

**LIMITATION OF FIRE RISK AT ELECTRICITY SUBSTATIONS - TS 2.10.06**

**GENERIC ELECTRICITY SUBSTATION DESIGN MANUAL**  
**FOR CIVIL, STRUCTURAL AND BUILDING ENGINEERING**

**SECTION NO : 06**

**TITLE : LIMITATION OF FIRE RISK AT ELECTRICITY SUBSTATIONS**

## **LIMITATION OF FIRE RISK AT ELECTRICITY SUBSTATIONS**

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## **1 INTRODUCTION**

### **1.1 Purpose and scope**

- 1.1.1 This technical specification TS 2.10.06 defines National Grid's requirements in respect of limitation of fire risk at new and existing (i.e. retrofit) electricity substations and other relevant operational sites. It shall also apply, as appropriate and via agreement, to third party assets installed on National Grid owned land.
- 1.1.2 This specification forms part of a suite of documents, TS 2.10.xx, which define design requirements (including mandatory prescriptive and functional requirements and/or performance characteristics) relating to new build and existing 'Civil, Structural and Building Engineering' assets forming part(s) of substation construction projects. Refer to TS 2.10.00 for general introduction and description of the respective parts of the series.
- 1.1.3 These design requirements shall be used in conjunction with the construction specification which is included in the TS 3.10.xx series of documents. Refer to TS 3.10.00 for general introduction.
- 1.1.4 This specification shall be applied in conjunction with all relevant National Grid standards as appropriate. The Level 1 and 2 Specifications for substations, TS 1 and TS 2.01, cover high level requirements which are mandatory for all design and construction.

### **1.2 Statutory requirements**

- 1.2.1 The relevant legislation is the Fire Safety Order: Regulatory Reform (Fire Safety) Order 2005, SI 2005/1541 in England and Wales and the Fire (Scotland) Act 2005 in Scotland.
- 1.2.2 The Fire Safety Order requires that a fire risk assessment is produced and kept up to date.
- 1.2.3 The Fire Safety Order requires that fire precautions (such as firefighting equipment, fire detection and warning, and emergency routes and exits) should be provided (and maintained) 'where necessary'. What this means is that the fire precautions required are those which are needed to reasonably protect relevant persons from risks to them in case of fire. This will be determined by the findings of the risk assessment.
- 1.2.4 The Fire Safety Order requires a written record of the effective planning, organisation, control, monitoring and review of the preventive and protective measures.

## **PART 1 – PROCEDURAL**

## **2 FUNDAMENTAL REQUIREMENTS**

### **2.1 Competent person**

- 2.1.1 National Grid shall nominate the competent person (in accordance with the Fire Safety Order) for the site.

### **2.2 Fire risk assessment**

- 2.2.1 A fire risk assessment is required for all operational sites.
- 2.2.2 For designs for new sites, a fire risk assessment shall be produced by the designer.
- 2.2.3 For modifications at existing sites, where there is no existing fire risk assessment then a fire risk assessment shall be produced.

- 2.2.4 Where there is an existing fire risk assessment, it shall be reviewed to confirm it still reflects the current site situation. The fire risk assessment shall be updated to reflect the proposed modifications.

INFORMATIVE: A fire risk assessment is an organised and methodical look at the operational site, the activities carried on there and the likelihood that a fire could start and cause harm to those in and around the operational site.

The aims of the fire risk assessment are:

- To identify the fire hazards.
- To reduce the risk of those hazards causing harm to as low as reasonably practicable.
- To decide what physical fire precautions and management arrangements are necessary to ensure the safety of people in your premises if a fire does start.

Guidance is available in the HMG publication Fire safety risk assessment: factories and warehouses.

- 2.2.5 The fire risk assessment shall include the following five steps:

(a) Identify fire hazards:

- Sources of ignition;
- Sources of fuel;
- Sources of oxygen.

(b) Identify people at risk:

- People in and around the premises;
- People especially at risk.

(c) Evaluate, remove, reduce and protect from risk:

- Evaluate the risk of a fire occurring;
- Evaluate the risk to people from fire;
- Remove or reduce fire hazards;
- Remove or reduce the risks to people:
  - i Detection and warning;
  - ii Fire-fighting;
  - iii Escape routes;
  - iv Lighting;
  - v Signs and notices;
  - vi Maintenance.

(d) Record, plan, inform, instruct and train:

- Record significant finding and action taken;
- Prepare an emergency plan;
- Inform and instruct relevant people; co-operate and co-ordinate with others;
- Provide training.

(e) Review:

- Keep assessment under review;
- Revise where necessary.

## **2.3 Principles of prevention**

2.3.1 Fire preventive and protective measures shall be implemented on the basis of the principles of prevention.

2.3.2 The principles are:

- (a) Avoiding risks;
- (b) Evaluating the risks which cannot be avoided;
- (c) Combating the risks at source;
- (d) Adapting to technical progress;
- (e) Replacing the dangerous by the non-dangerous or less dangerous;
- (f) Developing a coherent overall prevention policy which covers technology, organisation of work and the influence of factors relating to the working environment;
- (g) Giving collective protective measures priority over individual protective measures; and
- (h) Giving appropriate instructions to employees.

## **2.4 Standard preventive and protective measures**

2.4.1 This technical specification defines standard preventive and protective measures which have been developed over time to suit the normal configurations of National Grid operational sites.

**INFORMATIVE:** In many cases these standard measures will provide solutions which satisfactorily meet the requirements given above. However, the designer shall ensure that any standard measures which are implemented are appropriate for the particular situation. In some situations, measures may be required which are not covered in this technical specification.

### **3 BASIS OF DESIGN**

#### **3.1 Identification of fire hazards**

3.1.1 The designer shall identify fire hazards.

3.1.2 In particular, 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.

#### **3.2 Identification of people and elements at risk**

3.2.1 The designer shall identify those who would be at risk if there was a fire.

3.2.2 Additionally, the designer shall identify elements at risk which could cause escalation of a fire or outages of transmission circuits.

INFORMATIVE: National Grid has business requirements for continuity of operations, which are supplementary to the basic fire safety requirements of the Fire Safety Order.

3.2.3 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 fire hazards:

- (a) All third party land, property or infrastructure developments unless defined otherwise in the Scheme Specification or agreed with National Grid;
- (b) Other Fire Hazards;
- (c) Any equipment, structure or building which, if destroyed or seriously damaged, would cause or force consequential outages of other transmission circuits;
- (d) Any control, protection, data acquisition or communications equipment essential to the safe operation of the substation or transmission system;
- (e) Any other equipment or structures as defined in the Scheme Specification;
- (f) Substation buildings which are occupied.

### **3.3 Evaluate, remove, reduce and protect from risk**

#### **3.3.1 The designer shall:**

- Evaluate the risk of a fire occurring;
- Evaluate the risk to people from fire;
- Remove or reduce fire hazards;
- Remove or reduce the risks to people.

#### **3.3.2 A Fire Damage Zone shall be considered for each piece of equipment which is considered to be a Fire Hazard, in accordance with Section 3.1.2. Requirements for the Fire Damage Zone are provided in Section 4.**

#### **3.3.3 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;
- Fire Hazards contain synthetic oil (e.g. Midel 7131, though special considerations for oil containment will be required – see TS 2.10.01 Oil Containment).

#### **3.3.4 Where fire protection measures are required, the choice of installation method 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.

#### **3.3.5 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.**

#### **3.3.6 In the case of an asset replacement any existing fire protection systems shall be reassessed to determine compliance.**

### **3.4 Record, plan, inform, instruct and train**

#### **3.4.1 The designer shall provide the following records:**

- Drawings – All drawings shall be in accordance with TP 135.
- Operating Manuals – Operating Manuals for all installed equipment shall be provided.
- Commissioning file – On delivery the manufacturer/supplier shall provide all material documentation and shall comply with the requirements of TP 106.

#### **3.4.2 The fire risk assessment shall record significant findings and actions taken.**

### **3.5 Periodic review**

#### **3.5.1 National Grid may instruct periodic review of existing fire risk assessments.**

### 3.6 Fire design and fire resistance

- 3.6.1 Performance requirements for materials and products are given in this standard in terms of duration of fire resistance based on the British Standards for fire tests, in particular the parts of BS 476 Fire Tests on Building Materials and Structures. Equivalent European Standards may be used as an alternative to the designated test standard, subject to the designer demonstrating that they provide equivalent performance. Further guidance is provided in UK Building Regulations 2010 Approved Document B Fire Safety Appendix A.

INFORMATIVE: For some building products, there is currently no generally accepted guidance on the appropriate procedure for testing and classification in accordance with the harmonised European fire tests. Until such a time that the appropriate European test and classification methods for these building products are published, classification may only be possible using existing national test methods.

- 3.6.2 References to fire resistance durations in the NGTS suite of standards shall be taken as applying to a standard fire, rather than a hydrocarbon oil fire.

INFORMATIVE: Fire engineering design and test standards have traditionally addressed domestic fires within inhabited buildings rather than the hydrocarbon oil fires that would typically result from the failure of a SuperGrid Transformer or similar item of Oil containing plant.

Consequently, in order to simplify the design process (specifically in relation to reinforced concrete) and specification of fire resistance, these requirements are stated in terms of the standard fire. However, it should be noted that the actual requirement relates to a hydrocarbon fire (the time/temperature curves for the two are very similar in their initial stages) and, where it can be substantiated, design work may be in accordance with this measure.

