

Welsh Health Estates Guidance Note: Sprinkler systems in healthcare premises



WELSH HEALTH **ESTATES**
YSTADAU IECHYD CYMRU



NHS
WALES
GIG
CYMRU

© Welsh Health Estates 2009

Published by Welsh Health Estates in February 2009

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior permission of the copyright owner.

Designed by Keith James Design Associates

Front cover images provided by Job GmbH through BAFSA.

Printed by AA Media, print and media management, Pontypridd

For further information please contact:

Anthony Pitcher

Senior Fire Safety Advisor

Welsh Health Estates

PO Box 182

Bevan House

24 – 30 Lambourne Crescent

Llanishen

Cardiff CF14 5GS

T. 02920 315500

F. 02920 315501

Internet www.wales.nhs.uk/whe

Intranet howis.wales.nhs.uk/whe

Contents

1	Executive summary	1
2	Purpose of this Guidance Note	2
3	Background	2
4	Legislative requirements	3
5	Firecode requirements	4
6	Sprinkler operation principles	4
7	Issues for consideration	5
	Responsibilities	5
	Maintenance	5
	Firecode trade-offs	6
	Quick response and concealed sprinkler heads	7
	Future flexibility	7
	Protection of concealed spaces (ceiling void protection)	8
	Points of ligature	8
	Legionella control	8
	Accidental and malicious damage	9
8	Cost considerations	9
9	Conclusions and recommendations	10
	Appendix A Existing and proposed sprinkler systems in Welsh hospitals	11
	Appendix B Case study	12
	Appendix C Ysbyty Aneurin Bevan drawing details	15/16
	Appendix D Further sources of information	17

1 Executive summary

- 1.1** Sprinklers are underused in the NHS in Wales and yet their potential contribution to property protection, to service continuity and to life safety should not be underestimated. Whilst fatalities due to fire in healthcare premises are rare, even the smallest of fires can result in significant disruption to the well-being of patients and the continuation of delivery of patient care.
- 1.2** Whilst there are no statutory requirements for sprinklers to be provided in hospitals with the exception of certain high rise buildings and certain commercial enterprises contained within hospitals, the general direction of Assembly policy within Wales suggests that the benefits of sprinklers will increasingly be given due recognition. This is further supported by the Department of Health's Firecode guidance which expects design teams to consider the advantages that might be gained by installing life-safety sprinklers throughout healthcare buildings.
- 1.3** Through an objective consideration of the subject of sprinklers, this Guidance Note highlights the many benefits that should be taken into account when considering their potential inclusion in design solutions, exploding some of the myths particularly in the area of water damage and costs.
- 1.4** NHS Trusts and their design teams should familiarise themselves with the content of this guide. They should ensure that the implications and potential benefits offered by sprinkler systems in healthcare premises are taken fully into account through a robust option appraisal process.

2 Purpose of this Guidance Note

- 2.1** Sprinkler systems are extremely effective in minimising fire losses in buildings as can be seen by the widespread use of this technology within industry in general and the retail sector in particular. Frequently, decisions concerning the use of sprinklers are informed by requirements of the insurance industry.
- 2.2** By contrast, the use of sprinklers within healthcare premises within the UK is rare. Their infrequent use is often due to a lack of understanding of the technology and a failure to appreciate the benefits they bring, particularly in terms of service continuity. Facts are often replaced with myths and the rationale behind many designs is often not supported by robust option appraisals. Anecdotal evidence within the NHS in Wales suggests that the reluctance to adopt sprinklers is often influenced by perceptions of excessive cost and misconceptions of potential water damage.
- 2.3** In the light of the current major modernisation programme within the NHS in Wales, it is important that decisions concerning fire safety in healthcare premises should be well informed. Accordingly, the purpose of this Guidance Note is to explode some of the myths surrounding sprinklers. It provides the NHS and its design teams with an objective overview of the key issues that should be considered when evaluating the merits of sprinkler systems for particular projects.
- 2.4** This Guidance Note recognises that the subject of fire sprinklers is complex. Users of this guide, who wish to pursue particular aspects of this technology in more detail, should refer to the list of sources included in Appendix D.

3 Background

- 3.1** Historically, sprinklers have a good track record for extinguishing fires in buildings. Whereas, traditionally, they used to be provided for property protection, over recent years their contribution to life safety has been increasingly recognised. This can be largely attributed to their good record of detection and suppression as well as their ability to reduce the size of fires to a greater degree than would otherwise be the case without sprinklers.
- 3.2** It is recognised that the life safety benefits of incorporating sprinklers are greatest outside the room of fire origin. However, with the use of fast response sprinklers there is evidence that even in rooms where fires originate, persons are better protected with such systems. In healthcare premises there are seldom fire fatalities. However, even the smallest of fires in healthcare premises can result in significant disruption to the well-being of patients and the continuation of delivery of patient care. Therefore, by minimising fire growth, sprinklers could have a significant benefit to continuity of service delivery and hence life safety, though this is difficult to quantify.
- 3.3** Within hospitals in Wales (refer to Appendix A), the majority of existing sprinkler installations are provided as a means of mitigating fire risks within local areas, usually as a compensating feature specified as part of a fire engineered solution. Recognising the potential benefits of sprinkler protection, Gwent Healthcare NHS Trust has commissioned two hospitals (Ysbyty Aneurin Bevan and Ysbyty Ystrad Fawr), currently under construction, that will include a sprinkler installation throughout. There are also numerous examples of private healthcare facilities throughout Wales that are protected with sprinkler systems, albeit these installations are primarily led by the insurance industry.
- 3.4** Sprinklers in healthcare premises should be installed in accordance with BS EN 12845 – *Fixed fire fighting systems - Automatic sprinkler systems - Design, installation and maintenance* (supported by

the Loss Prevention Council (LPC) rules), which is also the standard adopted for commercial premises. Alternatively, subject to the type of building being considered, a BS 9251:2005 *Sprinkler systems for residential and domestic occupancies* system may be specified i.e. for staff residences or residential homes.

