Inspection of the South Wales Fire and Rescue Service to consider the effectiveness of its response to domestic dwelling fires

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Inspection of the South Wales Fire and Rescue Service to consider the effectiveness of its response to domestic dwelling fires

Dan Stephens, Chief Fire and Rescue Advisor and Inspector, Welsh Government

Mick Osborne, Deputy Chief Fire Officer, Buckinghamshire Fire and Rescue Service

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Executive summary

1. This report sets out the findings of an inspection of the South Wales Fire and Rescue Service undertaken in July and August 2024 at the request of the Commissioners appointed by Welsh Ministers to oversee the running of the Service.

2. The purpose of the inspection was to assess the operational effectiveness of the Service when responding to domestic dwelling fire incidents.

3. The incident type selected for analysis was dwelling fires where fire and heat damage was recorded beyond the room within which the fire had started. These incidents present significant risk to firefighters, trapped occupants and to the dwelling itself.

4. A total of 252 incidents occurring between 1 April 2021 – 31 March 2023 were analysed in detail.

5. Modern buildings are designed to be energy efficient and to keep heat in. Modern building contents are typically synthetic based which burn with a much greater intensity and consume twice as much oxygen than traditional materials. This can be an extremely dangerous combination for firefighters if the most effective tactics are not employed.

6. Given the weight of evidence available to us, we consider that the operational tactics employed by the Service, at a substantial number of incidents, have placed firefighters at unnecessary risk and/or resulted in avoidable damage to properties. We have serious concerns that the adverse safety events that can result from this are not being recognised, let alone being reported. The reasons for our concerns are explained in detail within the report.

7. Much of the content of the firefighting Standard Operational Procedures in use within the Service is disjointed, contradictory and in some instances scientifically incorrect. It reflects tactics partially introduced nearly 30 years ago, several of which were not scientifically proven at the time or designed for use within the UK. This is likely not to be limited to South Wales and may well be replicated across much of the UK.

8. To an extent this is reflected within the contents of training materials, although instructors have, using their own initiative, attempted to remedy this.

9. The training facilities available to instructors cannot fully recreate scenarios that are reflective of the modern fire environment.

10. These issues have been raised and subject to recommendations during previous Thematic Review inspections and are not limited to South Wales. The Commissioners and interim Chief Fire Officer have set up project groups to action the recommendations with progress now being made which is positive and welcomed.

11. The operational assurance processes are similarly disjointed. There are three separate entities within the Service who have responsibilities for elements of the operational assurance process.

12. For the most part they operate independently and in isolation of each other. There is no overarching operational assurance policy which causes confusion and a lack of understanding of the process across the Service.

13. The issues identified in this report are not insurmountable. The imminent publication of the revised 'Firefighting' National Operational Guidance and along with the 'Foundation for firefighting' present an opportunity for a fundamental reset. Firefighting guidance in the Service needs to be completely rewritten. That however will not address all the issues identified throughout the inspection.

14. Firefighters will need to be retrained in firefighting tactics. They will need to unlearn what have become default tactics and thought processes for them over the last two decades and more. This will require a significant investment in training in terms of resources and time.

15. The facilities at Cardiff Gate Training Centre for compartment fire behaviour training need to be supplemented to provide a realistic as achievable experience for firefighters.

16. The necessary additional training should not be undertaken at the expense of risk reduction activity. Substantial capacity exists within the station work routine for wholetime firefighters conditioned to the shift system. The recommendations of the 2021 Thematic Review into Fire and Rescue Service capacity should be actioned without any further delay to safely release this capacity.

17. The arrangements for operational assurance also need to be fundamentally reviewed. A single operational assurance team should be created working to an overarching and unambiguous policy.

18. These observations are not intended and nor should they be taken as a criticism of South Wales firefighters, officers or their training instructors. With strong leadership South Wales Fire and Rescue Service can make the necessary operational improvements. Throughout our engagement with the Service, we encountered highly professional, motivated and committed firefighters and officers. The will and desire to improve is clearly there. There are many excellent firefighters and officers who are more than capable of delivering what is required.

19. The recommendations set out in this report are intended to support South Wales Fire and Rescue Service on that improvement journey. They should be implemented in full and by no later than July 2025.

Introduction and background

20. In June of this year (2024) I was asked by the Commissioners, appointed by Welsh Ministers to oversee the governance of South Wales Fire and Rescue Service (SWFRS) to undertake an inspection of the Service to determine its operational effectiveness.

21. The Commissioners expressed specific interest in Breathing Apparatus and Incident Command training and how this impacted on outcomes at fire incidents. These themes are directly relevant to the recommendations I made in the Operational Training Thematic Review[1] of the 3 Welsh FRS from 2022. It is therefore timely that I undertook this inspection. I intend to conduct similar inspections of the other two FRSs in Wales over the coming year.

22. Sections 7,8 and 9 of the Fire and Rescue Services Act 2004 places a statutory duty on SWFRS, and the FRS across England and Wales, to make provision to respond to fires, road traffic collisions and other emergencies.

23. The incident type presenting greatest risk to firefighters, members of the public and their homes are fires in domestic dwellings, whether they be started accidentally or deliberately. Information relating to these incidents is captured through the Incident Recording System (IRS) and is published on the Welsh Government StatsWales website[2].

24. At the time of the inspection (July 2024) the most current data set available was for 2022/23. I therefore analysed the 3-year data set for:

- 2020/21 (664 incidents);
- 2021/22 (667 incidents); and,
- 2022/23 (709 incidents).

25. For the purposes of this inspection, I focused specifically on dwelling fire incidents where fire or heat damage was recorded beyond the room in which the fire started, referred to from here on in as the Room of Origin (ROO). This is because these are the most serious of this incident type.

26. Over the 3-year period this amounted to a total of 310 incidents, although on analysing each incident log in detail I established that 58 incidents had been incorrectly coded leaving an actual total of 252 incidents that met what I considered to be the true definition of fire or heat damage spread beyond the ROO.

27. The definitive point of reference for any incident is the incident log held on the mobilising system. The incident log is a digital record that is generated from the first

[1] Thematic Review of operational training within the Welsh Fire and Rescue Services (gov.wales)

[2] Fires and false alarms (gov.wales)

999 call to the Service and contains every single transaction relating to the incident including all messages sent from the incident ground. I was given full access to the SWFRS mobilising system by the interim Chief Fire Officer (CFO). To triangulate the information contained within the incident logs I accessed fire investigation reports where they were available and/or spoke to officers who attended the incident to establish the fire progression and full extent of the fire and heat damage.

28. Prior to undertaking the inspection fieldwork, I reviewed all relevant operational guidance and associated training materials which I accessed live through the SWFRS intranet. This included Standard Operational Procedures (SOPs) and policies for firefighting, incident command, operational assurance and audit along with training materials relevant to the same.

29. I was assisted on the inspection fieldwork by Deputy Chief Fire Officer (DCFO) Mick Osborne of Buckinghamshire FRS. The fieldwork included structured interviews with Compartment Fire Behaviour Training instructors, the Operational Intelligence Team, the Operational Development and Review Team, focus groups with Operational, Tactical and Strategic Commanders and station visits at 4 wholetime and 2 Retained Duty System (RDS) stations.

30. To maximise the effectiveness of the fieldwork I focused on operational guidance and training and DCFO Osborne focused on the operational assurance and audit process. This report sets out the findings of the inspection and builds on the recommendations made in previous Thematic Review reports.

31. The **first section** of the report contains:

- a review of the data;
- an explanation of how a fire develops within a room;
- how the tactics employed by the FRS affect the outcome of the incident; and,
- what the data shows for SWFRS.

32. The **second section** of the report is aligned to the Health and Safety Executive (HSE) publication HSG 65 Managing for health and safety (pre 2013 version) and considers SWFRS operational policies, the organisational arrangements to deliver operational policy and how operational performance is monitored, audited and subject to review. It is co-authored between us both and reflects our respective areas of focus.

33. The **third section** of the report contains a series of recommendations designed to improve firefighter safety and the operational effectiveness of SWFRS.

Section 1

A review of the data - Incident Recording System (IRS)

34. The IRS report for a domestic dwelling fire is typically completed by the Crew or Watch Manager in charge of the first attending appliance. The IRS records the extent of damage caused by the fire along with details of any injuries or fatalities. It records where there is no structural damage and no firefighting action. An example would be where residual oil in a grill pan momentarily ignites to generate sufficient smoke to actuate a smoke alarm, resulting in the mobilisation of the FRS. This is the largest single subset of data accounting for over half of all dwelling fire incidents and is shown in Table 1 below.

Table 1: No structural damage or firefighting action (overall %)

	2020/21	2021/22	2022/23
Total incidents	664	667	709
No structural damage	384	389	406
No structural damage %	58%	58%	57%

35. The IRS records whether fire or heat damage is contained to the ROO or if it has spread beyond the ROO. It also records the extent of fire or heat damage at the arrival of the FRS. Table 2 below shows the % of dwelling fires confined to the ROO.

Table 2: SWFRS dwelling fires confined to the ROO (overall %)

	2020/21	2021/22	2022/23
Total incidents	664	667	709
Confined to ROO	563	568	599
Spread beyond ROO	101	99	110
Confined to ROO %	85%	85%	84%

36. The subset of incidents where there is fire or heat damage beyond the ROO can be further broken down to incidents where there is (a) no fire or heat damage beyond the ROO on the arrival of the FRS (i.e. the fire is still in the ROO on the arrival of the FRS and then spreads subsequently) or (b) where it is recorded that there is fire and heat damage beyond the ROO on the arrival of the FRS.

37. Table 3 below shows a breakdown of fire and heat damage beyond the ROO broken down into reported as beyond ROO on arrival or fire and heat damage in ROO only on arrival. However, for reasons that are explained later in this report, there are grounds for believing that these data are not accurate, and that substantially more fires were contained within the ROO when the FRS arrived.

Table 3: SWFRS dwelling fires spread beyond ROO

	2020/21	2021/22	2022/23
In ROO on arrival	13	12	25
Beyond ROO on arrival	88	87	85
Total fires spread beyond ROO (IRS)	101	99	110

38. As previously stated, of the 310 incidents in the data set, 58 had been incorrectly coded which left an overall total of 252 incidents that fell within the analysis parameters. A typical example of a miscoded fire would be when fire or heat damage was caused to an external window frame from a fire in the open near the property or when fire or heat damage was caused to the exterior of the property from a vehicle on fire on the driveway. Where a fire starting externally had extended into the property to cause fire or heat damage within a room, which then spread beyond the ROO I included these incidents in the analysis.

39. Table 4 shows a breakdown across the 3-year reference period of the 252 incidents that fell within the parameters of the analysis split between in ROO on the arrival of SWFRS or beyond the ROO on the arrival of SWFRS.

Table 4: SWFRS dwelling fires subject to detailed analysis in this report

	2020/21	2021/22	2022/23
In ROO on arrival	11	8	23
Beyond ROO on arrival	64	74	72
Total fires spread beyond ROO (inspection analysis)	75	82	95

An explanation of how a fire develops in a room within a dwelling

40. The following is intended as a simplified explanation of how a fire develops in a room within a dwelling. It is provided to set context for the reader without going into excessive detail. It is concerned with a fire that has already ignited in a room within a dwelling and not the mechanisms that cause ignition.

41. For a fire to be sustained it requires heat, fuel, oxygen and an ongoing chemical chain reaction.

42. On the arrival of the FRS a fire in a room within a dwelling will be in one of two states, fuel controlled, or ventilation controlled. The fuel-controlled fire will have sufficient oxygen available such that its growth will be limited only by the item or items (fuel) on fire and their heat release rate (HRR).

43. The HRR is the amount of thermal energy generated by the items (fuel) involved in a fire, measured in Kilowatts (KW) or Megawatts (MW). HRR is not the same as temperature. As an example, a modern single upholstered chair may burn with a flame temperature of 800 degrees centigrade and generate a HRR of 2MW, whereas a modern 3-seater sofa may also burn with a flame temperature of 800 degrees centigrade but generate a HRR of 5MW. Modern, synthetic (plastic) based materials generate a significantly greater HRR than traditional materials. They also consume approximately twice the amount of oxygen than traditional materials to generate the increased HRR.

44. Research demonstrates that an item on fire with a HRR of 2MW (a modern single upholstered chair), can with sufficient available oxygen, cause all the combustible items (fuel) in a room to ignite simultaneously[3]. This transition is called a flashover and will almost certainly result in fire and heat damage beyond the ROO. Suffice to say conditions within a post flashover room are almost certainly unsurvivable for trapped occupants or firefighters wearing personal protective equipment (PPE) and Breathing Apparatus (BA)[4].

