

**NSWFB RETIREES FIRE NEWS  
INCIDENT REPORTS**



**4<sup>th</sup> ALARM GIRRAWEEEN FACTORY COMPLEX  
FIRE**



***“If I have Seen Further than Others...  
It is by Standing on the Shoulders of Giants”***

**Cover picture:** Heavy smoke vents from the complex, indicative of the intensity of developing fire conditions.

### **Incident Summary:**

During the late afternoon on a warm summer's day on 9<sup>th</sup> December 2023, FRNSW firefighters were called to reports of smoke issuing from a factory unit within an industrial complex at Girraween in Sydney's west. Upon arrival, firefighters found light smoke venting from multiple factory units within the 14-unit complex. SCBA crews made entry into several units to try to locate the source of the smoke. Firefighters found two of the units heavily filled with smoke, however initial efforts to locate the source of the fire were unsuccessful. Unknown to firefighters at the time, the fire initially involved electrical equipment associated with the refrigeration system of a cool room within one of the factory units. The cool room insulated sandwich panels were acting as a thermal barrier, blocking heat registrations from the fire being detected by thermal imaging cameras and allowing the fire to increase in size and intensity.

As firefighters continued to search for the fire, the expanded polystyrene cores of the insulated sandwich panels became involved in fire, resulting in a significant increase in fire conditions. The I.C. switched strategies, withdrawing internal attack crews and commencing aerial operations, resulting in fire control being gained. The industrial complex was fitted with separation walls between factory units that did not fully extend to the roof, potentially allowing extensive fire spread to multiple units to occur. The I.C. identified the need to establish effective fire containment and deployed crews into units either side of the units where fire had been located, to ensure the fire did not spread. The fire commenced in a factory unit containing elevated pallet racking being used for the storage of food products. Most of the elevated storage was stacked to roof level. Several areas of fire were burning in material behind the stored products, obstructing firefighting streams and presenting challenges to firefighters. Fire intensity from the involvement of the expanded polystyrene within the cool store insulated sandwich panels was so severe the building's structural steel frame expanded, causing significant cracking of the brick wall between Factory units 4 and 5, necessitating establishment of an internal collapse exclusion zone. The fire occurred on a warm day and it was necessary to take additional measures to correctly manage potential firefighter heat stress.

The incident contained a number of unique challenges for firefighters, which were identified by the I.C. during the continuing size-up process and appropriate taskings were established to meet the evolving challenges. Firefighters conducted systematic operations to establish containment, control and extinguishment of the fire, ensuring the best possible incident outcomes were achieved. All FRNSW crews operated at a very high standard of firefighting professionalism. There are some very positive lessons to be shared from this fire.

## **Relevant Definitions Used in this Report:**

Fire brigade booster assembly: Terminology used within AS 2419.1 to describe the booster fitting and installed equipment used by firefighters to increase pressure and flow within the installed fire main.

## **Time, date and place of Call:**

1859 hours on Saturday 9<sup>th</sup> December 2023, 114-118 Gilba Road, Girraween.

## **FRNSW Response:**

Pumpers 43 (Seven Hills), 72 (Merrylands), 27 (Parramatta), 73 (Yennora), 84 (Macquarie Fields), 5 (Newtown) and 22 Leichhardt, Rescue Pumpers 57 (Wentworthville) and 63 (Blacktown), CAFS Pumpers 67 (Baulkham Hills), 41 (Smithfield) and 64 (Lakemba), Hazmat Pumper 77 (St Marys), CAFS Aerial Pumpers 97 (Huntingwood) and 47 (Revesby), Aerial Pumper 86 (Penrith), Ladder Platform 27, Rescue 59 (Eastwood), Technical Rescue 63, Heavy Hazmat 77, Mobile Command Centre Bravo, Logistics Support Vehicle 1 (City of Sydney), Duty Commanders MW1, MW2 and MS3, Manager Safety, Fleet Operations Officer, Team Leader Program and Progression, Staff Officer Strategic Capability, Aviation Officer Bravo, Team Leader Fire Investigation (Hotel) and FIRU K9 Bravo.

In addition to the above, a further 7 pumpers attended the incident for fire duty purposes.

## **Additional Agencies/Services in Attendance:**

NSW Police, NSW Ambulance and Electricity authority.

## **Fireground Description:**

The fireground consisted of a row of 14 factory units, 140 m x 30 m. Each factory unit was 14 m x 30 m. A 17-metre-wide concourse was located to the west of the factory units. The Main Fire Occupancy (MFO) was located at factory unit 5, trading as “*Cosmo Food Packaging*”, a food and packaging business.

The MFO was 5.2 m high, formed from a portal steel I beam (300 mm web and 150 mm flange) frame, double brick walls and fitted with an iron sheet roof. A single 1.0 m wide polycarbonate skylight was fitted to the roof. Access to the MFO was via a 3.0 m wide steel roller shutter door. The MFO was fitted with a pedestrian access door secured with a steel grille security door. A window located at the front of the MFO was secured with steel bars.

Three rows of elevated metal storage racking were located within the MFO. The racking was 80 cm wide and 3.0 m high, facilitating pallet storage. Most of the materials within the MFO consisted of food products and plastic takeaway food containers, stored in cardboard and plastic packaging on timber pallets located on the elevated racking to roof height. An office area, 5 m x 3 m, was located at the front of the MFO, to the north of the roller door.

A mezzanine level, 2.2 m high and 3.0 m wide, was located at the rear of the MFO, used for the storage of palleted stock. A section of the mezzanine level extended 4.0 m forward, on the Bravo side of the MFO near the Bravo/Charlie corner. A cool room, 4.0 m x 3.0 m, **formed from expanded polystyrene (EPS) Insulated Sandwich Panels (ISPs)** was located beneath this section of mezzanine. A second cool room was located within the factory unit to the east of the office.

Factory units were separated by double brick walls 120 mm wide. The separation walls were tied into the structural steel frame. A 12 cm gap existed between the top of the wall and the roof line due to the presence of the roof purlins; therefore, **full separation did not exist between factory units and the openings at the top of the walls potentially allowed travel of smoke, fire and fire gases between units.** Exposure Bravo (unit 4) was a food storage warehouse. Exposure Delta was a joinery containing a large quantity of stored timber.

The Charlie side wall of the complex consisted of a brick wall 3.0 m high. Galvanised steel sheets ("Colorbond" style) formed the remainder of the wall from the brickwork to the roof. A pedestrian door was located at the rear of each factory unit. The Charlie side was a 10.0 m wide area of open grassland adjoining a sporting reserve. A steel gate and fence secured this area.

