

LIMITATION OF FIRE RISK IN SUBSTATIONS

This document is for internal and contract specific use only.

Disclaimer

NGG and NGET or their agents, servants or contractors do not accept any liability for any losses arising under or in connection with this information. This limit on liability applies to all and any claims in contract, tort (including negligence), misrepresentation (excluding fraudulent misrepresentation), breach of statutory duty or otherwise. This limit on liability does not exclude or restrict liability where prohibited by the law nor does it supersede the express terms of any related agreements."

TABLE OF CONTENTS

PURPOSE AND SCOPE.....	1
PART 1 – PROCEDURAL	1
1 REQUIRED MEASURES FOR PROTECTION OF EQUIPMENT FROM FIRE DAMAGE	1
2 REQUIREMENTS FOR FIRE PROTECTION FACILITIES.....	4
3 OTHER REQUIREMENTS FOR FIRE PREVENTION IN SUBSTATIONS	18
4 FORMS AND RECORDS	21
PART 2 - DEFINITIONS AND DOCUMENT HISTORY	21
5 DEFINITIONS	21
6 AMENDMENTS RECORD	22
7 IMPLEMENTATION.....	22
PART 3 - GUIDANCE NOTES AND APPENDICES	23
8 REFERENCES	23
APPENDIX A - DATA FOR CALCULATING FIRE SEPARATION DISTANCES.....	25

PURPOSE AND SCOPE

This specification details measures for the limitation of fire risk in National Grid substations. It is applicable in full to all new National Grid construction works and may, as defined in the Scheme Specification, be selectively applied or modified for use in relation to retrospective works in existing installations.

PART 1 – PROCEDURAL

1 REQUIRED MEASURES FOR PROTECTION OF EQUIPMENT FROM FIRE DAMAGE

General Requirements

- 1.1** The following equipment shall be considered a Fire Hazard and shall be installed with appropriate fire protection measures to minimise consequential damage to designated Elements at Risk:
- Oil-filled Transformers
 - Oil-filled Reactors
 - Diesel Generators
 - Oil Storage Tanks (Including Fuel Oil)
 - Oil Circuit Breakers
 - Oil Handling Plant
 - Oil-filled Cables and Cable Sealing Ends
- 1.2** Unless otherwise specified by National Grid, the following items shall be designated as elements at risk requiring protection from the consequential effects of a fire developing in any of the fire hazards defined in Clause 1.1:

All third party land, property or infrastructure developments unless defined otherwise in the Scheme Specification or agreed with National Grid

Other Fire Hazards as defined in Clause 1.1

Any equipment, structure or building which, if destroyed or seriously damaged, would cause or force consequential outages of other transmission circuits.

Any control, protection, data acquisition or communications equipment essential to the safe operation of the substation or transmission system

Any other equipment or structures as defined in the Scheme Specification.

Substation buildings which are occupied

1.3 The choice of installation method for fire protection shall as far as reasonably practicable be made following the preferential hierarchy as below;

- a) Physical separation in accordance with this specification between the Fire Hazard and the Element At Risk
- b) Installation of Fire Barriers in accordance with this specification between the Fire Hazard and Element At Risk
- c) By agreement with National Grid, the protection of the FIRE HAZARD by an Active Automatic Fire Protection System

1.4 The hazards of smoke shall only be considered where advised by National Grid Company in the Scheme Specification. In this case an Active Automatic Fire Protection System will be used to mitigate the risk.

1.5 In the case of an asset replacement any existing fire protection systems shall be reassessed to determine compliance with the requirements of Clause 1.3.

Specific Requirements for Protection in Substations

1.6 The Oil Retaining Areas of transformers and reactors shall be connected to an underground Oil Containment Facility compliant with NGTS 2.20, except that where permitted by the Scheme Specification, for transformers and reactors containing less than 50000 litres of oil, the base of the Oil Retaining Area shall be covered in sufficient stone (size 40-60mm) to act as a Passive Extinguishing Medium (minimum depth 150mm)

1.7 Fire detection equipment shall be installed in all basements and indoor switchhouses. Alarm indications shall be provided via National Grid's data acquisition equipment at both the local and remote substation control points.