- 3.6.3 Fire design of structures and structural elements, where required, shall be carried out in accordance with BS EN 1991-1-2, BS EN 1992-1-2 and BS EN 1993-1-2 and associated National Annexes. The use of advanced calculation methods to supplement the prescriptive requirements given in this standard shall be agreed in advance with National Grid.

INFORMATIVE: BS EN 1991-1-2 permits fire design using a variety of design procedures, ranging from prescriptive rules to performance based analysis.

BS EN 1991-1-2 includes time-temperature curves both for standard and hydrocarbon fires. However, the simplified tabulated design methods and prescriptive rules are based on the standard fire exposure.

- 3.6.4 Fire barriers and other components which protect Elements at Risk shall be designed such that the Element at Risk suffers no detrimental or restrictive effects or permanent structural damage due to a fire in the Fire Hazard and that the Element at Risk shall be capable of remaining fully operational and functional for the whole of the defined fire resistance period. Such fire barriers and other components shall maintain their integrity (criteria 'E') and insulation (criteria 'I') for the fire resistance period in accordance with BS EN 1991-1-2.

- 3.6.5 The designer shall distinguish between fire barriers which are considered to be entirely sacrificial and other components which could affect the performance of a wider structural system such as a building. The latter shall be detailed in such a way that any components that would be damaged beyond use during the fire resistance period do not compromise, in any way, the function and operation of the wider structural system and shall be easily and economically replaceable. The designer shall establish whether such components must also maintain their load bearing function (criteria 'R') for the fire resistance period in accordance with BS EN 1991-1-2.



**INFORMATIVE:** There is a difference from the use of fire resistance used more conventionally in fire engineering particularly where it is applied to the design of buildings. For buildings the purpose of the stated fire resistance is to facilitate emergency escape and fire fighting for a specified period after which time the items in question may no longer be fit for purpose and might therefore require demolition and replacement. In this context therefore the term only has immediate health and safety objectives rather than the additional longer term operational ones required by National Grid.

For example a free standing, fire barrier wall could, at the end of the stated 'fire resistance' period, be completely damaged beyond use and thus need replacing – it is regarded as entirely sacrificial - whereas the supergrid transformer ('Element at Risk') which it is providing 'fire resistance' to should be totally unaffected by flames or heat during the same time frame. However if a substation building is designed to incorporate a fire barrier as an inherent part of its structure it should be detailed in such a way that any components that would be damaged beyond use during the 'fire resistance' period do not compromise, in any way, the function and/or operation of the building and should be such that they are easily and economically replaceable or repairable.

## **4 INTERFACES: SUBSTATION LAYOUT, DIMENSIONS AND CLEARANCES**

### **4.1 Vehicular access**

- 4.1.1 A substation shall be configured such that in the event of a fire in any one Fire Hazard vehicular access to the remainder of the site (including car parks) is still possible. This shall be achieved by either ensuring that no Fire Damage Zone encroaches on an access road or that there are two or more vehicular routes into and/or around the substation thus allowing any Fire Damage Zones to be circumnavigated. In determining the arrangement it may be assumed that only one Fire Hazard fails at any one time.

### **4.2 Water Supplies for Fire Fighting Purposes**

- 4.2.1 A supply of 120,000 litres of water shall be available at all Substations for use by the fire brigade in the first hour for fire fighting purposes. The suitability of the sources of supply and the access to them shall be agreed with National Grid.
- 4.2.2 Where reasonably practicable, the water supply shall be obtained from hydrants connected to a suitable water main. Hydrants shall be provided within 90m of all equipment and buildings.
- 4.2.3 Hydrants shall be of a pattern approved by the local fire authority and located so that fire appliances can be connected whilst standing on normal access roads, either inside or outside Substation compounds. Hydrants shall be protected from frost.
- 4.2.4 The position of hydrants shall be agreed with National Grid and clearly marked. Marking symbols shall be to BS 3251.
- 4.2.5 By agreement with National Grid, rivers, streams, canals or ponds may be used to provide the water supply for fire fighting purposes. In this case, suitable hard standing areas for fire brigade appliances shall be provided - their location and construction shall be agreed with National Grid.
- 4.2.6 Where no suitable alternative water supply is available, static water tanks shall be provided to meet the requirements above. Tanks shall be suitable for service without emptying, cleaning, maintenance or repair for a period of not less than 15 years. Tanks shall be fitted with a suitable fire brigade inlet/outlet.
- 4.2.7 The tanks shall be suitably protected from frost and shall be provided with a system to automatically replenish the water level. The flow rate of the water supply for replenishment shall allow the tank to be refilled in the minimum reasonably practicable time.

4.2.8 All water mains for fire fighting purposes shall comply with BS 9990.

### **4.3 Fire Hazard equipment in Buildings**

4.3.1 The following hierarchy shall apply for equipment defined as a Fire Hazard installed in buildings:

- (a) No other equipment installed in same building;
- (b) Fire Hazard contained within a compartment of 4 hours Fire Resistance;
- (c) Fire Hazard protected by an Active Automatic Fire Protection System.

### **4.4 Routeing of Auxiliary Cables - Including Protection, Control and Telecommunications Cables**

4.4.1 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.

4.4.2 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.

4.4.3 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.

### **4.5 Separation of transformers**

4.5.1 Single phase transformers or similar plant forming part of the same circuit shall be separated by distance according to the fire damage zone and appropriately sized Fire Barrier Walls.

**INFORMATIVE:** Single phase units (three per circuit) are typically specified to facilitate transportation and/or to enhance HV system security in the event of a failure. Where installed for the latter reason fire control in the form of barrier walls or separation is mandatory to ensure catastrophic failure in a single unit doesn't escalate to others however adopting such configuration can have additional project benefits.

Where only one unit is assumed to fail the capacity of the Secondary Containment is based on the volume of oil it contains rather than the total of all three which would be the case if the units were not separated by distance according to the fire damage zones or fire barriers.

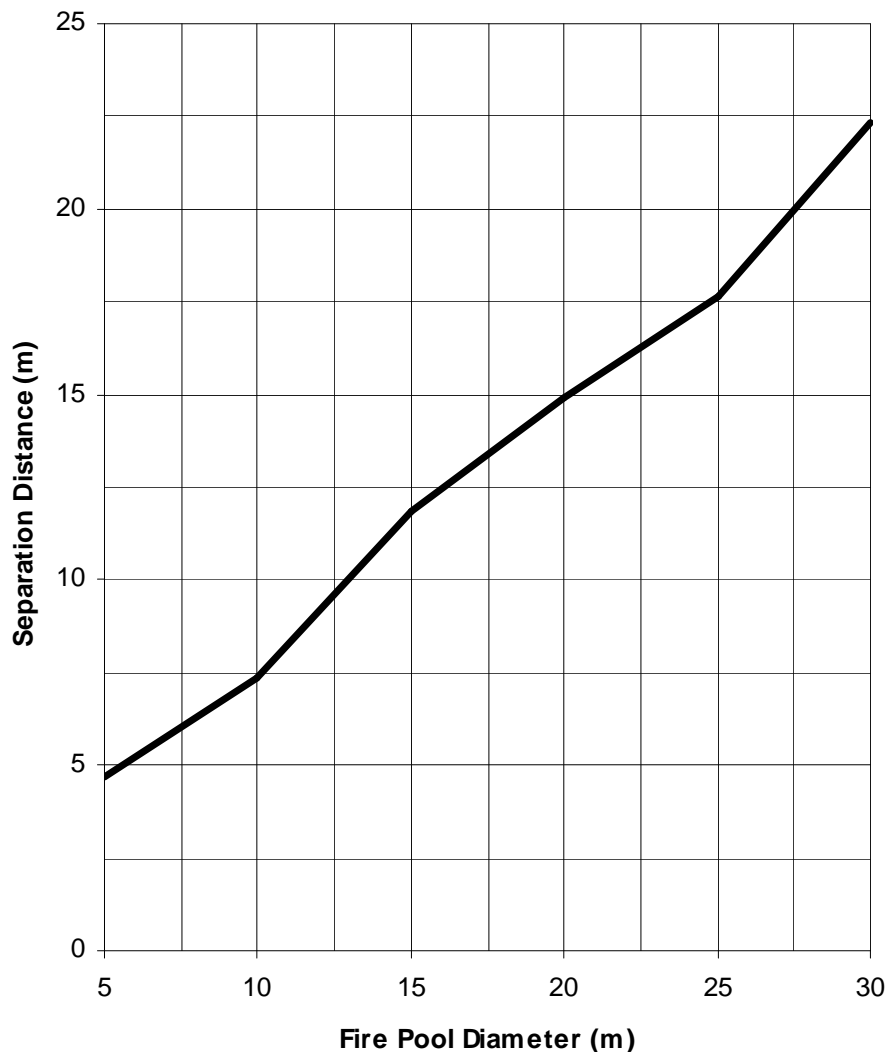
Further the size of 'Fire Damage Zone' of the system will be based on the individual plan areas of the 'bund' around each unit rather than the full plan area occupied by all three. By this means the configuration 'footprint' and associated construction costs may be significantly reduced and consequently this option should, as a minimum, be considered during design feasibility studies.

