer systems (e.g., intercom, telephone, fax) to be verified to ensure that the system will operate as specified.
10	●	●	Operation of decontamination systems (e.g., autoclaves, fumigation chambers, liquid effluent) to be verified for operation as specified and microbiologically tested using representative loads; resistance of test organism to be representative of organisms likely to be encountered.
11	●	●	For containment level 4 laboratories, drains and associated piping leading to liquid effluent treatment systems (including associated vent lines) to be tested in accordance with European Standards

## 15. Staff Competency & Registration

15.1 **Background.** The staff is the single most important asset in any laboratory and their competency profiles are coming under increasing scrutiny by biosafety and biosecurity professionals plus national authorities. It is therefore imperative that a transparent and well designed training and development system is identified, implemented and monitored.

15.2 **Audit aim:** To identify the essential staff selection, induction, and continuous professional and development training programmes that develops and review staff competencies. Monitoring of established evaluated selection, training and assessment of staff in accordance with the principles of biosafety and biosecurity requirements associated

with BSL4 addresses public concern surrounding the qualifications of those persons working in BSL4 facilities.

### **15.3 Selection criteria**

15.3.1 Laboratory management shall ensure that there are appropriate numbers of staff, with the required education and training, to meet the demands of the P4 containment facilities according to the appropriate European and national legislation and regulations.

15.3.2 Registration of staff shall be in accordance with current European, national legislation and regulations.

15.3.3 Selection criteria applied to scientific, technical, and engineering and management staff selected for working in or supporting BSL4.

15.3.4 Qualifications (Relevant scientific, technical engineering, and biosafety as basic entry point) plus appropriate laboratory or engineering based experience with high hazard group 3 pathogens at high containment. Work with animals requires additional high level experience as it is an additional biosafety hazard.

15.3.5 High containment experience & training at BSL3.

15.3.6 Security clearance criteria and registration authority

15.3.7 Biosafety experience & competency that satisfy set criteria.

15.3.8 Assessment and monitoring of scientific and technical competency.

15.3.9 Experience of handling high consequence BSL3 pathogens.

15.3.10 Experience of supporting and maintaining high containment facilities and equipment.

### **15.4 Induction and Training schemes/systems**

15.4.1 **Background.** A comprehensive orientation and induction programme is an important element in the introduction of new members of staff. This needs to be followed by having access to continuing education and training is important for all grades of laboratory and support staff and participation in Continuing Professional Development schemes is a method of achieving this for relevant staff groups.

15.4.2 All medical, scientific, technical, engineering and maintenance staff should produce evidence of participation in a

comprehensive staff induction programme that includes the following areas:

- The BSL4 laboratory and engineering support services.
- Terms and conditions of employment, patient confidentiality and data protection
- Health and safety
- Principles of P4 laboratory biosafety and biosecurity
- Induction into the use and maintenance of appropriate PPE
- Occupational health and engineering services interactions.
- Emergency alarms, actions and responses.
- Hazards and personnel protection
- Job description including an organisational chart
- Participation into responses to accident scenarios and emergency extraction procedures.
- Internal laboratory audit and response processes.
- Hazard storage and transportation.
- Physical and chemical disinfection processes.
- Waste management and treatment
- Animal containment husbandry and manipulation. (if appropriate)

15.4.3 There shall be evidence of a continual and progressive training and education programme for all members of staff governed by the following criteria:

- Training and education shall be in accordance with the policies of the parent organisation and guidelines from the relevant professional and registration bodies.
- All staff shall be given the opportunity for further education and training in relation to the needs of the service and their professional development under the terms of 'duty of care'.

## **15.5 Continuous professional development schemes**

15.5.1 Evidence of competency to perform assigned tasks shall be assessed following training and periodically thereafter.

Retraining and reassessment shall occur when necessary. Records of competency assessments shall be produced as evidence and continual professional development.

15.5.2 There shall be the resources for training and education that includes:

- access to reference material and information services
- staff attendance at meetings and conferences
- on-site approved generic and specific training and update training or continuous professional development programme.