45. In the incipient stages of a fire, it is most likely to be fuel controlled.

46. In steady state the concentration of oxygen in air is 21%. A fire becomes ventilation controlled when the oxygen concentration in a room on fire drops from 21%, to below 16%, because of the fire consuming the available oxygen faster than it is replenished by air circulating from outside the room. At this point flaming combustion cannot be sustained and the fire goes into decay.

47. The substantial amounts of international research undertaken over the past 10 – 15 years have shown that in rooms furnished with synthetic based materials this

[3] Fire Dynamics in Structures| FSRI Safety Academy

[4] Heat Transfer and PPE| FSRI Safety Academy

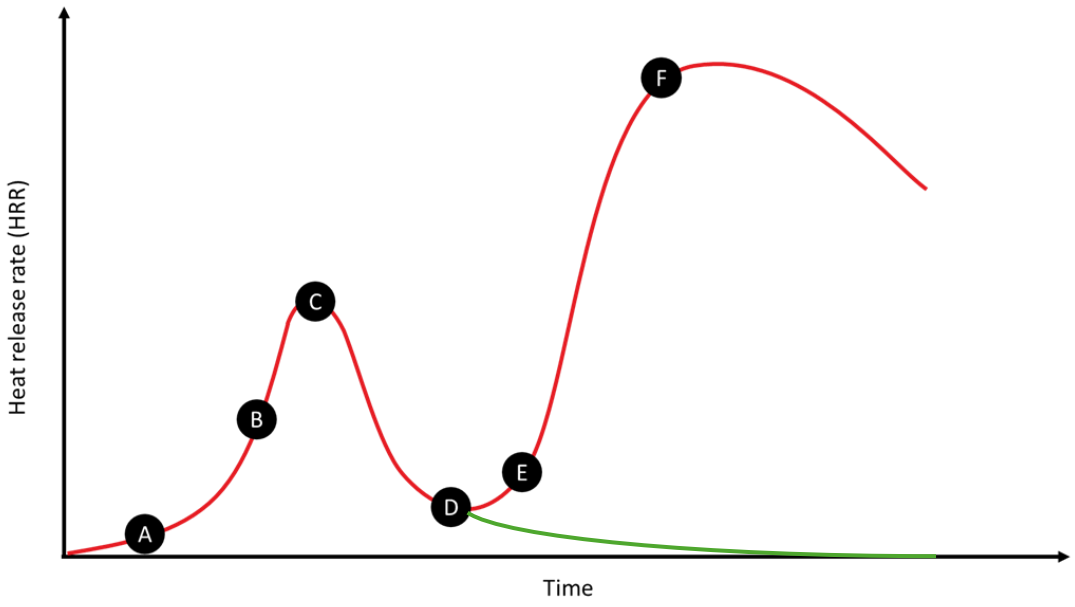
occurs within 2-3 minutes, and before a fire in a room transitions to flashover[5]. In essence, this is no different from the science experiment in which a lit candle placed inside an upturned glass jar will burn out after a few minutes, once it has consumed more of the oxygen within the jar than is needed to support combustion.

48. A fire in this state can smoulder for an extended period before eventually it will self-extinguish if there is no change to the supply of oxygen to the fire (the ventilation profile). Such a fire will however generate large volumes of smoke which is itself combustible, and which will contribute to rapid fire development if there is a change in the ventilation profile.

49. While the fire is stable for as long as the ventilation profile remains unchanged it still presents very significant hazards to trapped occupiers and firefighters. In all likelihood it will not extend beyond the room of origin without outside intervention (such as firefighters making entry through an external door and introducing oxygen), nor will it reach flashover.

50. The graph at Figure 1 below shows the typical progression of a fire in a room with a fuel load that has a sufficient HRR to transition the room to flashover (and therefore extend beyond the ROO).

Figure 1: Typical progression of a fire in a room with a fuel load that has a sufficient HRR to transition the room to flashover



[5] 20150116-ba-ul-fsp-it-depends-descriptive-research-into-fire-growth-and-the-chances-of-survival.pdf (nipv.nl) (Dutch research)/All UL FSRI research studies

- Points A - C indicate the development of a fire in a closed room from ignition through to the point where the oxygen content in the room drops below 16%.

- Point C – D shows a reduction in HRR because of there being insufficient oxygen available within the room to sustain flaming combustion. The fire at this stage is ventilation controlled. If there is no outside intervention, the fire will slowly decay, smoulder and self-extinguish, as shown by the green line.

- Point D – F shows a change in the ventilation profile which can occur when firefighters make an entry into the property to fight the fire. This is because firefighters often do not close over the door through which they have made entry into the property, to control the inflow of oxygen. At this point the HRR and temperature accelerate rapidly. If air flow into the room is not controlled or if enough water is not directed onto the fire or into the room on fire, then the room can transition to flashover in less than a minute.

51. This is an extremely hazardous situation and has resulted in firefighter injuries and fatalities in the UK and across the world.

52. Science dictates that the high pressure generated by the expansion of gases heated by the fire will move towards the lower pressure at the ventilation opening and that the hot fire gases will move towards the cooler air at the ventilation opening. This can place firefighters in between the fire and the outlet (exhaust) vent for the fire gases. In the absence of refuge behind a closed door, their only defence in these circumstances is a high flow rate of water directed at the fire.

53. The combination of uncontrolled ventilation and/or the utilisation of ineffective firefighting tactics has been a factor in almost every UK firefighter fatality occurring within a structure fire in the last 30 years[6].

54. It may be very difficult, if not impossible, for the first attending Crew or Watch Manager to determine the status of the fire on their arrival. Flaming combustion will be evident with a fuel-controlled fire. A ventilation-controlled fire however is likely to generate large volumes of smoke which would make it very difficult for the first attending Crew or Watch Manager to determine whether there was fire or heat damage beyond the ROO even if they were undertaking thermal scanning using a Thermal Imaging Camera (TIC).

55. As stated previously international scientific research[7] shows that any fire involving an item or items which have a sufficient HRR to transition the compartment to flashover, will become ventilation controlled with 2-3 minutes unless there is an unlimited supply of oxygen available. Typically, this would require the room door to be

[6] Fatal incident reports – Wealmoor Warehouse fire, Atherstone on Stour/ Balmoral bar fire, Edinburgh/Shirley Towers, Southampton/Bethnal Green Road, London et al

[7] All UL FSRI studies 2010 – present, Brandweeracadamie (2014, 2015, 2016, 2018)

open and the front or back door to the property or several large windows to be fully open. In South Wales and across the UK, other than on the warmest of days, this is unlikely[8].

56. That being so, it is probable that many of the fires subject to this analysis were contained in the room of origin at the time the FRS arrived. Some of the fires that extended beyond the room of origin most likely did so because of the actions of firefighters in re-ventilating the fire prior to the application of sufficient volumes of water, by them not controlling the door by which they entered the property.

57. In the interests of accuracy, I should highlight the deficiencies within the IRS in this context. Field 8.20 of the IRS asks, 'What was the extent of flame and/or heat damage on arrival?'. A drop-down menu then offers several choices including 'Limited to the room of origin', 'Limited to the floor of origin (not whole building)' right the way through to 'Whole building'. Depending on the position of the fire within a compartment it is possible that there would be heat damage in an adjacent compartment without fire spread, for example a synthetic based material starting to melt. To remove any ambiguity this question might be better phrased 'What was the extent of fire damage on arrival?'.

58. For most incidents, the messages on the incident log made it clear that there was fire and heat damage beyond the ROO. As a due diligence exercise, I reviewed where available fire investigation reports for incidents where it was reported through the IRS that there was fire and heat damage beyond the ROO on the arrival of the FRS and/or spoke to Officers who attended the incident.

59. The photographic evidence available to me showing the fire progression did not support the assessment that the fire had spread beyond the ROO prior to the arrival of the FRS, rather it supported the assessment that it had spread after the arrival of the FRS.

60. What the photographs also showed is that if the fire had spread beyond the ROO prior to the attendance of the FRS then the tactics employed (high pressure hose reels capable of low flow rates on an interior attack) would have exposed firefighters to unnecessary risk and would have taken longer to supress the fire than using a low pressure, high flow alternative (therefore resulting in unnecessary damage). I will return to this point in more detail in the next section on incident analysis.

[8] Equations 18 and 19 (p.91 -92) within 'Enclosure fires' written by Lars-Goran Bengtsson reference Thorntons rule and the calculations for required ventilation openings to generate HRRs (1m x 1m = 1.5 MW, 2m x 1m = 4.5 MW, 1m x 2 m + 1m x 1m = 10.5 MW)

How the tactics employed by the FRS affect the outcome of the incident

61. Over the 3-year data analysis period there was a total of 2040 domestic dwelling fire incidents across South Wales at which at 310 incidents fire or heat damage was recorded beyond the ROO.

62. Through access to the SWFRS mobilising system I was able to analyse the incident logs of each of the 310 incidents in detail. As stated previously, through this analysis I established that 58 incidents did not meet the criteria of fire and heat damage beyond the ROO so were discounted from any further analysis leaving a total of 252 incidents.

63. For each incident I recorded the following information:

- The response time of the first attending appliance (taken from time of alert to time in attendance)
- The elapsed time from the time of the first appliance in attendance to the time of the first informative message which stated the operational tactics in use
- The elapsed time from the time of the first appliance in attendance to the time of the second appliance in attendance
- The content of the first informative which stated the operational tactics in use (i.e. 2BA 1HRJ which stands for a 2-person Breathing Apparatus team deployed with a high-pressure hose reel)
- Any significant information from the first caller or first appliance in attendance (i.e. 'Smoke issuing' or 'Property well alight')
- Room of origin and property type (i.e. Kitchen, Living Room, Bedroom, Terrace, Semi Detached, Detached)
- Any relevant information from the Stop[9] message including the extent of overall damage

64. This information allowed me to establish what the initial caller had witnessed and how long it had taken the first fire appliance to arrive from that point. For example, a caller reporting heavy smoke issuing is an indication of a ventilation-controlled fire. Similarly, I could establish what the first attending Crew or Watch Manager had witnessed to give me a sense of the state of the fire at that point and how it might have developed from the time of the first call.

[9] A Stop message is sent from the incident ground by the Officer in Charge to confirm that no further FRS resources will be required at the incident

65. The room of origin gives an indication of the fuel loading, and the type of property gives an indication of the likely size of the compartments within the property. As an example, a 3-seater sofa in a living room or a mattress on a king size bed in a bedroom can generate a HRR of 5MW whereas chipboard kitchen units may only generate a HRR of 1.5MW. The intensity of a bedroom or living room fire is therefore likely to be greater than that of a fire in a kitchen.

66. The first informative message gives definitive information on the tactics in use at first intervention which is critical to the subsequent development or otherwise of the incident. The extent of damage, typically stated on the Stop message confirms the amount of overall damage sustained at the dwelling.

67. At the time of this inspection (July 2024) the extant FRS National Operational Guidance (NOG) for dwelling fires was contained predominantly within 'Fires and firefighting' and 'Fires in buildings'. FRS NOG can best be described as generic risk assessments presented in the form of hazard and control measure statements which are developed by the National Fire Chiefs Council (NFCC) for policy writers within each FRS to use to form the basis of local Standard Operational Procedures (SOPs) or equivalent.

68. I will address NOG and SWFRS SOPs for dwelling fires later in this report but for the purposes of this section I offer the following definitions which are deliberately simplified and assume no knowledge on the part of the reader. These definitions, which are drawn from the Dutch 4 Quadrant Model,[10] do not currently feature within NOG.

Note - the NFCC have recently approved for publication 'Firefighting' NOG alongside new 'Foundation for firefighting' guidance which use similar terminology to that in the 4 Quadrant Model and will replace the extant 'Fires and firefighting' NOG.

69. A Crew or Watch Manager in charge of the first appliance to arrive at a dwelling fire incident should undertake an initial assessment of the scene to gather hazard information to inform decision making in respect of the control measure tactics they will employ to resolve the incident.

70. International research[11] identifies that the most effective control measure tactic to reduce risk to firefighters and trapped occupants at a dwelling fire is to get water onto the fire or at least into the room on fire in the shortest possible time. The quickest method to do this is to direct water into the room from outside the structure using either a high-pressure hose reel jet or a low-pressure jet on a straight stream which in SWFRS will be via a 45mm delivery hose (preferably the latter for reasons explained further on in this report). For the purposes of this report, I will refer to this control measure tactic as an 'offensive exterior attack'.