## 5 FIRE DAMAGE ZONE

### 5.1 Size of Fire Damage Zone

- 5.1.1 The Fire Damage Zone shall be calculated from the Separation Distances given in Figure 5-1 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.

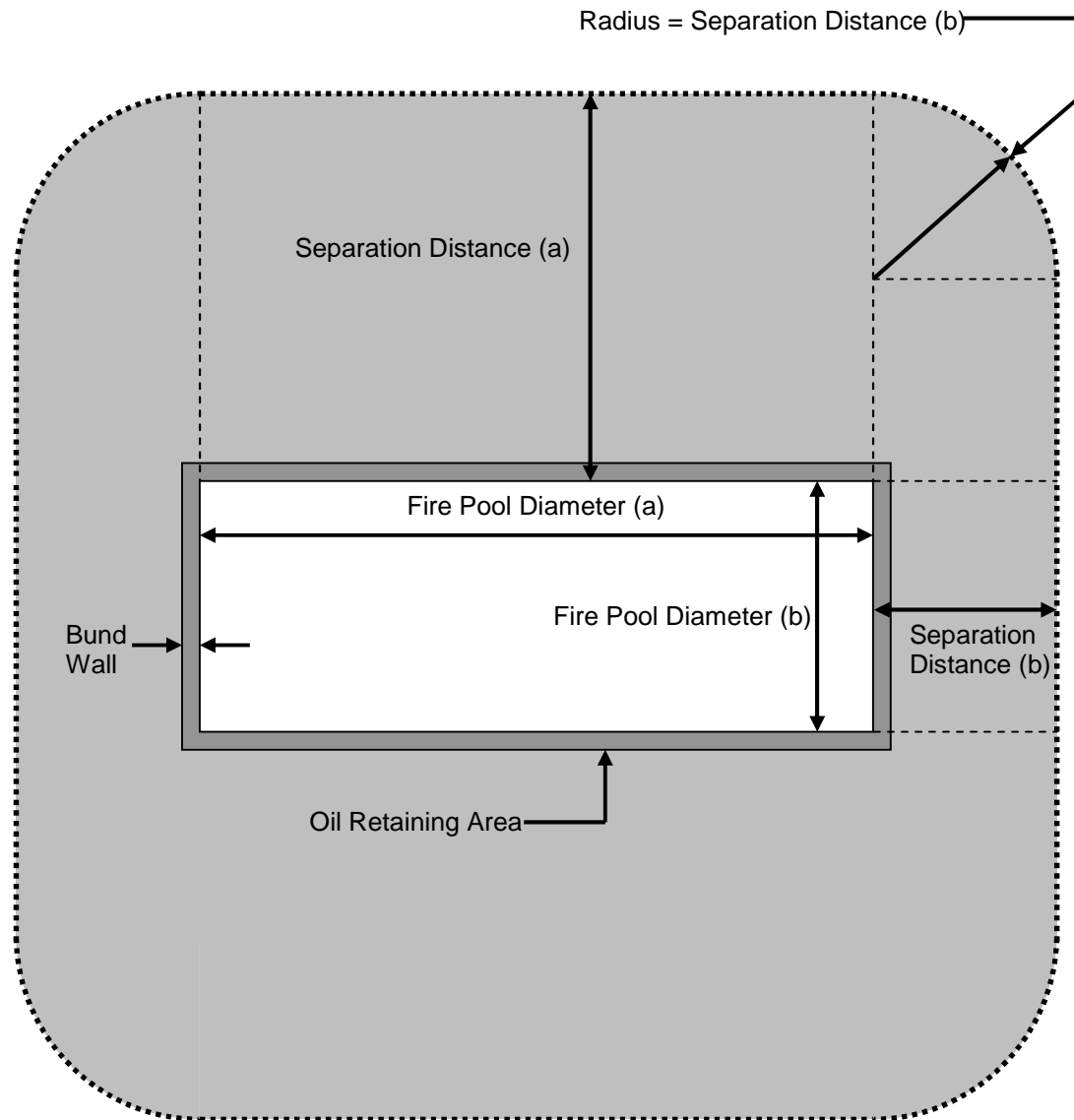
N.B: The graph in Figure 5-1 has been derived from the data in Appendix A.



**Figure 5-1: Separation Distance**

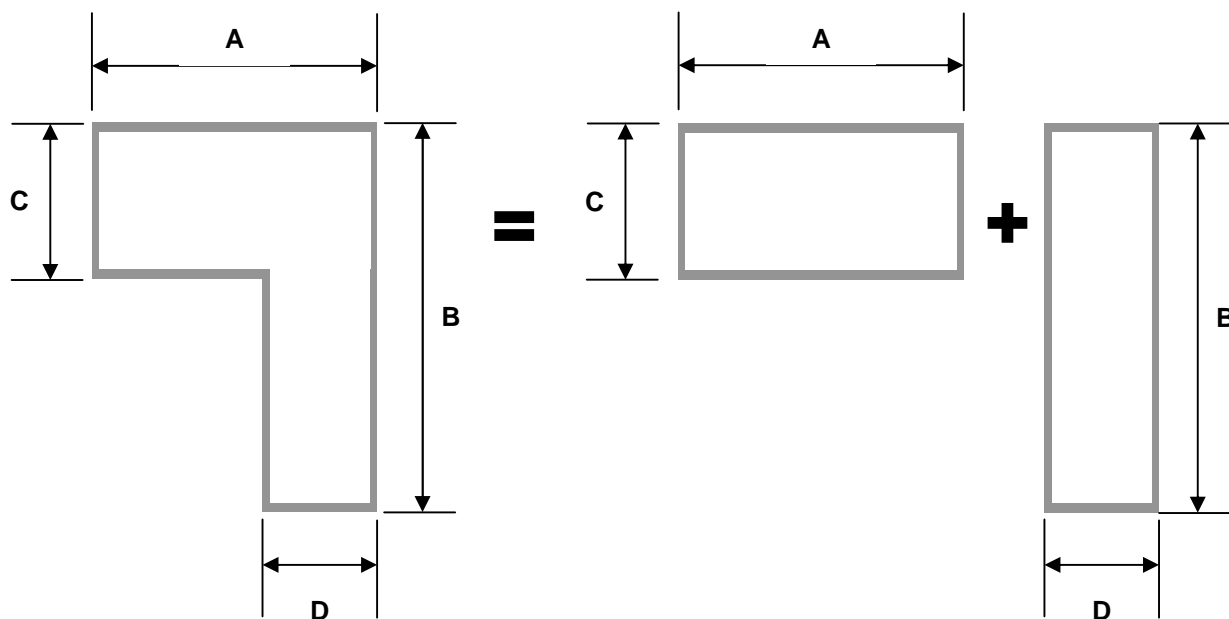
**INFORMATIVE:** Figure 5-1: Separation Distance in this Issue of TS 2.10.06 differs from the equivalent figure included in TS 3.1.3, Issue 1 in that there is now a single line which represents both the “With Oil Containment Tank” and “Without Oil Containment Tank” conditions.

The reason for this is that the Fire Engineering analysis which forms the basis of the calculation establishes a thermal radiation “contour” that is independent of the time for which the related fire burns. Consequently removing the fuel (i.e. oil) from the fire source adds no value within the constraints of this particular theoretical model.

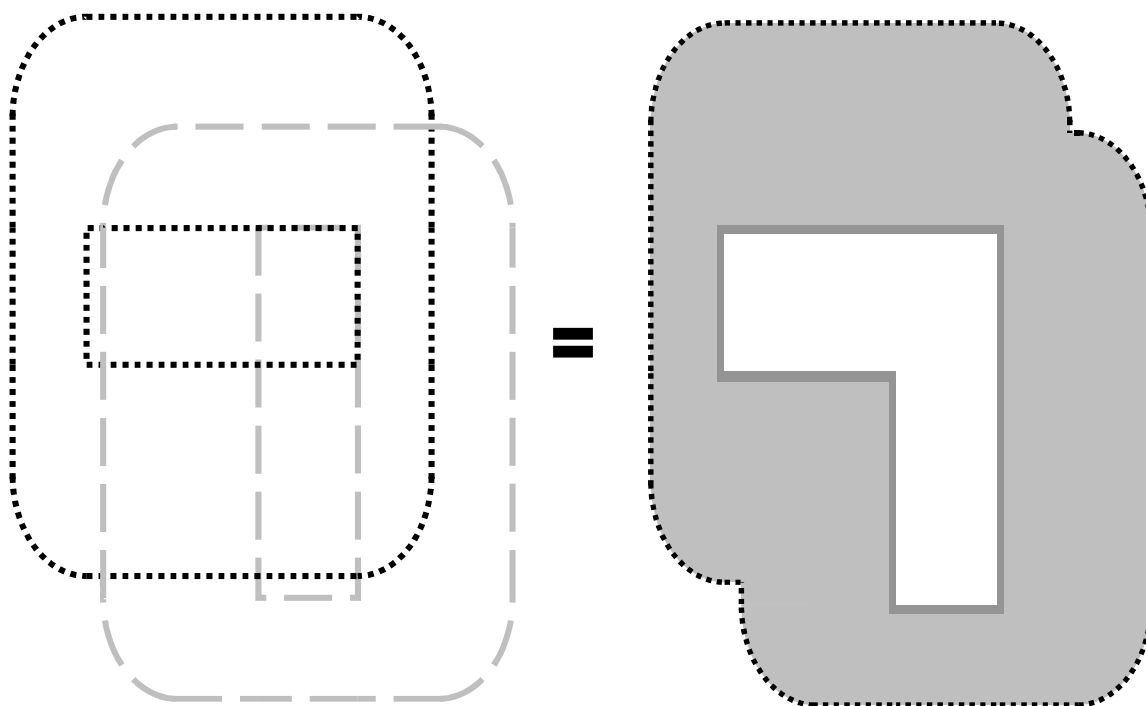


**Figure 5-2: Calculation of Fire Damage Zone**

- 5.1.2 Where the Fire Hazard is situated in a rectangular Oil Retaining Area, the Fire Pool diameter shall be 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 5-2.
- 5.1.3 Oil Retaining Areas that comprise more complex shapes shall 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 5-3.
- 5.1.4 Any part of an Element at risk that lies within the Fire Damage Zone requires fire protection measures, applying the hierarchy given in Clause 3.3.4. Other parts of the element can be discounted.
- 5.1.5 During development for retrofit National Grid has developed an alternative FDZ to be used to assess special circumstances during project development. Please consult Asset Policy for further guidance.