1.8 Equipment defined as a Fire Hazard in Clause 1.1 shall not be installed in buildings with other equipment unless contained within a compartment of 4 hours Fire Resistance or protected by an Active Automatic Fire Protection System.

Specific Requirements for Protection of Oil Filled Power Cables in Substations

1.9 No protection is required for power cables installed in troughs back-filled with sand or weak-mix concrete.

1.10 Unless agreed otherwise with National Grid, cables within Integral Cable Ways and basements shall be protected by incorporating a flame retardant over-sheath or in tumescent coating. In addition, protection of adjacent circuits shall be achieved by one of the following the preferential hierarchy outlined in Clause 1.3.

- 1.11** Where oil-filled cables are connected to metal enclosed switchgear in indoor substations, the oil filled cables and their associated accessories e.g. sealing ends / oil tanks, shall, where reasonably practicable, be located outside the Switch house. Otherwise the preferential hierarchy outlined in Clause 1.3 shall be followed.
- 1.12** Where power and / or auxiliary cables pass through a switch room floor into a cable tunnel or basement, adequate precautions shall be taken to prevent:
- Cables slipping into the basement or tunnel if burnt away from their cable boxes.
 - Smoke, combustion products or natural gas entering the switchroom.
- 1.13** Where reasonably practicable, the oil reservoir tanks of oil-filled cables installed in Integral Cableways shall be located outside the cableways. Otherwise, by agreement with National Grid, the reservoir tanks for each circuit shall be separated as widely as possible and the tanks for each circuit shall be contained in a separate enclosure designed to prevent risk of spread of oil fires having a Fire Resistance of 4 hours.
- 1.14** Vertical cable risers shall be provided with horizontal fire stops of 4 hours Fire Resistance to prevent a chimney effect. Fire and smoke stops shall also be included at points where cables pass from a cableway / tunnel into switchgear, relay cubicles etc.
- 1.15** The installation of cable joints in Integral Cableways shall be avoided where reasonably practicable. They shall only be installed by agreement with National Grid and the requirements of NGTS 3.5.12 shall apply.
- 1.16** Integral Cableways shall be fitted with barriers at 100m intervals. Such barriers shall be fitted with Fire Doors that are normally latched open to allow ventilation but automatically close in the event of fire. Both shall have a Fire Resistance of 4 hours.
- 1.17** Detectors for the toxic products of combustion shall be installed in Integral Cableways and cable basements.
- 1.18** Where a basement is ventilated by fans, arrangements shall be made for them to be turned off automatically whenever a fire protection or alarm operates.
- 1.19** Where necessary, natural ventilation shall be supplemented by forced ventilation to prevent the formation of a toxic atmosphere from the products of combustion. The forced ventilation shall be capable of being operated from outside the cableway.
- 1.20** All ventilation grilles shall be fitted with louvres that close automatically in the event of fire being detected.

Specific Requirements for Protection of Auxiliary Cables - Including Protection, Control and Telecommunications Cables

- 1.21** Protection, control, telecommunications and fire alarm cables shall be run on separate routes from power cables and be segregated in accordance with the arrangement of the switchgear. In indoor locations and confined spaces such as Integral Cableways, cable basements etc., cables shall be Low Smoke/Low Fume/ Zero Halogen. This shall also apply to the supporting cable trays, which shall be GRP (pultruded with a minimum glass content of 45%), and additionally meet the requirement for surface spread of flame to BS 476-7 Class 1. All relevant test certificates shall be submitted for the cable trays to confirm the requirements for fire resistance, and the limitations on smoke emission and toxicity.
- 1.22** Control and protection cables shall be routed at least 3m from any oil filled equipment. They shall not be routed through Oil Retaining Areas or Oil Containment Facilities.

