ACTIVE FIRE SUPPRESSION IN TRADITIONAL BUILDINGS

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REMINDER: THE RISK ASSESSMENT – ALL OCCUPIED BUILDINGS

- The purposes of risk assessment should be to:
  - Identify people especially at risk (including firefighters)
  - Eliminate/mitigate hazards where possible
  - Control by identifying appropriate measures
  - Avoid and prevent fires
  - Provide a framework for fire safety improvements

THE RISK ASSESSMENT: TRADITIONAL AND HERITAGE BUILDINGS

- The purposes of a fire risk assessment should be to:
  - Identify people especially at risk (including firefighters)
  - Eliminate/mitigate hazards where possible
  - Control by identifying appropriate measures
  - Avoid and prevent fires
  - Provide a framework for fire safety improvements
  - Consider the heritage, aesthetic and cultural value of the building and its contents
  - Consider the potential impact of firefighting activities

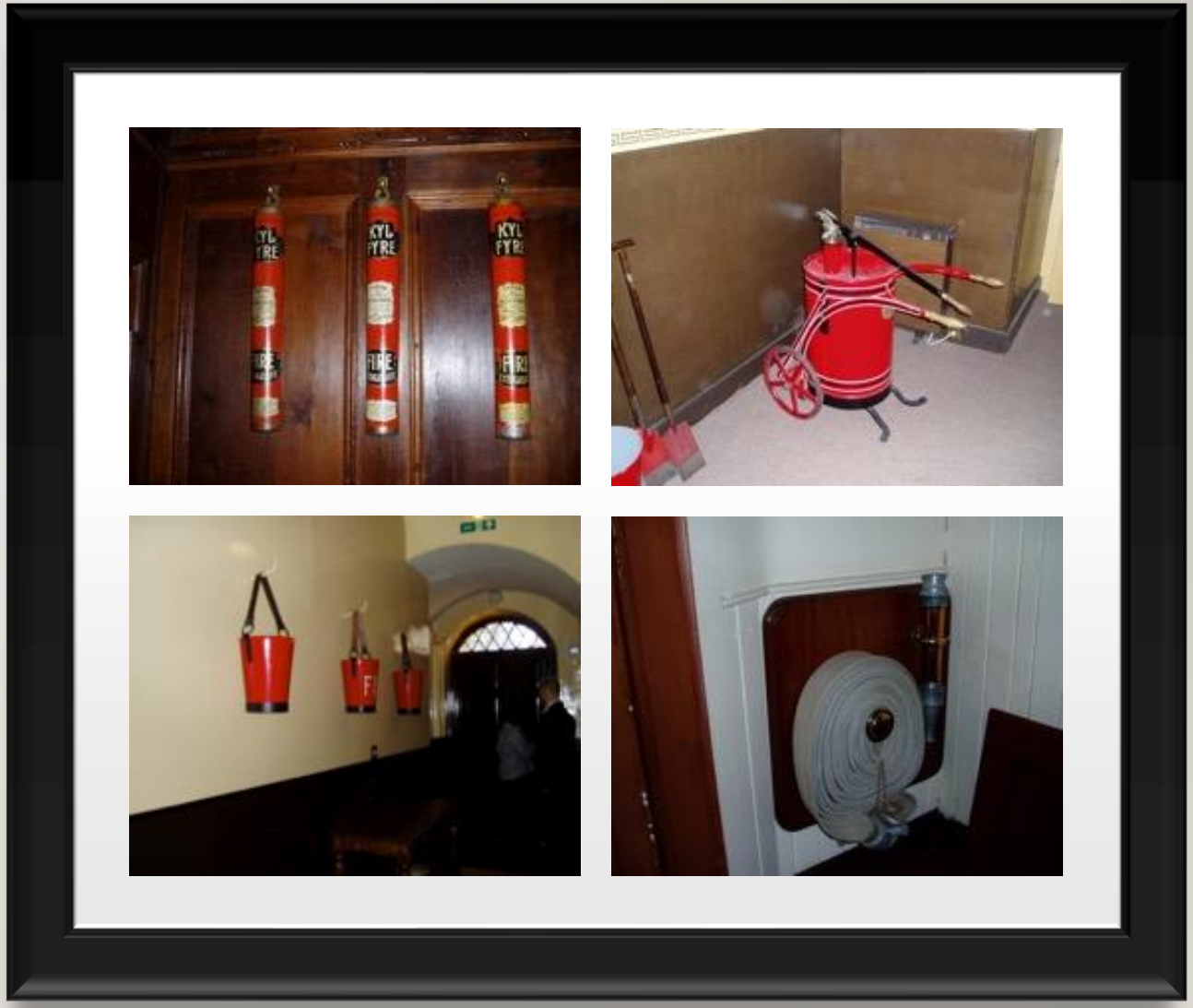
TRADITIONAL BUILDINGS – THE FIRE RISKS

- The age of the building will usually determine its type of construction and the inherent fire risk
- Fires spread more easily where there is insufficient compartmentation and where there are unstopped shafts, ducts, voids and flues
- Some traditional and heritage buildings are unoccupied for long periods and are often located where the F&RS will have water supply problems. This has historically been a factor in many fires in rural locations.
- Risk assessments matter - as for any building - but here should include consideration of the impact of fire service intervention and property/contents protection considerations

Culzean Castle:
Hydrant and Fire Pond

FIRE PROTECTION EQUIPMENT

- Fire detection and alarm – including off-site
- Means for securing means of escape
- Compartmentation
- Smoke control
- Portable fire extinguishers and hose reels
- Wet/dry risers for fire service use
- Automatic fire suppression