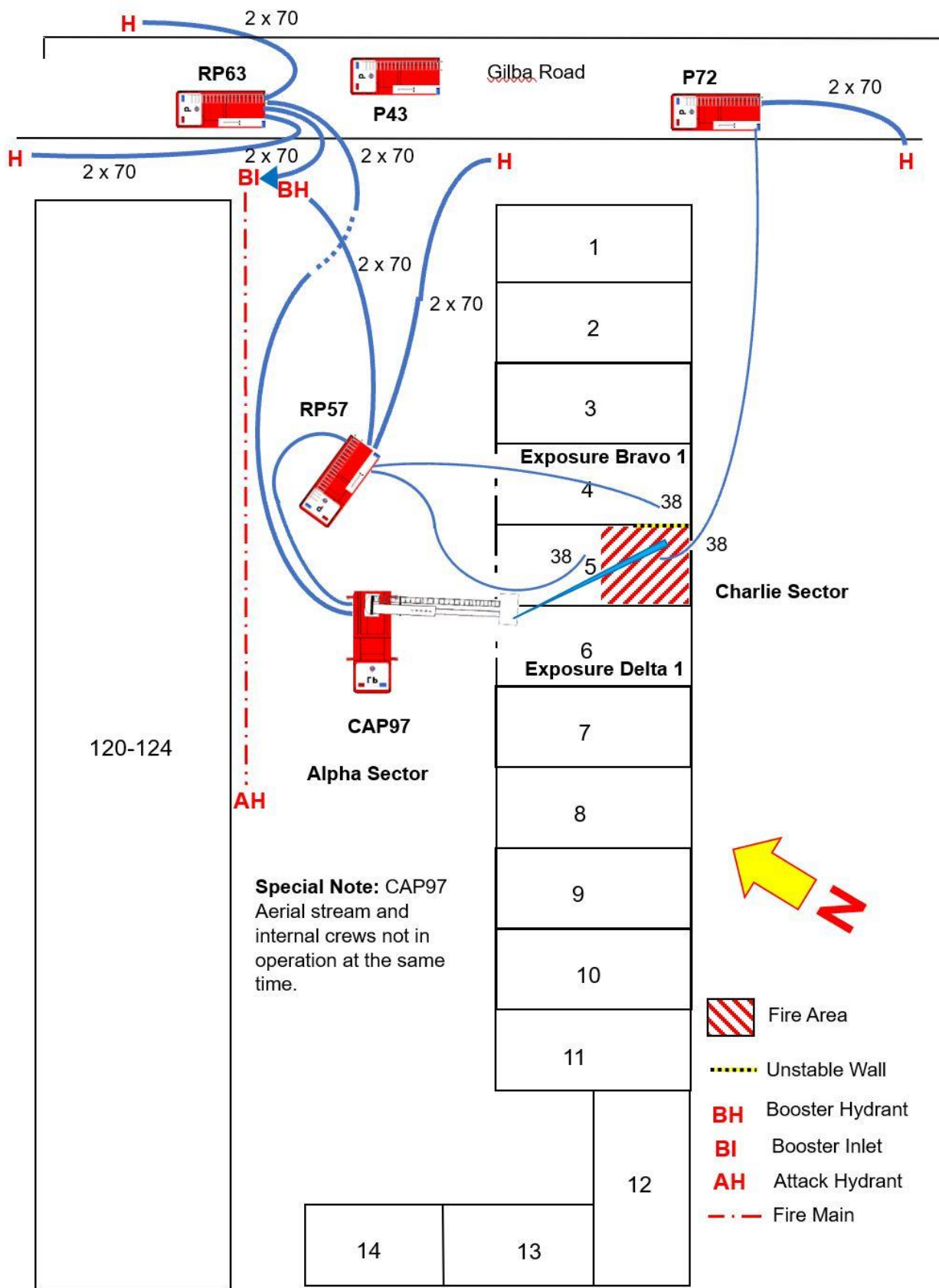
#### **Installed Fire Protection:**

One CO<sub>2</sub> extinguisher was located against the Delta wall 2.0 metres from the roller door within the MFO. The site was fitted with an installed 100 mm hydrant system, originally installed as an Ordinance 70 system and upgraded to an AS2419.1 system (Originally consisting of two 65 mm booster inlets, these were replaced with two inlets and two feed hydrants at the booster). The hydrant system consisted of one single headed attack hydrant located 72 metres from the entrance to the site. The hydrant was located in close proximity to a shipping container amongst overgrown grass and bushes, surrounded by stored materials and was very difficult to identify. **There was no signage at the Fire Brigade booster assembly. There was no block plan at the booster assembly identifying the location of the fire main and hydrants.** Consequently, it was difficult for firefighters to identify the location of attack hydrants.

#### **Weather at Time of Fire:**

Temperature 36.7°C (apparent 35.9°C), relative humidity 23%, Winds North Northeast at 9 km/h, gusting to 19 km/h, nil rain, cloud 0/8 and mean sea level pressure 1008.8 hPa.

At 1949 hours a significant weather event (southerly wind change) impacted the fireground consisting of winds Southeast at 28 km/h, gusting to 43 km/h, humidity 44% and temperatures 30.2°C (apparent 27.1°C). Weather data was recorded at Bureau of Meteorology Horsley Park automatic weather station (approximately 10.5 km from the fireground).



**Fireground Drawing.**  
Not drawn to scale.

## **Situation Prior to FRNSW Arriving on Scene:**

The MFO (Unit 5) was closed and not trading on the day of the fire. Indications suggest the fire may have initially involved an electrical motor associated with the refrigeration equipment for the cold store, located near the Bravo/Charlie corner of the MFO. Smoke travelled into Unit 4 via the gap at the top of the wall between Units 4 and 5. Initial reports from '000' callers reported light, white coloured smoke issuing from the roof line of Factory Unit 4.

## **Initial Call and Response:**

At 1859 hours on Saturday 9<sup>th</sup> December 2023, FRNSW Fire Communications received a '000' call reporting a unit fire at 114-118 Gilba Road, Girraween. Rescue Pumper 57 and CAFS Aerial Pumper 97 were assigned to the call.