[10] 201411-BA-Quadrant-Model-for-Fighting-Structure-Fires.pdf (nipv.nl)

[11] 20170926-BA-The Offensive exterior approach (nipv.nl)/All UL FSRI research

71. An offensive interior attack is when firefighters, typically in 2-person team multiples wearing BA (from here on in referred to as a BA team), enter the affected property to locate and then fight the fire with some form of firefighting media. This can take longer to achieve, even when the location of the fire, and the quickest route to it, is known. This is because firefighters must progress through heavy smoke, heat and humidity while manoeuvring a high-pressure hose reel or a low pressure 45mm delivery hose, sometimes through several rooms and around numerous obstructions. At this point it is necessary to make a distinction between the capabilities of the high-pressure hose reel versus the low pressure 45mm delivery hose.

72. Every fire appliance in SWFRS carries 2 x high pressure hose reels. They are stowed in lockers on either side of the fire appliance and coiled on a drum for ease of deployment. Each hose reel consists of 3 x 20m lengths of 19mm diameter hose with the final length of hose terminating in a branch (the device that controls the flow of the water discharged out of the end of the hose, usually supplied with a pistol grip). They operate at between 25 – 30 bar pressure and can flow around 100 litres of water per minute (lpm). This is known as the flow rate. The primary advantage of the high-pressure hose reel is that it can be quickly deployed and that it is easier to manoeuvre than a low pressure 45mm delivery hose. A significant disadvantage is that the 100 lpm flow rate is inadequate to effectively supress a fully developed (post flashover) fire in a room.

Note: Hose reel tubing of 22mm diameter provides almost twice the flow rate of 19mm hose reel tubing and is in use in several UK FRS[12].

73. Each fire appliance in SWFRS carries 6 x 25m lengths of 45mm low pressure delivery hose and 6 x 25m of 70mm low pressure delivery hose. At one end of the hose is a male coupling and at the other end of the hose is a female coupling. The male coupling on the first length of hose is inserted into an outlet (delivery) on the fire pump and the branch is inserted into the female coupling at the other end of the hose. If more than one 25m length of hose is required, the male coupling on the second length of hose is inserted into the female coupling on the end of the first length of hose and so on until the required total length of hose is reached. The total length of hose is known as a line. In SWFRS there are typically 3 delivery outlets on fire appliances so each appliance can supply 3 low pressure hose lines consisting of 2 lengths of 70mm and 2 lengths of 45mm hose or any combination thereof.

74. The 70mm low pressure delivery hose is used to supply water from a fire hydrant into the fire appliance water tank to augment the water supply or to initiate a hose line prior to adding low pressure 45mm delivery hose at the end of the line to be used on an interior attack, as it is easier to manoeuvre than the 70mm variant. A low pressure 45mm delivery hose typically operates at between 3 – 7 bar pressure and can flow up to 600 lpm dependent on the type of branch utilised. The primary advantage of the low pressure 45mm delivery hose is that the flow rate is sufficient to effectively supress a fully developed (post flashover) fire in a room. It is however more

[12] Flow method | Fire Protection Association (thefpa.co.uk)

difficult to manoeuvre than a 19mm high pressure hose reel. Hose management can be a physically demanding task which requires regular practice to perform effectively.

Note: Research undertaken through the Building Disasters Assessment Group (BDAG) following the 11 September 2001 terror attacks identified that 51mm hose provides greater flow rates than 45mm hose in a high-rise scenario although the same is true for any structure fire[13]. Several UK FRS utilise 51/52mm low pressure delivery hose.

75. In some UK FRS fire pumps are equipped with flow meters which allow the pump operator to observe the actual flow they are delivering to the firefighters through the low-pressure hose line. SWFRS pumps are not equipped with flow meters, but this is something that they should consider providing as it is difficult for a pump operator to accurately estimate flow rates without them.

76. SWFRS training packages cover flow rates and give guidance on which firefighting media is appropriate to use against fires of differing HRR. This training determines that a high-pressure hose reel is ineffective against fires with a HRR > 2MW and will be covered in more detail later in this report. It follows that fires with a HRR > 2MW must be attacked with at least a 45mm delivery hose.

77. At all 252 incidents at least one high pressure hose reel was utilised. From analysis of the incident logs, it is almost certain that the high-pressure hose reel was the first and subsequent firefighting media deployed, and at almost all the incidents in an offensive interior attack. As an example, the first informative message on almost every occasion was either 2BA 1HRJ or 4BA 2HRJ which means a BA team of 2 firefighters equipped with a high-pressure hose reel or 2 x BA teams of 2 firefighters each equipped with a high-pressure hose reel.

78. At only 17 incidents was a low pressure 45mm delivery hose stated as being utilised, and on no occasions was this explicitly stated on the incident log as being in the capacity of an offensive exterior attack (there is only one occasion when I know for certain this did happen). However, at 210 of those incidents the Crew or Watch Manager completing the IRS recorded that there was fire or heat damage beyond the ROO on their arrival which indicates a fully developed (post flashover) fire.

79. On every informative message reference was made to a safety jet. This is a line of low pressure 45mm delivery hose which should be charged with water and of equal length to any hose line (high or low pressure) deployed for the purposes of interior attack. It is intended to be available for use should there be any adverse development with the incident, particularly one that renders the primary attack line inoperable. While the logic for this is sound, it does not negate the need for the primary attack line to be capable of effectively dealing with any fire for which it is deployed.

80. A safety jet deployed outside the dwelling primarily as a back-up will be of no use to BA teams deployed on an interior attack with a high-pressure hose reel in the

[13] Fire Service Circular 55-2004, The Building Disaster Assessment Group – Key Research Findings

event of a deterioration of the fire conditions. By the time any subsequent BA team had deployed the safety jet it would be too late to mitigate the effects of rapid-fire development on any BA teams already within the dwelling.

81. On station visits firefighters stated to us that they had attacked dwelling fires externally. I do not doubt this, but it was not reflected on any of the incident logs that I analysed. I am aware however of incidents occurring recently (July 2024 and beyond) where an offensive exterior attack has been undertaken and to good effect.

82. The interim CFO has proactively monitored what media is in use at incidents, particularly where a high-pressure hose reel is used at what is obviously a well-developed fire. This serves to focus attention and is welcomed.

83. What I was unable to determine definitively was how firefighters attacked the fire when deployed on an offensive interior attack. Over the last two decades UK firefighters have been trained to cool fire gases using pulses of water on a spray setting from a high-pressure hose reel as they progress towards the fire. This will almost certainly be ineffective against a high HRR fire. It can result in firefighters being subject to excessive thermal insult and unnecessary damage being caused to the property through taking longer to control the fire.

84. Dutch research demonstrates that arching a straight stream of water from a low-pressure high flow delivery hose achieves greater temperature reductions than pulsing with a high-pressure hose reel when advancing towards a fire[14]. In addition, it is an easier technique to achieve than pulsing in a spray pattern.

85. A low-pressure delivery hose can also achieve a substantial reach (more than that achievable by a high-pressure hose reel) which places a greater distance between the firefighters and the fire thus reducing thermal insult.

86. I return to these issues in greater detail further on in this report however one of the Dutch principles set out within the 2018 publication 'The Renewed View of Firefighting'[15] is of relevance here:

'*Gas cooling has limitations and is predominantly effective in small spaces (maximally 70 m2 and with a maximum height of 4 metres) (Lambert & Baaij, 2011). It is important to keep the depth of the attack as short as possible and to apply water to the fire as quickly as possible. Extinguishing the fire is the best form of gas cooling'.*

[14] 20211207-BA-When-water-goes-up-in-smoke.pdf (nipv.nl)

[15] 20180423-BA-The-Renewed-View-on-Firefighting.pdf (nipv.nl)

What the data shows for SWFRS

87. Science and research evidence suggests that at many of these incidents there would not have been fire spread beyond the ROO on the arrival of the FRS (although there may have been heat damage). If we accept however that there was fire spread beyond the ROO, then the first challenge to the Crew or Watch Manager utilising the tactical option of a high-pressure hose reel would be what was the rationale for exposing firefighters to a fully developed (post flashover) fire with an attack option only capable of a flow rate of 100 lpm. The analysis of the operational assurance process determines that this challenge had not been happening as a matter of routine up until the appointment of the interim CFO.

88. If on the other hand, we conclude that, based on science and all the available research, many of the 210 fires had not spread beyond the ROO on arrival of the FRS then the fire and heat damage has occurred after the arrival of the FRS and is likely to have happened because of the tactical options employed. The absence of any control of the door through which firefighters enter the property for an offensive interior attack typically results in an unlimited supply of oxygen entering the structure quicker than the firefighters can progress to and get water onto what is likely to be a ventilation-controlled fire on their arrival. The science and research evidence presented in this report demonstrate that with the additional oxygen the fire develops rapidly thereafter and causes a flashover in the room possibly in under a minute. This post flashover fire is then much harder to control with a low flow rate high pressure hose reel particularly when using the pulsing technique. Not only does this invariably result in additional fire and heat damage, but it also places firefighters at significant risk.

89. It can be reasonably concluded that this was the case at the 42 incidents where the officer completing the IRS recorded that there was no fire or heat damage beyond the ROO on their arrival.

90. Out of the total 252 incidents analysed I identified causes for concern at over 100. As stated previously, where I have been able to, I have accessed fire investigation reports and/or spoken to officers who attended the incidents. On all but one occasion this process of triangulation has confirmed my concerns.

91. I noted concerns on the 36 occasions over the 3-year period that Positive Pressure Attack (PPA) was employed as a tactical option. PPA involves the deployment of a powered fan to force air into an inlet (usually the front door of a house) to create a flow path within the property which forces smoke and fire gases out of an outlet (exhaust) vent. The theory is that this will improve conditions for firefighters and trapped occupants however a significant disadvantage is, as has been previously established in this report, that providing additional oxygen to a fire will on every occasion increase its intensity unless there is simultaneous application of water, in sufficient volume, onto the fire. To be successful it also requires the outlet vent to be covered by a firefighting jet and most importantly to be larger than the inlet vent (at least 2:1). This is to avoid the scenario whereby the volume of fire gases is greater than the capacity of the outlet vent to exhaust them which results in them being forced back into the room on fire and towards the advancing firefighters.

92. Even if the outlet vent was larger than the inlet vent a safer and more effective control measure tactic would have been to utilise the covering jet, which should also have been in place prior to PPA being commenced, to direct a straight stream of water into the room on fire. This would make conditions safer for firefighters deployed on an interior attack by reducing the intensity of the fire (as opposed to increasing it through substantially increasing the oxygen supply) and reduce any subsequent fire and heat damage to the property.

93. In summary, I do not believe that the actions of SWFRS have contributed to an adverse outcome at all 252 incidents. However, given the weight of evidence available I consider that the control measure tactics employed have on a substantial number of occasions resulted in firefighters being exposed to a level of hazard that had the potential to cause serious injury or worse and/or that avoidable damage to property has occurred. This is a view shared by DCFO Osborne.

94. What I would say is that this will not be limited to SWFRS and will to a greater or lesser extent be reflected across the UK FRS. I know from the limited research I have undertaken to date that it is the case in Mid & West and North Wales FRS. In the next section of this report, I consider the underlying causes as to why this might be.

Section 2

Operational policy – background

95. Regulation 3 of the Management of Health & Safety at Work Regulations 1999 places a duty on employers to make a suitable and sufficient assessment of the risk to the health and safety of its employees to which they are exposed to while at work. FRS are therefore required to produce risk assessments setting out hazards and control measures for all activities including responding to dwelling fires.

96. The NFCC produces NOG on behalf of the FRS sector across the UK. NOG can best be described as incident specific generic risk assessments presented in the form of hazard and control measure statements which are developed nationally for policy writers within each FRS to use to form the basis of local Operational Risk Assessments, SOPs or equivalent. This is intended to assist the FRS to meet its duties under Regulation 3 of the Management of Health & Safety at Work Regulations 1999.

97. When NOG was conceived the intention was to replace all previous nationally published FRS guidance (Generic Risk Assessments (GRAs), Fire and Rescue Service Manuals, Dear Chief Officer Letters etc) by consolidating it in one place and with a structure that was simple to understand and easy to navigate. The following description is copied directly from the NOG website[16]:

'Operational Guidance spans a wide range of activity. There is a structure to make sense of it all; it uses the hazards encountered at incidents and the measures used to control or eliminate them. The guidance is structured so that it starts with the elements that affect all incidents, then explores the environments in which fire and rescue services work, and finally the activities that are carried out'.