Mansion House Fire Equipment 1880-1920

AUTOMATIC FIRE SUPPRESSION: THE CHOICES

FOR A WHOLLY INDEPENDENT VIEW, REFER TO BS 5306 PART 0: 2020

- Gas systems
  - Inert gases
  - Halocarbon gases
- Water based systems
  - Sprinklers
  - Water mist
  - Foam
- Powder systems
- Air inerting/oxygen reduction systems

TABLE 1: BS 5306 PART 0: 2020

Table 1 — *Method A: Typical examples of fixed firefighting system by building occupancy (or part thereof) — by common purpose groups (1 of 2)*

System type	Suitability according to purpose group													
	Domestic	Residential	Residential (mixed use e.g. residential + commercial)	Hotel	Office	School and educational	Warehouse	Data centre	Laboratory or cleanroom	Places of assembly or recreation	Licenced premises (bars and restaurants)	Retail	Hospital	Factory or process facility
Sprinkler to BS 9251	●	●	◐[A]	◐[B]	○	○	○	○	○	○	○[C]	○	○	○
Sprinkler to BS EN 16925	●	●	◐[A]	◐[B]	○	○	○	○	○	○	○	○	○	○
Water mist to BS 8458	●[D]	●[D], E]	◐[A], D], E]	◐[B], D], E]	○	○	○	○	○	○	○[F]	○	○	○
Sprinkler to BS EN 12845	●[A]	●[A]	●	●	●	●	●	◐[G]	◐[H]	●	●	●	●	●
Water mist to BS 8489-1	○	◐[D], I]	◐[D], I], J]	◐[D], K]	◐[D], L]	◐[D], M]	○	◐[D], N]	○	◐[D], J]	◐[D], J]	○	○	○[O]
Foam to BS EN 13565-2	○	○	○	○	○	○	◐[P]	○	◐[P]	○	○	○	○	◐[P]
Powder to BS EN 12416-2	○	○	○	○	○	○	○	○	○	○	○	○	○	◐[Q]
Water spray to DD CEN/TS 14816	○	○	○	○	○	○	◐[R]	○	○	○	○	○	○	◐[R]
Aerosol to BS EN 15276-2	○	○	○	○[S]	○[S]	○[S]	○[S]	○[S]	○[S]	○[S]	○[S]	○[S]	○[S]	◐[S]
Gaseous extinguishing to BS EN 15004-1	○	◐[I]	◐[I]	◐[I]	◐[I]	◐[I]	◐[I]	◐[G]	◐[H]	◐[I]	○	◐[I]	◐[I]	◐[I]
Gaseous extinguishing to BS 5306-4	○	○	○	○	○	○	○	○	○	○	○	○	○	◐[Q]
Oxygen reduction systems to BS EN 16750	○	○	○	○	○	○	◐[T], U], V]	◐[U], V], W]	◐[U], V], W]	○	○	○	◐[Q], U], V]	○
Personal protection systems to LPS 1655 [8]	◐[X]	◐[X]	◐[X]	○	○	○	○	○	○	○	○	○	○	○

Key

● Suitable if in full compliance with cited standard.

◐ Suitable for specific applications or areas within this purpose group, if in full compliance with cited standard and paying particular attention to accompanying footnotes.

○ Unsuitable (out of scope of the system design, installation and maintenance standard).

GASES FOR FIRE SUPPRESSION

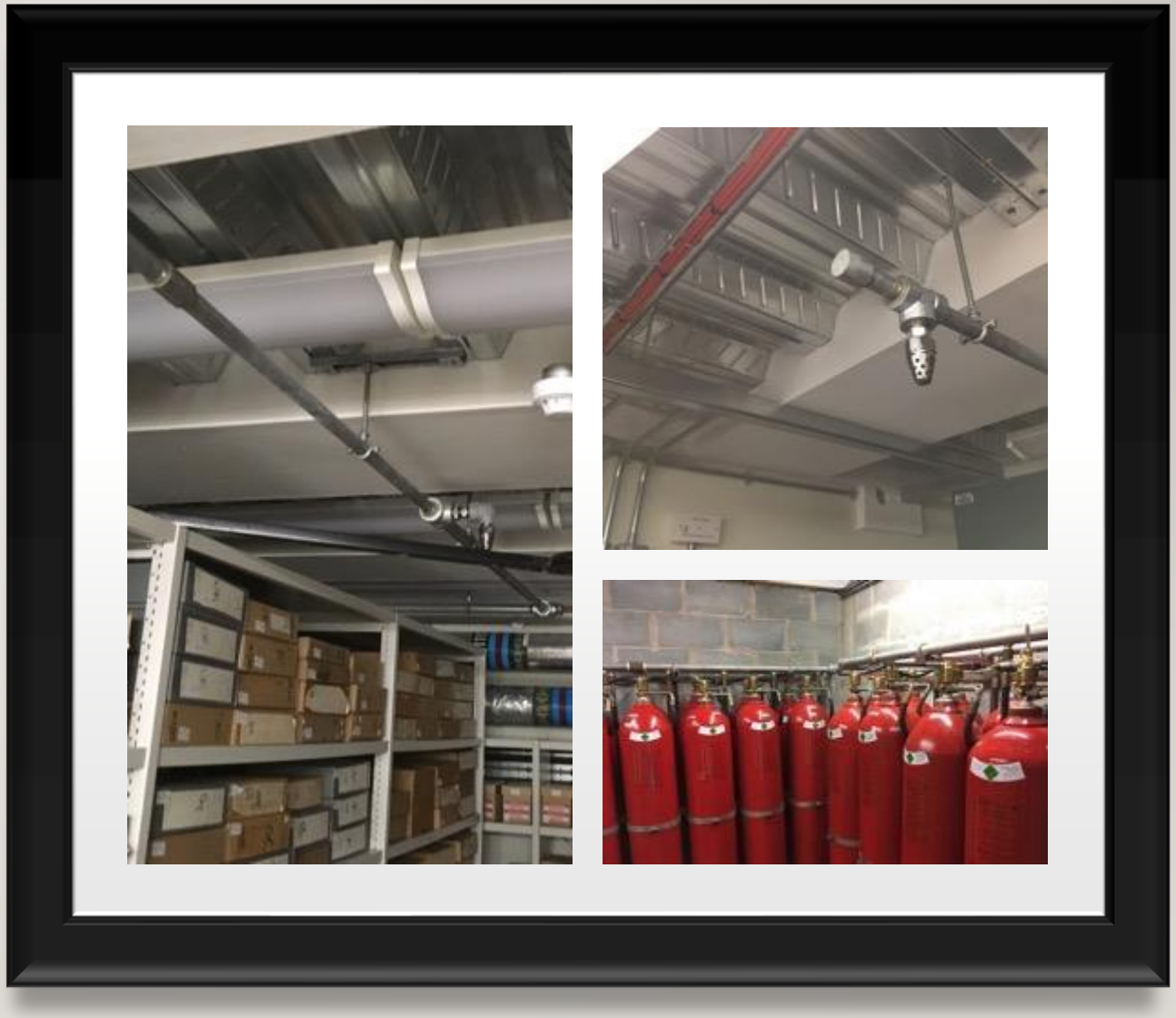
- All the chemical gases contain Fluorine which in a fire will degrade to form Hydrogen Fluoride and this may then form Hydrofluoric Acid.
- *All the HFC gases are subject to review under the EU's 2015 F Gas Regulations