- 3.5** Sprinkler installations are a specialist field. Therefore, designs, installations, servicing and maintenance should only be carried out by suitably qualified personnel, such as those certificated under the LPSI048/1050 scheme or FIRAS.

4 Legislative requirements

- 4.1** There are no statutory requirements for sprinklers to be provided in hospitals with the exception of high rise buildings (in excess of 30m) and in certain commercial enterprises contained within hospitals.
- 4.2** The Regulatory Reform (Fire Safety) Order 2005 does not require the inclusion of sprinklers in healthcare premises, although the healthcare guidance document supporting the Order does recognise their potential benefits. Furthermore, under Article 17 of the Order, where a sprinkler system is deemed necessary in order to safeguard the safety of relevant persons, the responsible person must ensure the installation is suitably maintained in efficient working order.
- 4.3** Within Wales, the Assembly recognises the potential benefits that sprinklers can have on life safety and property protection, as demonstrated by the following initiatives:
- ❖ Currently the Assembly is progressing a Legislative Competence Order¹ with the aim of introducing a requirement that sprinkler systems be installed in new residential/

domestic premises. This is primarily being pursued due to the number of fire fatalities occurring in residential/domestic settings.

- ❖ Furthermore, the Assembly has long recognised the problem and extent of arson in Wales and, building on previous reports², published the *Wales Arson Reduction Strategy*³ in 2007. This provides a focus for policy makers, practitioners and other stakeholders working in the field of arson reduction. (Within Wales during 2007, 39% of reported fire incidents in hospitals were attributed to arson). The benefits of sprinklers are recognised in this publication, primarily citing schools but also referencing other public buildings. One of the actions identified is to 'reduce the cost to society of fires in public buildings', noting that actions to increase the use of sprinklers in public buildings (which includes those of the NHS) should be explored with incentives introduced to encourage their use.

With regard to the healthcare sector, this action has not been fulfilled as yet although initiatives are currently being considered; however, the examples provided above serve to illustrate the direction of policy in future.

- 4.4** The Welsh Assembly Government's *NHS Wales Fire Safety Policy* issued under cover of WHC(2006)74 identifies two principle aims:
- To minimise the incidence of fire throughout the NHS estate in Wales; and
 - To minimise the impact from fire on life safety, delivery of service, the environment and property.

Whilst sprinklers will not prevent fires occurring, they will greatly assist in minimising their impact.

¹ National Assembly for Wales, (Legislative Competence) (No.7) Order 2008, Committee Report, June 2008

² Up in Flames (2003) - A report of the Community Fire Safety Working Group into Arson for the Welsh Assembly Government

³ Wales Arson Reduction Strategy, Report of the Joint Arson Group, August 2007, Welsh Assembly Government

5 Firecode requirements

- 5.1** The Department of Health's Health Technical Memorandum (HTM) series of Firecode publications adopted in Wales requires sprinkler protection to be installed only in high-rise hospitals i.e. those in excess of 30m above ground level and in certain commercial enterprises located within hospital premises. However, HTM 05-02 Para 6.94 states that '... the design team is expected to consider the advantages that might be gained by installing life-safety sprinklers throughout the building.' Any decision should be considered as an integral part of the fire safety strategy.
- 5.2** Firecode recognises that certain standards can be 'relaxed' where sprinklers are installed; these issues are explored further in Section 7. Firecode also states that, where sprinklers are installed to satisfy the requirements of Firecode or the Building Regulations, they should be regarded as a life-safety system. Life-safety systems are defined in BS EN 12845 as 'sprinkler systems forming an integral part of measures required for the protection of life'.
- 5.3** Life-safety systems require additional features, including duplicate water supplies, valve sets and pumps, increased zoning, fast response sprinkler heads (in certain circumstances), and increased monitoring of valves in accordance with BS EN 12845 Annex F.
- 5.4** Firecode and BS EN 12845, require that, where installed, sprinkler protected areas should be separated from non-sprinkler protected areas by at least 60 minutes fire resisting construction. Local exceptions to sprinkler coverage, for example en-suite facilities, may be permitted and need not necessarily be protected or enclosed.

6 Sprinkler operation principles

- 6.1** An automatic sprinkler system is designed to detect a fire and extinguish it with water in its early stages or hold the fire in check so that extinguishment can be completed by other means.
- 6.2** Firecode recommends that sprinkler systems provided for 'life safety' should be designed as 'wet pipe installations'. This means that the full network of distribution pipes and array of range pipes are constantly charged with water.
- 6.3** A sprinkler head is a heat-sensitive valve that opens to release a spray of water when the heat-sensitive element reaches a specific temperature. The sprinkler head's operating temperature is generally selected to be 30°C above the highest anticipated ambient temperature, normally being 68°C. Most sprinkler heads in the UK are of the glass bulb type (heads using a two-part metal link held together with fusible alloy are also available). The glass bulb or link applies pressure to a pipe cap, which acts as a plug and prevents water from flowing until the ambient temperature around the sprinkler reaches the operating temperature of the individual sprinkler head.
- 6.4** As each sprinkler head operates independently, it will only release water if sufficient heat reaches the individual bulb and causes it to fracture. Therefore, the number of activated sprinklers is limited to those near the fire. This also maximises the available water pressure over the point of fire origin. It is a myth that all sprinkler heads will operate simultaneously throughout the premises causing widespread water damage.
- 6.5** It is also generally acknowledged that during a fire incident, a sprinkler activation will cause less water damage than the Fire Service would using hoses.* Furthermore, a sprinkler head will discharge water almost immediately after the fire produces enough heat to activate the head at its defined temperature, thereby minimising potential fire growth, whereas the Fire Service will require time

to attend the premises and set up their equipment before the first hose jets can be directed at the fire. This additional time can result in a much larger fire, requiring more water to achieve extinguishment.