98. At the time of writing 'Fires and firefighting' and 'Fires in buildings' is the relevant extant NOG in the context of this inspection. Both fall within the 'Activity' section of NOG. The content of both pieces of guidance is largely based on the Fire and Rescue Service Manual 'Compartment Fires and Tactical Ventilation' which was first published in 1997 to replace amongst others the legacy Manual of Firemanship Book 6a 'Practical Firemanship' (the legacy Manuals date back many years hence the archaic and sexist terminology). The contents of Book 6a were to an extent still based on the essays of James Braidwood (the founder of what is now the London Fire Brigade) written in the 1800s and which strongly advocated tactics such as controlling the flow of oxygen into a structure (ante ventilation) along with applying enough water onto a fire in the shortest possible time (all the control measure tactics advocated through international research and supported by science).

99. 'Compartment Fires and Tactical Ventilation' was strongly influenced by two studies commissioned by the Fire Research Development Group in 1994 and which

[16] About Operational Guidance - NFCC

are referenced in the ‘Compartment Fire Behaviour Training’ section of the Thematic Review report on Operational Training. These reports considered firefighting tactics developed in Sweden and the approach to tactical ventilation utilised in America at the time. The reports recommended both tactical approaches for adoption by the UK FRS. It should be noted that the intent of both reports was to reduce losses to the insurance industry rather than to achieve any improvements to firefighter safety.

100. The Swedish approach[17] had been developed by Matts Rosander (a fire behaviour training instructor) and Krister Gisselson (a fire engineer) in the late 1970s in response to a spate of firefighter fatalities at incidents in Sweden. This consisted of a full system inclusive of new equipment, tactics and training facilities.

101. The Rosander and Giselsson system was designed primarily for use in Swedish apartments built from concrete, that were well insulated, with triple glazed windows that could be expected to still be intact when the FRS arrived. Fires in these circumstances will almost certainly be ventilation controlled. Unlike in the UK and in SWFRS, BA teams in Sweden consist of three firefighters. The third firefighter, who performs the role of team leader, holds the door closed behind the two remaining firefighters in the team to prevent the ingress of oxygen into the room on fire, thus limiting the chances of rapid-fire development. Critically, the system was only ever intended for use in small residential compartments with limited fire loads (and therefore HRR potential) when compared to larger commercial or industrial compartments.

102. When creating their system, Rosander and Giselsson spent two years working with a manufacturing company to develop the Fogfighter branch. This became the universally used firefighting branch in Sweden for over 20 years. It was designed to have the optimum droplet size on a spray setting for the purposes of cooling fire gases through pulses of spray as the firefighters progressed through the structure towards the room on fire. It was (and still is) used with low pressure 38mm delivery hose and can deliver a flow rate of 300 lpm. This cooling of fire gases through the pulsing technique combined with controlling the inflow of oxygen is what in very simplistic terms prevents a ventilation-controlled fire developing as rapidly as is seen in Figure 1 in Section 1 of this report. Once the firefighters close in on the room on fire, they switch from pulses of water in a spray pattern at the branch to a straight stream of water to extinguish the fire with the maximum achievable flow rate.

103. In SWFRS (and across much of the UK), the door through which firefighters enter a property is not routinely controlled to prevent the inflow of oxygen (although smoke curtains are now in the process of being issued across SWFRS).

104. As has been demonstrated through the analysis of incident data in Section 1, the default firefighting medium in SWFRS is the 19mm high pressure hose reel which is capable of a flow rate of 100 lpm on a straight stream but in practice would deliver far less than 100 litres each minute when discharging pulses of water using a spray

[17] This description is taken from a comprehensive report into NOG written in 2017 by Lee Johnson, a Station Manager in West Sussex FRS

pattern for the purposes of gas cooling when progressing towards the fire. The pulsing technique, albeit with a 19mm high pressure hose reel as opposed to a low pressure, high flow delivery hose, is the only substantive element of the Rosander and Giselsson system that has been adopted and embedded as a tactic across the UK and within SWFRS.

105. The position is compounded when considering the American approach to ventilation advocated within 'Compartment Fires and Tactical Ventilation', namely 'vent early, vent often' which is the opposite of what the UK FRS had practiced up until 1997 when ventilation overwhelmingly took place only once a fire was extinguished.

106. There are many differences between FRS in the UK and Fire Departments in America. Fire stations in America are typically crewed by an Engine Company and a Ladder Company. Both will typically arrive at an incident at the same time.

107. The Engine Company provide large volumes of water for the purposes of offensive exterior or interior attack through 1 ½, 1 ¾ or 2-inch diameter low pressure delivery hoses (38mm, 45mm or 51mm). In America the domestic water supply is drawn from the fire main (400mm diameter plus) which is the opposite to the position in the UK where fire hydrants are located on domestic water mains (100mm diameter) so there is usually no shortage of water available in urban areas across America.

108. Ladder Company firefighters have typically utilised their apparatus (the equivalent of an extendable turntable ladder in the UK) to access the roof to cut a vertical outlet (exhaust) vent through which smoke and fire gases exit the structure using natural buoyancy. When coordinated with an offensive interior attack to supress the fire this is undoubtedly an effective tactic, (notwithstanding the damage to the roof made by creating the vertical vent) and will result in improved conditions for firefighters and trapped occupants. If, however, water is not applied to the fire at the same time as the fire is ventilated then rapid-fire growth inevitably follows when modern building contents are involved leading to a significant deterioration in conditions.

109. This technique may well have been successful in the days when lower HRR building contents would have been involved in fire as the fires may well have been fuel controlled rather than ventilation controlled. There is however very little, if any, margin for error with the typical modern fire loads of today when dealing with a ventilation-controlled fire. As a result of research carried out by Underwriters Laboratories Fire Safety Research Institute (UL FSRI) many US Fire Departments no longer practice this tactic.

110. Vertical ventilation (creating an outlet vent in the roof) is not a tactic which has gained significant traction in the UK. Horizontal ventilation through opening doors or windows is however much easier to achieve. Up until 1997 and the publication of 'Compartment Fires and Tactical Ventilation' UK firefighters would not routinely ventilate at fires within buildings until the fire had been extinguished. That undoubtedly changed after 1997.

111. 'Compartment Fires and Tactical Ventilation' strongly advocated the advantages of ventilation but was less explicit over the disadvantages and the

imperative to simultaneously apply water to the fire at the same time as ventilation is undertaken. To an extent this is still reflected in the 'Fires and firefighting' and 'Fires in buildings' NOG although there are several explicit references to the effects of uncontrolled ventilation on a fire without concurrent water application within NOG.

112. The following is copied directly from the Executive Summary of the 2017 report authored by Station Manager Lee Johnson of West Sussex FRS entitled 'Firefighting guidance in the UK: A proposal to move to an evidence-based strategy'.

'UK firefighting guidance underwent a complete transformation between 1994 and 1997. Following a programme of research aimed at reducing the financial losses from large fires, UK fire service guidance began advocating an American-style ventilation strategy combined with a Swedish-style suppression strategy.

However – neither strategy was fully implemented; neither was fully suited to the UK fire environment; the two approaches had not been designed to work together; US ventilation theories were not based on scientific evidence and have since been disproved; and both the US and Sweden have moved on in many ways from the strategies that they used in the 1990s, while the UK has not'.

113. In my view this is an accurate reflection of the position in the UK and in SWFRS in respect of the control measure tactics typically employed at dwelling fires and why that is.

Operational policy – SWFRS SOPs

114. SWFRS SOPs are aligned to the legacy GRA index that was replaced by NOG. GRAs were published by the UK Lead Government Department for the FRS which at various times has transitioned between the Office of the Deputy Prime Minister, the Department for Communities and Local Government (and various iterations thereof) and the Home Office. The purpose of GRAs was broadly similar to that of NOG, to provide guidance to FRS policy writers when developing local Operational Risk Assessments, SOPs or equivalents.

115. The SWFRS index is structured as follows:

- Section 1 – Responding to an emergency
- Section 2 – Rescues
- Section 3 – Fighting fires
- Section 4 – Transport
- Section 5 – Generic hazards
- Section 6 – Specific procedures
- Section 7 - Miscellaneous

116. For the purposes of this inspection, I reviewed the following SOPs in detail:

- SOP 3.1 Fires in buildings
- SOP 3.1.1 Fires in basements
- SOP 3.2 High rise firefighting
- SOP 3.6 Tactical ventilation
- SOP 5.8 Backdraught, flashover & fire gas ignition
- SOP 6.1 Incident Command
- SOP 6.4 Breathing Apparatus procedures

117. The format of the SWFRS is standardised. At the beginning of the SOP is an Aide Memoir which lists in bullet point format prompts on actions to be taken on arrival at the incident followed by the Sections listed below:

1. Scope
2. Specific Hazards & Risks
3. Key Control Measures
4. Operational Procedures
5. Additional Considerations
6. References

118. For SWFRS to demonstrate that they have adopted NOG the content in Sections 2 and 3 of the SOPs should be based on the hazard and control measure knowledge statements for the relevant operational activity i.e. ‘Fires and firefighting’ and ‘Fires in buildings’. Section 4 of the SOP should then contain any SWFRS specific context in relation to how the Key Control Measures are applied in practice.

SWFRS SOP content analysis

119. The following is intended as a summary of the analysis I undertook of the content of SWFRS SOPs with particular focus on hazard knowledge and control measure tactics. I have shared the full summary with SWFRS for their consideration.

120. SWFRS does not have a single definitive Policy that sets out its position in respect of firefighting tactics. That in of itself is not a cause for concern. **SOP 3.1 Fires in buildings** should be viewed as the primary overarching guidance in this respect with the remaining Section 3 SOPs as supplementary context guidance to address additional hazards that would be unique to, for example, fires in high rise buildings or basements. In practice that is not the case, which is a cause for concern.

121. On p. 5 the 'Specific Hazards and Risks' section of SOP 3.1 the hazard of 'Ultra-fast fire growth' is listed:

'Certain types of fuels (e.g. polyethylene, polypropylene or similar plastics) can produce very rapid-fire development. In extreme cases, and with sufficient air supply, fire growth may be ultra-fast'.

122. Many modern building contents are made from synthetic based materials and so are capable, with sufficient available oxygen, of a high HRR which results in ultra-fast fire growth. This should be viewed as the norm rather than the exception and certainly not something that only happens in extreme cases. There is very little specific reference in either the extant 'Fires and firefighting' and 'Fires in buildings' NOG or in Supplementary information sheets on the effect of modern building contents on fire growth.

123. From analysis of the 'References' section, the narrative for this Hazard must have been drawn from Safety Flash 03 2012 Sudden and Rapid-Fire Spread. This was issued on 14 March 2013 with a review date of March 2014. If it was reviewed at that time or subsequently the research undertaken over the last decade (and referenced heavily in this report) would confirm that ultra-fast fire growth is not something that happens only in extreme cases. On a related matter, there are several SOPs I reviewed that are now well past their review date. It is imperative Hazard knowledge remains current and accurate across all SOPs. I return to this point later in this section.

124. The following hazard is identified under the heading of 'Ventilation' on p. 9:

'Ventilating a property incorrectly can result in a deterioration of conditions and may create a flammable atmosphere that leads to a backdraught. Use of PPV (Positive Pressure Ventilation)… can significantly increase the hazard'.

125. 'Incorrectly' applied ventilation of a ventilation-controlled fire will always cause a deterioration of conditions which are as a direct result of the 'ultra-fast' fire growth that inevitably follows if water is not simultaneously applied to the fire in sufficient quantities.

126. There are several references within NOG to the negative effect that uncontrolled ventilation will have on a ventilation-controlled fire, although these are arguably undermined by multiple references to the advantages of ventilation. It is perhaps understandable then that inaccuracies and contradictions relating to ventilation appear in this and other SWFRS SOPs (as referenced further on in this report).

127. Section 3 'Key Control Measures' does not contain reference to any control measure tactics or tactical options to be employed either to control ventilation to limit fire growth or to fight the fire.

128. There is a limited reference to compartment firefighting procedures in Section 4 'Operational Considerations', but this only extends to seven sentences. It covers door entry procedures and gas cooling (but with no mention of door control to limit oxygen inflow), the need for PPE and for crews to continually assess conditions within the compartment.