## **First Crews Arrive on Scene:**

Appliances responding to the call did not see any signs of fire enroute. As Rescue Pumper 57 entered Gilba Road and began to drive towards the call address, Officer-in-Charge Station Officer Sean Askew observed light white coloured smoke rolling out from beneath the roof eaves on the Charlie side of the industrial complex. Rescue Pumper 57 entered the driveway of the complex and travelled for a short distance before coming to a stop at the front of Unit 3. Light coloured smoke was venting from beneath the eaves of Units 4 and 5, however increased volumes of smoke were venting from Unit 4. Station Officer Askew assumed command and established a command point, known as "*Girraween Command*". The I.C. tasked the crew of Rescue Pumper 57 to gain entry into Unit 4 and commence fire attack (N.B., Unit 4 was the call address and the unit where the largest volume of smoke was issuing from). At 1906 hours the I.C. sent the following arrival message:

**“FIRE COMS RESCUE PUMPER 57 RED! FROM GILBA ROAD, GIRRAWEEEN, WE HAVE A LARGE ROW OF INDUSTRIAL UNITS. SMOKE IS ISSUING FROM A MIDDLE UNIT. WE ARE CURRENTLY GAINING ENTRY ON THE DELTA SIDE AND ARE IN THE OFFENSIVE STRATEGY. S.O. 57 IS I.C. REQUIRE A STRUCTURE FIRE 2<sup>ND</sup> ALARM, POLICE, AMBULANCE AND ELECTRICITY. THE INCIDENT WILL BE KNOWN AS GIRRAWEEEN COMMAND, OVER”.**

## **Initial Firefighting Operations:**

The I.C. identified a number of initial incident critical factors including:

1. There were no persons within the involved units.
2. The location of the fire was identified.
3. The fire was contained and fire was prevented from spreading to additional units.
4. Electricity to fire affected areas was switched off.
5. The fire was controlled and extinguished.

Rescue Pumper 57 firefighters wearing SCBA and under the protection of a charged 38 mm line connected to Rescue Pumper 57 used a power saw to cut into the Unit 4 steel roller shutter door. A water supply, consisting of two 70 mm collector lines, was obtained from two feed hydrants fitted to the Fire Brigade booster assembly located at the front of complex. Stage I B.A. Control was established at the rear of Rescue Pumper 57. Firefighters gained entry into Unit 4 and attempted to locate the fire. The factory was filled with smoke and visibility was poor. Eventually firefighters identified the smoke was coming from an area above the elevated storage racking near the Charlie/Delta corner of Unit 4, although they could not detect any fire present.

CAFS Aerial Pumper 97, under the command of Station Officer Daniel Mori, arrived on scene while Rescue Pumper 57 firefighters were searching for the fire in Factory Unit 4. The I.C. tasked the crew of CAFS Aerial Pumper 97 to make entry into Factory 5 and make investigations for the source of the fire. S.O. Mori was tasked to switch off electricity to the site. S.O. Mori located the Main Switch Board at the front of the complex, where he switched off power. 97 Station firefighters wearing SCBA cut through the steel roller shutter door of Factory Unit 5 and advanced a second 38 mm line from Rescue Pumper 57 into the factory unit, which was heavily filled with smoke. Firefighters advanced towards the Charlie side of the factory unit, searching for the source of the smoke. The internal attack crew located an area above a cool room near the Bravo/Charlie corner close to roof level that they believed the smoke was coming from, however could not locate any actual fire.

As crews continued to search for the source of the fire, the I.C. sent the following CAN report at 1914 hours:

**“FIRE COMS RESCUE PUMPER 57, GIRRAWEEEN COMMAND BLUE. 360 IS INCOMPLETE DUE TO SIZE OF PREMISES. WE HAVE A FIRE IN PALLET RACKING IN THE MIDDLE UNIT OF A LARGE ROW OF FACTORY UNITS. WE HAVE ONE CREW AT WORK ON THE DELTA SIDE, AND A 2ND CREW IS AT WORK ON THE CHARLIE SIDE. THERE HAVE BEEN NO EVACUATIONS AND NO REPORT OF OCCUPANTS. FURTHER MESSAGE TO FOLLOW, OVER.”**

Fourth arriving Rescue Pumper 63 obtained water from two 70 mm lines connected to a hydrant fitted to the 200 mm Gilba Road main and provided Rescue Pumper 57 an additional two 70 mm collector lines. The Rescue Pumper 63 pump operator reported water pressure from the main was good.

#### **Response Increased to 4<sup>th</sup> Alarm:**

Rescue Pumper 57 firefighters were reporting difficulty accessing the fire due to material stored on elevated racking in Unit 4. CAFS Aerial Pumper 97 firefighters were unable to locate any areas of fire within Unit 5 and repositioned to Unit 4 to assist Rescue Pumper 57. The I.C. was concerned that the fire had still not been located, smoke was issuing from multiple units and therefore the fire was potentially increasing in size.

At 1917 hours the I.C. sent the following **RED** message increasing the response to a Structure Fire 4<sup>th</sup> Alarm:

**“FIRE COMS RESCUE PUMPER 57, GIRRAWEEEN COMMAND RED! CAN REPORT. CREWS ARE REPORTING DIFFICULTY TRYING TO ACCESS FIRE. REQUIRE STRUCTURE FIRE 4<sup>TH</sup> ALARM, OVER.”**

### **Operations Commence on Charlie Side:**

Pumper 72, under the command of Station Officer Phil Holdsworth arrived on scene and was tasked to commence operations in Charlie Sector. S.O. Holdsworth was appointed Charlie Sector Commander. Firefighters gained entry to the Charlie side of the complex after cutting through a steel gate and advanced a 38 mm attack line to the rear of Unit 5, where flames were beginning to vent from joints in the steel sheet cladding. Firefighters commenced to attack the fire through the openings in the cladding.

### **Significant Increase in Fire Conditions:**

The crew of CAFS Aerial Pumper 97 had withdrawn from Unit 4 and were repositioning the aerial appliance onto the concrete apron to prepare the aerial for operation in the event fire conditions continued to increase. Pumper 43, under the command of Station Officer Jason Rickwood was the third appliance to arrive on scene. The I.C. appointed S.O. Rickwood Alpha Sector Commander and tasked Pumper 43 crew to continue investigations in Unit 5 to locate the source of the fire. Pumper 43 firefighters donned SCBA and made entry to Unit 5, operating the 38 mm line previously used by 97 Station firefighters. As Pumper 43 firefighters made entry into Unit 5, a significant change in fire conditions occurred. S.O. Rickwood describes the change in fire conditions:

***“Initially, the smoke colour was light and dirty. As firefighters were entering Unit 5, the smoke became thick, black and dense. The smoke volume began to increase significantly.”***

At the same time, S.O. Mori describes the change in fire conditions:

***“Smoke inside Unit 4 started to turn dark and was beginning to roll violently within the factory. Dark coloured smoke was now venting under pressure from the roof area above units 4 and 5.”***

Pumper 43 SCBA fire attack crew Firefighters David Wicks and Jenna Gregory encountered heavy black smoke within Factory Unit 5 as they advanced the 38 mm attack line. Firefighters used a thermal imaging camera to try to locate the fire, which showed a yellow registration (temperature range 150°C - 300°C) indicating fire was located in pallet racking near the Bravo/Charlie corner of the factory unit. Firefighters were sweeping the attack stream along the top of the Delta internal wall, attempting to stop fire spread into Exposure Delta 1 (Unit 6).