Inert Gases	Trade Names	Chemical Composition
I-501	Argotec®, Argofire®	Argon 100%
IG-55	Argonite®	Argon 50%, Nitrogen 50%
IG-541	Inergen®	Argon 40%, Nitrogen 52%, CO_2 8%
Chemical Gases		
HFC-227ea	FM-200®, FE 227, Solkflam 227, MH 227, Typhoon®	C_3HF_7 (HFC)*
HFC-236A	FE-36®	$C_3H_2F_6$ (HFC)*
FK-5-1-12	NOVEC 1230®	$C_6F_{12}0$

INERT GAS SYSTEMS

ALL GAS SYSTEMS WILL REQUIRE SUBSTANTIAL STORAGE SPACE AND MAY CREATE FLOOR LOADING PROBLEMS

- Much to be preferred over chemical gas systems – most contain fluorine and can generate corrosive by-products
- IG-541is inherently safe for occupied areas and provides flexibility in mobile racking in libraries and archives
- CO2 can also be used but requires large volumes of gas and storage areas for cylinders
- Soon, the chemical agents are likely to face restrictions on their use or even outright bans



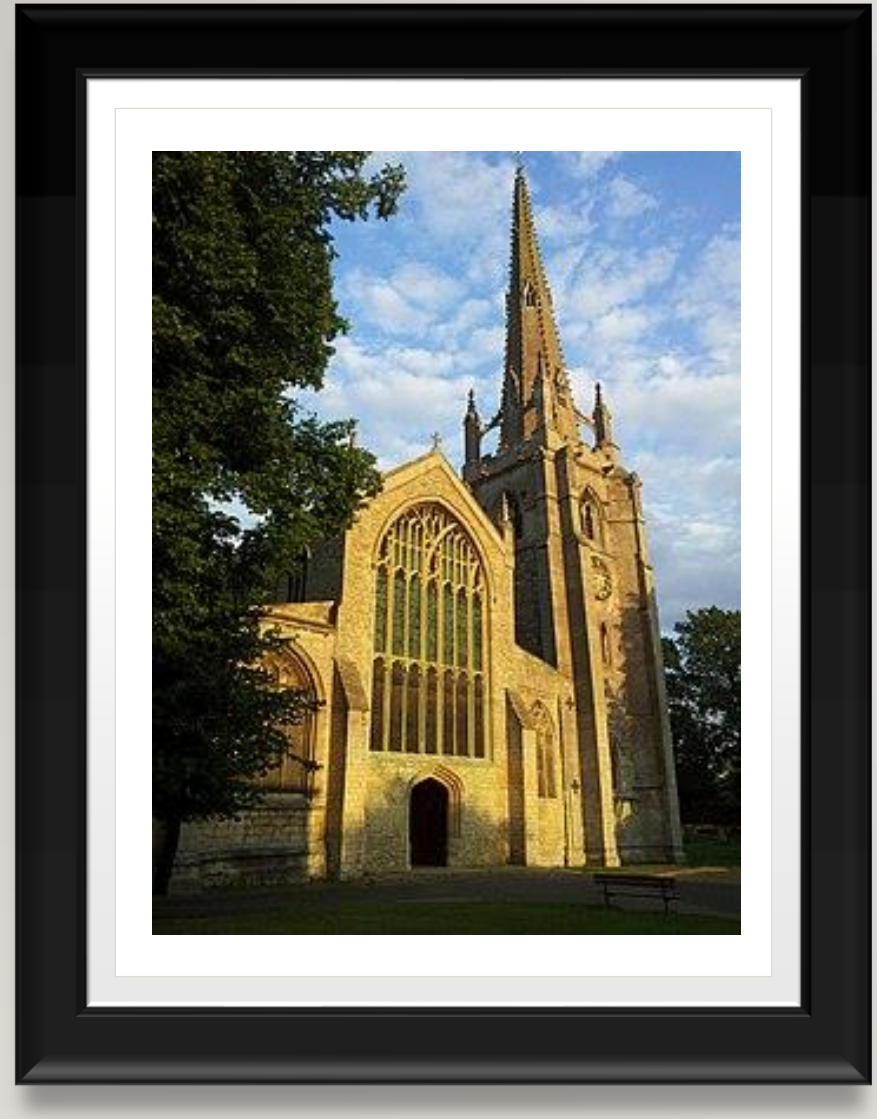
OTHER SYSTEMS

Air Inerting (Hypoxic) Systems

- Reduces oxygen levels to below 16/17% to prevent combustion
- Superficially attractive for heritage protection
- Can be used for large new book/art/textile or natural history storage buildings
- But:
  - Compartmental integrity?
  - Energy costs?
  - Life safety?
  - Noise issues from compressors?