129. It does not explicitly reference any tactical options beyond gas cooling even in generic terms such as offensive exterior or offensive interior attack. Nor is there a mention of flow rates which was a recommendation from the 'Learning the lessons from Grenfell' Thematic Review published in 2021[18]. Flow rates feature as a stand-alone control measure within 'Fires and firefighting'. It is therefore a cause for concern that it does not feature in SOP 3.1 or indeed any other SWFRS SOP.

130. On p. 6 of the 'Key Control Measures' section within **SOP 3.1.1 Fires in basements** under the heading 'Training' there are high level references to procedures and techniques for firefighting without explicitly stating what they are:

'The procedures to be adopted when fighting fires in basements…

The techniques and equipment to be used for firefighting in basements'

131. In the 'Operational Procedures' section on p.8 under the heading 'Compartment firefighting in basements' there is one of the few references anywhere across the SWFRS suite of SOPs to controlling the inflow of oxygen when making entry:

'Minimise oxygen entry on entering compartment'

132. The 'Key Control Measures' section of **SOP 3.6 Tactical Ventilation** (p. 8) advocates the early use of Positive Pressure Attack (PPA) and contains the following guidance:

[18] WG42080 (gov.wales)

'…Using PPA early in the incident will benefit BA teams entering the building due to a reduction in the heat and smoke levels thus enabling the teams to ***rapidly attack and extinguish the fire…***

…The most important principle is that the fire has to be controlled by the fire attack crew the moment ventilation is started. The extra air will make for an increase in power of the fire, but this effect will be countered by the extinguishment capacity of the attack crew'.

133. The first statement directly contradicts the second and is scientifically incorrect. Using PPA prior to attacking the fire will achieve the opposite of a reduction in heat and smoke levels as it will significantly increase the intensity of the fire. The second statement is only true if the extinguishment capacity of the attack crew is sufficient to counter the effect of the *'increase in power'* of the fire. A high-pressure hose reel, even on a straight stream flowing a maximum of 100 lpm may not to have sufficient extinguishment capacity to supress a high HRR fire.

134. Also, within the 'Key Control Measures' section on p. 9 under the heading 'Command and Control' on the following guidance is offered:

'…Tactical Ventilation has significant beneficial effects on firefighting when employed correctly:

It assists escape and aids rescue operations by restricting the spread of smoke and improving visibility.

It makes it easier to locate and deal with the fire by removing heat and smoke so that crews can enter a compartment earlier with improved visibility

It restricts fire spread by limiting the movement of smoke and hot gases

It reduces property damage by making it possible for the fire to be located and tackled more quickly'

135. While the first statement is true, the outcome for the remaining statements will be the opposite if the fire is not first suppressed. Furthermore, the final statement cannot be interpreted any other way than to suggest that by ventilating it makes it easier for firefighters to locate the fire. This is at odds with the earlier guidance in the same section that correctly states that the '*fire has to be controlled by the fire attack crew the moment ventilation is started'.*

136. This contradiction is compounded in the 'Operational Procedures' section on p. 11 which offers the following guidance:

Before commencing tactical ventilation at an incident the Incident Commander should consider:

'…The location of the fire and stage of fire development'

137. The reason I am highlighting these contradictions is because there have been instances at incidents in the UK and internationally when firefighters have not been able to locate the fire or when structures have been heavily smoke logged, and windows have been opened or broken by firefighters in the mistaken belief that this will improve conditions, including visibility. What has followed has been rapid fire development of a previously ventilation-controlled fire resulting in firefighter injuries, fatalities[19] and significant structural damage.

138. Equally concerning is the absence anywhere in the SOP of an unequivocal statement confirming that if PPA is to be employed as a control measure tactic then the outlet vent **must** be larger in size than the outlet vent (my emphasis). The only substantive reference to Outlet vents is in the 'Operational Procedures' section on p. 12:

'The outlet vent MUST be created before employing fans, and should be positioned as close to the fire as possible…

Where it is identified in the DRA, a covering branch with designated personnel is to be provided at the outlet vent'.

139. The ''Specific Hazards and Risks' section of **SOP 5.8 Backdraught, flashover and fire gas ignition**, under the heading 'Signs of flashover' on p. 2 includes a table copied directly from 'Fires and firefighting' NOG (Control measure – Understand signs and symptoms of flashover), several of which are not signs and symptoms of flashover and instead relate to backdraught or a ventilation-controlled fire.

140. There are limited references to offensive and defensive firefighting strategies within the 'Key Control Measures' section of SOP 5.8 without any guidance at all as to what they might entail.

141. The only direct and specific reference to an offensive exterior attack is within the 'Scope' section of **SOP 6.4 Breathing Apparatus procedures**. This is followed with the only direct and specific reference to door control to restrict air flow:

'Consideration should be given to:

…Transitional attack – 20/30 seconds of water into the fire compartment before committing BA crew will slow the HRR and make conditions safer…

Consider defensive tactics, if no persons reported do we need to commit a BA crew in the risk area in the early stages to fight the fire? Can it be fought from outside…

Consider ante ventilation, take control of the flow path by closing the external door…'

[19] Sofa super store, Charleston NC/Balmoral bar, Edinburgh/Shirley Towers, Southampton et al

142. While this is absolutely the type of content I would expect to see within SWFRS guidance it should be prominent within **SOP 3.1 Fires in buildings** which is the primary SOP for firefighting tactics. The same is true of all the other scientifically correct references to control measure tactics listed above.

Operational policy - summary

143. On a station visit a probationary firefighter who was preparing for a 12-month competency assessment stated that he had spent an inordinate amount of time searching through SOPs to find content to refresh his knowledge on. Overwhelmingly on station visits the view was expressed by firefighters that a single point of reference for firefighting control measure tactics would be helpful. The absence of a definitive single point of reference for firefighting control measure tactics (or tactical options) is a serious omission but is one which can be easily remedied.

144. The 'Specific Hazards and Risks' section of **SOP 3.1 Fires in buildings** should unequivocally set out the hazard knowledge for all reasonably foreseeable hazards arising from a fire in a building. The 'Key Control Measures' section of SOP 3.1 should be the single repository where the full suite of SWFRS firefighting control measure tactics is set out. All other firefighting related SOPs should then link back to this section to avoid repetition.

145. The National Fire Protection Association (NFPA) 1700 'Guide for structural firefighting' is the American version of 'Fires and firefighting' and 'Fires in buildings' NOG. The 'Tactical Considerations for Fire Control and Extinguishment' set out in Chapter 10 have been developed from the UL FSRI research undertaken over the last 15 years and referenced heavily in this report.

146. Chapter 10 is the best example I have seen of a clear and unambiguous articulation of control measure tactics ranging from what would be considered in the Dutch 4 Quadrant Model as a Defensive Exterior Attack, right the way through to an Offensive Interior Attack with an easily understandable explanation of how each is executed in practice. What Chapter 10 also does is to differentiate firefighting attack control measures from tactical ventilation control measures using the distinct headings of 'Water' and 'Air'. The interim CFO is a strong advocate of NFPA 1700 which I believe has gained some traction within SWFRS in the time he has been there.

147. SWFRS should use the forthcoming publication of the revised 'Firefighting' and 'Foundation for firefighting' NOG as the opportunity to fundamentally review their Section 3 Fighting Fires SOPs and any other SOPs which contain references to fire related hazard knowledge or control measures tactics.

148. This should be followed by a fundamental review of all related training packages to ensure that the two are completely aligned. I cover this point in more detail in the following section and in the report recommendations.

Organisational arrangements for the delivery of operational policy

149. Operational Policy is predominantly imparted to firefighters through their initial and ongoing training. There are three phases to firefighter training in SWFRS:

- Phase 1 Initial Skill Acquisition – Wholetime duty system firefighters undertake an initial 13-week training course at Cardiff Gate Training Centre covering all core skills. RDS firefighters initial acquisition program is delivered over two modules. Module 1 is a 10-day foundation firefighting skills course. Module 2 is a 10-day Breathing Apparatus course. The 13-week initial course and both RDS Modules cover input on hazard knowledge and control measure tactics for fighting fires in dwellings.

- Phase 2 Development to Competent - For wholetime firefighters the 13-week initial training course is followed by a 24-month period within which the firefighter is expected to move from development to competent and thus achieve the Skills for Fire & Rescue (SFJ) diploma apprenticeship. Wholetime firefighters undertake quarterly assessments against all core skill areas. RDS firefighters undertake 6 monthly assessments on Core Skills (x 2), Road Traffic Collision techniques and Breathing Apparatus.

- Phase 3 Maintenance of Competence - SWFRS utilises the pdrPro competency recording system to implement a risk-based approach to competency maintenance training and assessment. The pdrPro system is linked to the LearnPro Learning Management System which consists predominantly of theoretical training packages, some of which are directly linked to SOPs. This is supplemented by periodic structured skill maintenance training courses delivered by instructors at the Cardiff Gate Training Centre including BA and Compartment Fire Behaviour refresher courses.

150. For the purposes of this inspection, I reviewed the following training packages relevant to dwelling fire hazard knowledge and control measure tactics which I accessed through the 'Training' section of the SWFRS intranet and through the pdrPro Learning Management System (LearnPro).

- Water flow
- Practical and effective use of water at incidents
- Tactical Ventilation (LearnPro)
- Tactical Ventilation (One day course)
- Backdraught, flashover & fire gas ignition
- Smoke Blocker

151. There is limited read across from the SWFRS SOPs to the training packages I reviewed. In the focus group with the Compartment Fire Behaviour instructors at Cardiff Gate it was explained to me that training package content tended to evolve through instructors taking the initiative to make additions based on their own research rather than through any formal internal mechanisms to align SOPs and training content. I return to this point later in this section.

SWFRS training package analysis

152. From the 'Core Skills Presentations' section of the Pre-Course Learning intranet page, I reviewed the '**Water flow**' and '**Practical and effective use of water at incidents**' presentations. The content of both presentations is similar and covers the hoses in use within SWFRS, methods of water application and the types of fire for which they are suitable.

153. The '**Water flow**' presentation focuses on the flow rates achievable from the hose and branch combinations available within SWFRS. It contains a table listing typical items found within a room in a dwelling and their HRR along with the required flow rate to supress a fire involving each of them. This is followed by input on the sources of water available to firefighters in SWFRS and simple calculations to work out how long they will last. This was a recommendation from the 'Learning the lessons from Grenfell' Thematic Review published in 2021 so is welcomed.

154. The '**Practical and effective use of water at incidents**' presentation contains a UL FSRI video (micro teach) on air entrainment and water mapping which gives a visual demonstration of the control measure tactic for an offensive exterior attack to be utilised to achieve maximum water coverage and therefore cooling for a fire in a room. This was a recommendation from the Operational Training Thematic Review published in 2022 and is also welcomed.

155. Both presentations provide simple, easily digestible factually and scientifically correct underpinning hazard knowledge alongside a demonstration of a highly effective control measure tactic. I took the target audience to be recruit firefighters however the content would be equally relevant to competent firefighters on watches for the purposes of competency maintenance.

156. From the BA refresher online training page, I reviewed the '**Flow rates**' presentation. It is my understanding that this presentation forms part of the BA refresher course delivered at Cardiff Gate. The learning outcomes of the session are listed as follows.

'At the end of the session the student should be able to:

- *Identify what flow rate is*
- *Explain what flow rate is <u>not</u>*
- *Understand heat release rate*
- *Identify pros and cons of each method of water delivery in a fire scenario'*

157. The content on HRR is broadly consistent with that in the 'Water flow' presentation. Input is given on the fireground calculations for Flow Rates which feature as a stand-alone control measure in the 'Fires and firefighting' NOG but not in any SWFRS SOP.

158. Alternative calculations based on HRR of materials likely to be found in typical rooms in dwellings (like that in the '**Water flow**' presentation) are covered on the next slide.

159. The following slides match the extinguishing media and flow rates available in SWFRS (19mm high pressure hose reel, 45mm and 70mm low pressure delivery hose) with reasonably foreseeable HRR scenarios for dwelling and commercial fires. Finally, there is a summary of the advantages and disadvantages of the 19mm high pressure hose reel, 45mm and 70mm low pressure delivery hose from a firefighting attack perspective. Again, none of this input features in any SWFRS SOP highlighting a concerning disconnect between policy and training materials.

160. The **Tactical Ventilation** presentation on the Learn Pro platform is linked to SOP 3.6 of the same name.

161. The beginning of the presentation deals with definitions of ventilation including '*Ante ventilation*' which is concerned with controlling the inflow of air into a room on fire and is an effective control measure tactic if executed correctly.