At 1927 hours the I.C. sent the following CAN report:

**“FIRE COMS RESCUE PUMPER 57, GIRRAWEEEN COMMAND BLUE. WE HAVE ACTIVE SECTORS IN ALPHA AND CHARLIE. CREWS ARE IN THE OFFENSIVE STRATEGY. CAP97 IS BEING SET UP FOR AERIAL OPERATIONS. POWER IS SWITCHED OFF, OVER”.**

### Fire Behaviour Considerations

The following fire behaviour considerations are of note:

1. Initial observations by firefighters and members of the public consisted of light white coloured smoke near the roof of Factory units 4 and 5. FIRU Investigations identified a likely area of origin involving refrigeration electrical motors and equipment associated with the cool room near the Bravo/Charlie corner of Factory Unit 5.

2. A sudden change in fire conditions occurred, described by firefighters as “*thick, black, billowing, dense and black smoke that was rolling violently*”. This is consistent with the involvement of expanded polystyrene (EPS) within the cool room insulated sandwich panels in fire. The following fire conditions will occur due to the involvement of expanded polystyrene in fire:

- a. Expanded polystyrene (EPS) starts to soften at a temperature of about 100°C.
- b. At temperatures above 232°C, EPS will give off flammable gases, producing extreme fire conditions including explosions.
- c. EPS burns at temperatures in excess of 1,000°C.
- d. Smoke from EPS is hydrocarbon laden, superheated, highly combustible and will reignite upon mixing with air.
- e. EPS will transform to liquid at temperatures above 427°C.
- f. EPS has a calorific value of 40 MJ/kg.
- g. EPS is a pure hydrocarbon (C<sub>8</sub>H<sub>8</sub>).

3. Post fire examination of the cool room near the Bravo/Charlie corner of Factory Unit 5 identified an event known as “**panel delamination**” had occurred. Such an event is extremely dangerous. Panel delamination is characterised by the following events:

- a. Insulated sandwich panels consist of an expanded polystyrene core housed between two thin outer facings, formed by 0.5 mm thick steel or aluminium rigid sheet metal.
- b. The expanded polystyrene core is secured to the outer facings by a bonding adhesive.
- c. The panels are held together in tension, to increase rigidity and strength.

- d. Under fire conditions, the adhesive will fail at a temperature of 130°C, causing the panel to “spring” open, exposing all of the inner core to fire.
- e. A sudden, violent and explosive increase in fire conditions will occur, due to the rapid exposure of the expanded polystyrene core to fire. Temperatures will rapidly rise to in excess of 1,000°C.
- f. Panel delamination is characterised by high heat release rates, intense flames, rapidly spreading fire and large volumes of thick, black, superheated and hydrocarbon-based smoke.

4. Some of the issues associated with panel delamination include:

- a. Panel delamination can occur at relatively low temperatures (130-290°C).
- b. Insulated sandwich panels are designed to act as thermal barriers. Fires burning on the opposite side of an insulated sandwich panel could be concealed and difficult to detect, due to the inability of a thermal imaging camera to detect heat registrations through the panel.

5. On the occasion of the subject fire, the quantity of insulated sandwich panels involved in the fire was not large. The cool room was 4 m x 3 m x 2 m high. Only the panels on 1½ sides and the roof were involved in fire and subject to panel delamination. Despite the area of ISP involvement being relatively minor, the heat produced from the burning expanded polystyrene was so intense buckling of the steel structural frame occurred, resulting in wall cracking occurring.

6. The building was fitted with a metal sheet roof and 1.0-metre-wide polycarbonate roof panels. The metal sheet roof held heat, fire, smoke and fire gases within the building, facilitating “under roof” lateral fire travel. Conditions were much hotter for firefighters, due to the lack of ventilation associated with the metal sheet roof. Limited ventilation occurred through the polycarbonate panels, which were breached by heat produced by the fire.

The attached link is a video showing a “test burn” of Expanded Polystyrene Insulated Sandwich Panels, conducted at Leipzig, Germany. Note at 1 minute 16 seconds, panel delamination occurs, followed by extreme fire behaviour, including multiple explosions. The rapid change in fire behaviour following panel delamination is very significant. Further, there is almost no warning that panel delamination is about to occur. This type of fire situation has claimed the lives of numerous firefighters in Europe and North America. It is also important to note the relatively small size of the test burn structure, which is not much bigger than a backyard garden shed.



(Control + Click on YouTube symbols to watch)

### **Transfer of Command:**

Duty Commander MW1 Inspector Robert Mey arrived on scene. Following a handover briefing, command was transferred to Inspector Mey and S.O. Askew appointed Operations Officer.

### **Aerial Operations Commence:**

CAFS Aerial Pumper 97 was already in position on the Alpha side of the complex, in line with the boundary of Units 5 and 6, upwind of the venting smoke. Water supply for the aerial was provided by two 70 mm lines from Rescue Pumper 57. A third line provided water supply to CAFS Aerial Pumper 97 from a street hydrant. Two charged 70 mm lines were connected to the Fire Brigade booster fitting boost inlets from Rescue Pumper 63 in standby mode, however the hydrant system was not placed in operation as adequate water was being supplied to appliance working in Alpha Sector.

Firefighter Mark Sampson was located in the aerial working cage of CAFS Aerial Pumper 97. The aerial working cage was elevated, enabling Firefighter Sampson to provide a roof report to the I.C. Firefighter Sampson observed an area of fire was located near the Bravo Charlie corner of Unit 5, beneath a polycarbonate panel that had melted due to heat from the fire.

The aerial diffuser spray nozzle was placed in operation, allowing the aerial steam to be directed through the breached roof panel onto the area of fire, rapidly achieving significant knockdown of the fire. Within a short time of the operation of the aerial stream, venting smoke changed from dark to light in colour, indicating the aerial stream was having significant impact. Working in conjunction with the Pumper 43 internal attack crew, who were located remote to the operation of the aerial stream, firefighters were successfully stopping the fire from progressing to Exposure Delta 1 (Factory Unit 6). At 2029 hours the I.C. reported fire control had been achieved.