- 1.23** Duplicate dc supply cables for switchgear tripping shall be segregated for their entire length by a barrier of 1 hour Fire Resistance, except where a higher level of resistance is otherwise specified.

Specific Requirements for Protection of Standby Diesel Generators

- 1.24** The diesel generator enclosure shall be ventilated to disperse oil vapours and fumes and shall have one hour Fire Resistance.
- 1.25** A fusible link shall be fitted over the engine to automatically shut the day tank inlet / outlet fuel shut off valve and interrupt the electrical supply to any main fuel storage transfer pumps in the event of fire.

Specific Requirements for Protection of Oil Storage Tanks

- 1.26** The construction of any building housing oil storage tanks shall be in non-combustible materials with one hour Fire Resistance. Adequate natural ventilation should be provided to disperse oil vapour and fumes.

2 REQUIREMENTS FOR FIRE PROTECTION FACILITIES

- 2.1** No protective measures for the effects of heat and flame from a fire are required where:

- The Element At Risk is outside the Fire Damage Zone as detailed below
- Fire Hazards contain synthetic oil (e.g. Midel Oil).

- 2.2** The Fire Damage Zone is calculated from the Separation Distances given in figure 1 and Appendix A. Where the Fire Pool diameter is less than 5m or greater than 30m it shall be limited to the appropriate lower or upper value.

N.B: The graph in figure 1 has been derived from the data in Appendix A

Where the Fire Hazard is situated in a rectangular Oil Retaining Area, the Fire Pool diameter is determined from the length of each side measured between the internal faces of the Oil Retaining Area walls. Offset lines are drawn at the appropriate Separation Distance (also measured from the internal face of the walls) parallel to and the same length as the respective Fire Pool sides. These are then joined using a circular arc of minimum possible radius (i.e. equal to the lesser of the two Separation Distances). The area so defined is the Fire Damage Zone and the methodology is illustrated in figure 2.

Oil Retaining Areas that comprise more complex shapes are to be reduced to the combination of over lapping rectangles which, when subject to the above criteria, can be combined to produce the largest possible Fire Damage Zone envelope. Refer to figure 3.