162. The point is made, correctly, on the slide entitled '*What do we mean by Fire/What do we mean by Extinguish*' that '*the direct application of water to fuel is the only method to stall both combustion and pyrolysis'* (extinguish the fire).

163. On the slide '*Types of fire – significantly ventilated, fuel controlled'* the bullet point '*Effect of forced air*' correctly identifies a predicable increase in growth rate (of the fire).

164. The bullet point '*Application of media*' also correctly advises '*a large flow rate directed to the burning fuel*…' as a control measure tactic.

165. On the slide '*Types of fire – significantly under ventilated, ventilation controlled*' the bullet point '*Effect of forced air*' correctly identifies *'a significant increase in growth rate requiring rapid fire suppression with a high flow rate of water'*.

166. The bullet point '*Application of media*' also correctly advises *'a large flow rate directed to the burning fuel'* but first advises that *'(fire) gases should be either removed or diluted prior to advancement of firefighting crews…'* without stating how the fire gases should be removed.

167. On the slide '*Types of fire – under ventilated, ventilation controlled*' the bullet point '*Effect of forced air*' correctly identifies *'an increase in growth rate requiring rapid fire suppression with a high flow rate of water'*.

168. The bullet point '*Application of media*' again correctly advises '*a large flow rate directed to the burning fuel'* but first advises that *'(fire) gases should be either removed or diluted prior to advancement of firefighting crews…*' without stating how the fire gases should be removed.

169. On the slide '*Characteristics of modern fans*' the following reference is made to outlet vent size '*Since flow, not pressure is important, exhaust sizes can be much larger'.*

170. This is the only reference to exhaust sizes in the presentation. It does not however explicitly state that when undertaking PPA the exhaust (outlet) vent **must** be (significantly) larger than the inlet vent. Nor does it state explicitly that the location of the fire should be known before commencing PPA. This is a serious and risk critical omission which is reflected throughout the suite of SWFRS SOPs and within the presentation delivered on the **Tactical Ventilation one day duration course** reviewed below.

171. On the subsequent slides, actions on not achieving an effective flow of fire gases through the outlet vent are listed including the use of an offensive exterior attack. This begs the questions as to why the offensive exterior attack is not being advocated as a control measure tactic ahead of PPA rather than as an intervention if PPA fails.

172. While not featuring on LearnPro, in the interests of consistency I will review the content of the '**Tactical Ventilation one day duration course** presentation next and then return to the **Backdraught, flashover & fire gas ignition** and **Smoke Blocker** packages on Learn Pro.

173. Slide 7 entitled '*The modern problem*' correctly highlights the fact that modern building contents (synthetic based materials) generate significantly higher HRR than traditional materials.

174. The following slide entitled '*Types of fire*' identifies '*Under Ventilated*' and '*Fully Ventilated*' and correctly makes the point that most compartment fires will become under ventilated, and that ventilation will increase the intensity of the fire. This is followed by correctly making the point that if ventilation is controlled then the fire is controlled and finishes with a bullet point advising consideration of ante ventilation (as a control measure tactic).

175. The presentation goes on to compare American tactics with Swedish tactics followed by a slide which asks the question '*Are SWFRS tactics American or Swedish?*' This slide includes the following text boxes:

- *The property we are attending have changed from drafty structures with wooden furnishings to sealed, insulated and furbished by Ikea and Microsoft*
- *We ventilate early but don't always use attack teams to extinguish the fire first*
- *We gas cool but don't control the inrush of oxygen, limiting fire growth*

176. These statements are all true and consistent with the findings of this inspection. In one sense it is good that these hazards are recognised. It is a serious cause for concern however that the implications of these hazards are not then explicitly stated and nor, apart from ante ventilation, are the control measure tactics listed to mitigate them. Better still, there should be an unequivocal direction to immediately cease the last two.

177. A subsequent slide entitled '*Door control and Ante Ventilation*' lists the following points:

- *Forcible entry is ventilation*
- *Control the access door*
- *Limit O2 through front door*
- *Door Control Operator*
- *Maintain compartment integrity*
- *Closed doors save lives*
- *Interrupt Air Track to limit fire growth and reduce temperatures…*

178. This is all correct. This list of control measure tactics does not however appear explicitly in any SWFRS SOP. I will return to this point in the summary below.

179. The remainder of the presentation deals with PPA which directly contradicts the points listed above. I understand why PPA is included in a presentation on Tactical Ventilation however I believe it would be more effective, if PPA is to be retained as a control measure tactic, to present it as distinctly separate from ante ventilation to avoid any possible confusion between the two.

180. The **Backdraught, flashover & fire gas ignition** package on the LearnPro platform is directly linked to SOP 5.8 of the same name.

181. The text on the '*Flashover*' slide lists backdraught hazard indicators alongside flashover hazard indicators which is a possible cause for confusion and should be rectified. This is reflected in SOP 5.8 and is copied directly from the 'Fires and firefighting' NOG as highlighted earlier in this report.

182. There is only one limited control measure reference on the slide:

'Where flashover conditions are suspected, consider employing a combination of direct firefighting and gas cooling to control conditions'.

183. The next slide gives limited options for '*Stay*', '*Advance*' or '*Withdraw*'.

'*Stay*' advocates protecting the position by gas dilution (pulse spray into fire gases) before moving forward.

'*Advance*' advocates attacking the fire gases and/or the fire, using correct branch techniques without saying what these are.

'*Withdraw*' again advocates gas cooling for protection.

184. The slide '*Methods of applying water*' describes direct, indirect and gas cooling. Under '*Direct firefighting*' it correctly states that crews should not become distracted by gas dilution techniques when the direct application of firefighting media is required to extinguish the fire.

185. This is then immediately undermined by the following statement:

'Direct firefighting has the potential to generate large amounts of steam, as it involves applying a controlled amount of water directly to the seat of the fire. Crews should consider taking measures to ensure they are protected from steam burns and the increased heat in the fire compartment'.

186. This statement is factually and scientifically incorrect as proven by research[20]. Direct application of water into a room on fire using a straight stream results in significant temperature reductions, not '*increased heat in the fire compartment*'. Any expansion of water into steam is more than offset by the contraction of the gases in the fire compartment because of the reduction in temperature.

187. As the temperature increases in a room on fire so gases expand resulting in an increase in pressure. This is reversed when the temperature decreases. The quality and effectiveness of modern PPE, if worn correctly, is such that firefighters would be unlikely to suffer steam burns in any event.

188. The statement highlighted above does not feature in any of the SWFRS SOPs. It is drawn directly from the extant 'Fires and firefighting NOG' which again highlights a disconnect between policy and training. Appropriate governance arrangements around policy should prevent content which is obviously incorrect being included in SOPs and by extension training materials.

189. Under '*Indirect Firefighting*' the example given is directing spray into the smoke layer from outside the fire compartment. What the slide would be better advocating is a straight stream on a steep angle directed towards the ceiling of the fire compartment to achieve maximum water dispersion and therefore cooling whilst minimising air entrainment. This method is referenced in the '**Water flow**' presentation so I consider it a reasonable expectation that it should also be referenced here. That it does not is a cause for concern and is in my view a consequence of the ad hoc development of training materials by well-intentioned instructors rather than any formalised mechanism to ensure operational policy is consistently reflected in training materials.

190. Under '*Gas Dilution*' the point is made again, correctly, that this technique should not be considered for dealing with a fast developing or post flashover fire and that in such cases a straight stream should be directed at the base of the fire.

191. Gas dilution or gas cooling through pulsing on a spray setting is strongly advocated through the training package. This is despite Dutch research referenced earlier in this report having demonstrated that the method is less effective at achieving and maintaining temperature reductions as firefighters advance towards a room on fire and is harder to achieve in practice than using a straight stream. This is another cause for concern not least as I bought this research to the attention of SWFRS Principal Officers when it was first published in 2021.

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[20] Study of the Impact of Fire Attack Utilizing Interior and Exterior Streams on Firefighter Safety and Occupant Survival | UL's FSRI – Fire Safety Research Institute

192. On the '*Firefighting Tactics*' slide, fighting the fire externally is correctly identified as a control measure tactic. It is however incorrectly referred to as a defensive tactic which in a cultural sense can have a negative connotation, the inference being that it is in some way inferior to an offensive tactic. While this may seem trivial its importance should not be understated.

193. The '*Ventilation*' slide lists all the benefits of ventilation without once stating that the opposite will be the outcome if the fire is not first attacked with enough water. The only note of caution offered in any of the subsequent ventilation slides is around creating a vent in a previously under-ventilated area which is identified as increasing the risk of creating a backdraught. A backdraught is one of several possible outcomes, but rapid-fire development is a certainty.

194. At no point is the absolute requirement for an outlet vent to be (substantially) larger than the inlet vent when deploying PPA made.

195. The '**Smoke Blocker**' presentation is instructional in nature and concerned with demonstrating how the F70 Pro Smoke Blocker is deployed for inward or outward door opening scenarios and then how it is removed and packed away.

196. A short video demonstrates how a stairwell is kept clear of smoke when the curtain is used for entry into a room on fire compared to when it is not. At no point is the tactical advantage of controlling the inflow of oxygen into a room on fire to control the growth of the fire stated.

Issues raised on previous Thematic Review inspections

197. The 3 previous Thematic Reviews I have undertaken have raised issues which are relevant to this inspection and to the organisational arrangements through which operational policy is delivered.

198. Recommendation 4 of the Learning the lessons from Grenfell Thematic Review (copied below) concerned tactical flow rates as I had noted the default to high pressure hose reels at incidents during this inspection.

199. *Recommendation 4 – that input on tactical flow rates for firefighting attack and fire ground calculations be included on the syllabus for Breathing Apparatus and Compartment Fire Behaviour initial and refresher courses. This should be supplemented by an online training module for skill maintenance within the station work routine.*

From the analysis of training packages this has clearly happened although it is not reflected within any SWFRS SOP.

200. Recommendation 5 was concerned with the FRS establishing a robust method by which to ensure the recommendations of the Thematic Review were embedded. The text of the recommendation is copied below:

Recommendation 5 - Should the 3 FRS be minded to accept the recommendations contained within this report the Operational Assurance criteria in use within each of the FRS should be amended to capture specific evidence in relation to the recommendations in order to demonstrate they are being applied on the incident ground. Alternatively the 3 FRS could utilise a Thematic Assurance process to target the issues identified within this report.

201. The Learning the lessons from Grenfell Thematic Review report was issued on 25 February 2021. The incident data analysed in this report covers the periods 1 April 2020 – 31 March 2023 and includes over 2 full years after this recommendation was made. There is no evidence whatsoever from the analysis that suggest the default position of using a high-pressure hose reel (the tactical option offering the lowest flow rate and therefore lowest level of protection to firefighters) has in anyway shifted in SWFRS. This suggests strongly that the operational assurance processes in SWFRS are ineffective. DCFO Osborne considers this issue further on in this report.

202. In the Broadening of the role of firefighters Thematic Review[21] report published in December 2021 I raised a concern that the current shift system, dating back to the 1970s, does not allow sufficient time for training, exercising and risk reduction activities.

[21] WG43934 (gov.wales)

203. There is no formalised station work routine in operation within SWFRS but custom and practice dictates that 50% of all available time is allocated to meal breaks, private study and rest periods with the latter accounting for 14 hours of the available 48 hours worked across the 8-day reference period.

204. Any interruption to this rest period, which is reasonably foreseeable from emergency calls, increases the risk of excessive fatigue for firefighters and for which there is no control measure. This is a failure on behalf of the Service to meet its legal duties under Regulation 3 of the Management of Health & Safety at Work Regulations.

205. The existing shift system is either highly inefficient if firefighters sleep for the full rest period at the expense of training and risk reduction activities or unsafe if they do not. Neither can be considered acceptable. I made recommendations to address this within the Thematic Review report, but they are yet to be actioned. This must change and the additional capacity released must be used to increase the amount of training that will be required to ensure firefighters in SWFRS are safe and effective when responding to incidents.

206. In the Operational Training Thematic Review report published in October 2022 I raised several concerns which remain directly relevant to the issues highlighted throughout this inspection.

207. The first was that none of the Welsh FRS know definitively the amount of time that should be allocated within station work routines to skill maintenance training. I made the point that each Service first needs to carry out a strategic risk assessment to understand the threats, hazards and risks across its area from fires and other emergencies (in England this would be a fundamental component of the Community Risk Management Plan). They then need to determine the operational capability they can reasonably deploy from their existing resources to mitigate the identified threats hazards and risks. This capability assessment can be considered as the full range of control measure tactics (or tactical options) each Service can deploy. This capability assessment should then inform the Training Needs Analysis.