Foam

- Offers no benefits over water (sprinklers and mist) for 'normal combustibles'
- Still requires water supply, pumps and pipework and visible discharge heads
- Many foam compounds are slightly acidic
- Foam compound costs have increased significantly and some are now banned
- Discharge of foam run-off to sewers is forbidden and into watercourses will attract fines

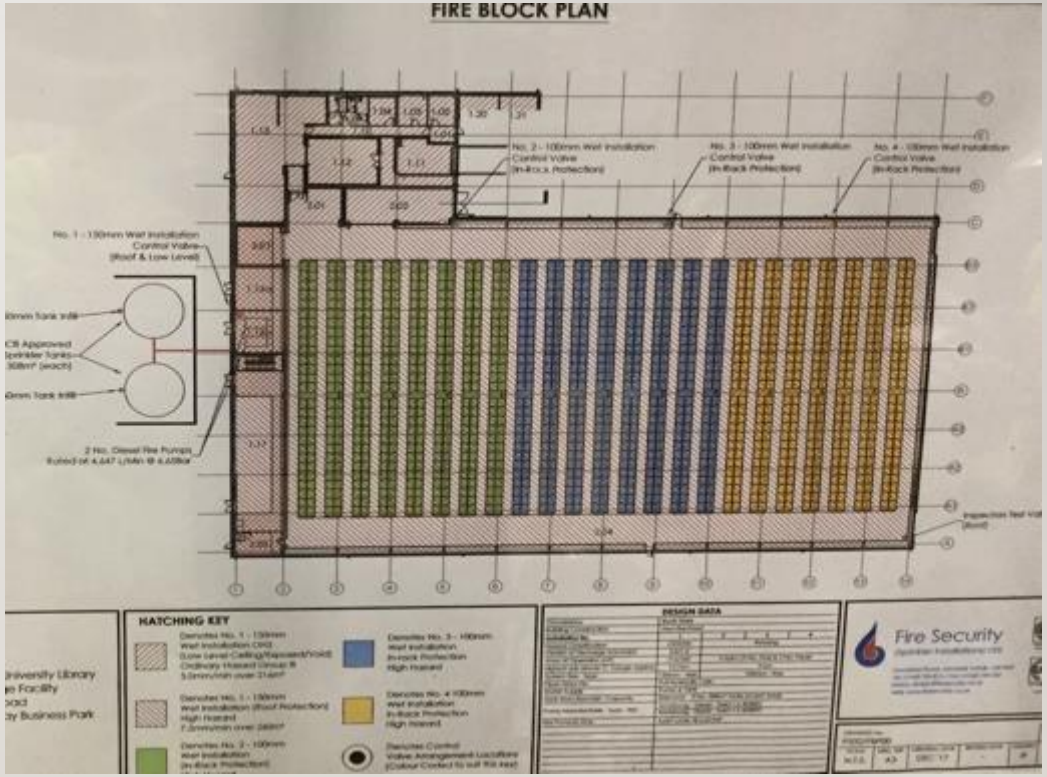


OTHER ALTERNATIVES: POWDER

- In a word, NO !
- In two words, Please, NO !
- Spalding Parish Church: Willful discharge of one 6kg dry powder extinguisher resulted in clean-up costs of £250,000 – and litigation
- All heritage and conservation bodies, including the Cathedral Architects' Association now retrict their presence inside heritage and historic buildings