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

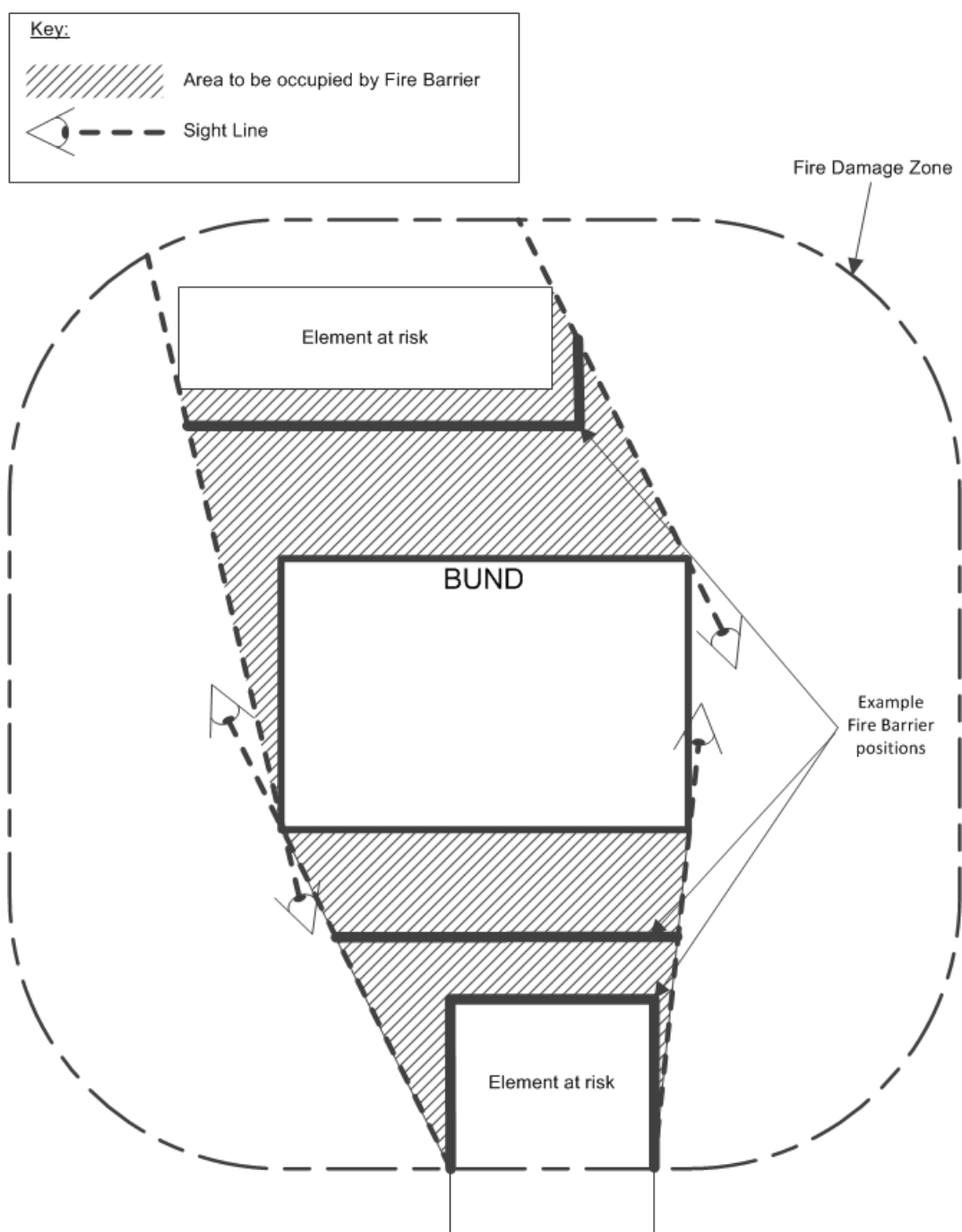


b). Individual Fire Damage Zones are combined to produce the worst case envelope

Figure 5-3: Fire Damage Zone for Complex Oil Retaining Areas

## **5.2 Fire barrier Geometry**

- 5.2.1 Fire barriers shall be provided on a 'line-of-sight' basis to protect the Element at Risk from the calculated fire damage zone and flame height, in accordance with the requirements of this section.
- 5.2.2 A limiting fire barrier wall height of 9m from substation level shall be applied, even if a fire barrier wall height in excess of 9m is determined by calculation.
- 5.2.3 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.
- 5.2.4 To determine the plan position of the Fire Barrier, 'sight lines' shall be 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 may occupy any position within the Fire Damage Zone between the Element At Risk and the Fire Hazard. Refer to Figure 5-4 for examples.
- 5.2.5 The minimum height of the Fire Barrier shall be determined as follows, subject to the maximum given above;
- 5.2.6 Calculate the flame height from the corresponding bund size using Figure 5-5.
- 5.2.7 Using the calculated flame height, a sight line shall be drawn between the centre of the pool/fire bund and the furthest part of the element at risk located within the fire damage zone, as shown in Figures 5-6 and 5-7. The fire barrier may be located in any position between the pool fire/bund and the element at risk provided it extends to obscure the sightline ensuring that none of the flame is visible, as shown in Figures 5-6 and 5-7.
- 5.2.8 The installation of Fire Barriers shall not restrict air circulation so as to limit the normal current rating (continuous electrical rating) of the protected equipment.
- 5.2.9 Fire Barriers shall be designed and installed such that electrical clearances specified in TS 2.01 Tables 1 and 2 are maintained.