### **Collapse Exclusion Zones Established:**

Firefighters observed an area of severe wall buckling and cracking, involving the brick separation wall between Units 4 and 5. The area of deformation extended for a distance of approximately eight metres from the Charlie wall. Collapse exclusion zones were established either side of the wall in Units 4 and 5.

### **Protection of Exposure Delta 1:**

Alpha Sector Commander Station Officer Rickwood observed turbulent light coloured smoke venting from beneath the roof eaves of Factory Unit 6 (Exposure Delta 1). S.O. Rickwood tasked the crew of CAFS Pumper 41 to gain entry to Exposure Delta 1 and check for fire spread. Firefighters used the Rapid Intervention Kit to make entry through the Factory Unit 6 steel horizontal bi-folding door. After gaining entry, firefighters advanced a 38 mm protection line into the factory to search for any fire spread.

Factory Unit 6 was a joinery and contained large quantities of timbers, lacquers, adhesives and machinery. The factory unit was filled with smoke when firefighters made entry, however a thorough search revealed no signs of fire travel into the factory unit.

### **Firefighter Safety and Welfare:**

Ambient conditions at the fireground were quite warm (temperature 36.7°C and apparent temperature 35.9°C, relative humidity 23% at time of call) and likely to cause heat stress if not managed correctly. Firefighters reported hot conditions working internally with the Main Fire occupancy. The I.C. ensured a high level of crew rotation was established to minimise exposure to adverse fireground heat conditions. On-deck crews in Alpha Sector to facilitate crew rotation consisted of firefighters from 27 and 73 Stations. On-deck crews in Charlie Sector to facilitate crew rotation consisted of firefighters from 86 and 67 Stations.

Hazmat Pumper 77 and Heavy Hazmat 77 crews conducted firefighter decontamination and established firefighter rehabilitation. AreaRAE monitors were positioned at different locations across the fireground to ensure crews were not exposed to hazardous atmospheres without appropriate respiratory protection. Hazmat crews monitored firefighters returning from SCBA wearing and provided drinking water for rehydration. This was particularly important due to the prevailing weather conditions. Rescue Pumper 63 Station Officer Brad Hojel was appointed Safety Officer. Station Officer Hojel liaised with Ambulance paramedics to ensure firefighter welfare was being maintained in relation to heat stress.

As darkness began to fall across the fireground, scene lighting was established by Rescue Pumper 63 and Technical Rescue 63 appliance stem lights.

### **Hazmat Operations:**

In addition to conducting firefighter welfare operations, Hazmat crews conducted water run-off sampling, identifying a pH level of 6.

### **Offensive Operations Continue:**

From the aerial working cage Firefighter Sampson observed fire travelling towards the Charlie side of Unit 5, which he reported to the I.C. The spreading fire was beyond the reach of the aerial stream due to the metal roof of the factory. Following a significant reduction in fire intensity, the CAFS Aerial Pumper 97 aerial stream was shut down to allow internal firefighters to attack the fire.

Pumper 72 firefighters gained entry to Factory Unit 5 through a pedestrian door fitted to the Charlie side wall of the factory unit and began to advance a 38mm attack line into the factory. The Pumper 43 fire attack crew were continuing to advance the attack line from the Alpha Side further into the factory. The Pumper 43 and 57 fire attack crews met inside the factory and conducted fire attack on burning material located on elevated storage racking.

Firefighters observed significant fire activity within stored material located on the mezzanine level against the Charlie wall of Factory Unit 5. S.O. Holdsworth noted that the burning material consisted largely of plastic takeaway containers. Firefighters directed 38 mm attack streams onto the fire area, however the fire was deep seated and burning behind palletised stock that was stored to the roof line, preventing the fire attack streams from reaching the fire. At this time, Duty Commander MS3 Inspector Bruce Fitzpatrick had arrived on scene and was appointed Charlie Sector Commander. From the exterior of the factory unit on the Charlie side firefighters used an access ladder (also known as a “*Little Giant*” or “*Jumbo*” ladder) to gain access to the steel sheet wall panels, which were undone using a cordless drill to remove hexagonal screws and removed with a Halligan tool, providing access to the fire area. With the assistance from a thermal imaging camera, firefighters were able to locate the fire area, directing extinguishing streams onto the fire, achieving extinguishment.

### **Incident Command Structure:**

The Incident Command Structure was established as follows:

**Incident Commander:** Duty Commander MW1 Inspector Robert Mey

**Operations Officer:** Rescue Pumper 57 S.O. Sean Askew.

**Safety Officer:** Rescue Pumper 63 Station Officer Brad Hojel.

**Alpha Sector Commander:** Pumper 43 S.O. Jason Rickwood.

**Charlie Sector Commander:** Duty Commander MS3 Inspector Bruce Fitzpatrick

### **Post Fire Control Operations:**

Once fire control had been established the I.C. began to release appliances from the fireground. A two-pump fire duty remained in place overnight. A number of small pockets of deep-seated fire remained within areas of elevated racking that were difficult to access and extinguish. The following morning the fire duty was reduced to a single pumper to ensure all fire had been extinguished and no areas of hidden fire remained. Fire Investigation and Research Unit crews attended the scene to conduct cause and origin determinations. At 1351 hours, following the completion of FIRU duties, the final FRNSW appliance departed the scene. The following day, all businesses within the complex, with the exception of Units 4 and 5, had resumed full operations.

### **Incident Outcomes:**

The following incident outcomes were achieved:

1. The fire was contained to the factory unit of origin (despite openings in the fire separation walls). Exposures under direct threat were protected and saved.
2. The fire was contained, controlled and extinguished.
3. Disruption to adjoining businesses was minimal. With a short time following the fire, most businesses within the complex had returned to full operation.

## Conclusion:

A number of critical factors combined to create a challenging fire scenario for firefighters at Girraween, each with its own unique characteristics. These critical factors are important reminders of the very broad spectrum of conditions that can be encountered at firegrounds, requiring specialised operations to manage safely and effectively.