SPRINKLER SYSTEMS – PROS

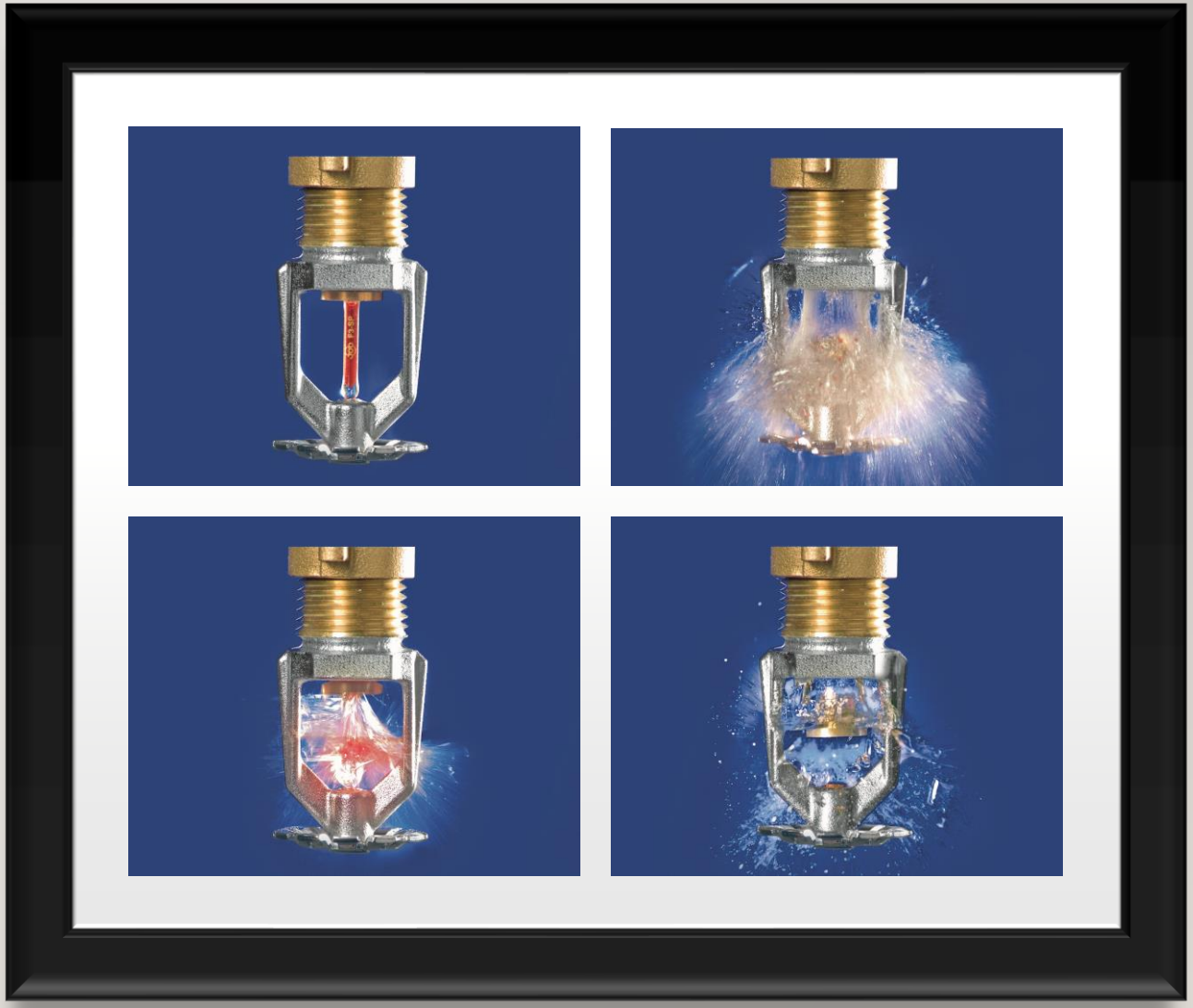
- Detect, warn, report and suppress fires - automatically
- Very low probability of false alarms/spurious actuation
- Ideal for properties which are often left vacant for long periods
- All parts of the building are normally protected
- Will compensate for inadequate compartmentation
- Will compensate where fire service response is restricted due to weather or terrain or poor water supply
- Protect means of escape so ideal solution when there is only one escape route/staircase
- Very effective at enabling old buildings to meet intent of modern regulations



Cambridge University Library Off Site Store

SPRINKLER SYSTEMS – CONS

- Potential for water damage can be an issue in premises which are left empty for long periods – waterflow alarms are essential, interconnected to an Alarm Receiving Centre and should be specifically labelled as such
- Frost problems, particularly in roof spaces – trace heating/lagging and anti-freeze may be needed.
- Tanks and pumps may be required
- Pipework may have to be surface run if floorboards cannot be lifted. Boxing in may be possible. Where possible, existing voids/ducts should be used



WATERMIST SYSTEMS (1)

