## A1. Containment Integrity

This addendum provides guidance and clarification for clause 2.6 of NVF/DG001 Issue 1.

### 2.6 CONTAINMENT

This section introduces the principle of 'containment' provided by multiple physical barriers. The inner-most barrier contains the nuclear material and is usually constructed to the highest level of structural integrity – this refers to both strength and leak tightness. Successive outer barriers may be constructed to lesser standards of integrity, depending on the potential for nuclear material to escape (and the subsequent hazard) during normal and fault conditions. Figure 1 illustrates this principle.

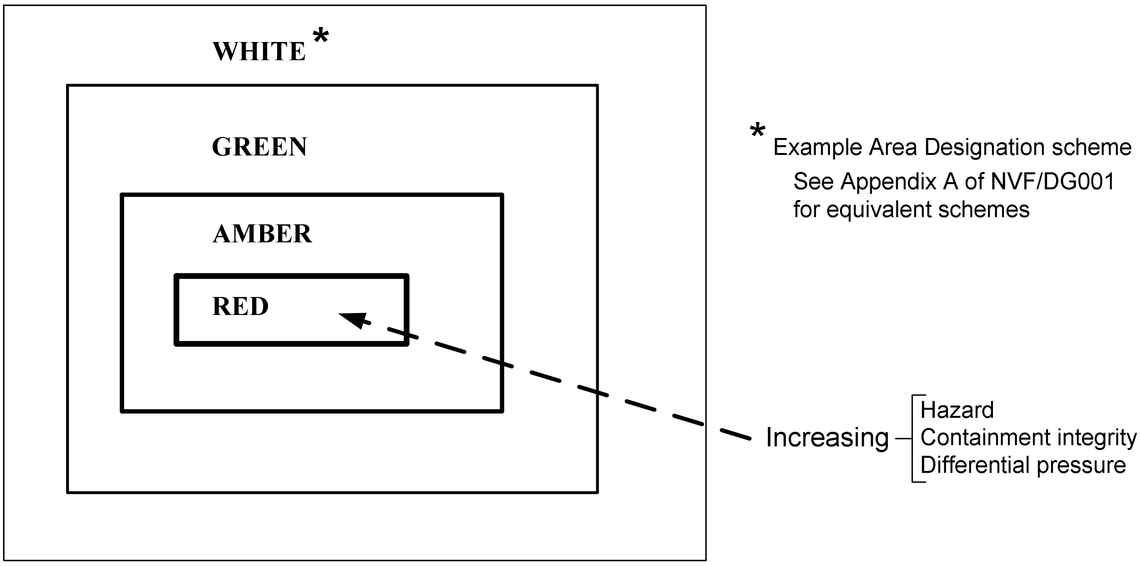


**Figure 1. Multiple barrier containment principle**

**Clause 2.6.2** confirms that whilst a sealed containment is the most effective way to prevent the escape of particulate and gaseous substances, openings are necessary for the transfer of people, materials and equipment. Most containments will also have adventitious leak paths such as construction gaps, joints, seals, and cracks. Ventilation is used to provide "a depression across each containment barrier ... to create inward flows of air to minimise leakage". [For clarification, this should read "a differential pressure across each containment barrier should be maintained to create airflow directions from clean to less clean areas to minimise back flow of contamination".]

The containment performance of each barrier must be appropriate for the enclosed hazard. The actual differential pressure required (and achievable) depends on the leak tightness of barrier. A poorly constructed containment may require a high extract flow to achieve a suitable depression and inward flow, whereas a good containment will have minimal leakage and easily sustain a depression. There should be a preference for good physical containment (high structural integrity) with minimal extract flow, instead of excessive ventilation to compensate for poor construction. The depression and associated leakage of a given type of containment will vary from plant to plant and may vary from initial construction to decommissioning – this may affect the optimal configuration for older plant.

**Clause 2.6.3** confirms that the degree of containment, including the number of barriers required, must be determined by risk assessment. This is required before considering the ventilation requirements, and where possible involves the ventilation engineer, to help achieve an optimal solution. For clarification, the last sentence uses the term 'potential dispensability' - this should read 'potential dispersal' (the ease by which the contaminant can spread from its source).

**Clause 2.6.6** explains that additional barriers may be required at openings (see addenda A2). The aim here is to provide good containment at potential leakage areas, particularly when access is required into a total enclosure. Ideally, the containment performance at the entry point should be comparable to the overall barrier performance [hence the additional barriers]. Whilst the clause states entry provisions are for maintenance and replacement of equipment, this will particularly apply for decommissioning where barriers are breached or removed.

**Clause 2.6.7** confirms the need for engineers to seek an understanding of the functional and operational requirements of the areas to be ventilated, and the potential effects of the resulting airflow patterns. The engineer should consider and understand the following, as a minimum, when designing ventilation systems to support containment:

1. Hazard being contained
2. Manual or remote handling requirements
3. Equipment and personnel access/egress requirements
4. Permanent or temporary nature of the containment
5. Affects of adjacent areas and the external environment
6. Positive or negative pressure requirements
7. Temperature and Humidity
8. Multiple barrier provisions
9. Open doorway protection or airlock philosophy
10. Transient conditions and behaviour
11. Shielding requirements
12. Containment integrity and present/future leakage allowance
13. Interfaces with existing systems
14. Monitoring requirements
15. Discharge requirements

ALARP principals should be applied to firstly eliminate/reduce/fix contamination sources to reduce the potential load on the ventilation systems. Engineers should also ensure that the varying requirements for ventilation throughout the life of the facility are considered. Guidance on containment types, integrity and leakage can be found in sections 4 and 6 of NVF/DG001.

**Further Guidance**

1. NVF/DG001- An Aid to the Design of Ventilation of Radioactive Areas
    a. 3.4 Containment and Area Classification
    b. 4.2 Glove Boxes
    c. 4.3 Caves and Cells
    d. 4.4 Fume Cupboards
    e. 4.6 Process Vessels
    f. 6.0 Building External Containment

2. Safety Assessment Principles for Nuclear facilities (SAPs), HSE.

3. NF 0165/1 (AECP 59) – Code of practice for shielded and unshielded glove boxes for hands on operation.

4. BNF.EG.0083_3 Velocities and Containment, Sellafield Sites Ltd.
   A guidance note providing background information and philosophies in relation to air velocities for containment, cascade flow and pressure gradients and containment issues around penetrations in barriers.

5. ISO 17873 Nuclear facilities – criteria for the design and operation of ventilation systems for nuclear installations other than nuclear reactors.

6. ISO 10648 Containment Enclosures
   Part 1 – Design Principals
   Part 2 – Classification according to leak tightness and associated checking methods.

7. BNF.EG.0083_2 Fundamentals of Ventilation Design, Sellafield Sites Ltd
   A guidance note for the design of ventilation systems for buildings containing nuclear material - intended for those new to the discipline, provides a background to containment philosophies.