* (Sprinkler installations will be provided with sprinkler control valves, which can isolate the water supply to the whole system or individual zones. The decision to shut down an installation or zone which has operated because of fire should be taken only by the fire service. To assist this, the location of all stop valves should be clearly indicated.)

- 6.6** It is also a common misconception that a sprinkler system will discharge water upon activation of the fire alarm system. This is not possible with 'wet pipe installations' as these are typically totally independent of and are not linked to the fire alarm system. Typically, a sprinkler system would only be linked to the fire alarm on specialist systems such as 'pre-action or recycling installations', neither of which would be generally specified in a hospital.

Did you know?

Losses from fires in buildings protected with sprinklers are estimated to be 1/10 of those in unprotected buildings.

In buildings fully protected by sprinklers:

- 99% of fires were controlled by sprinklers alone
- 60% of fires were controlled by the spray from no more than 4 sprinklers

Source: *European statistics over 10-year period*

Accidental discharge of water from all causes is 1 in 500,000 (per year of service) - Source: *Loss Prevention Council*

Accidental discharge of water due to manufacturing defects is 1 in 14,000,000 (per year of service) - Source: *FM (USA) and Loss Prevention Council (UK) statistics*

7 Issues for consideration

- 7.1** The following issues may also influence the decision whether or not to install a fire sprinkler system:

Responsibilities

- 7.2** The Regulatory Reform (Fire Safety) Order 2005 requires that all passive and active fire precautions are subject to a suitable maintenance regime with the aim of ensuring that the precautions remain effective. This duty rests with the 'responsible person', who is deemed to be anyone in control of the premises or part thereof. Similar to other passive and active precautions, the standard for maintenance is generally outlined in the relevant British and European Standards supplemented by the manufacturers' and installers' recommendations. For sprinkler systems the responsibilities of the 'user' is defined by the installer, who has to provide the user with a logbook documenting the inspection and checking procedures for the system in line with the recommendations of BS EN 12845.

Maintenance

- 7.3** As with any form of active fire precautions, a sprinkler system requires planned preventative maintenance as well as robust procedures for reactive maintenance. In general, individual sprinkler heads are virtually maintenance free; therefore, any costs related to maintaining a system are associated with weekly tests to water motor alarms and the upkeep of additional water supplies/pump equipment.
- 7.4** BS EN 12845 outlines the requirements of the service and maintenance schedule where, typically, this would include the annual service of the water supplies, i.e. fire pumps, inspection and service to the sprinkler control valves including a full function test at the sprinkler control valve to ensure correct operation. (This is local to the control valves and does not discharge water through the heads). The BS also recommends 3 and 10-yearly routines for water tanked supplies.

- 7.5** BS EN 12845 Annex F stipulates additional precautions during maintenance of life-safety systems, such as limiting the number of zones and the length of time these are isolated for maintenance.
- 7.6** Under BS EN 12845 Annex K, a 25-year function test of sprinkler heads is also recommended. Typically, the sprinkler heads are tested for the temperature at which they are activated, also conducting a water flow test, pressure test and function test. Furthermore, every 25 years, a sample(s) of pipework should be inspected to ensure clear waterway. Periodic thorough flushing to maintain a clear waterway is also recommended.
- 7.7** LPC Technical Bulletin 203 builds upon the recommendations of BS EN 12845, for example, stressing the importance of having appropriately trained staff and procedures to ensure fire safety during maintenance works on the sprinkler installation.
- 7.8** It is generally accepted in the sprinkler industry that correctly specified and installed sprinkler systems will not need any major modifications for at least 30 years. There are examples demonstrating that sprinkler systems installed in the 1920s remain in good working order – often having had only minor modifications since their first installation.

Did you know?

In January 2005, a fire in the laboratory of a paint factory in Oldham was extinguished by a sprinkler system installed, it was thought, in 1929. The system had had its water supplies upgraded in 2001 but was largely original. – *Source: BASA BIF No 6 Nov 2005.*

Firecode trade-offs

- 7.9** Firecode recognises that certain standards can be ‘relaxed’ if sprinklers are installed; hence HTM 05-02 Para 6.109 states, *Where sprinklers are installed, the guidance may be modified subject to a suitable and sufficient risk assessment being undertaken and the information being recorded in the fire safety manual.*

- 7.10** The following points summarise the recognised trade-offs permitted in Firecode:

- *progressive horizontal evacuation (paragraphs 5.4–5.11)* – the fire resistance of compartment walls on floors up to 12m above ground can be reduced from 60-minutes to 30-minutes integrity and insulation.
 - *glazing in sub-compartment walls (paragraphs 5.29–5.31)* – the size limitations on un-insulated glazing located in sub-compartment walls is not applicable where sprinklers are provided, i.e. there is no limit on the use of glazed screens that provide a minimum period of fire resistance of 30-minutes (integrity only), provided the glass is not of the type referred to as ‘modified toughened’. Compared to un-insulated glass, insulating glass is significantly more expensive; furthermore, removing the limitation allows greater design flexibility.
 - *elements of structure (paragraphs 6.2–6.4 and 6.11)* – where sprinklers are provided throughout the building the periods of fire resistance to elements of structure can be reduced by 30-minutes compared to a non-sprinklered building* i.e. 60-minutes could be reduced to 30-minutes. In terms of concrete framed buildings this is unlikely to have a significant cost benefit; however, in steel framed buildings the cost benefit could be significant. Where sprinklers are provided throughout the building the restrictions on the use of materials of limited combustibility can also be dispensed with.
- * The reduction in fire resistance is conditional upon clear instruction regarding the maintenance and inspection requirements for the sprinkler system.
- *compartmentation (paragraphs 6.5–6.11)* – for sprinklered healthcare buildings up to 12m above ground level the fire resistance of compartment walls can be reduced from 60-minutes to 30-minutes. In terms of construction cost this is only likely to result in minor cost savings, e.g. a 60-minute fire door could be reduced to 30-minute rating. However, as the walls would still be

considered to be compartment walls, they would still require fire smoke dampers (linked to the fire alarm system) as opposed to thermally actuated dampers to mechanical ventilation ducts penetrating the wall.

