VETBIONET

Veterinary Biocontained facility Network for excellence in animal infectiology research and experimentation

Deliverable D3.6

Process guidelines for designing and upgrading BSL3/3+facilities for farmed animal species including design and assessment

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Table of contents:

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1. Summary

Objectives: Work package 3 (WP3, “Best practices for biosafety, biosecurity and quality management in high containment farmed animal facilities”) centres on the elements and principles of the CWA 15793 workshop agreement drafted by the CEN (European Committee for Standardization) in September 2011 (CWA 15793:2011). The CWA 15793:2011 relates to “Laboratory biorisk management”, and WP3 aims to inspect and highlight the specific requirements for the management of high containment farmed animal facilities (HCFAFs). The objective of D3.6 is to provide process guidelines for designing and upgrading HCFAFs to ensure that they can meet the CWA 15793:2011 standard.

The “Process guidelines for designing and upgrading BSL3/3+ facilities for farmed animal species” (Technical Report, ANNEX 2) were produced by circulating a draft document among the WP3 participants; next a workshop was organised to discuss and revise the draft with project partners and concerned members of the GOHLD (Group of High containment Laboratory Directors). The present Deliverable/D3.4 report comprises the finalised Technical Report and delineates the operational procedure to achieve the Deliverable. The Technical Report will be accessible on the VetBioNet website (https://www.vetbionet.eu/best-practice-guidelines/) and in the VetBioNet area on the International Veterinary Biosafety Work group (IVBW) website (http://ivbw.camp9.org/page-1434634).

2. Introduction

The CWA 15793:2011 provides a management guidance approach for addressing laboratory biorisk management and was translated into an ISO standard in 2019 (ISO 35001:2019, “Biorisk management for laboratories and other related organisations”). While this ISO standard stipulates best practices in laboratory biorisk management, it is of limited suitability for the situation in HCFAFs. WP3 “Best practices for biosafety, biosecurity and quality management in high containment farmed animal facilities” is therefore dedicated to pinpoint the challenges for HCFAFs to meet the CWA 15793:2011/ISO 35001 standards and to provide best practice guidance documents

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that are adapted to the specific HCFAFs requirements. The objective of D3.6 is to provide “Process guidelines for designing and upgrading BSL3/3+ facilities for farmed animal species” (Technical report, ANNEX 2).

HCFAFs are extremely complex and expensive to construct with costs running into tens of millions of euros, if not hundreds of millions, depending on the size of the facility/units. They need to be designed to have a working life span of several decades. During this period, it is expected that there will be a requirement to refurbish and upgrade the facility (or individual units) to overcome the wear and tear of use. Technical equipment may not only wear out but also become obsolete and not maintainable for ensuring biosafety and animal welfare.

In the design and construction of complex buildings such as HCFAFs, the main focus is on how the facility will meet the operational requirements, which includes meeting all legal/regulatory standards (e.g. biosafety, animal welfare and quality). To prove that this is the case, the building should undergo a commissioning process (Cx) against these specified operational needs at the beginning of its construction. Cx is now considered an all-inclusive systematic quality assurance process of ensuring that building systems are designed, installed, tested, and capable of being operated and maintained to perform interactively according to the design intent and the specified operational needs. For new constructions the process ideally begins at a project’s inception (i.e., the beginning of the design process) and continues through construction, start-up, inspection, testing, balancing, acceptance, training, and an agreed warranty period (i.e., occupancy and operations). Cx therefore encompasses all the necessary planning, delivery, verification, and managing risks to critical functions performed in, or by, facilities. Cx also accomplishes higher biosafety and animal welfare by making sure that the building components are working correctly and that the operators’ specifications (user requirements) have been implemented. It confirms that the building and its systems are effective, that there is documentation to show this and that the operators (including facility maintenance personnel) are appropriately trained to run and maintain it.

HCFAFs differ at a basic level to routine laboratories as in HCFAFs, the room is the primary containment of the infection/contagion whereas in the routine laboratory, the microbiological safety cabinets and other mechanical equipment have this function. This means there are substantial differences in the design, management and working

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practices to allow safe working. Staff working in HCFAFs have to rely on personal protective equipment to prevent infection when working with zoonotic agents, the maintenance of barrier procedures to stop spread of infection out of the unit and also have a need for physical protection from the animals. In addition, there is a larger amount of potentially infectious material produced (liquid effluents, used bedding and air volumes). As animals used in HCFAFs are experimental animals, it is also necessary to consider animal welfare under the European Directive 2010/63/EU, which has been translated into national legislation in the member states. All these factors substantially affect the design of a facility if it is to perform effectively.