The Girraween fire consisted of a large industrial complex containing various assorted occupancies. Breaches within separation potentially could have allowed continuous fire spread to multiple units within the complex. The fire involved expanded polystyrene insulated sandwich panels; these materials concealed the presence of fire because of their insulating properties. When they became involved in fire, the phenomenon of *panel delamination* occurred, resulting a rapid increase of fire intensity that was so severe that deformation of the building structural steel frame occurred. Panel delamination is a dangerous fire occurrence that has killed many firefighters, particularly in North America and Europe. The involvement of expanded polystyrene insulated sandwich panels in a fire situation can never be underestimated. The fire involved materials stored on elevated pallet racking. Although some of the extreme fire behaviour associated with elevated racking (i.e. *ultra rapid fire spread*) did not occur at this fire, firefighters encountered a number of hazardous conditions and operational difficulties due to stored materials blocking attack streams. Firefighters conducted operations on a warm day, within a building that provided minimal ventilation of heat, smoke and fire gases, increasing the dangers associated with firefighter heat stress. Appropriate precautions ensured crews were protected as best as possible from this risk, including increased crew rotations, shortened wearing times, increased hydration and monitoring of crews for signs of heat stress. Again, the hazards associated with heat stress can never be underestimated.

As mentioned above, firefighters encountered numerous critical factors involving a broad spectrum of operational requirements. Operations were undertaken in a systematic manner, in accordance with clearly defined taskings and objectives directly related to incident critical factors. FRNSW crews overcame a number of significant challenges and the best possible incident outcomes were achieved. Despite avenues of fire spread being present, the fire did not spread past the factory unit of origin and a significant percentage of the Main Fire Occupancy was saved. All other businesses in the complex resumed full operation the next day with minimal impact to business continuity. Fireground commanders displayed strong command presence and leadership. All firefighters worked with determination and professionalism in accordance with assigned tasks. There are many positive lessons to be shared from the operations at this fire.



Operations in Alpha Sector consisted of attack lines going into Factory Units 4 and 5. When fire conditions escalated due to the involvement of expanded polystyrene insulated sandwich panels, internal crews were temporarily withdrawn while the aerial stream of CVAFS Aerial Pumper 97 attacked the fire. Firefighters had to lay hose almost 100 metres from the street to supply appliances with water.

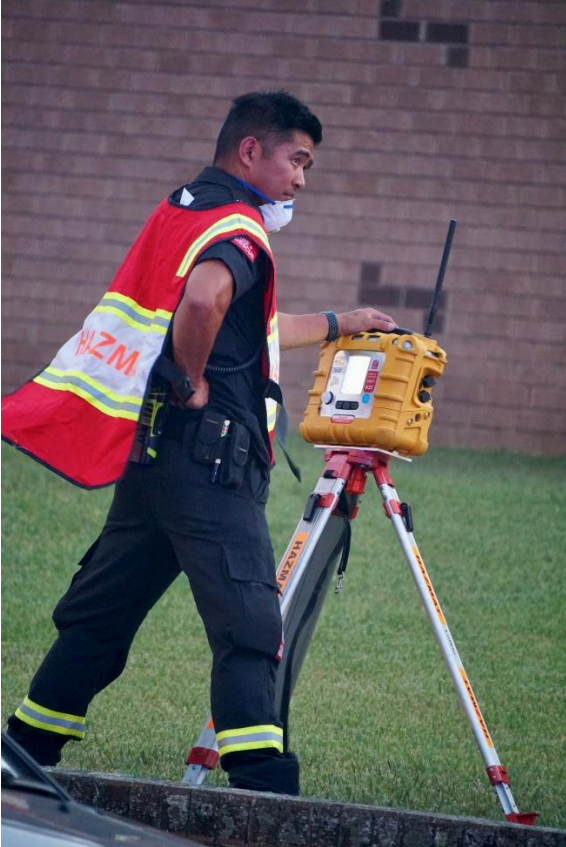


Operations in Charlie Sector were initially defensive (top). Once a significant reduction in fire intensity had been achieved, crews in Charlie Sector made entry into the building and attacked fire burning on elevated racking (lower). At this point Duty Commander MS3 Inspector Bruce Fitzpatrick had been appointed Charlie Sector Commander.





Top: Rescue Pumper 63 provided water to appliances attacking the fire. Middle upper: Appliances in staging and on-deck crews prepare to relieve fire attack crews. Middle lower: Incident Command Point – The Incident Commander established an effective command point at the Duty Commander vehicle. Bottom: A view of the rehabilitation area and on-deck crews await tasking.



Upper left: Incident Commander Duty Commander MW1 Inspector Bob Mey is on the radio to the Sector Commanders, coordinating firefighting as the aerial appliance goes into operation. Inspector Mey's high levels of experience, focus and calm demeanour are an enormous asset on the fireground. Upper right and lower left: CAFS Aerial Pumper 97 cage operator Firefighter Mark Sampson directs and aerial stream into the breached polycarbonate roof panels, resulting in a significant diminishing of fire intensity. Lower right: Hazmat 77 firefighters positioned a number of AreaRAE monitors across the site.



There are indications the fire initially involved electrical equipment that was part of the refrigeration system for one of the factory units two cool rooms, which were formed from expanded polystyrene insulated sandwich panels. The insulated sandwich panels at the front of the cool room (A) acted as a barrier, preventing thermal imaging cameras from detecting heat, allowing the fire to remain concealed at the rear of the cool room. Panel Delamination (B) occurred, allowing the expanded polystyrene panel cores to become involved in fire, producing extreme fire conditions.



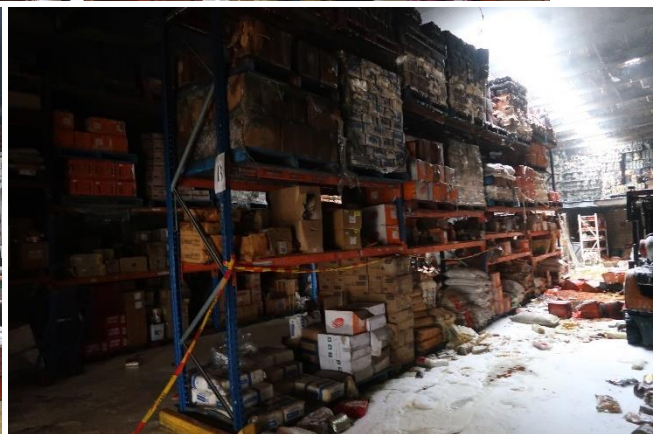
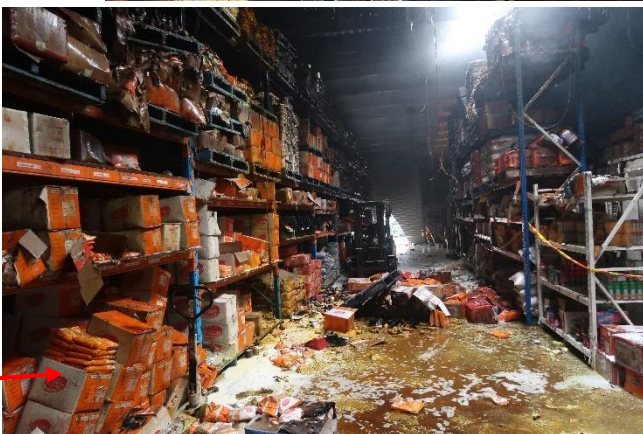
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A