**Figure 5-4: Example of Fire Barrier Locations**

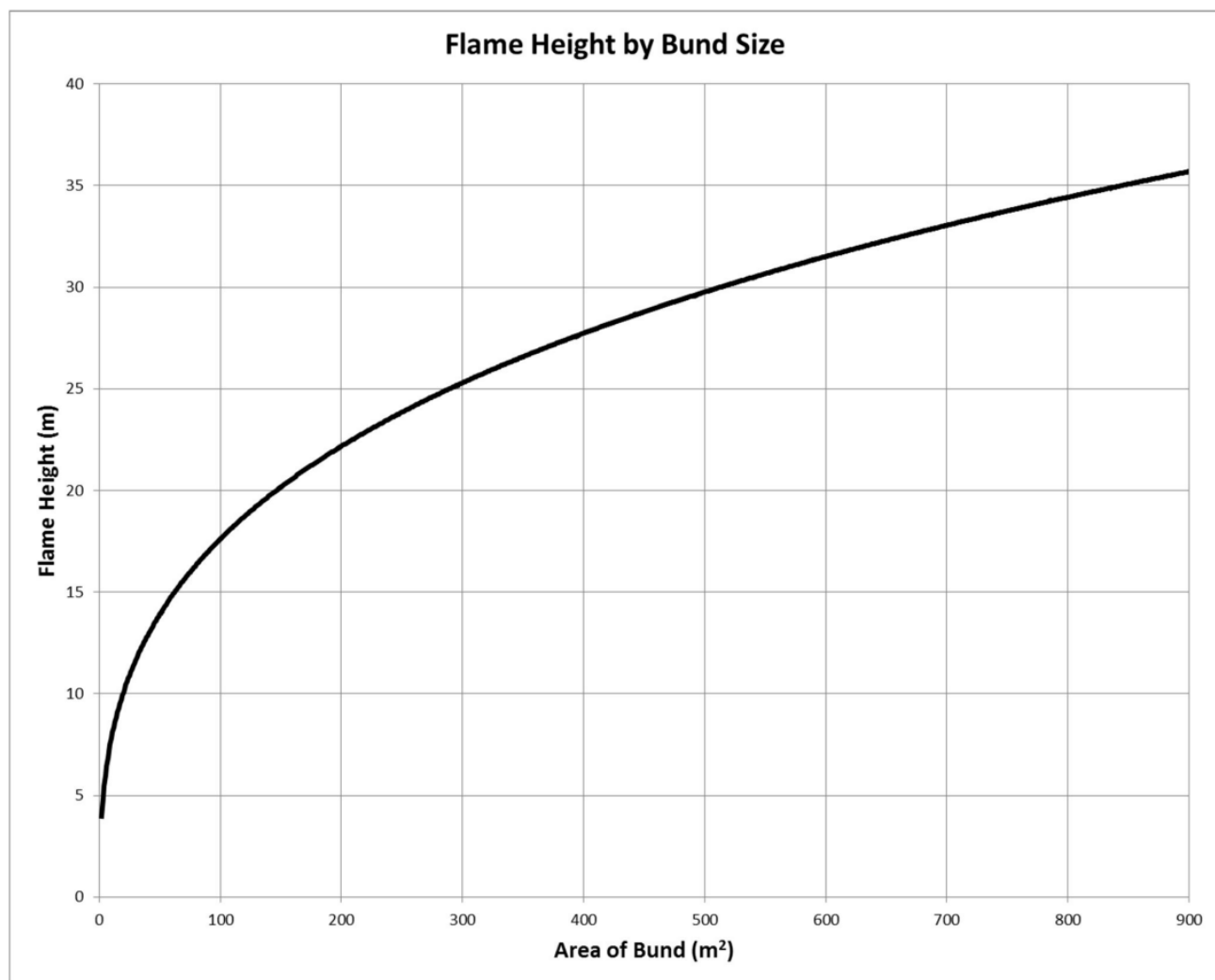


Figure 5-5: Flame Height

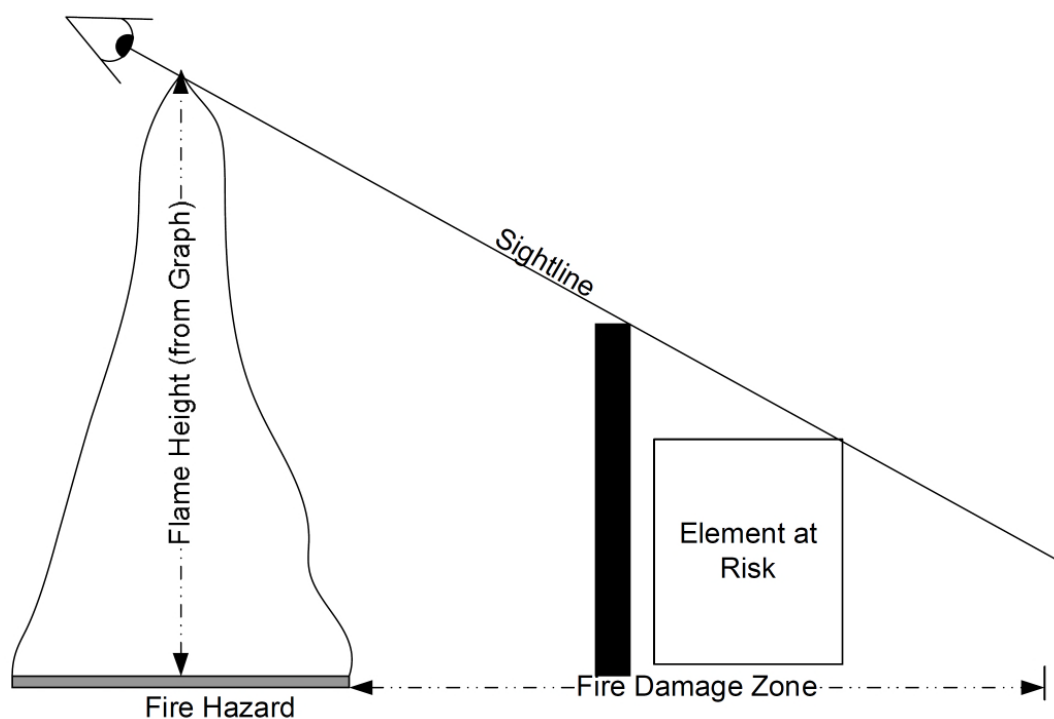
INFORMATIVE: With reference to 'Figure 5-5: Flame Height' the following equation may be used:

$$y = 3.8371 \cdot x^{0.3295}$$

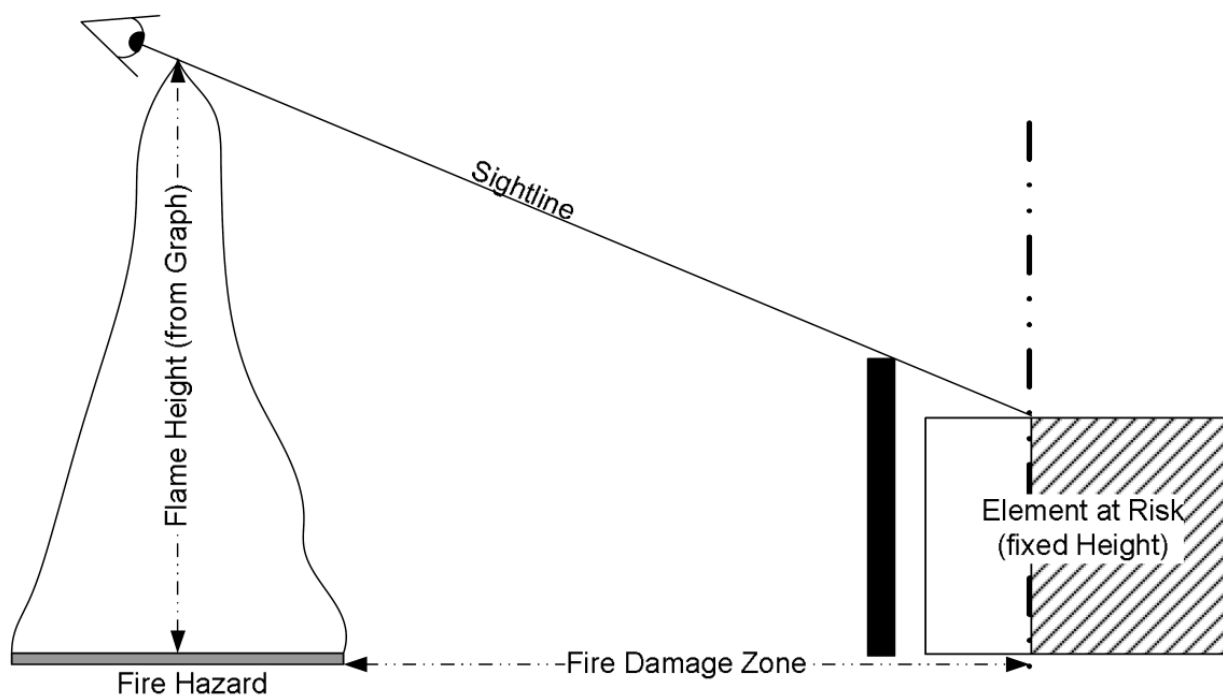
Where:  $x$  = Plan area of Bund (m<sup>2</sup>)

$y$  = Flame Height (m)





**Figure 5-6: Fire Barrier Sightline (Section) – Element entirely within separation zone**



**Figure 5-7: Fire Barrier Sightline (Section) – Element partially within separation zone**

## **6 FIRE PROTECTION REQUIREMENTS FOR COMPONENTS, ELEMENTS AND MATERIALS**

### **6.1 Fire Barriers**

- 6.1.1 Unless otherwise specified, all Fire Barriers shall have a minimum Fire Resistance of 4 hours to BS 476.
- 6.1.2 Where a building, or part thereof, is situated within the Fire Damage Zone its walls and roof (as appropriate) may be provided with 4 hour Fire Resistance as an alternative to a free standing Fire Barrier, subject to the requirements of Section 3.6.
- 6.1.3 When requested by National Grid, evidence shall be provided that materials used to construct Fire Barriers have been tested to determine Fire Resistance in accordance with BS 476 and the requirements of this Specification.

### **6.2 Oil Containment Facility**

- 6.2.1 For details of the sizing, construction and rate of discharge to the Oil Containment Facility, reference shall be made to TS 2.10.01 Oil Containment.
- 6.2.2 The Oil Retaining Areas of transformers and reactors shall be connected to an underground Oil Containment Facility compliant with TS 2.10.01 Oil Containment. Stone chipping shall not be used as a passive extinguishing medium.

INFORMATIVE: Historically stone chippings or similar have been used to surface the base of 'bunds'. This has proven problematic from the health and safety perspective when inappropriately sized or shaped stone has formed tripping and/or stepping hazards and from the environmental and commercial perspective when contaminated waste in the form of Oil stained chippings requires specialist disposal. Additionally the presence of a stone layer often prevents the early identification of drainage and/or oil leakage problems.

### **6.3 Protection of Oil Filled Power Cables in Substations**

- 6.3.1 No protection is required for power cables installed in troughs back-filled with sand or weak-mix concrete.
- 6.3.2 Unless agreed otherwise with National Grid, cables within Integral Cable Ways and basements shall be protected by incorporating a flame retardant over-sheath or intumescent coating. In addition, protection of adjacent circuits shall be achieved by one of the preferential hierarchy outlined in Clause 3.3.4
- 6.3.3 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 3.3.4 shall be followed.
- 6.3.4 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.
- 6.3.5 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.

- 6.3.6 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.
- 6.3.7 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.
- 6.3.8 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.
- 6.3.9 Detectors for the toxic products of combustion shall be installed in Integral Cableways and cable basements.
- 6.3.10 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.
- 6.3.11 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.
- 6.3.12 All ventilation grilles shall be fitted with louvres that close automatically in the event of fire being detected.

