NSWFB RETIREES FIRE NEWS

INCIDENT REPORTS

4th ALARM CAMPBELLTOWN SERVICE STATION FIRE

"If I have Seen Further than Others…
It is by Standing on the Shoulders of Giants"

Cover picture: Fierce and intense flames extend almost 100 metres into the night sky. A running fuel fire is visible in the gutter.

Incident Videos (**Control + Click** on YouTube symbols to watch)

Incident Summary:

On the evening of Friday 24th February 2023, a petrol tanker was unloading fuel at a service station within the southwestern Sydney suburb of Campbelltown when a fire broke out near the underground tank filling point. At this time, four persons were present at the service station, including the tanker driver and service station attendant. Fuelled by petroleum, the fire rapidly grew in size and intensity, quickly spreading to the tanker, cars parked at the service station and the service station building. Miraculously all persons at the service station managed to escape from the fire, which was rapidly taking hold and continuing to increase in size and intensity. Within a short time the tanker, motor vehicles and service station were fully involved in fire, resulting in a large column of thick black smoke extending hundreds of metres into the night sky, containing large flames and fireballs. At ground level multiple explosions were occurring, radiant heat was ferocious and conditions were continuing to deteriorate. Exposures on all sides, including a nearby shopping complex and residential houses were under severe threat. Located within the fire area were multiple LPG cylinders of varying sizes. Escaping fuel from the tanker was alight and flowing along gutters towards the drains, creating additional hazards.

First arriving firefighters were confronted with a worsening and deteriorating fire scenario. Pyrolysis gases were pouring off the walls of the adjoining shopping complex, which was now in imminent danger. The first arriving Incident Commander made two immediate critical decisions; the fire involving the service station and tanker was too advanced to attempt effective firefighting operations at that time with the available resources, however the first building in the row of shops was in immediate danger and could be saved. The first line to be placed in operation was used to protect the most vulnerable exposure under threat. As additional resources arrived on scene, firefighters commenced a systematic firefighting operation to protect further exposures under threat. Containment was established on the fire edges and the running fuel fire was controlled. During these operations, a number of major LPG cylinder BLEVEs (Boiling Liquid Expanding Vapour Explosions) occurred, resulting in cylinders becoming projectiles that knocked down service station brick walls. Firefighters were prevented from using the closest hydrants to the fire because of a danger that high volage powerlines located above could (and did) fall, creating water supply problems. Firefighters overcame numerous hazardous and challenging conditions to establish containment, control of the fire and final extinguishment. Numerous exposures under heavy threat when firefighters arrived on scene were protected. Firefighters fought the fire with courage, determination and professionalism. There are many valuable and positive lessons to be shared from the firefighting operations undertaken at this extremely ferocious, challenging and dangerous fire.

Abbreviations/Acronyms Used in this Report:

BA – Breathing Apparatus.
BLEVE – Boiling Liquid Expanding Vapour Explosion.
CAFS - Compressed Air Foam System.
FireComs – FRNSW Fire Communications.
FIRU – Fire Investigation and Research Unit.
FRNSW – Fire and Rescue NSW.
IC – Incident Commander.
LPG – Liquefied Petroleum Gas.
MDT- Mobile Data Terminal.
PPC – Personal Protective Clothing.
SAR – Search and Rescue.
SCBA – Self Contained Breathing Apparatus.
SFF – Senior Firefighter.
SO – Station Officer.
TIC – Thermal Imaging Camera.

Time, date and place of Call:

2218 hours on Friday 24th February 2023, 104 Lindesay Street, Campbelltown.