A Technical Report was drafted by the WP3 participants listed in ANNEX 1 and presented for discussion at the VetBioNet Annual Meeting in 2020. The finalised document ("Process guidelines for designing and upgrading BSL3/3+ facilities for farmed animal species") integrating partner feedback is appended to this Deliverable/D3.6 report (ANNEX 2) and will be posted on the VetBioNet website (https://www.vetbionet.eu/best-practice-guidelines/) and on the VetBioNet area of the IVBW workspace (http://ivbw.camp9.org/page-1434634).

3. Results

The WP3 working group considered that designing and upgrading HCFAFs should follow the design safety qualification process illustrated in Figure 1, with each delivery stage of the construction undergoing the appropriate testing or qualification regime against its specification.

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Figure 1 Design Safety Qualification

As part of the detailed design process, it necessary to undertake a Quantifiable Risk Assessment (QRA) which is a formal and systematic risk analysis approach to quantify the risks associated with the operation of the engineering processes. A QRA is an essential tool to support the understanding of exposure of a risk to employees, the environment, owner/operator assets and its reputation. A QRA also helps to make cost effective decisions and manages the risks for the entire asset lifecycle.

The overall objective of the QRA is:

1) To identify the hazards associated with a facility
2) To determine the potential frequencies and consequences of the identified hazards
3) To determine the system availability of the protection systems
4) To quantify the risks associated with a facility.

This is done in a structured way, using the following techniques detailed in the technical report:

- A HAZOP (Hazard and Operability) study to identify a series of hazardous scenarios that could lead to significant adverse consequences

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- A determination of safety integrity study, typically done using the Layers of Protection Analysis (LOPA) method
- A Fault Tree Analysis (FTA) to determine the event frequencies associated with the hazardous scenarios from the HAZOP and LOPA studies
- A consequence analysis to determine the consequences of the hazardous release from a facility (including infectious, flammable, explosion and toxic).
- An impact analysis to determine the frequency of a specific hazardous impact using Event Tree Analysis (ETA). ETAs are “bottom up” analytical tree diagrams that determine the overall likelihood of a particular impact following a hazardous release
- Risk Reduction Measures to identify the options to reduce or mitigate the risks

An example of the process is given in Figure 2:

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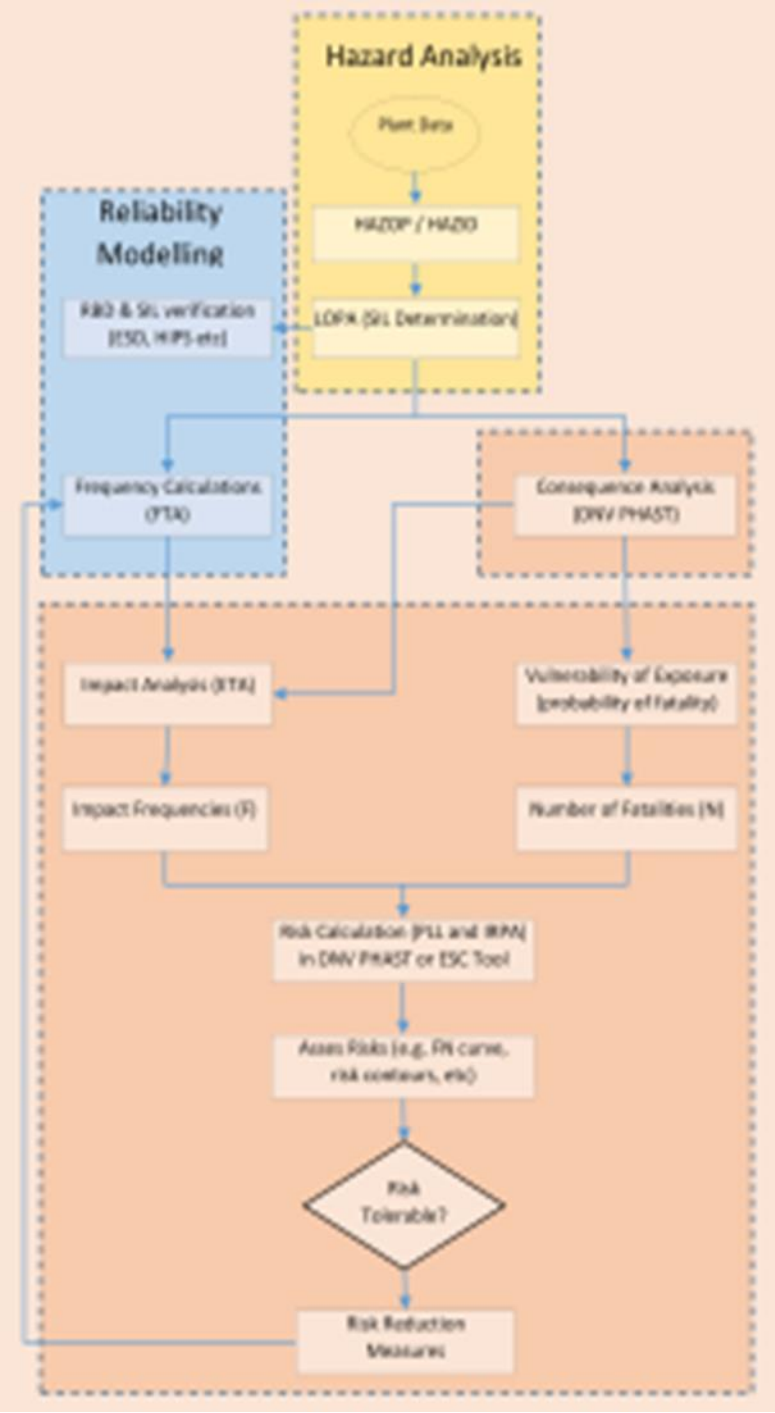