208. In simple terms each control measure tactic or tactical option and associated hazard knowledge should be articulated within an Operational Risk Assessment or SOP. Each should then have its own training package inclusive of theoretical and practical aspects. These training packages can be subject to a time and motion study which gives a time value for each. Time is a commodity that wholetime firefighters have in abundance. The opposite is true for RDS firefighters but having a time value for each control measure tactic allows Services to prioritise control measure tactics and match them against the available time for their RDS resource.

209. This was the driver behind Recommendations 1, 2a, 2b, 3 and 4 from the Operational Training Thematic Review. Recommendations 5 and 6 are directly relevant to the substantive issues raised throughout this inspection.

210. As I have already identified, some aspects of international research are now reflected in training packages, although not in SOPs. I am of the view that this has happened by chance rather than by design.

211. I make the point within the Operational Training Thematic Review that there are significant challenges for the FRS in replicating real world modern fire conditions in a training environment.

212. The fire behaviour training facility at Cardiff Gate has several limitations including around the HRR that can be achieved with training fires and the effect of ventilation profiles on the scenarios that can be created.

213. In the focus group held with the Compartment Fire Behaviour instructors they advised me that the firefighting media deployed on all scenarios at the training facility was a high-pressure hose reel. I understand why this is, as using a low pressure 45mm line would extinguish the fire which would then have to be rebuilt multiple times to accommodate the number of students in the rotation. I believe however that it serves to perpetuate the default position of using the high-pressure hose reel as the tactic of first resort at dwelling and other structure fire incidents.

214. In the Dutch report 'When water goes up in smoke' referenced earlier, the experiments to determine the safest and most effective firefighting method of advancing through a property towards a room on fire were conducted in a purpose-built rig. The text copied below directly from the report describes the construction of the test rig:

'One base scenario was applied to all experiments:

A major fire in a living room (6 – 8 MW) where the door from the fire room to the corridor is open, smoke is flowing into the adjacent corridor and the front door to the residence is open; no fire attack…

…In order to best approximate the real-life situation, the research was conducted in a brick building. The building was L-shaped, with the long part of the L-shape consisting of a 2- metre wide, 2.5 metre high and 20-metre long corridor. The fire room was located in the short part of the L-shape. This shape was chosen so that it would be impossible for the seat of the fire to be reached directly while carrying out the smoke cooling methods'.

215. Such a rig would be relatively easy to construct, notwithstanding the limitations of available space at Cardiff Gate and any environmental considerations. It would provide firefighters with exposure to a real-world fire scenario utilising a 45mm low pressure delivery hose in a safe and controlled environment while at the same time allowing instructors to conduct multiple rotations. Critically it would allow firefighters to practice hose management techniques with low pressure delivery hose which can considerably increase their speed of progression through a structure when carrying out an offensive interior attack.

216. In the Operational Training Thematic Review, I referenced the UL FSRI Hose Stream prop. The text copied below describes its evolution:

'The idea for the innovative Hose Stream Prop was sparked when FSRI research studies began to yield thought-provoking findings around the fundamentals of hose stream mechanics – specifically air entrainment and water mapping. These concepts are the ground-level building blocks needed to understand the impact of varying suppression tactics on the fireground. From these findings, FSRI research engineers began by building a prototype training prop to visualize and interactively demonstrate these concepts.

With the help of trusted fire service partners and live training demonstrations throughout the country, FSRI research engineers designed several enhancements to optimize usability, increase the suppression concepts able to be visualized with the prop and much trial and error – leading up to the final version and current construction plans'.

217. UL FSRI have shared the plans online to allow FRS to build their own Hose Stream props along with instructional videos and lessons plans. It would not be cost prohibitive for SWFRS to provide one of these training props on every fire station.

218. The recommendation relating to training at the end of the report is intended to be complementary to the earlier Thematic Review recommendations.

219. Progress against these recommendations is now being made through project groups set up by the Commissioners and interim CFO. This is positive and is welcomed.

Organisational arrangements for the delivery of operational policy - summary

220. To an extent the contradictions and inaccuracies highlighted in the review of SOPs are also reflected in the review of training packages. There is however a clear disconnect between the content in SOPs and some of the content in training packages. This can be explained by a lack of formalised organisational process to update training packages when SOPs are reviewed (acknowledging that some of the SOPs referenced in this report have not been reviewed for over 2 years). What has resulted is instructors making changes to content after undertaking their own research and continued professional development. While this is commendable on their behalf it is not how an organisation should function.

221. SOPs and Training are dealt with by distinctly separate areas of the Service.

222. The Operational Intelligence Team is responsible for SOPs and sits within the Operational Risk Management function alongside Health & Safety, Appliances & Equipment and Resilience & Planning. These Teams are located at Service Headquarters. This function is the responsibility of an Area Manager who reports into the Assistant Chief Fire Officer (ACFO) for Service Delivery.

223. Training instructors are located at the Cardiff Gate Training Centre. Within Training there are two Departments. The Core Skills Department is responsible for recruit, BA, technical rescue, hazardous materials and driver training. The Incident Command Department is responsible for Supervisory, Middle and Strategic Manager incident command training, skills maintenance packages on LearnPro (Training Support Unit) and some elements of operational assurance through the Operational Development and Review Team. The overall Training function is the responsibility of an Area Manager who reports to the ACFO for Technical Services.

224. I am particularly concerned that risk critical failings are identified in a training package, yet no obvious measures have been taken to correct this within SOPs. By that I mean there is no operational guidance that contains an unequivocal direction not to ventilate prior to or at least concurrent with suppression (bullet point ***'We ventilate early but don't always use attack teams to extinguish the fire first'*** refers).

225. There is also no operational guidance that contains an unequivocal direction to not utilise low flow pulse techniques (gas cooling) if no means of ventilation control (door control or smoke curtain) has been implemented (bullet point ***'We gas cool but don't control the inrush of oxygen, limiting fire growth'*** refers).

226. It begs the question as to how these issues were identified, by who and what was done about it. It also calls into question how one function within the Service can hold risk critical knowledge that is not shared and then acted on as a matter of routine with all other functions in the Service. This is an issue that is explored in detail in the next section of this report considering how operational performance is monitored, audited and subject to review.

Organisational arrangements for monitoring, auditing and reviewing operational performance

227. A robust operational assurance process is a critical component of any safety performance management system. In the FRS it consists of the active monitoring of incidents (either remotely or on scene), incident ground audits and reviews including through the debrief process. Done properly it allows the FRS to continually check the effectiveness of operational procedures, equipment and training and to make changes where necessary. It is critical to firefighter and public safety which is why it featured so prominently in this inspection.

228. There are three separate entities within SWFRS involved in the monitoring of and information gathering from incidents. These sit alongside other processes for operational crews and officers to feedback information and learning, much of which I found to be disjointed and lacking any holistic strategic oversight and governance.

229. The three entities concerned with operational assurance within SWFRS are the Operational Development and Review Team (ODRT), the Operational Audit and Support Team (OAST) and Operational Mentoring Support Officers (OMSOs). For the most part they operate independently and in isolation of each other.

230. The process of operational assurance within SWFRS lacks a systemic approach. It is compartmentalised across different departments and directorates with no overarching policy or procedures. This causes confusion and a lack of understanding of the process across the Service.

231. Consequently, much of this section of the report relies heavily upon information gathered directly during focus groups, through direct engagement with ODRT officers and on station visits. This is cross referenced with existing policies and procedures where they are available.

ODRT, OMSO and OAST

232. As outlined in **SOP 6.1 Incident Command**, the Operational Development & Review Team (ODRT) *'consists of operational personnel whose primary role is incident monitoring'*. This is further reinforced within **Policy OP-08.005 Operational Development & Review Team**.

233. It was established during the inspection that incident monitoring is achieved in several ways, ranging from attending certain incidents (if an ODRT member is on duty and available), active monitoring via airwave radio/mobilising system, feedback from operational crews and officers via form O-25 and other reactive monitoring in respect of debriefs and incidents of interest.

234. During the inspection, past and present members of ODRT stated that there was either no policy covering their remit or that existing policies had not been updated. There is an ODRT Policy (OP-08.005) however it has not been reviewed since April 2020 with the next review scheduled for Second Quarter 2023 (which hasn't happened yet).

235. It is a cause for concern that the existence of OP-8.005 is not widely known within ODRT and suggests that team members are working to their best endeavours to provide a level of operational assurance and learning rather than through any structured approach.

236. I was advised that the function of OMSO also falls within the purview of ODRT, but I was unable to establish if there was an extant policy or any specific guidance detailing their ways of working.

237. There is no obvious Policy for OMSOs on the SWFRS intranet. The only specific reference to the OMSO function is contained within SOP 6.1 which states that OMSOs may attend incidents to:

- *Provide a critical friend to Incident Commanders*
- *Provide a mentoring and validation facility to individuals who are newly promoted or in development*
- *To increase experiential learning opportunities for all Incident Commanders*
- *Provide resilience for developing incidents by improving command continuity*

'The OMSO provides a sustainable improvement framework for operational competence whilst making the Incident Command System more capable of dealing with developing incidents'.

238. During the inspection I was informed that a review of the OMSO function was underway with a view to drafting a new policy.

239. Despite the guidance contained within SOP 6.1 the OMSO role and function was not fully understood across the staff groups I met with, and confusion arose between the ODRT and OMSO remits and functions. There is no specific reference

to the OAST within SOP 6.1 and nor does OAST have a Policy which sets out its role and function.

240. There was no opportunity during the inspection window to meet exclusively with OAST members. I was able however to establish a broad understanding of OAST's functions and responsibilities through staff focus groups and other documentation provided to me.

241. What is evident is that OAST do not perform a role in respect of active incident monitoring. Rather, their focus is on station administration including measures such as compliance with the periodic assessment regime on the pdrPro system. They also receive copies of Analytical Risk Assessments (ARAs)[22] from incidents but it is not clear as to what is then done with them.

[22] An analytical risk assessment should be undertaken as soon as possible at an incident and then reviewed at regular intervals. It records all foreseeable hazards and the control measures implemented to reduce the risk arising from the hazards

Incident monitoring

242. There are several different approaches as to how incidents are monitored and supported across SWFRS, with different feedback routes and processes available for attending crews and officers.

243. The primary route for attending crews to feedback in relation to operational matters is via form O-25 which are submitted to ODRT. During the fieldwork visits to stations, it was widely reported that although acknowledgement of receipt was received, they were unsure as to what if any effect or influence they achieved through the submission of the O-25 as further progress reports were not forthcoming. This in turn has had the effect of crews not proactively submitting O-25's due to the perceived inertia within the system. For their part ODRT members advised that they did respond to O-25s within 28 days.

244. From what was reported to me during the inspection, the actual process for incident monitoring appears to be in many cases ad-hoc and disjointed.

245. The main responsibility for operational monitoring and assurance within SWFRS sits with ODRT as set out within SOP 6.1 and OP-8.005, but beyond that there is little by way of guidance for any other officers attending incidents in respect of operational assurance and monitoring.

246. Members of ODRT will mobilise to certain thematic incidents and will complete a proforma tailored to that incident type. Attendance and mobilisation of ODRT appeared ad-hoc in nature and dependent upon who was on duty at the time. OP-8.005 sets criteria for the incident types that ODRT may respond to, but it is caveated by 'if available'. Operational assurance cannot be considered as discretionary. It should be resourced accordingly.

247. The understanding of team members was that a business case to grow the team would be deemed too expensive, however it was acknowledged that upskilling the Service in respect of incident monitoring would not be cost prohibitive.

248. SWFRS is not short of Middle Managers with 60 established Station and Group Manager roles. The resources are most definitely there to provide 24/7 operational assurance cover.

249. What was evident during the review of incident logs is that Level 2 (Tactical) officers[23] are mobilised to the majority if not all incidents attended by two or more fire appliances. Once in attendance, these officers can choose to declare the role they are adopting after their initial information gathering and evaluation of the incident.

[23] Officers in the Station and Group Manager role typically conditioned to the Flexible Duty System

250. The options open to Tactical officers are to either adopt a supportive OMSO role if the initial officer in charge (OIC) is in development, declare that they are performing an operational assurance role or to assume command of the incident.

251. The evidence from the incident analysis and feedback received suggested that it is not standard practice or usual for Tactical officers to declare they are adopting an operational assurance role. On many occasions, Tactical officers either assume command or adopt the OMSO role.