- *fire hazard rooms and areas (paragraphs 6.28–6.34)* – identified fire hazard rooms should be enclosed in 30-minute fire-resistant construction, unless sprinklers are provided, in which case the need to enclose fire hazard rooms in fire-resistant construction should be risk assessed. This is likely to have a significant cost benefit especially in facilities providing care for mental health or elderly occupancies, as the individual bedrooms do not necessarily have to be enclosed in fire resistant construction if sprinklers are provided.
- *external fire spread (paragraphs 6.63–6.76)* – space separation distances required between buildings or facing compartments can be halved if sprinklers are provided. In addition, external envelope protection requirements for re-entrant angle protection (i.e. 1m storey height fire resistant banding and 3m fire resistant protection to low level roof abutments) can be relaxed if sprinklers are provided. This element could allow for greater design freedom and yield potential cost benefits.
- *number and location of fire-fighting shafts (paragraphs 7.19 and 7.20)* – subject to the height above ground, the number and location of fire-fighting shafts is determined by the floor area and maximum hose layout distances (e.g. 1 shaft for every 1000m² or part thereof). If sprinklers are provided this ratio increases to 1:1500m², effectively reducing the number of fire fighting shafts required.

7.11 In addition to the above recognised trade-offs, the provision of sprinklers can be used to compensate for greater design freedom, more open spatial planning and extended travel distances. These issues would generally be specified as part of a more detailed fire engineered package of fire precautions.

7.12 There is no ‘trade off’ or relaxation of the requirements for an LI standard of alarm and

detection or a reduction in portable fire extinguisher provisions. Appropriate smoke detectors are more likely to raise the alarm, possibly enabling local intervention by staff utilising fire extinguishers, before sufficient heat is generated to activate the sprinkler system.

Quick response and concealed sprinkler heads

7.13 Firecode states that the performance of life-safety sprinklers can be enhanced by the specification of ‘quick response’ sprinkler heads. These enable faster activation of the system once the head has reached its operating temperature when compared with conventional heads, even though the operating temperatures will be the same for both types of head. This is related to the thermal inertia of the head, the sensitivity of which is expressed as the Response Time Index (RTI).

7.14 Where there is a perceived threat of malicious or accidental activation or where aesthetics are a key consideration and sprinkler heads may be viewed as unsightly, concealed heads could be specified. However, it is unlikely that concealed heads will be classed as ‘quick response’. Therefore, the use of these heads should be risk assessed, agreed by the approving/enforcing authority and documented as a deviation on the installation certificate.

Future flexibility

7.15 Hospitals are often considered to be dynamic environments subject to cyclic changes. The change of use of individual rooms or ward occupancies is unlikely to result in any significant complications with the sprinkler system. However, where alterations to the internal partitions are proposed (i.e. removing or erecting new partitions), it will be necessary to liaise with the sprinkler installation/maintenance contractor to ensure that the alterations do not negate the effectiveness of the installation.

7.16 Where modification of a sprinkler installation becomes necessary, robust procedures will also be required to ensure adequate fire safety during periods of isolation.

Protection of concealed spaces (ceiling void protection)

7.17 BS EN 12845 Clause 5.4 states *If the height of the concealed space at roof and floor exceeds 0.8m, measured between the underside of the roof and the top of the suspended ceiling or between the floor and the underside of the raised floor, these spaces shall be sprinkler protected. If the height of the concealed space at roof and floor is no greater than 0.8m, the spaces shall be sprinkler protected only if they contain combustible materials or are constructed with combustible materials. Electrical cables with voltage less than 250V, single phase, with a maximum of 15 cables per tray, are allowed.*

7.18 LPC Technical Bulletin TB230 has recently been redrafted; this provides more detailed guidance on the protection of floor voids, ceiling voids and roof spaces and may be used as an alternative to the above clause.

7.19 Generally, raised floor voids are not utilised in healthcare buildings. However, ceiling voids are prevalent and are often in excess of 0.8m in depth, which, in the light of the above clause, would necessitate the provision of ceiling void protection. However, following a systematic assessment of the risks and form of construction, an increase in the 0.8m threshold may be justifiable, thus omitting the need for ceiling void protection.

7.20 Any deviation from the requirements of BS EN 12845 should be formally documented in the fire strategy, recorded in the installation certificate and agreed by the approving/enforcing authority.

7.21 The cost exercise referenced in Section 8, indicates that the inclusion of ceiling void suppression will add approximately 20% to the overall cost of the sprinkler installation.

Points of ligature

7.22 Points of ligature are a concern especially in mental health facilities. It is possible that the body (yoke) of a traditional sprinkler head could be misused as

a point of ligature. Where this is a perceived risk 'institutional' sprinkler heads could be specified. These sprinkler heads were originally designed for use in prisons and mental health facilities to obviate the risk of the exposed sprinkler head being used as a point of ligature, whilst also reducing (not eliminating) the potential for tampering.

7.23 Where non LPCB-approved institutional type heads are specified, their use should be recorded in the installation certificate as a deviation.



Institutional (Anti-ligature) Sprinkler Tyco Fire & Integrated Solutions

Legionella control

7.24 Legionellosis can be contracted by inhaling fine aerosols (clouds of fine droplets/mist) from a water source contaminated with legionella. For human infection to occur, any legionella present in a fire fighting system would have to grow to an infectious level, be present in an aerosol and be inhaled by a susceptible individual. Generally, it is perceived that the medical condition of many patients would increase the potential for being susceptible to contracting legionellosis.