Figure 2 Quantitative Risk Assessment Process

The key element when using any QRA is the decision on what level of risk is considered tolerable or acceptable.

When designing and specifying HCFAFs, it is important to have a mechanism in place to obtain clear agreement on the level of risk acceptance. Otherwise, hypothetical biosafety risks will be considered in cases where the organism present is biologically insufficient to give an infectious dose (if present at all), leading to complex solutions

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and excessive engineering with the associated reduction in Reliability, Availability and Maintainability (Appendix 4).

This does put pressure on the user and scientist to provide suitable data at the risk assessment stage. It may require experimental work and mathematical modelling to provide suitable data.

The working group also identified the specific challenges of upgrading an existing facility. HCFAFs are typically designed for a 40 to 50 years lifespan. During this period, it is likely that there will be changes in use (different diseases, types of research etc.) and changes in standards due to technical/knowledge advances. During this lifetime, it will be necessary to replace the majority of the electro-mechanical components due to wear and tear, obsolescence/unavailability of components. Strategies for this are given in VetBioNet's "Best practice for facility management, including emergency response and planning" (D3.10).

Upgrades present a particular challenge in that they have to work with elements of the existing structure and, depending on the extent of the upgrade work, with existing subsystems.

Once the user brief has been drawn up, the state of the existing HCFAF should be surveyed and the performance measured, and the results of this exercise compared to the specifications. The key questions are what upgrades are necessary to deliver the user brief and whether this is feasible/financially viable. Upgrading an existing building is usually subject to physical constraints that must be considered. It is also important to get a complete picture of the state of the building. Upgrading systems over the years means a large amount of downtime, so unless the HCFAF was originally designed to allow areas of independent running, there will be a large amount of down time with the associated loss of science and income.

In addition,

- as HCFAFs are complex buildings with a long life span, it was stated that not only facility operation and maintenance documents should be kept, but also all documents related to its design and commissioning should be archived.
- any changes to the design or operation should be appropriately controlled (risk assessed, approved, recommissioned if necessary and recorded). This should be

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controlled by the HCFAF owner/operator, as staff running and maintaining the facility change over time and if the facilities management is sub-contracted, subcontractors can change. A building passport showing the history of the building is often a good idea.

It is important that records are archived for the life of the building, especially in the case of mid-life refurbishments or upgrades, as information will be needed about the original design and how it was executed.

Conclusions

A Technical Report has been produced by the WP3 working group providing good practice and process guidelines for the design and upgrade of BSL3/3+ facilities for farmed animal species, including their design and assessment. The finalised document ("Process guidelines for designing and upgrading BSL3/3+ facilities for farmed animal species") integrating partner feedback is appended to this Deliverable/D3.6 report (ANNEX 2) and will be posted on the VetBioNet website (https://www.vetbionet.eu/best-practice-guidelines/) and on the VetBioNet area of the IVBW workspace (http://ivbw.camp9.org/page-1434634).

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ANNEX 2 Technical Report "Process guidelines for designing and upgrading BSL3/3+ facilities for farmed animal species"

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