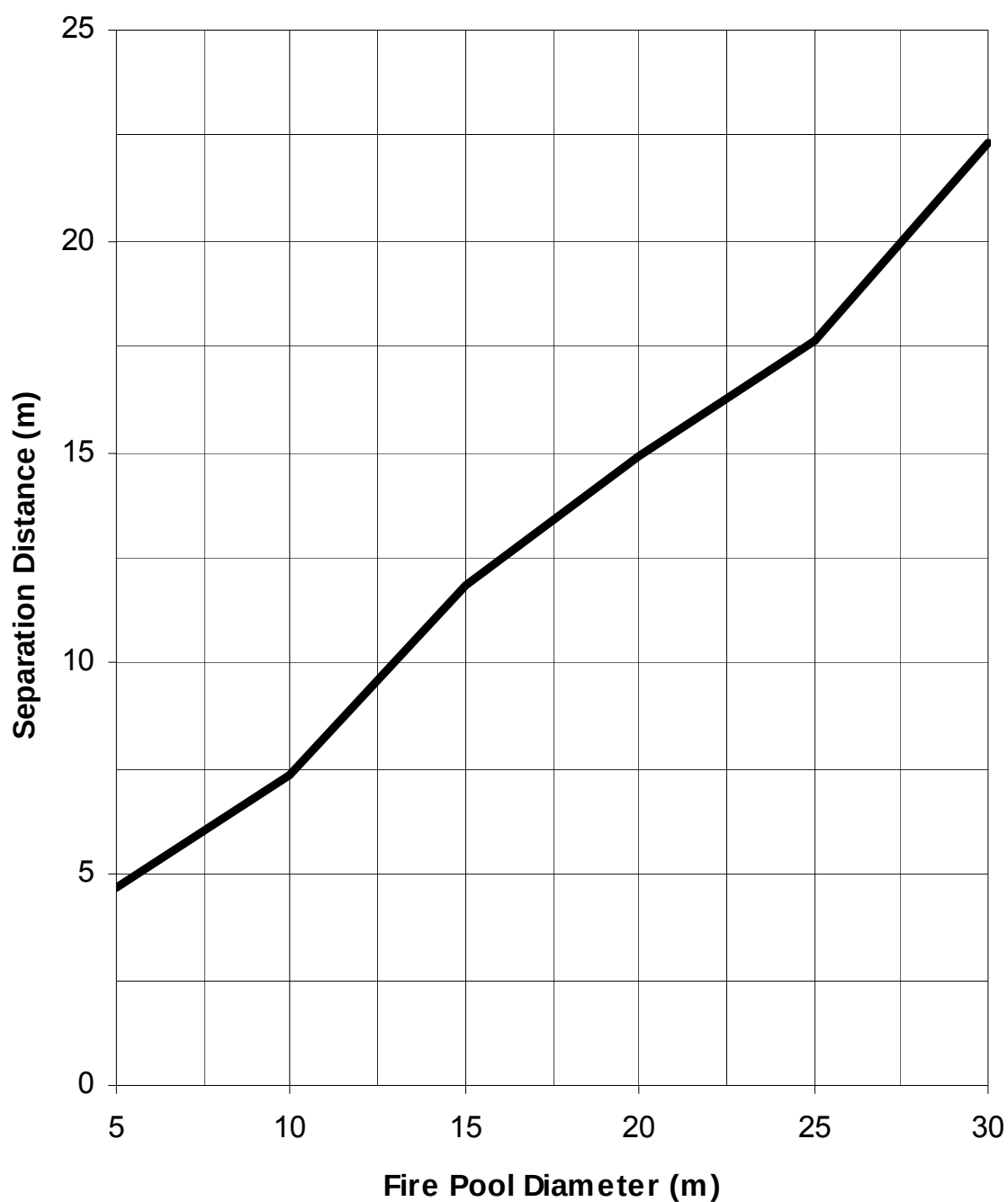


Figure 1: Separation Distance