7.25 The Fire Protection Association and Loss Prevention Council have undertaken extensive research on this subject, although not specific to the healthcare environment. More information on this issue can be found in *Technical Briefing Note (TBN) – Legionella and Fire Fighting Systems*.⁴ This acknowledges that fire fighting systems may create inhalable water droplets; however, the TBN also

⁴ Technical Briefing Note - Legionella and Fire Fighting Systems is part of the LPC Rules for Automatic Sprinkler Installations published by the Fire Protection Association

acknowledges that the risk of catching legionellosis from a properly installed and maintained fire fighting system is probably negligible.

7.26 Generally, the conditions found within fire fighting systems are not thought to be able to support the growth of significant populations of legionella; furthermore the risk of transmission during operation is very low: the triggering conditions for a sprinkler would tend to preclude any unprotected person being in the operation area. Maintenance personnel and fire fighters are considered to be the people most likely to be exposed. However, well established testing and maintenance procedures should minimise the production of aerosols and the exposure to persons nearby.

Did you know?

There have been no recorded cases of legionella being contracted from any fire protection system anywhere in the World. – Source: BASA BIF No 6 Nov 2005.

Accidental and malicious damage

7.27 Sprinkler systems have the potential for accidental or malicious damage as is the case with any fire protection element. Statistically, the likelihood of a sprinkler head activating spuriously from any cause is 1 in 500,000. This is corroborated by research carried out by Welsh Health Estates (WHE) into accidental and malicious damage to the sprinkler systems incorporated in the hospitals listed in Appendix A. This confirms that there has been only one such instance, whereby a sprinkler head in close proximity to a faulty heater outlet activated.

7.28 The risk of accidental damage can be further mitigated with the provision of sprinkler head guards or concealed type sprinkler heads, in areas where heads may be exposed to potential damage.

7.29 An integral component of all sprinkler systems is an 'alarm valve'. Therefore, any activation will cause the water flow alarm to operate, thus alerting the occupants.

8 Cost considerations

8.1 The limited use of sprinkler systems in hospitals in Wales is partly due to a perception that this type of fire safety technology is more costly than traditional passive and active fire precautions, and is not generally affordable. In WHE's experience, however, decisions concerning design solutions adopted in many hospital projects in the NHS in Wales are made in the absence of a robust option appraisal involving sprinkler systems.

8.2 In an attempt to better understand the cost implications of design solutions based on sprinklers compared with traditional passive and active fire precautions, WHE commissioned consultants to carry out a cost evaluation based on a live project currently being procured under the Designed for Life: Building for Wales procurement framework. The details of that case study are included in Appendix B. Although the case study has its own limitations and points to the need for further research into the subject, the following conclusions can be drawn:

- 1 The capital costs associated with sprinkler systems are not necessarily greater than ones based on traditional passive and active fire precaution principles. Each case must be assessed on its own merits through a robust option appraisal process.
- 2 More particularly, sprinkler systems would appear to have a very significant beneficial impact on the design of hazard room enclosures, such as may be required in accommodation for elderly or mentally ill patients. In these cases, subject to risk assessment, the enclosure does not need to be fire rated, resulting in a number of benefits, including:
 - Greater design flexibility;
 - The possibility of including extensive glazing in the internal partitions without incurring the penalty of specifying expensive fire rated glass;
 - No requirement for fire dampers, which are often difficult and costly to maintain;
 - No requirement for fire rated doors.

8.3 In the case study undertaken in support of this Guidance Note the cost savings achieved by incorporating a sprinkler system were substantial, primarily because the extensive glazing included between the en-suite single bedrooms and the corridor did not require to be fire rated.

9 Conclusions and recommendations

9.1 The information contained in this Guidance Note points to the fact that sprinkler systems offer the NHS considerable benefits to life safety, property protection and continuity of service delivery. These are consistent with the aims identified in the Welsh Assembly Government's Fire Safety Policy for the NHS estate in Wales.

9.2 A number of misconceptions have developed around the use of sprinklers in healthcare facilities. However, a sound understanding of the technology, properly applied to the facilities under consideration, will result in an installation offering greater fire protection without the disadvantages that often preclude sprinklers from being specified.

9.3 NHS Trusts should undertake option appraisals of alternative fire precaution solutions which should include sprinkler systems.

9.4 The case study included in Appendix B demonstrates that there are circumstances where sprinkler installations offer a more economic solution than traditional passive and active ones.

9.5 Where the cost of sprinklers can be demonstrated to be higher than non sprinkler solutions, account should be taken of other benefits that cannot be easily quantified in financial terms, such as minimising disruption to patients, service continuity and reduced property damage. This approach is consistent with Firecode, which states that '... the design team is expected to consider the advantages that might be gained by installing life-safety sprinklers....'.

9.6 In the light of the information contained in this Guidance Note it is recommended that NHS Trust representatives and their appointed design teams should familiarise themselves with sprinkler technology and fully consider all of the implications and potential benefits offered by sprinkler systems in the design of healthcare premises.