B



The Main Fire Occupancy contained elevated pallet racking, with stock stored almost to roof level, creating a number of hazardous conditions for firefighters. Fire burning within the stock piles caused the material to become unstable, resulting in collapse occurring **A** or material becoming unstable and likely to collapse **B**. Water from firefighting streams can dislodge stored products, weaken the base of stored materials or increase the weight of stored materials, either causing collapse or increasing collapse potential. Firefighters established internal exclusion zones **C** within the main fire occupancy due to collapse risks. A further problem encountered by firefighters were pockets of fire located in materials behind stock located on racking, preventing firefighting streams from being able to access the fire. It is important to constantly monitor for signs of internal collapse when working inside structures where elevated racking is present.



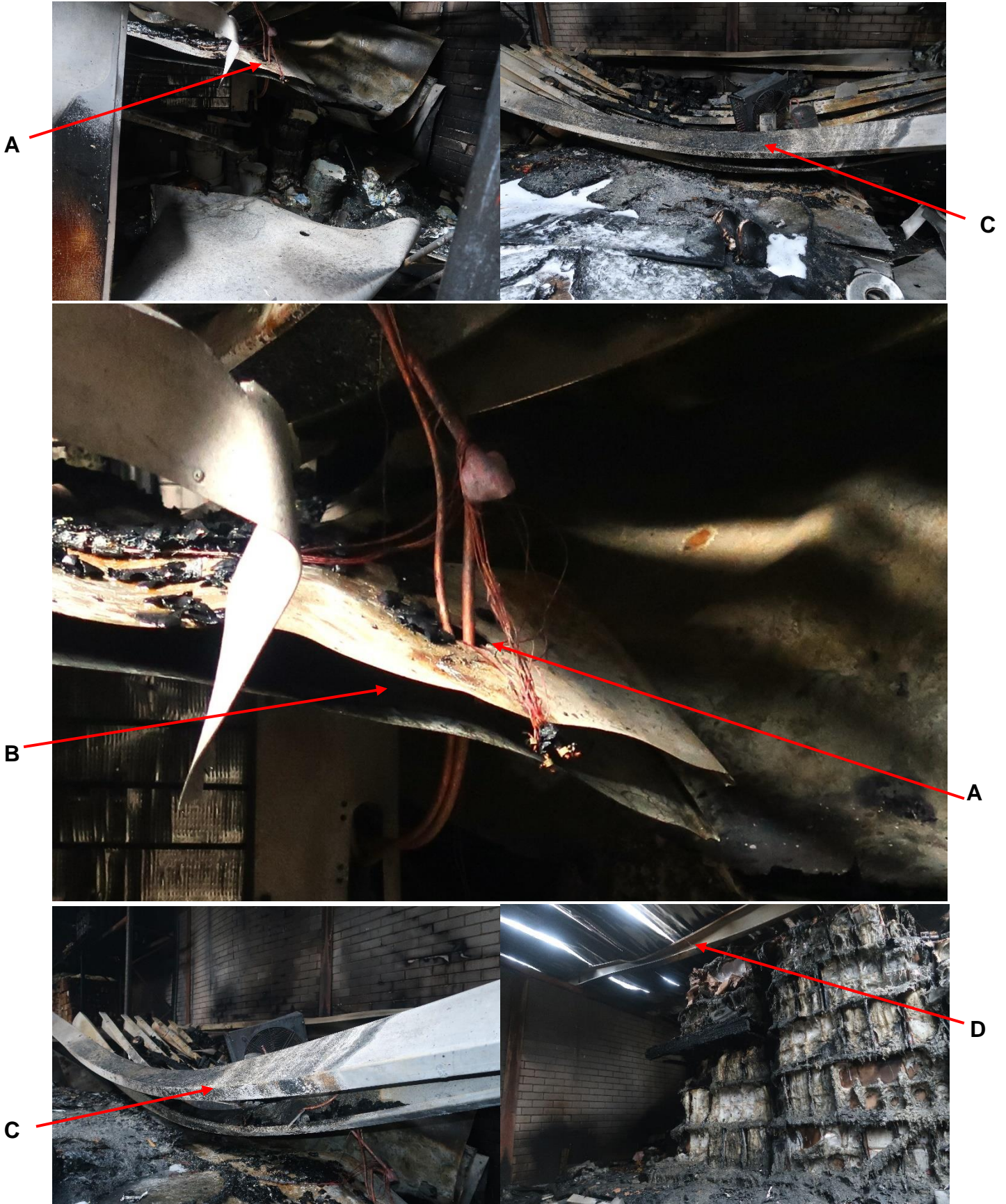
Intense heat from the burning expanded polystyrene within the insulated sandwich panels caused expansion of the structural steel building frame, resulting in movement and subsequent cracking and bowing of the brick wall (evident in the middle photograph) tied into the steel frame. The wall provided separation between Factory Units 4 and 5. The I.C. withdrew crews and conducted a defensive attack when fire conditions worsened; a very wise decision due to the strong possibility of internal wall collapse.



A gap of 12 cm (A) existed between the top of the brick wall separating factory units and the roof line due to the presence of steel roof purlins (B), allowing fire, superheated gases and smoke to spread from the factory unit of origin to adjoining units. Firefighters successfully fire from spreading through these openings with 38 mm protective streams, resulting in the most severely threatened Exposure Bravo 1 (top left) and Delta 1 (top right) being saved. It is sometimes advantageous to gain entry to a non-involved unit to determine if openings exist near roof level that could facilitate fire spread.