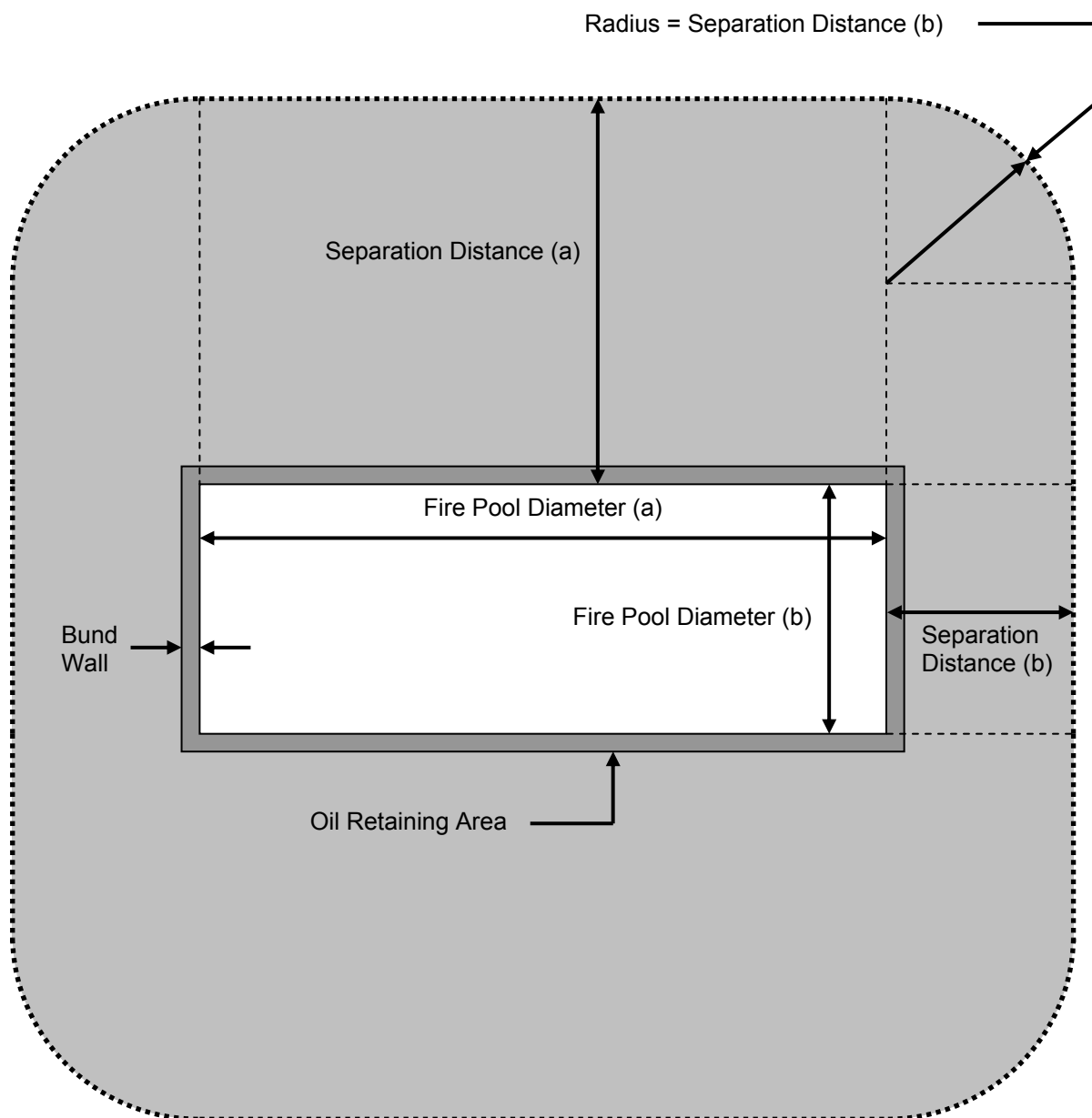