Appendix A Existing and proposed sprinkler systems in Welsh hospitals

Name of Hospital	Location	Full/Partial	Comments
Existing			
Neath Port Talbot Hospital	Baglan	Partial	Wet Pipe - Central Atrium
University Hospital Wales	Cardiff	Partial	Wet Pipe - Basement and main circulation areas/lift cores, retro-fitted installation fire engineered solution to risks
Withybush Hospital	Haverfordwest	Partial	Wet Pipe - Administration area, partial protection to compensate for restricted space separation
Royal Glamorgan Hospital	Llantrisant	Partial	Wet Pipe - Main atrium and immediately adjoining departments, fire engineered solution to compensate for enclosed courtyard in Nucleus scheme
Royal Glamorgan Hospital (Mental Health Unit)	Llantrisant	Partial	Wet Pipe - Mental health facility atrium, fire engineered solution offering protection to adjoining patient areas
Morrison Hospital	Morrison	Partial	Dry Pipe* - Undercroft (below Tempest Burns High Dependency Unit.
Singleton Hospital	Singleton	Partial	Dry Pipe* - Basement (under Main Theatres / HSDU)
Central Clinic	Swansea	Partial	Dry Pipe* - Underground car park
Proposed			
Ysbyty Ystrad Fawr	Ystrad Mynach	Full	Wet to internal areas - Sprinklers provided throughout in-lieu of standard Firecode 'trade-offs', in addition to supporting more open planning to the hospital street 270 bed hospital, anticipated completion date 2011/12 Alternate system to undercroft car park area
UHW Tertiary block extension	Cardiff	Full	Wet Pipe - 7 storey extension partial compensation for restricted fire brigade access
Ysbyty Aneurin Bevan	Ebbw Vale	Full	Wet Pipe - Sprinklers provided throughout in-lieu of standard Firecode 'trade-offs' 107 beds, anticipated completion date 2010/11

* These systems were originally installed as alternate systems and are now used as dry pipe systems.

Appendix B

Case Study: Ysbyty Aneurin Bevan cost evaluation of fire precautions

Evaluation principles

The cost evaluation involved the comparison of four options based on Ward A at Ysbyty Aneurin Bevan (YAB), which comprises 32 single bed en-suite rooms. The hospital is currently under construction and was selected for the following reasons:

- Size – It is large enough to be typical in terms of Welsh hospitals; economy of scale etc.
- Cost data was readily available.
- A sprinkler system was specified.
- The Schedule of Accommodation (mainly elderly) is common to many hospitals and it is likely that the lessons learned from the YAB development, can be transferred to many new healthcare developments in the future.

The four options included in the cost evaluation were:

- Option 1 Ward A without sprinklers (assuming Elderly Occupancy)
- Option 2 Ward A without sprinklers (assuming Medical/Surgical Occupancy)
- Option 3 Ward A with sprinklers (including ceiling void suppression)
- Option 4 Ward A with sprinklers (without ceiling void suppression)

Each option was based on a fully code-compliant HTM 05/02 design, with the exception of Option 4 which addressed a derogation omitting ceiling void suppression. Option 4 was the actual strategy adopted for the YAB scheme. The fire strategy drawings were used in conjunction with the mechanical ventilation drawings and, where possible, the costs used in the evaluation were those provided by the framework supply chain partners; however, costs from Spons were also used where it was not possible to provide a unit cost based on the lump sum quotations provided.

The cost for Option 4 was calculated to be £52,202 as a proportion of the overall lump sum for the sprinkler installation for the entire hospital, based on the floor area of Ward A. The cost, therefore, includes an allowance for the control set and water supply etc. and has formed the basis of this evaluation.

Limitations of the cost evaluation

Section 7.9 of this Guidance Note outlines the standard recognised 'trade-offs' permitted in Firecode if sprinklers are provided. However, the scope of this evaluation only addresses the cost implications relating to the enclosure of 'fire hazard rooms'. Therefore, it is likely that a more detailed costing exercise, focussed on all of the 'trade-offs', such as elements of structure and external envelope protection, would identify further cost benefits offsetting the installation cost of sprinklers.

In addition, life cycle costing has not been addressed. For example, if Option 1 were adopted there would be an additional revenue cost for accessing and maintaining all 71 additional fire dampers on at least an annual basis. This should be offset against the costs of maintaining the sprinkler installation.

Furthermore, as the cost evaluation is scheme-specific, one should not assume that every finding should be capable of being replicated on other projects. However, there are lessons to be learned and many can be applied to future schemes, subject to careful use of the report data. The results of this evaluation should be used to inform designers and cost advisors at an early stage in the procurement process, when key design decisions must be made.

Cost comparison of options

The results of the options cost comparison exercise are summarised in the table overleaf.

Cost Comparison of Options				
Option	Description	Comments	Cost of fire precautions	Cost difference compared with Option 4
1	Elderly Occupancy without sprinklers	<p>Firecode requires that individual bedrooms for this class of occupancy include a 30-minute fire resistant enclosure incorporating:</p> <ul style="list-style-type: none"> thermally actuated fire dampers to mechanical ventilation (71xdampers per ward) fire doors to all hazard rooms including bedrooms (albeit excluding door closers to bedrooms) <p>Fire-rated glazing to the screens adjacent to bedroom doors achieving 30/30 integrity & insulation (i.e. Pyrostop or similar at a cost of approximately £650/m² totalling £53,034 per ward).</p>	£80,429	£28,227 more expensive than Option 4
2	Medical/ Surgical Occupancy without sprinklers	<p>Firecode does not require individual bedrooms for this class of occupancy to be enclosed in 30-minute fire resistant construction, therefore there would be no requirement for fire doors, fire dampers and fire rated glazing to the bedrooms.</p> <p>Other hazard rooms as identified in Firecode would still need to be enclosed.</p>	£1,617	£50,585 less expensive than Option 4
3	Ward A with sprinklers (Including ceiling void suppression)	<p>None of the identified hazard rooms or bedrooms require fire resistance. Suppression system provided in accordance with BS EN 12845 Ordinary Hazard group I.</p>	£64,681	£12,479 more expensive than Option 4
4	Ward A with sprinklers (Excluding ceiling voids)	As option 3 above excluding sprinkler heads from the complete ceiling void.	£52,202	£0

Case Study explanatory notes

1. Ward A has a floor area of 1,436m².
2. The costs are inclusive of: VAT, Supply Chain fees, and preliminaries, and are based at mid 2008 tender levels i.e. MIPS 544.
3. The cost of fire precautions identified above, relates solely to the features that can be varied through the recognised trade-offs if sprinklers are provided. It does not include costs for the fire precautions that are common to all four options, such as the provision of escape lighting, alarm and detection system, signage or portable extinguishers, as these features will be required regardless of the provision of sprinklers or not.
4. The design solution for Option 1 includes very expensive floor to ceiling fire-rated glazing as indicated in figures 2 and 3 included in Appendix C. If the quantity of glazing was to be halved, the cost of Options 1 and 4 would be comparable. However, if the glazing was to be omitted entirely, there would be a cost saving of approximately £25,000 compared with a sprinklered solution.
5. Firecode HTM 05/03 Part J cites further examples of potential cost savings associated with the provision of sprinklers in mental health/care of the elderly facilities.