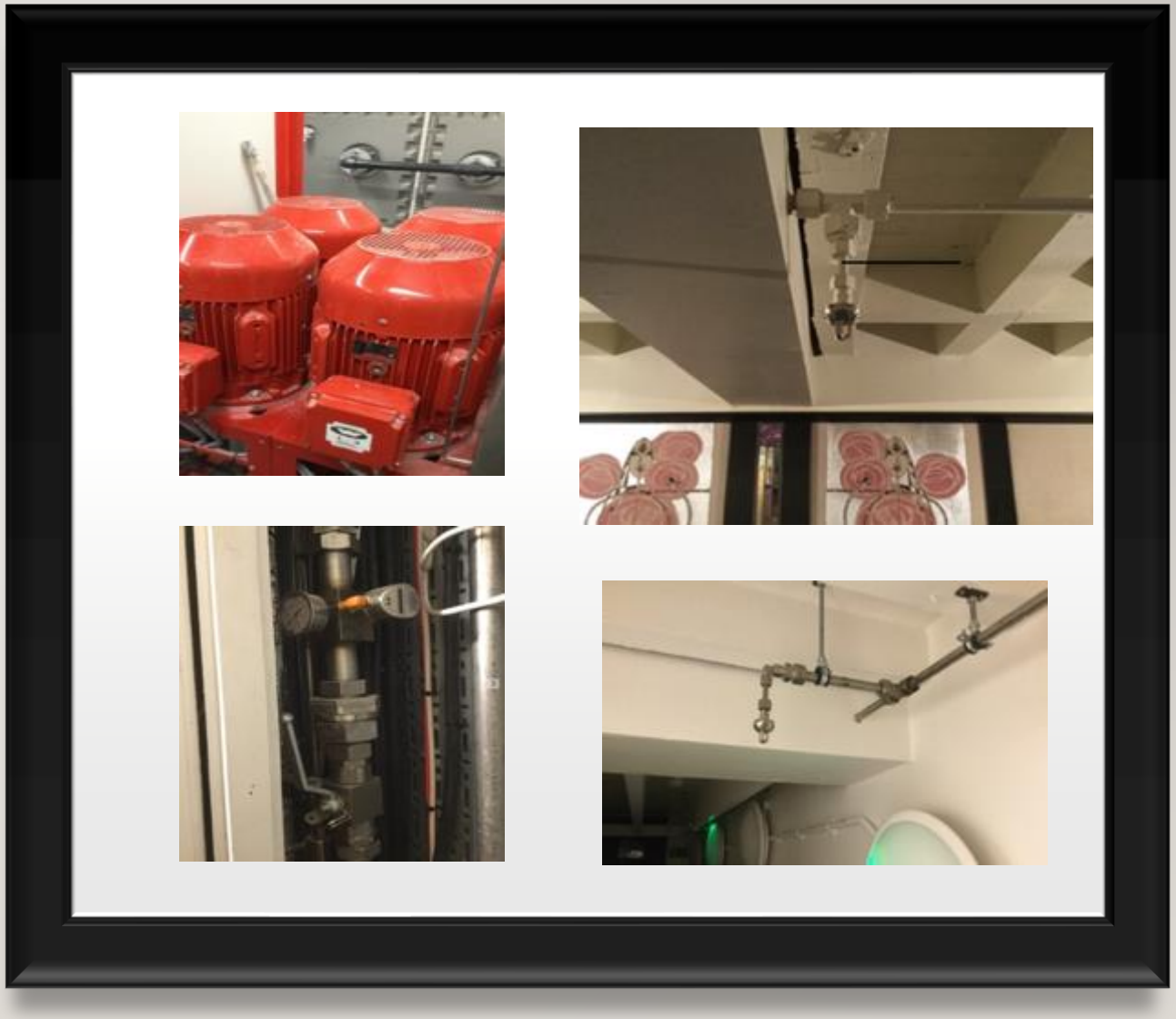
High Pressure

- 20 – >200 Bar
- Requires specialist pumps or high-pressure gas supply
- Usually needs stainless steel pipework
- Usually need high-quality water supply
- Heads can be open (with separate detection system) or closed (thermal glass bulb - as for sprinklers)

Low Pressure

- 12 – >20 Bar
- Pumps 'off the shelf'
- CPVC plastic, copper or steel pipework
- Heads can be open (with separate detection system) or closed (thermal glass bulb - as for sprinklers)
- Water must be free from solids

HIGH PRESSURE WATERMIST AS COMPENSATION FOR SINGLE WOODEN STAIRCASE IN CATEGORY 'A' LISTED BUILDING



WATERMIST SYSTEMS (2)

Pros

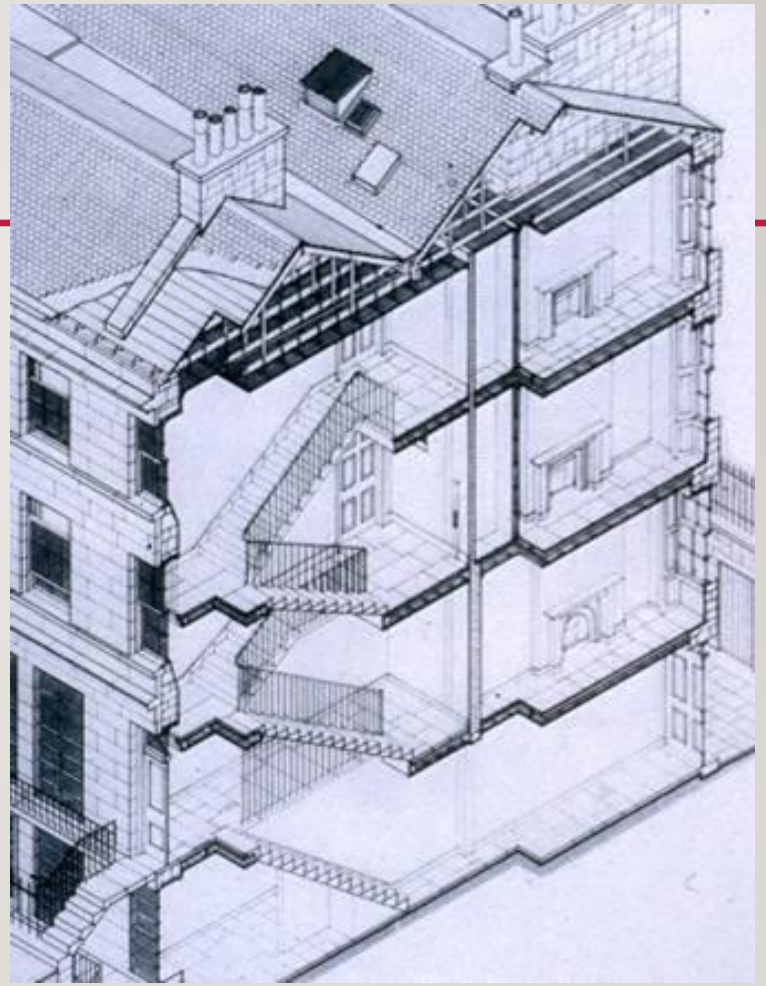
- In some types of fires, mist may suppress fire more quickly than sprinklers and will use less water
- Lower possibility of collateral damage so ideal for heritage fabric and contents
- Can use smaller 12mm pipework