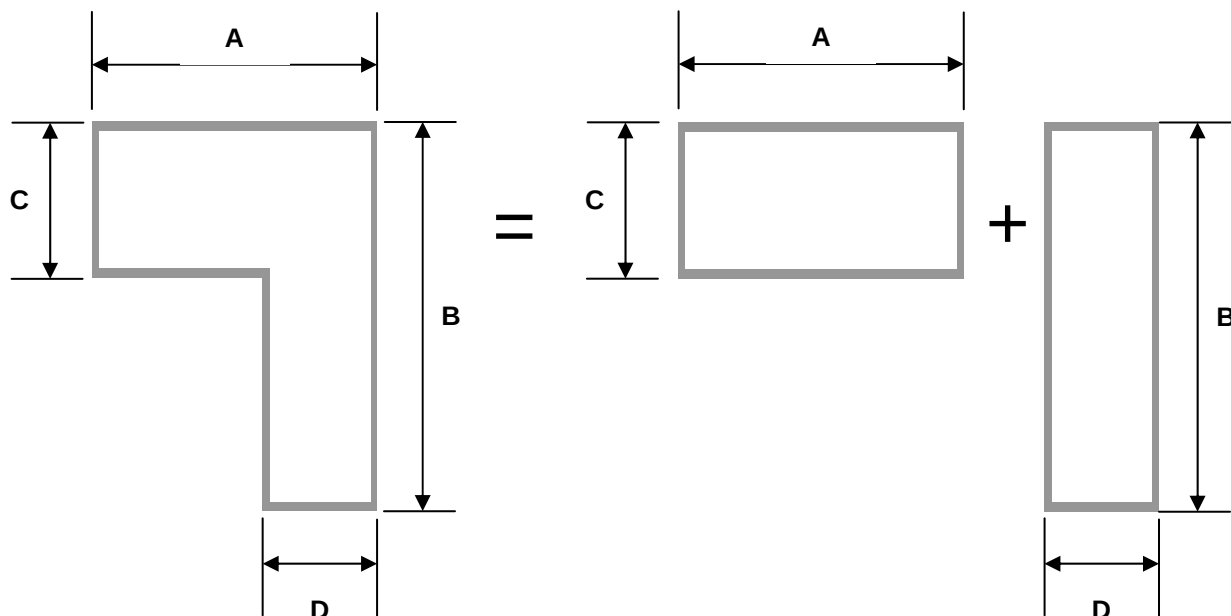
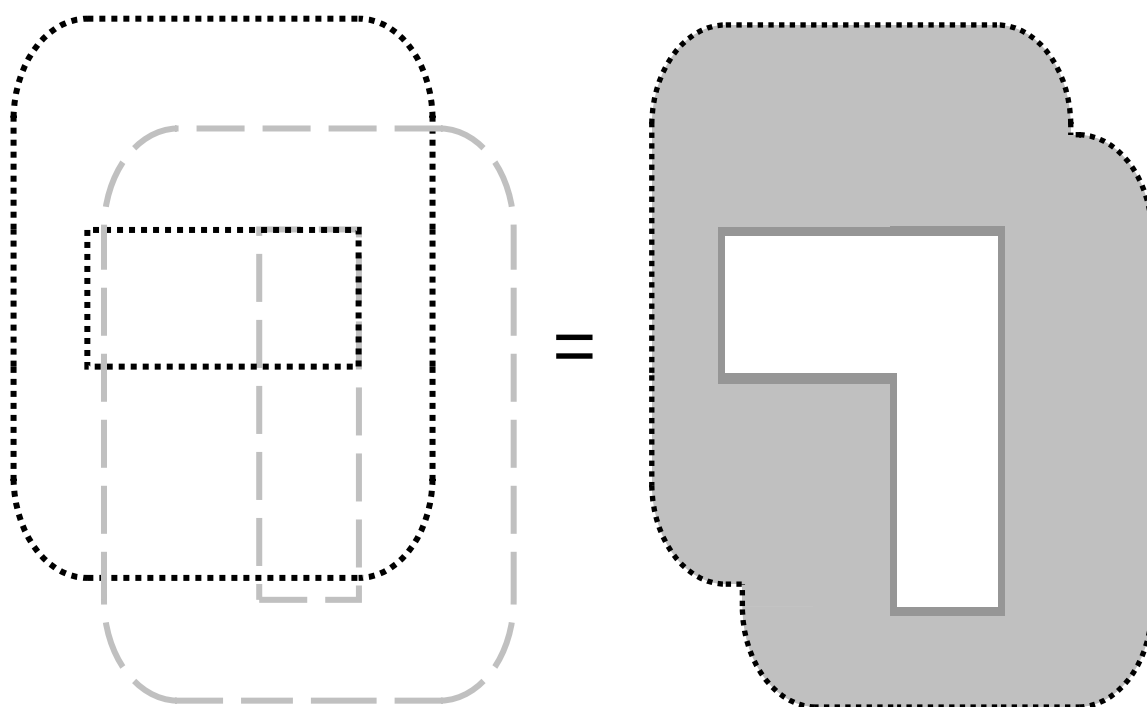