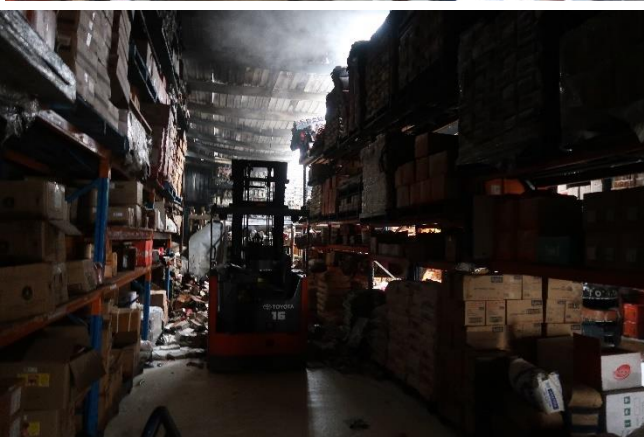


The site was fitted with an AS 2419.1 Fire Brigade booster system (top right). Lack of a block plan prevented from identifying critical information including the location of the site fire main and attack hydrants. The one attack hydrant found at the site (middle left) was surrounded by bushes and stored materials and was difficult to locate. Polycarbonate roof panels failed above the fire area, allowing heat and smoke to vent and providing an avenue for the aerial steam to attack the fire. Delaminated insulated sandwich panels exposed expanded polystyrene to the fire, creating extreme fire conditions (middle right). Firefighters removed a number of LPG cylinders used to power forklifts units in the fire's path (lower).

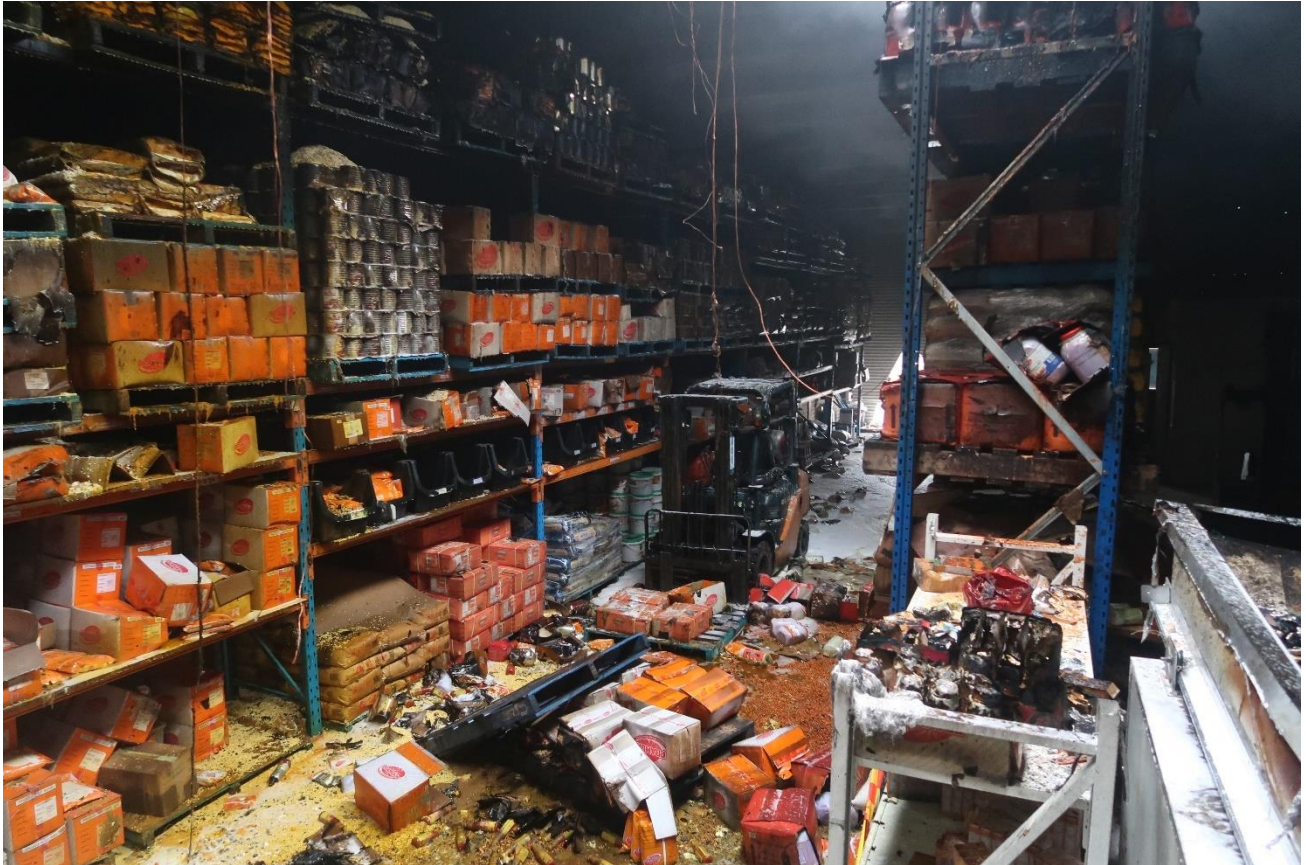
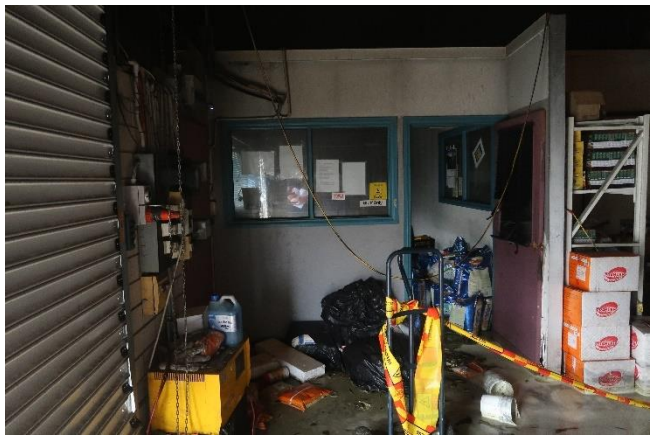


Breaches (**A**) in the outer facings of the insulated sandwich panels allowed fire to impact the expanded polystyrene core (**B**) of the ISPs, resulting in extreme fire behaviour occurring, including temperatures that exceeded 1,000°C resulting in deformation of structural (**C**) and non-structural (**D**) steel. No where else was fire damage as severe as the area around the ISPs. The ISP Code of Practice recommends that openings in ISPs for the passage of services be sealed to prevent exposure of the core to fire.





One of the problems for firefighters associated with stock burning on pallet racking were areas of fire burning behind elevated stock, preventing fire attack streams from reaching areas of fire. Ultimately, these fires could only be extinguished through the slow and careful removal of stored products allowing firefighters to access areas of fire.



The main fire occupancy contained a second cool room (top left) and an office (top right). A combination of fire activity and hose streams resulted in some elevated stock becoming unstable and collapsing (middle). The factory units were fitted with two types of doors; steel roller shutter doors (lower left) and steel horizontal bi-folding doors (lower right).