Cons

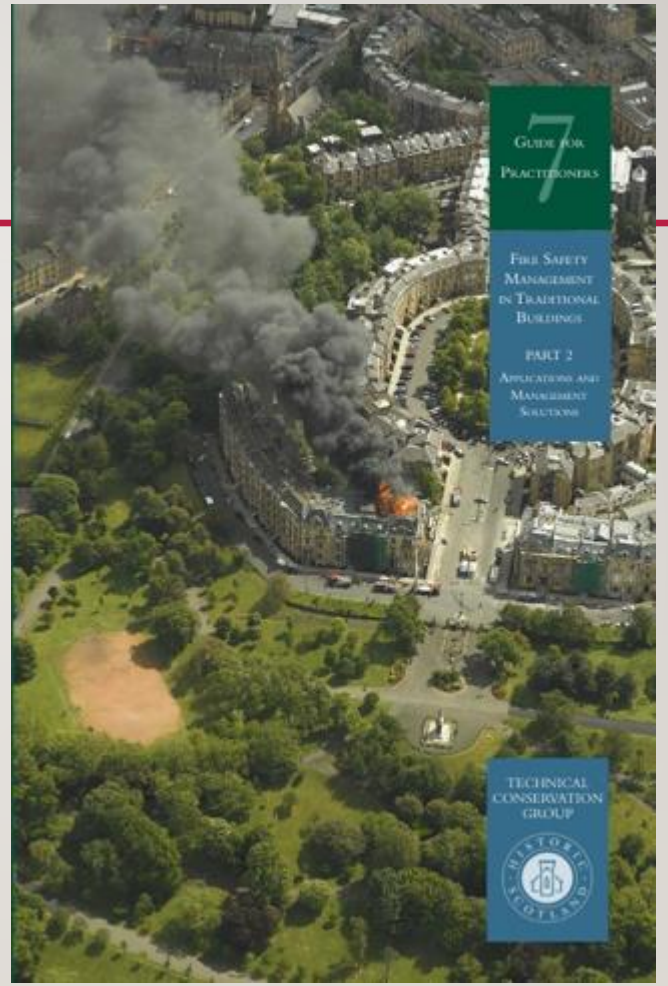
- Need higher quality water
- Ineffective in deep storage Class A fires
- High pressure systems will be more expensive than sprinklers and may require 3-phase supply
- Design requires highly competent installer – cannot just follow the standard
- No interoperability of components – maintenance and spares only from the installer
- Only a few third-party certificated installers and systems

CONSERVATION PRINCIPLES: INSTALLATION OF NEW SYSTEMS IN TRADITIONAL BUILDINGS

- Understand the historic fabric, its value and authenticity
- Be sympathetic in design
- Plan for and arrange full co-ordination of the work team
- Produce a method statement
- Employ specialist support trades and conservation skills including a specialist fire consultant if needed
- Ensure adequate supervision and direction of work force.



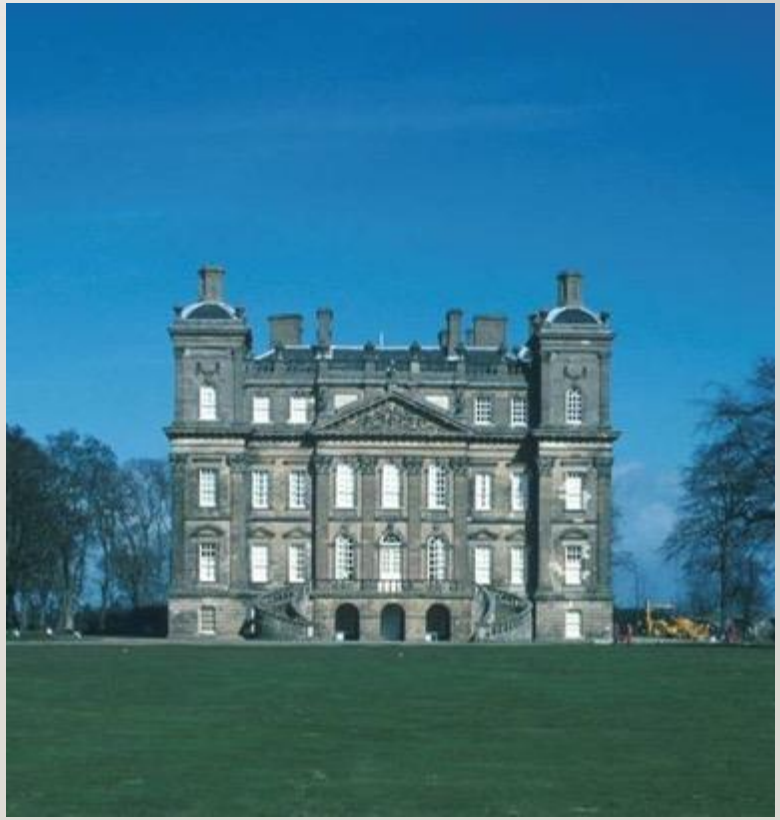
HISTORIC ENVIRONMENT SCOTLAND: GUIDE FOR PRACTITIONERS NO. 7: *FIRE SAFETY MANAGEMENT IN TRADITIONAL BUILDINGS*



- No equivalent English/Welsh publication but GP7 has been successful referenced in England and Wales
- The Guide is an ACOP - supporting Scottish Building Standards - and makes it clear that automatic fire suppression systems are a major asset for adaptive reconstruction or legal compliances
- Part 2 of the Guide provides extensive information on the installation and use of fire suppression systems in older buildings
- https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=7300097e-415f-4d27-a5fe-a5ad00ab8501 ISBN 978-1-84917-035-2
- To be revised in 2024/5?