Figure 2: Calculation of Fire Damage Zone



a) The Oil Retaining Area is reduced to a combination of rectangles



b). Individual Fire Damage Zones are combined to produce the worst case envelope

Figure 3: Fire Damage Zone for Complex Oil Retaining Areas

- 2.3** Only that part of the ELEMENT at risk that lies within the Fire DAMAGE Zone requires fire protection measures. Other parts of the element can be discounted.

To determine the plan position of the Fire Barrier, 'sight lines' are drawn between the extremities of the Fire Pool and those of the Element At Risk that lie within the Fire Damage Zone. The Fire Barrier can occupy any position within the Fire Damage Zone between the Element At Risk and the Fire Hazard. Refer to figure 4 for examples.

The Fire Barrier location shall not impede access for inspection or maintenance to any equipment or to any other areas of the site. Due consideration must be given to all necessary operational clearances.

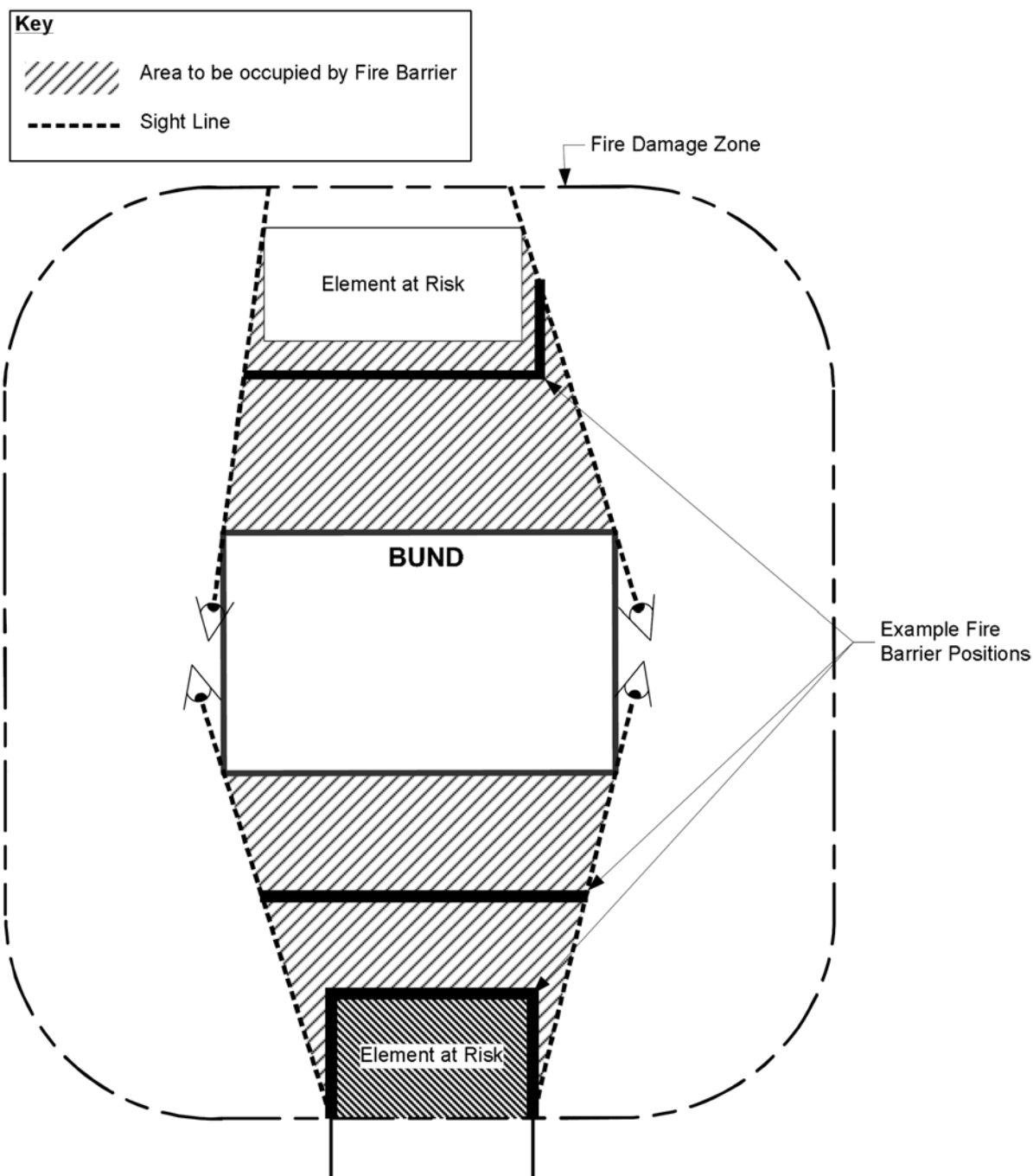


Figure 4: Example of Fire Barrier Locations