#### **6.4 Auxiliary Cables - Including Protection, Control and Telecommunications Cables**

- 6.4.1 Material requirements for cables and supporting cable trays in indoor locations and confined spaces such as integral cableways and cable basements are given in TS 3.10.2.

#### **6.5 Protection of Standby Diesel Generators**

- 6.5.1 Refer to TS 2.10.01 Oil Containment for requirements for protection of diesel generators

#### **6.6 Protection of Oil Storage Tanks**

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

#### **6.7 Steelwork**

- 6.7.1 Requirements for fire protection to steelwork are given in TS 3.10.12 Structural Steelwork and Aluminium.

#### **6.8 Buildings**

- 6.8.1 Requirements for substation buildings including fire resistance and detailing are given in TS 2.10.10 GIS and Substation Buildings.

#### **6.9 Active Automatic Fire Protection Systems - Water Spray Type**

- 6.9.1 Systems shall be designed to automatically extinguish a high temperature oil fire. Such fires may be initiated by high power electrical arcing and will become established within a few seconds; systems designed to limit fire spread by cooling will therefore be ineffective.

- Unless otherwise specified or agreed by National Grid, the fire protection system shall be of the high velocity water spray type and shall comply with all relevant requirements of this specification.
- 6.9.2 The specification for other types of Active Automatic Fire Protection System shall be agreed between National Grid and the Contractor.
- 6.9.3 The installation shall consist of a water storage tank, two independent 100% duty fire pumps, water main, air operated detection system using thermal bulbs, water spray nozzles and associated pipework, and all necessary control and alarm facilities. The water spray pipework downstream of the deluge valves shall remain dry at all times the system is in its detection state.
- 6.9.4 Fire pumps shall be diesel operated or, by agreement with National Grid, one may be electrically operated and one diesel operated.
- 6.9.5 Where an electrically operated pump is installed, the Contractor shall be responsible for ensuring the capability of the existing site LVAC system and carrying out any necessary reinforcements or modifications. Design studies and calculations shall be made available to National Grid and shall take account of future development options for the site as defined by National Grid. The requirements of NGTS 2.12 and NGTS 3.12.3 shall apply where appropriate. In this situation the fire pump shall be configured such that it cannot be supported by the site standby diesel generator(s) in any circumstances.
- 6.9.6 The system shall be suitable for automatic unattended operation and shall be such that routine inspections will not be required at less than monthly intervals.
- 6.9.7 The system shall comply with the appropriate design, construction and test requirements of BS EN 12845 for automatic sprinkler systems. It shall also meet the appropriate compliance criteria of the Loss Prevention Council including the LPC Tentative Rules for Medium High Velocity Water Spray.
- 6.9.8 The protection system shall automatically detect the outbreak of fire in each protected zone and shall automatically initiate the water release from the spray nozzles. The maximum time delay from operation of a detector to full water flow at the spray nozzles shall be 60 seconds.
- 6.9.9 Facilities shall be provided in the substation control room for manual initiation of the system in any protected zone.
- 6.9.10 The system shall be configured such that a disassociated fire will not activate it.
- 6.9.11 The protection system will generally be installed to protect high voltage power transformers and/or similar equipment. In these cases spray nozzles shall be located so as to ensure that, in addition to the main tank, cooler banks and fittings, the entire bushing assemblies and floor of the Oil Retaining Area are comprehensively covered by water spray.
- 6.9.12 Where equipment other than high voltage power transformers is to be protected then the extent of coverage shall be specified by or agreed with National Grid.
- 6.9.13 Operation of any one detector within a protected zone shall cause all the spray nozzles within that zone to operate.
- 6.9.14 The system shall be suitable for operation within an outdoor ambient temperature range of -25°C to +40°C. Where components are located within buildings, cubicles or enclosures then the Contractor shall be responsible for determining the minimum and maximum temperatures to which those components may be exposed (taking into consideration the full outdoor ambient temperature range specified) and to take this into account in his design.

- 6.9.15 The system shall apply water at a minimum rate of 25 litres/m<sup>2</sup>/ minute directly to the protected equipment. This flow rate shall apply to the area of the equipment not the bund plan area. A reduced rate of application to the floor of the Oil Retaining Area (which shall be considered as non-absorbing ground) will be acceptable.
- 6.9.16 The system shall run for a minimum of 10 minutes at full capacity unless specified otherwise by National Grid.
- 6.9.17 The minimum water pressure during operation shall not be less than 3.5 bar.

#### **Detectors**

- 6.9.18 The detectors shall be selected and installed such that design operating temperatures of the protected plant, high ambient temperatures or solar gain does not initiate operation of the system. The colour of the detection bulb shall indicate its operating temperature. All detectors shall be of types approved for use by the Loss Prevention Council.
- 6.9.19 All detectors shall be fitted with protective cages to avoid inadvertent or malicious breakage. Such a cage shall not impair the operation of the detectors.
- 6.9.20 In areas where fires with a smoke / no heat initiation phase could be present, suitable smoke detectors shall be provided. Such detectors shall initiate the appropriate zone of the Deluge System.
- 6.9.21 Smoke detectors are not required for protection of high voltage power transformers unless otherwise specified or agreed by National Grid. The Contractor shall advise National Grid of any specific risk factors known to him that might require the use of smoke detectors in specific installations to complement detector bulbs.
- 6.9.22 The clear distance between the heat detectors of an 'Active Automatic Fire Protection System' and the inside face of the walls of an adjacent 'Oil Retaining Area' (or bund) containing a transformer, reactor or similar item of plant defined as a 'Fire Hazard' shall be not less than 6 metres.

#### **Pipework**

- 6.9.23 The pipework shall be designed and supported so as to withstand the combined mechanical loads imposed by :
- (a) Operation of the system.
  - (b) 10mm radial ice coating on all pipework and supports located outdoors (excluding pipes installed in covered trenches).
  - (c) An effective wind speed of 34 ms<sup>-1</sup> from any direction.
- 6.9.24 The exposed water carrying pipework shall be suitably protected against freezing either by lagging, trace heating or a combination of both.
- 6.9.25 Pipework shall be protected both externally and internally against corrosion.
- 6.9.26 All exposed pipework and equipment shall be painted externally throughout its length in the appropriate colour as specified in BS EN 50272.
- 6.9.27 The trunk main pipework and the connection to the water company stopcock may be of high-density polyethylene (HDPE) where approved by the Loss Prevention Council for this use. HDPE pipework shall not be used in any areas that may be subject to fire or accidental mechanical damage.

- 6.9.28 Pipework shall be installed so as not to impede maintenance of the equipment being protected and shall not infringe the electrical clearances from live conductors specified in NGTS 2.1.
- 6.9.29 All pipework, both air and water, shall be fitted with suitable drain / blowdown manually operated valves with locking facilities in both open and closed positions.
- 6.9.30 All spray nozzles shall be of the single orifice type and manufactured from corrosion free materials.
- 6.9.31 All pipe fittings shall be of bolted or threaded construction. Clamp-type grooved mechanical couplings may be used on water main pipework.

#### **Water Supply**

- 6.9.32 The water storage tank shall be of sectional construction and designed to resist corrosion. The tank shall meet the requirements of a Type A suction tank as defined in BS 9990. The tank shall be sized to cover operation of the system for the single largest risk, as agreed with National Grid, for at least 12 minutes plus 15%. The tank shall be sealed to prevent leakage and suitably protected to withstand the specified ambient temperature range.
- 6.9.33 The water storage tank shall be located outside any Fire Damage Zone.
- 6.9.34 An access ladder and top platform compliant with BS 5395-3, BS EN ISO 14122 and BS 4592-0 shall be provided for access to the inlet water ball cock. A gauge shall be provided to indicate the water level in the tank. The gauge shall be clearly visible from ground level.
- 6.9.35 The system shall be connected to a suitable water supply from the utility company serving the site. The main water feed pipework shall be installed at a depth suitable to prevent freezing.

#### **Fire Pumps**

- 6.9.36 Two 100% duty fire pumps shall be provided and shall be installed in a prefabricated container unless otherwise agreed with National Grid. Integral diesel fuel storage shall be provided of sufficient volume to ensure a minimum run time of at least 30 minutes. Main and standby starting batteries shall be provided.
- 6.9.37 With one pump running, the sound pressure level measured 1m from the enclosure shall not exceed 85-dB (A).
- 6.9.38 The pump enclosure shall be sealed to prevent leakage of diesel fuel, oil or water and ventilation shall be provided. The enclosure shall drain to an Oil Containment Facility.
- 6.9.39 The fire pumps shall be located outside any Fire Damage Zone.
- 6.9.40 A drop in water pressure in the fire main shall initiate operation of the 'Main' pump. Operation of the 'Standby' pump shall be initiated if the 'Main' pump fails to start on demand.
- 6.9.41 The pumps shall be fitted with an automatic shutdown facility that operates after the end of the specified run-time and when there is at least 2 minutes water supply remaining. This shutdown circuit shall not interfere with the starting circuits of the pumps.
- 6.9.42 The pumps shall have sufficient water re-circulation to allow them to run without a deluge valve being operated for the duration of the fuel supply without the pump components overheating.
- 6.9.43 The position of pump suction and discharge valves shall be monitored and, if incorrect shall initiate the appropriate 'fire pump faulty/inoperative' alarm.