THE TRAILBLAZER – SPRINKLER RETROFIT DUFF HOUSE 1993-4

- Category A Listed Georgian Mansion
- Constructed 1735 – 1740 by William Adam for the Earls of Fife
- Since 1956 in State Care through Historic Environment Scotland
- Since 1995 operated as a Country House Gallery by the National Galleries of Scotland
- The major restoration project included the installation of a modern fire detection and alarm system, automatic sprinkler system and a sophisticated security, surveillance and access control system



THE SPRINKLER INSTALLATION

- Property protection system
- Designed to Light Hazard BS 5306 Part 2 (1990) in 1993-4 as part of major refurbishment process
- Limited FRS response by retained crews confirmed need for AFFS to protect collections as well as building
- Installation facilitated by removal of flooring on upper levels for rewiring
- Sprinkler installation in steel with concealed, pendant and sidewall heads
- Existing riser shafts were used where possible

SPRINKLER HEAD LOCATIONS DESIGNED FOR MINIMUM VISUAL IMPACT – SIDEWALLS ABOVE PICTURE RAILS

CAREFUL SELECTION AND SITING OF HEADS WAS IMPORTANT TO THE SUCCESS OF THE PROJECT

POSITIONING CONCEALED HEADS IN FINE CEILINGS TAKES PLANNING

- Today, a flexible connector would be specified

Some damage to historic
fabric may be unavoidable but can
be minimized

Existing service risers
can usefully be used
to minimize fabric disruption




Simultaneous sprinkler pipework, electrical, fire detection and security systems wiring. Orange cpvc pipe is used for smoke aspiration detection. However, today notching of timbers would be minimized.

ATTIC PROTECTION IS ESSENTIAL IN COUNTRY HOUSES OF THIS PERIOD – WINTER AMBIENT TEMPERATURE CAN BE MINUS 5°C

Insulation and Trace Heating are essential

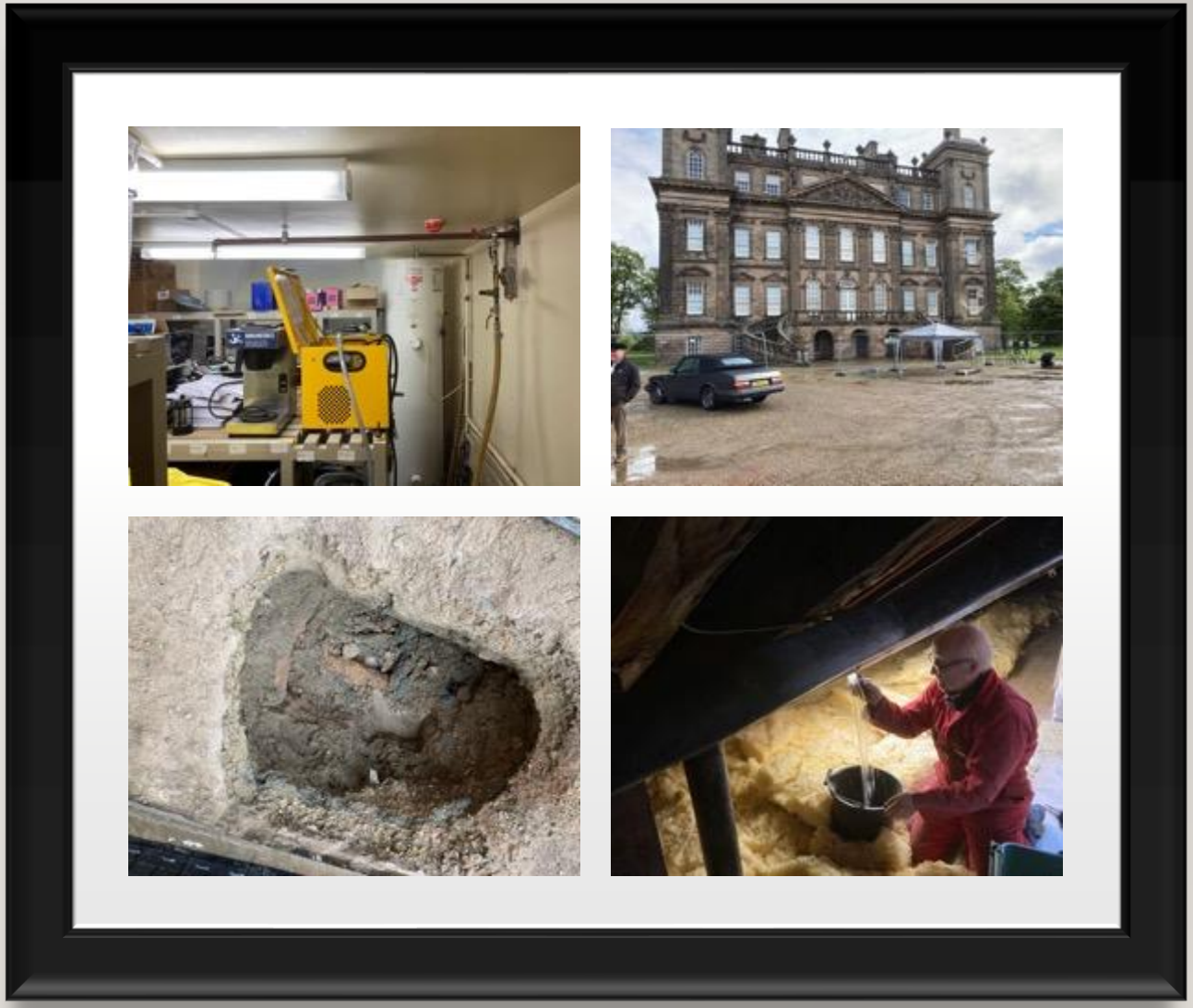
WATER STORAGE AND PUMPHOUSE

- Underground water storage is fine – pumphouses less so! (Confined spaces issues)
- Pumphouse has flooded twice from R. Deveron
- There is a plan in place (with budget) to replace pumps with an above ground ‘package’ unit in 2024/5

ALL FIRE SYSTEMS NEED TO BE MAINTAINED:

25-YEAR TEST OF SPRINKLERS IN DUFF HOUSE MAY 2021

Sprinkler heads and pipe sections sent off for testing to original specifications.



Note that water being drained is not excessively contaminated

THANK YOU!

GSA Second Fire 16 June 2018