Appendix C Ysbyty Aneurin Bevan drawing details

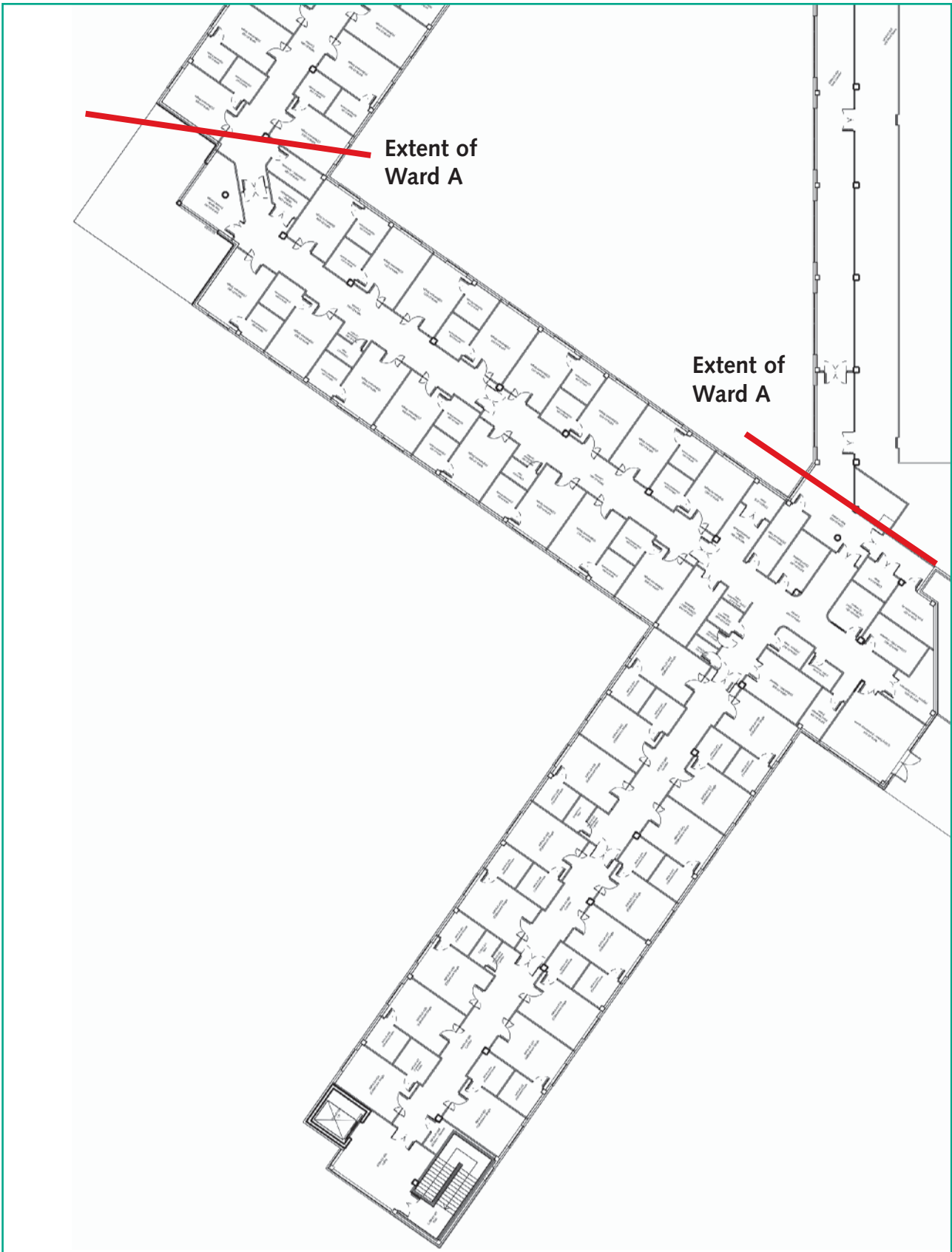


Figure 1 'Ward A' floor plan

Appendix C Ysbyty Aneurin Bevan drawing details

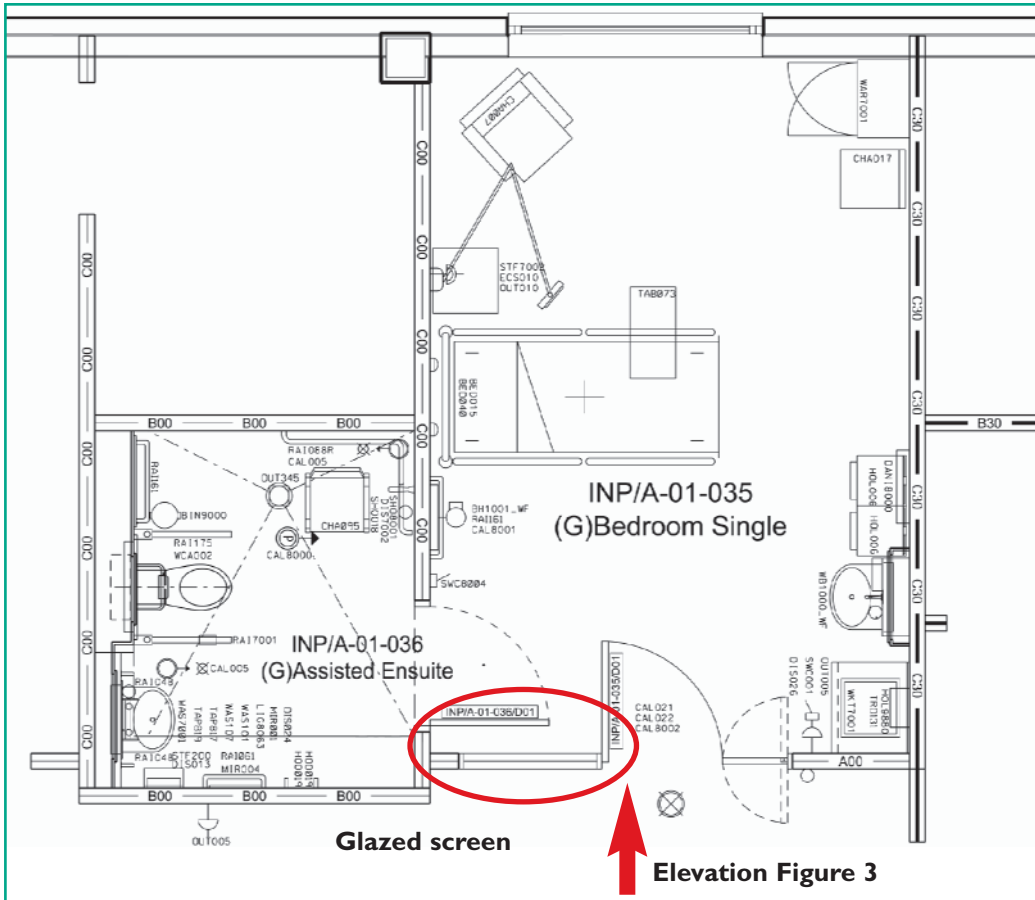


Figure 2 Typical single bedroom layout

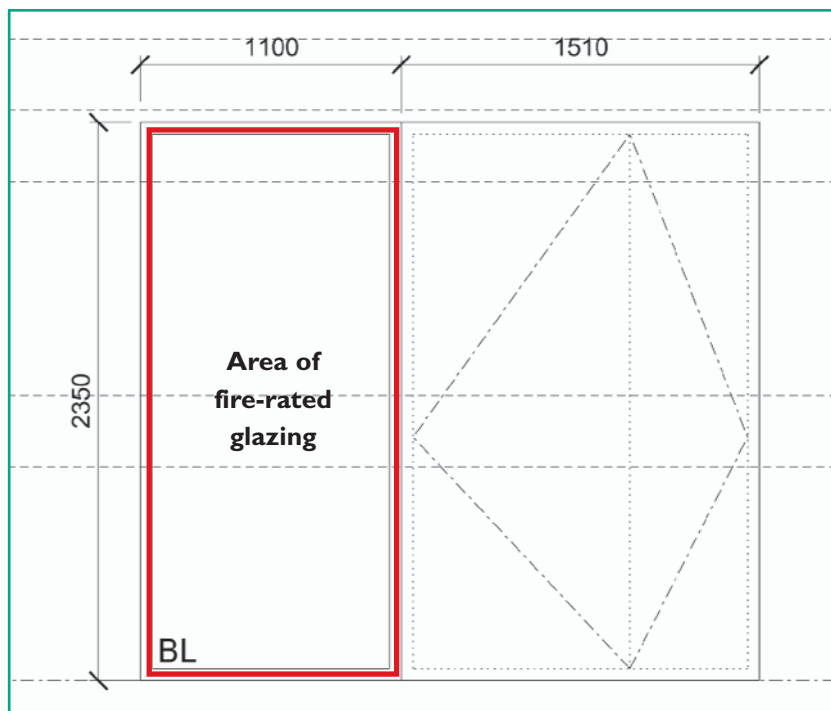


Figure 3 Elevation of glazed screen adjacent to door

Appendix D Further sources of information

Useful publications
BS EN 12845:2004 Fixed fire fighting systems – automatic sprinkler systems – design, installation and maintenance
LPC Rules for Automatic Sprinkler Installations incorporating BS EN 12845
Sprinklers for Safety – Uses and benefits of incorporating sprinklers in buildings and structures ARUP/BAFSA
Sprinkler Yearbook 2009/10 British Automatic Fire Sprinkler Association
Firecode HTM 05/03 Part J Guidance on fire engineering in healthcare premises

Organisations/Associations	
<p>BAFSA British Automatic Fire Sprinkler Association Ltd Richmond House Broad Street Ely Cambridgeshire CB7 4AH</p> <p>T. 01353 659187 F. 01353 666619 Email info@bafsa.org.uk Web http://www.bafsa.org.uk/</p>	<p>LPCB Loss Prevention Certification Board BRE Global Ltd Bucknalls Lane Watford Hertfordshire WD25 9XX</p> <p>T. 01923 664100 F. 01923 664994 Web http://www.bre.co.uk/global</p>
<p>European Fire Sprinkler Network 70 Upper Richmond Road London SW15 2RP</p> <p>T. 020 8877 2600 F. 020 8877 2642 Email info@eurosprinkler.org We: http://www.eurosprinkler.org/</p>	<p>FPA The Fire Protection Association London Road Moreton in Marsh Gloucestershire GL56 0RH</p> <p>T. 01608 812500 F. 01608 812501 Email fpa@thefpa.co.uk Web http://www.thefpa.co.uk</p>
<p>National Fire Sprinkler Network Web http://www.nfsn.co.uk</p>	

Acknowledgements

Welsh Health Estates is grateful to Faithful and Gould, the Designed for Life: Building for Wales National Cost Advisors and Davis Langdon, the Designed for Life: Building for Wales Trust Cost Advisors for their input into the cost comparison evaluation that informed the issues reported in Section 8.0 and Appendix B of this guide.

Welsh Health Estates is also grateful to BAM and Nightingale Associates for supplying the drawings included in Appendix C.