- 6.9.44 An emergency stop button shall be located inside the door to the pump enclosure.
- 6.9.45 Each fire pump / fuel tank shall be provided with fire detection and extinguishing equipment.
- 6.9.46 The diesel engines shall automatically shutdown in the event that there is insufficient oil pressure or high coolant temperature.
- 6.9.47 To cater for small drops in the water main pressure, a 415 V AC operated jockey pump shall be provided.

#### **Control**

- 6.9.48 A main control panel shall be provided remote from the fire pump enclosure located in a position agreed with National Grid (normally the site central control building). Facilities shall be provided on this panel to stop the fire pumps and to remotely trip each deluge valve.
- 6.9.49 A local control panel shall be provided in the fire pump enclosure which shall be fitted with an isolating switch to allow the automatic start functions to be isolated for test and maintenance purposes. A test run facility shall be provided on this panel for each pump.
- 6.9.50 The alarms and indications listed in Table 6-1 are indicative of the minimum requirements at the main and local control panels. The supplier shall provide any additional alarms necessary for safe and effective operation of the system. Alarm schedules shall be agreed with National Grid during the Scheme.
- 6.9.51 The fire pump faulty/inoperative alarm shall be repeated by means of a prominent indicator lamp located adjacent to the door of the fire pump house and clearly visible when leaving. A separate alarm lamp shall be provided for each pump.
- 6.9.52 Control equipment shall comply with all current EMC regulations. The Contractor shall also take into consideration in his design the EMC implications of locating control equipment in a HV substation environment. NGTS 2.13 may be used as guidance on the required performance levels.

Alarm	Location
Deluge Valve (Zone) Air Compressor AC Supply fail	Main panel
Deluge Valve (Zone) Air Compressor Fail	Main panel
Deluge Valve (Zone) Air Compressor Excess Running	Main panel
Individual Zone Detector Pipework Air Pressure Extremely Low	Main panel
Deluge Valve Operated	Main panel
Fire Pump Faulty/Inoperative	Main and Local panels
Fire Pump Running	Main and Local panels
Fire Pump Stopped Remotely	Main and Local panels
Main Panel Loss of DC Supply	Main and Local panels
Local Panel Loss of DC Supply	Main and Local panels
Main Panel Loss of AC Supply	Main and Local panels
Local Panel Loss of AC Supply	Main and Local panels
Water On (and Zone Indication e.g. SGT 1)	Main panel
Water Storage Tank Level Low	Main panel
Fire Pump Faulty / Inoperative	Main and Local panels
Fire Main Pressure Low	Main panel
Main Fire Control Panel Fault	Main panel
Pump House Temperature Low	Main and Local panels
Smoke Detect Zone (State)	Main panel
Jockey Pump Fail	Main panel
<p>All alarm relays within the main control panel shall be provided with one pair of volt free normally open and normally closed contacts to interface with National Grid alarm schemes.</p> <p>The main panel refers to that located in the National Grid control / relay block.</p> <p>The local panel refers to that mounted in the fire pump enclosure.</p>	

**Table 6-1 - Alarms and Indications**



- 6.9.53 Although demonstration of compliance with NGTS 2.13 is not mandatory, the Contractor shall ensure that the fire protection system will operate in accordance with the design intent under all credible power system conditions, including transient events.
- 6.9.54 The main control panel shall be fitted with a schematic mimic diagram of the system showing the complete system layout and status.
- 6.9.55 A lamp test facility shall be provided on the main and local control panels and for the pump house repeater alarms.
- 6.9.56 The control panels shall derive secure electrical supplies from the substation 110V DC distribution board. The voltage of this supply may vary within the range specified in NGTS 1 (87.5 to 137.5 V DC, nominally 125V DC).
- 6.9.57 Alternatively, the Contractor may utilise other non-secure supplies (e.g. 400/230V AC) but in these cases shall provide integral backup capable of maintaining system functionality for AC minimum duration of 6 hours.
- 6.9.58 The control panels shall be fitted with a local alarm accept / reset facility. In addition, provision shall be made to accept / reset these alarms via the substation control system.
- 6.9.59 Personnel on site shall be made aware that the system has operated by klaxon alarms located within the substation. These klaxons shall be supplied from the substation 110V DC distribution board and produce an audible tone of at least 120 dB.
- 6.9.60 The alarms and system mimic diagram can either be displayed on the main control panel via engraved, illuminated fascias or on a VDU.

#### **Deluge Valves**

- 6.9.61 All deluge valves shall be located in enclosures above ground. These enclosures shall be of sufficient size to allow easy inspection and maintenance of the valves and, where reasonably practicable, shall be located outside the expected risk zones.
- 6.9.62 Facilities shall be provided to isolate the water spray pipework from the fire main and to lock each isolation valve in both the open and closed positions.
- 6.9.63 A water operated alarm motor and gong shall be provided on each deluge valve.
- 6.9.64 Operation of the deluge valves shall only be initiated automatically by a loss of air pressure. Pressure surges and water hammer caused by whatever reasons shall not cause the deluge valves to pass water from the wet to dry sides. It shall be possible to manually trip the deluge valve from the local position to facilitate testing and emergency operation.

#### **Miscellaneous**

- 6.9.65 The system shall be designed and installed in accordance with relevant parts of NGTS 2.1.
- 6.9.66 Labelling shall be in accordance with NGTS 2.1. A laminated A4 sized schematic shall be provided at each deluge valve showing the schematic valve trim arrangement.
- 6.9.67 The control and auxiliary cabling for the system shall comply with NGTS 2.19.
- 6.9.68 All penetrations through walls, floors and ceilings shall be made watertight on completion.
- 6.9.69 All equipment and exposed metallic parts shall be bonded to the substation earthing system in accordance with NGTS 2.1 and NGTS 3.1.2. Where metallic pipework is installed in the vicinity of exposed high voltage conductors then the earthing of that pipework shall be capable of safely conducting the substation rated fault point current. Where pipework is

installed such that it may be touched from ground level ( $\leq 2.4\text{m}$  above a normally accessible area) then equipotential bonding shall be provided by appropriately dimensioned conductors. Fortuitous connections through pipe couplings will only be accepted as part of this bonding where the Contractor can provide evidence of long-term electrical stability.

- 6.9.70 The system as installed shall comply with the Pressure Systems Safety Regulations.
- 6.9.71 All isolation and drain valves forming part of the system shall have facilities for locking in both the open and closed position by means of a National Grid safety padlock.
- 6.9.72 Air compressors for the detector pipework shall be installed such that they can be readily replaced in the event of failure. Quick-release air couplings and plug and socket electrical connections (or other systems providing similar functionality) shall be provided.
- 6.9.73 Additional requirements apply to gutters of noise enclosures situated in areas served by an Active Automatic Fire Protection System. Refer to TS 2.10.07 for details.
- 6.9.74 Refer to TS 2.10.01 Oil Containment for requirements for disabling Bund Water Control Units in areas served by an Active Automatic Fire Protection System – Water Spray Type.

### **Testing**

- 6.9.75 The satisfactory operation of water spray systems shall be demonstrated on site. Other commissioning tests shall be proposed by the supplier and shall be subject to the agreement of National Grid. The results of tests shall be recorded on test sheets, copies of which shall be provided to National Grid. All commissioning to be in accordance with TP106.

## **6.10 Active Automatic Fire Protection Systems - Gas Type**

### **Transformers/reactors**

- 6.10.1 Systems of this type shall only be installed by agreement with National Grid and their requirements shall be agreed on a Scheme specific basis.
- 6.10.2 The entry point(s) to the protected zone shall be interlocked so that access cannot be obtained until the extinguishing media has been isolated. It shall not be possible to re-enable the extinguishing media until access doors are closed and secured.
- 6.10.3 Illuminated signs showing the system operational status shall be installed at all entry points to the protected zone. These shall be supplied from the substation 110V DC battery. A lamp test facility shall be provided at each sign.

### **Design Submissions**

- 6.10.4 The supplier shall submit the design calculations to confirm the expelled volumes of the extinguishing medium are sufficient to guarantee the fire is extinguished within the duration of operation of the installed system being proposed.

### **Equipment rooms in indoor substations**

- 6.10.5 In substations where the protection/control/telecommunication or LVAC services are housed centrally, i.e. the services are not dispersed around site in blockhouses, then the effect on the operation of the substation from a fire without those equipment rooms should be considered. Where it can be demonstrated through assessment that the room's construction, the intended use of the rooms or the equipment used within them does not support combustion, then no further action is required.

6.10.6 Following the assessment, where it can be seen that the room's construction, its intended use or the equipment within it can support combustion then either:

(a) All combustible materials associated with the room construction, its intended use or the equipment within it should be replaced as part of an asset replacement scheme with a non combustible alternative to control that risk.

or

(b) A (non-toxic) gaseous extinguishing system in accordance with BS 14520-1 should be installed to control the risk.

6.10.7 Examples of combustible materials (not exhaustive) that may promote combustion are oil impregnated cables, bitumen wrapped cables, vulcanised indian rubber (VIR) secondary wiring, flammable office furniture, paper records or permit books.

## **7 PROTECTION OF PEOPLE**

### **7.1 Fire Detectors & Alarms**

7.1.1 Fire detection & alarm systems shall be in accordance with the recommendations of BS EN 54. Detectors and alarm sounders shall be located such that they can be accessed for test, maintenance or repair without infringement of safety distances to HV equipment specified in TS 2.01.