252. Tactical officers taking command of what in many instances are small and relatively straightforward incidents denies Crew and Watch Managers the opportunity to develop their command competencies. The incident analysis in the first section of this report shows that over half of dwelling fires result in no firefighting action. The exposure of all officers to significant incidents has much reduced over the last two decades so I can understand why Tactical officers take over at much smaller incidents, but it is to the detriment of the experiential learning of Crew and Watch Managers. This is why training and exercising is so important as highlighted elsewhere in this report and through the recommendations.

253. What would help is clear guidance and rationale on trigger points when officers must take charge of an incident to ensure spans of control are not exceeded. This is absent from SOP 6.1 and is an omission which if addressed might go some way to removing any ambiguity on the incident ground over which roles officers should be performing.

254. In the focus group meeting with ODRT it was confirmed that there is frequent confusion among firefighters as to who is performing what role whilst at an incident in respect of OMSO and ODRT. This was validated when engaging with crews on station visits.

255. Another observation made by ODRT was that "*if ops assurance was more prescriptive people would feel more comfortable to utilise it, rather than take over at a scene*". This again links back to a lack of overarching policies, procedures and understanding of what the aims and objectives of operational assurance and learning are.

256. ODRT officers expressed the view that there is a mindset within SWFRS that they are the 'P*olice of the service'* along with concerns that it will take a lot of work to convince firefighters that they are there to support adaptation and learning.

257. There were however examples offered of good engagement with crews and other areas of the Service to educate and build trust and confidence in the team.

258. It was reported that there was a feeling that Tactical officers who are responsible for stations, could be biased in their assessment of operational performance involving their own crews. Although this comment was made anecdotally, it did raise concerns as to how serious risk critical operational matters may or may not be reported upon.

259. It was established that Level 3 and 4 officers[24] do actively monitor incidents when on duty via either Airwave radio, mobile phone and or the mobilising system. This is not expressly captured in policy or procedure and appeared to only be custom and practice for fire incidents, although it was stated that this was being considered for road traffic collision and water rescue incidents.

260. Another area explored was around the relationship between the Health & Safety department and ODRT. This is expressly set out within OP-8.005 which lists the following duties in this respect:

- *Liaising with the H&S Dept to identify trends relating to operational injuries, near misses, vehicle accidents.*

- *When the on-call member is requested, they will attend any accident to carry out accident investigation and information gathering using forms: H-01b Injury Investigation form and H-01c Injury Interview form*

- *Analysing statistical information made available by the H&S Dept relating to safety events occurring during operational events.*

- *Reporting to AM T&D on trends relating to Health and Safety and operational issues…*

261. There were no near miss reports from operational incidents submitted to ODRT that were available to us to view. The absence of near miss reports suggests complacency and is a serious cause for concern. Anecdotally we have been made aware of occurrences at incidents which are absolutely near misses and could have resulted in serious injury or worse for firefighters. It would appear that the near misses have not been recognised as being such at the time.

262. When the matter of how ARAs conducted at operational incidents were recorded and reviewed was raised, ODRT officers confirmed that they did not have sight of these as they are sent to OAST at the conclusion of an incident. It was unclear as to how any issues or learning from these was then fed back to ODRT or indeed any other relevant stakeholders.

263. The systems in place for recording all the information gathered from incidents are disparate and not easily accessible to be viewed by the Service. I was shown several different processes being utilised to record, store and monitor information, ranging from excel spreadsheets to 'MS Teams' areas and 'SharePoint' which was described as unreliable. Utilising these different platforms is disjointed and reliant upon a small team of people to maintain and update the information. Of more concern, it was unclear as to what internal organisational governance arrangements were in place to ensure that actions were being monitored and escalated if required outside of ODRT.

[24] Area Manager and Principal Officer roles

264. ODRT officers clearly understand the importance and value of good operational assurance and learning. It is apparent they are open to change in the best interests of the Service and the public.

265. What was clear from evidence gathered during the inspection, is the absence of a joined up systemic approach across SWFRS in respect of incident monitoring and how that feeds into organisational learning. This is explored further below in relation to incident debriefs.

Incident review and debriefing

266. **OP-04.004 Review and Debrief Procedures** is the extant guidance within SWFRS that covers debrief procedures. It describes two different types of debriefs which can either be a facilitated structured debrief or a standard debrief ('hot debrief' or 'periodic debrief').

267. There are no specific triggers within the procedure as to when a debrief will take place. There are some suggestions as to when a structured debrief may be considered which in practice appears to be at the discretion of attending crews and officers to request a debrief if they feel it is required. This was borne out during staff focus groups and station visits.

268. Any significant outcomes from a hot debrief should be conveyed to the ODRT via a form O-25**.** As previously described, there is a lack of confidence in this system due to the perceived inertia in respect of any outcomes and how these are communicated back through the Service. Examples were given of repeated form O-25's being submitted on the same issue, with little or no feedback being received such that firefighters have effectively given up on the system.

269. O-25 forms are also sent out by ODRT following what they deem as incidents of interest following active monitoring or interrogation of the mobilising system, however when questioned as to what the return rate was, this information was not available.

270. We were advised that 1690 O-25 forms had been submitted, which was credited to the team in being effective and proactive in looking to gather information from incidents. In addition, a process is currently underway to create a new system to store and review all submitted O-25's.

271. I was advised during the inspection of the development of an electronic debrief app, but it was unclear as to who had access to this app or how widely this was understood and being used within the Service.

272. A selection of some of the comments and concerns that were articulated during the inspection in respect of the debrief and O-25 process include the following:

- *Supervisory managers were unsure if ODRT forms are being used to monitor incidents or if they are being used to monitor crew competency*
- *Hot debriefs – it was reported that there is currently no fixed process in place, with opportunities for sharing good working processes being missed. It was said there is a strong belief amongst the service that debriefs only occur if something has gone wrong or crews are in trouble. One previous ODRT member of staff stated that he had only been involved in a maximum of 4-5 debriefs during 3 years of service in the team*

- *The processes of feedback and debriefing have been described as too long winded for the Service to make any meaningful decisions or produce outcomes.*

- *Frustrations were shared at the pace of change, with firefighters unsure as to what the hurdles are from the 0-25 forms. Concerns were raised around sharing of information with little or no communication passed back down on the process.*

- *When submitting 0-25's, the only feedback crews have is a submission acknowledgement. There was strong consensus among some crews that no change has come from submissions. This is in turn giving a loss of confidence to crew members.*

- *Debriefing is only happening when requested. Crews find more productive and honest debriefing is had when back at the stations other than on scene (but this doesn't always get fed back into the system) It was reported that younger in-service crew members may be afraid to speak openly in the presence of more senior officers.*

- *Debriefing only occurs on station and is not shared with the wider service. This is done verbally and not through the 0-25's. This is mainly because the time constraints after incidents in the case of RDS crews where they would prefer or need to return to work/home.*

273. From the comments above, it can be reasonably concluded that the current debrief system and processes are not delivering for the Service in the way they are designed to do so.

274. It appears that much rich and critical incident information is either not being fed back into the Service or if it is, the perception of many is that this information is not being used to effect positive change in respect of policy, procedures, training or equipment.

275. The process of structured debriefing is well understood across the Service, however as mentioned earlier there were no firm requirements within the extant procedure as to when a structured debrief should be carried out.

276. We were shown examples of completed structured debriefs and how actions were recorded, allocated and monitored. This was in a system created by ODRT, but it was unclear as to how this was accessible to the rest of the Service.

Organisational arrangements for monitoring, auditing and reviewing operational performance – summary

277. Operational assurance and learning as a process is not widely understood or embedded within SWFRS. It is seen more as a function carried out by ODRT and to some extent officers when performing the role of OMSO.

278. There is confusion amongst operational crews as to what roles are being performed by officers at incidents.

279. Obvious trends are not being identified which highlights deficiencies in active monitoring and post incident audit. The most obvious example is that demonstrated through the incident analysis in this report in that high pressure hose reels are the default tactical option at all dwelling fire incidents even when fire and heat damage is being reported as beyond the ROO on arrival of crews.

280. A plethora of risk critical operational information and intelligence, along with examples of good practice are not being reported back or making their way through the system.

281. There are many learning opportunities that have been missed and therefore SWFRS has not benefitted from these lessons. There is a commitment and desire from the teams, focus groups and crews we engaged with to improve in this critical area for the Service. This requires support at all levels within SWFRS to achieve the desired outcomes in ensuring enhanced public and firefighter safety.

Section 3

Recommendations

282. The recommendations from the 3 previous Thematic Reviews referenced within this report are all directly relevant to issues identified during the inspection. If implemented, they would have gone a long way towards improving firefighter safety and operational effectiveness. They should be implemented in full without any further delay.

Recommendation 1: All previous Thematic Review recommendations should be implemented without further delay and by no later than July 2025

283. The imminent publication of the revised 'Firefighting' NOG and 'Foundation for firefighting' guidance will require SWFRS to fundamentally review their firefighting SOPs. If an outcome of that review is that they retain the current format and indexing system for their SOPs (which would be entirely reasonable) then the 'Specific Hazards & Risks' section of SOP 3.1 Fires in buildings should clearly and unambiguously set out all the hazards identified through international research and supported by science.

284. Similarly, the 'Key Control Measures' section should clearly and unambiguously set out all the control measure tactics identified through international research. Chapter 10 of NFPA 1700 Guide to structural firefighting is an exemplar of best practice in this respect. All other firefighting SOPs should then reference back to SOP 3.1 to ensure consistency and to remove duplication.

Recommendation 2: SWFRS should undertake a fundamental review of their firefighting SOPs. The outcome of this review should be that firefighting hazard knowledge and control measure tactics are scientifically correct, reflect the most current research and are clearly and unambiguously expressed in one piece of guidance that is easily accessible to all firefighters. Work on this recommendation should commence immediately with updated guidance published no later than January 2025

285. The default tactics utilised by SWFRS set out in this report reflect the adoption of one aspect of a Swedish firefighting system combined with American ventilation techniques which have since been largely disproven through extensive research.

286. Rewriting SOPs will only be the first step in changing well embedded practices. A comprehensive program of retraining will be required to shift the current default approach followed by an ongoing program of maintenance training. This will require a substantial investment of time and effort, but it is critical to improving firefighter and public safety.

Recommendation 3: In parallel with Recommendation 2 a comprehensive training program must be developed. Underpinning knowledge packages on the LearnPro system must fully reflect the content of the updated SOPs. Micro teaches should be developed for every control measure tactic to give Crew and Watch Managers the best possible resource library of training aids to support the delivery of on station practical skill maintenance training. Combined, and subject to a time and motion study, these packages will give a meaningful time value to inform the allocation of blocks of time within the station work routine. Work on this recommendation should commence immediately with updated training packages published no later than April 2025.

287. The operational assurance process utilised by SWFRS set out in this report are disjointed and lack coherence. There is no overarching policy that clearly articulates the role that the existing teams tasked with operational assurance will perform and nor is there for Tactical officers who are mobilised to incidents.

288. There is limited faith in the O-25 process. This is in no small part due to the lack of visibility as to how issues raised through the submission of O-25s are actioned or if they are actioned at all.

289. Risk critical failings are not being identified let alone addressed as has been highlighted throughout this report. While that says as much about the weaknesses in operational guidance and training, stronger audit arrangements should have identified trends such as the default to the use of high-pressure hose reels at every dwelling fire incident.

Recommendation 4: An overarching operational assurance policy should be developed and implemented which articulates clearly and unambiguously the process of how incidents will be monitored, audited and reviewed to ensure that operational guidance, equipment and training remains effective. This should be published no later than April 2025.

Recommendation 5: SWFRS should consolidate the responsibility for operational assurance into one central and dedicated team. All other officers conditioned to the flexi duty system should be considered as a resource to this team for the purposes of active operational monitoring and audit when providing operational cover and when not mobilised to an incident to undertake the role of incident commander. This team would be best located within the Operational Response function, should report directly to the Chief Officer and should be in place no later than April 2025.

290. The governance arrangements and meeting structures within SWFRS need to support the operational assurance process in respect of how the inputs received by any new consolidated team are then translated into outputs and actions and how this then influences and informs other areas of the Service.

291. With the current arrangements it was difficult to navigate and understand the flows of information through the Service and the processes for how this was used in respect of operational learning and improvement.

Recommendation 6: The new Chief Officer should review the existing structures and distribution of corporate responsibility to ensure that there are clear and unambiguous relationships between the Operational Preparedness function (policy, training and equipment) and Operational Response (operational assurance) to deliver the outcomes intended through HSG 65.

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