15.5.3 Records shall be kept of all training and education together with monitoring and authorisation process

## **15.6 Training evaluation**

15.6.1 Evaluate the information that helps to determine if instruction has had the intended effect.

15.6.2 Evidence of training evaluations generally take the following four forms;

- measurement of trainees reaction the instruction provided
- measuring the trainees recollection and/or performance
- assessing behavioural change on the job
- measuring tangible results in terms of the organisation objectives or goals.

## **16 Legislative, regulatory and guidance framework**

### **16.1 Biosafety and training**

1. EU Directive 2000/54/EC of the European Parliament and of the Council of 18 September 2000 on the protection of workers from risks related to exposure to biological agents at work.
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3. CEN Laboratory Biorisk Standards <ftp://ftp.cenorm.be/PUBLIC/CWAs/wokrshop31/CWA15793.pdf>
4. World Health Organisation, Biorisk Management – Laboratory Biosecurity guidance, WHO/CDS/EPR/2006.6, September, 2006.
5. World Health Organisation, Laboratory Biosafety Guidelines, 3<sup>rd</sup> Edition 2004.
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9. LeDuc JW, Anderson K, Bloom ME, Estep JE, Feldmann H, Geisbert JB, et al. Framework for leadership and training of biosafety level 4 laboratory workers. *Emerg Infect Dis.* 2008;14:1685–8. [PubMed DOI](#)
10. USGAO, High-containment biosafety laboratories: Preliminary Observations on the Oversight of the Proliferation of BSL-3 and BSL-4 Laboratories in the United States, October 2007,
11. WHO. Guidelines for the safe transport of infectious substance and diagnostic specimens. Geneva: Division of Emerging and Other Communicable Diseases Surveillance and Control, WHO/EMC/97.3, 1997.
12. EN ISO 9001:2000, Quality management systems- Requirements (ISO 9001:200)
13. EN ISO 14001:2004, Environmental management systems\_Requirements with guidance for use (ISO 14001:2004)
14. OHSAS 80001:2007, Occupational health and safety management systems – Requirements
15. EN ISO 9000:2005, Quality management systems – Fundamentals and vocabulary (ISO 9000:2005)
16. EN ISO 19011, Guidelines for quality and/or environmental management systems auditing (ISO 19011:2002)
17. ISO/IEC 17025:2005, General requirements for the competence of testing and calibration laboratories.
18. EN 12128:1998, Biotechnology – Laboratories for research, development and analysis – Containment levels of microbiology laboratories, areas of risk. Localities and physical safety requirements.
19. ISO 15190:2003, Medical laboratories – Requirements for safety
20. BS EN 1822-1: 1998 High efficiency air filters (HEPA and ULPA). Classification, performance testing. Making British Standards Institution ISBN 0 580 29837.
21. EU Directive 98/81/EC of 26 October 1998 amending Directive 90/219/EEC on the contained use of genetically modified micro-organisms.

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22. World Health Organisation Biorisk Management – Laboratory Biorisk Guidance 2006 [http://www.who.int/csr/resources/publications/biosafety/WHO\\_CDS\\_EPR\\_2006\\_6.pdf](http://www.who.int/csr/resources/publications/biosafety/WHO_CDS_EPR_2006_6.pdf)
23. Centres for Disease Control and Prevention .US Department of Health and Human Services. Select Agent Program, final rules. Atlanta, Centres for Disease Control and Prevention, 2005 ([http://www.cdc.gov/od/sap/final\\_rule.htm](http://www.cdc.gov/od/sap/final_rule.htm)).
24. FAO. *Biosecurity in food and agriculture*. Committee on Agriculture. Seventeenth session, Rome, 31 March-4 April 2003. Rome, FAO, 2003(COAG/2003/9, <http://www.fao.org/DOCREP/MEETING/006/Y8453E.HTM>).

25. FAO/WHO. Biosecurity risk analysis: an overview and framework manual. Chapter 4. Rome/Geneva, 2005, FAO/WHO (draft, May 2005).
26. Institute of Medicine and National Research Council. *Globalisation, biosecurity, and the future of the life sciences*. Washington DC, The National Academies Press, 2006
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