7.1.2 Audible alarms shall be located so that they cover all areas to which personnel have access. Alarms shall also be transmitted to the substation remote control point by means of National Grid's data acquisition system.

7.1.3 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.

7.1.4 A Distributed Temperature Sensing (DTS) system complete with monitoring equipment shall be used for the detection of fires in cable basements and Integral Cableways. Smoke detectors shall also be provided.

7.1.5 Smoke detectors shall additionally be provided in each amenity room.

### **7.2 Personnel Safety**

7.2.1 In confined spaces where the exit route may not be immediately obvious, i.e. cable basements, switch-houses etc., luminous arrows shall be painted on the floor to clearly define the nearest and the nearest alternative escape routes.

7.2.2 A leaky feeder shall be installed within all confined spaces to allow the use of two-way radios in accordance with TS 3.08.02.

### **7.3 Fire Safety Signs**

- 7.3.1 All Fire Safety Signs must be in accordance with BS ISO 3864. Signboards shall be made of shock and weather resistant material suitable for the surrounding environment.
- 7.3.2 Warning Signs, 900mm × 450mm shall be affixed at each entrance to a substation or switchhouse bearing the following legend:

#### **FIRE WARNING**

##### **DANGER OF LIVE ELECTRICAL CONDUCTORS**

##### **BEFORE FIRE FIGHTING RING TELEPHONE NUMBER .....**

The appropriate emergency telephone number will be advised by National Grid.

- 7.3.3 Apparatus containing SF6 shall carry a suitable Warning Sign.
- 7.3.4 At the entrances to areas containing PVC covered cable, Warning Signs shall be displayed drawing attention to the hazard of toxic gases released by burning PVC as follows;

##### **PVC CABLE IS INSTALLED IN THIS BASEMENT**

##### **IN THE EVENT OF FIRE DANGEROUS GASES MAY BE PRESENT**

##### **PARTICULARLY AT LOW LEVELS**

- 7.3.5 A smoking and naked flame Prohibition Sign shall be installed adjacent to each entrance to a cable basement together with a Supplementary Sign as follows:

##### **NO SMOKING**

##### **NAKED LIGHTS AND WELDING PLANT**

##### **MUST NOT BE USED IN THIS BASEMENT**

##### **EXCEPT BY PERMISSION OF AN AUTHORISED PERSON**

## PART 2 – REFERENCES, DEFINITIONS AND DOCUMENT HISTORY

### 8 REFERENCES

This specification makes reference to, or should be read in conjunction with, the following documents:

#### 8.1 Her Majesty's Stationary Office

Regulatory Reform (Fire Safety) Order 2005, SI 2005/1541

The Building Regulations

The Pressure Systems Safety Regulations

The Electromagnetic Compatibility (EMC) Regulations

The Control of Substances Hazardous to Health (COSHH) Regulations

#### 8.2 British Standards Institute

Note: The date of issue of the standards listed below is purposely omitted. This is to allow designers to use the version of the document which is current at the commencement of the project.

BS 476	Fire Tests on Building Materials and Structures
BS 1710	Specification for Identification of Pipelines and Services
BS 3251	Specification-Indicator Plates for Fire Hydrants and Emergency Water Supplies
BS 4592-0	Flooring, stair treads and handrails for industrial use. Common design requirements and recommendations for installation
BS 5395	Stairs, Ladders and Walkways
BS 9990	Code of practice for non-automatic fire-fighting systems in buildings
BS ISO 3864	Graphical symbols – Safety colours and safety signs
BS EN ISO 14122	Safety of machinery. Permanent means of access to machinery Part 1: Choice of a fixed means of access between two levels Part 2: Working platforms and walkways Part 3: Stairways, stepladders and guard-rails Part 4: Fixed ladders
BS EN 54	Fire Detection and Fire Alarm Systems
BS EN 1886	Ventilation for buildings – Air handling units – Mechanical performance
BS EN 1991	Eurocode 1: Actions on structures and the UK National Annexes
BS EN 1991-2	Eurocode 1: Actions on structures exposed to fire (and UK NA)
BS EN 1992-2	Eurocode 2: Design of concrete structures – structural fire design (and UK NA)

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BS EN 1993-2	Eurocode 3: Design of steel structures – structural fire design (and UK NA)
BS EN 12845	Fixed firefighting systems. Automatic sprinkler systems. Design, installation and maintenance
BS EN 15004	Fixed fire-fighting systems – Gas extinguishing systems
BS EN 50272	Safety requirements for secondary batteries and battery installations

### **8.3 National Grid**

TS 1	Ratings and General Requirements for Plant, Equipment, Apparatus and Services for the National Grid System and Connection Points to it
TS 2.01	Substations
TS 2.10	Generic Electricity Substation Design Manual for Civil, Structural and Building Engineering
TS 3.10	Generic Technical Specification for Civil, Structural and Building Engineering
TS 2.12	Substation Auxiliary Supplies
TS 2.13	Electronic Equipment
TS 2.19	Ancillary Light Current Equipment
TS 3.01.02	Earthing
TS 3.5.12	Cable Tunnels and Cable Bridges
TS 3.8.2	Tunnel Communications
TS 3.12.3	Substation LVAC Supplies
TP106	Equipment Commissioning and Decommissioning

### **8.4 Fire Protection Association**

LPC Rules for Automatic Sprinkler Installations 2009

### **8.5 Loss Prevention Certification Board**

List of Approved Fire and Security Products and Services (LPCB 'Red Book', Volume 1)

List of Approved Companies and Approved Construction Products (LPCB 'Red Book', Volume 2)

Any components not specifically covered by the requirements of this document must comply with the appropriate British Standards Institution publications.

## 9 DEFINITIONS

**Active Automatic Fire Protection System** - An 'intelligent' system which detects a fire and extinguishes it.

**Bund Water Control Unit** - an 'intelligent' system that will automatically remove any rainwater but not oil from an Oil Retaining Area or Oil Containment Facility thereby maintaining the maximum storage capacity

**Competent person** - A person with enough training and experience or knowledge and other qualities to enable them properly to assist in undertaking the preventive and protective measures (defined in the Fire Safety Order).

**Deluge System** - An Active Automatic Fire Protection System that applies water to a fire under controlled conditions.

**Element at Risk** – plant, buildings, structures or any other items designated as requiring protection from the damaging effects of a Fire Hazard.

**Fire Barrier** - a wall or partition, the purpose of which is to prevent fire damage occurring to an Element At Risk from a Fire Hazard.

**Fire Damage Zone** – the area within which items are assumed to be liable to damage due to the effects of heat and flames from a fire.

**Fire Door** - a door designed and positioned to delay the spread of fire from one room or compartment to another.

**Fire Hazard** – plant or equipment capable of starting and/or fuelling a fire.

**Fire Pool** – the area immediately adjacent to a Fire Hazard that, in the event of a fire, is deemed to be burning.

**Fire Resistance** - the ability of an element of building construction to withstand exposure to a standard temperature / time and pressure regime without loss of its fire separating function or load bearing function or both for a given time (refer also to Section 3.6 for further explanation).

**Integral Cableway** - a cableway located within the boundary of a Substation which is an integral part of a Substation and to which access is necessary.

**Oil Containment Facility** – an underground storage area connected to an Oil Retaining Area specifically designed to contain major spillages and isolate the fuel supply from a potential source of fire, in accordance with TS 2.10.01.

**Oil Retaining Area** – the above ground, banded area around oil filled plant capable of retaining spillages or leaks, in accordance with TS 2.10.01.

**Separation Distance** - the distance between the edge of the Fire Pool and the boundary of the Fire Damage Zone.

## 10 AMENDMENTS RECORD

Issue	Date	Summary of Changes / Reasons	Author(s)	Approved By (Inc. Job Title)
1	April 2017	Replaces TS 3.01.03 & to comply with Eurocodes and General updates	Gibson Bhunu	EEPIG

## 11 IMPLEMENTATION

### 11.1 Audience Awareness

Audience	Purpose Compliance (C) / Awareness (A)	Notification Method Memo / letter / fax / email / team brief / other (specify)
Electricity Transmission Owner	A	e-mail
UK Construction	A	e-mail/Eurocodes Launch
Construction Delivery Units	C	Eurocodes Launch

### 11.2 Training Requirements

Training Needs	Training Target Date	Implementation Manager
N/A / Informal / Workshop / Formal Course		
Eurocodes Launch	25 May 2017	Phil Clements

### 11.3 Compliance

This document is essentially a reproduction of existing information previously available in TS 3.01.03 Limitation of fire risk at substations and some material from DH10 Substation Design Handbook. Consequently compliance is generally regarded as ongoing and retrospective application unnecessary in the main. Minor exceptions to this principle shall be incorporated into the works wherever possible and where not National Grid shall be advised via the appropriate project design management routes.

### 11.4 Procedure Review Date

5 years from publication date.



## PART 3 – GUIDANCE NOTE AND APPENDICES

### APPENDIX A – DATA FOR CALCULATING FIRE SEPARATION DISTANCES

Fire Pool Diameter (m)	Separation Distance (m)
5	4.671
10	7.388
15	11.825
20	14.894
25	17.647
30	22.322

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