FRNSW Response:

CAFS Pumpers 88 (Campbelltown) and 31 (Busby), Hazmat Pumpers 87 (Rosemeadow) and 85 (Chester Hill), Pumpers 248 (Camden), 84 (Macquarie Fields), 34 (Riverwood) and 73 (Yennora), Rescue Pumper 93 (Narellan), CAFS Aerial Pumpers 92 (St Andrews) and 47 (Revesby), Heavy Hazmat 85, CAFS Tanker 88, Bulk Tanker 92, Technical Rescue 8 (Liverpool), Tanker 84, Mobile Command Centre Bravo, Duty Commanders MS3 and ME3, Zone Commander MS3, Fire Investigation and Research Unit and On Call Media officer.

In addition to the above, a further 13 pumpers and specialist appliances and 8 senior officers and specialist support staff attended the incident during the fire duty and hazmat component of the incident.

Additional Agencies/Services in Attendance:

NSW Police, NSW Ambulance, Electricity authority, Campbelltown City Council, Environmental Protection Authority, Safe Work NSW, liquid waste removal contractors, fencing contractors and private security.

Fireground Description:

The fireground consisted of the following structures and features:

1. A petrol station, situated on a 40 m x 30 m site. Located on the site were:

a. The retail shop, 15 m x 10 m, single level, timber frame, brick construction and metal sheet roof. The building was glass fronted on the northern side (facing the fuel pumps) and contained a counter and retail area. There was a single point of entry/exit to this building on the northern side facing the fuel pumps.

b. The fuel pump forecourt was located to the north of the retail store, consisting of an area 20 m x 15 m of concrete surface construction. There were six fuel pumps within the forecourt.

c. Two shipping containers of steel construction, containing retail consumable products, were located to the west of the retail shop.

d. Seven 210 kg LPG cylinders were located at the front of the western end of the retail shop, facing the fuel pump forecourt. Two storage cages containing approximately 30 x 9 kg and 4 kg LPG cylinders was located on the southern side of the site. A storage cage containing approximately 20 x 20 litre drums of pool chlorine was located adjacent to the LPG cages.

e. A 4 tonne 8,000 litre bulk LPG vertical storage tank was located on the northern side of the site, 10 metres from the fuel pump forecourt.

f. An awning, 18 m x 12 m, steel frame and metal sheet clad, was located above the fuel pump forecourt, to the west of the retail shop.

g. The underground tank fill point was located in the centre of the fuel pump forecourt, beneath the awning.

2. A row of 12 retail shops was located to the west of the service station. The closest shop (Exposure Delta 1) was a drive through bottle shop. The building was single level, 30 m x 17 m, brick construction and metal sheet roof, located adjacent to the service station.

3. A residential house on Ronald Street was located immediately to the east of the service station (Exposure Charlie).

4. Numerous houses were located on Lindesay Street, to the east of the service station. The road sloped downwards towards these houses (Exposures Bravo).

5. A single level church was located to the west of the service station, on the opposite side of Lindesay Street (Exposure Alpha).

6. At the location of the service station, Lindesay Street was 12.0 m wide. With the exception of the retail shops and church, the immediate area was surrounded by residential houses. Low and high voltage overhead power lines were located attached to timber poles on the southern side of Lindesay Street and the western side of Ronald Street. A pole mounted transformer was located 20 metres to the south of the service station.

Installed Fire Protection:

Two 9 kg ABE dry chemical powder fire extinguishers were located adjacent to two of the fuel pumps. An emergency fuel shut off switch was located at the control console within the retail shop.

Weather at Time of Fire:

Temperature 15.9°C (apparent 17.1°C), relative humidity 88%, Winds calm 0 km/h, nil gusts, nil rain, cloud 1/8 and mean sea level pressure 1020.5 hPa recorded at Bureau of Meteorology Campbelltown automatic weather station (approximately 2.5 km from the fireground).

Situation Prior to FRNSW Arriving on Scene:

The service station was open to the public. Two motor cars were at the fuel pumps. A third motor car was parked on the southern side of the site near the LPG cylinder storage cages. A petrol tanker containing 40,000 litres of fuel was unloading at the underground tank fill point. The tanker was located beneath the awning, facing south. There were four persons present at the service station, consisting of the service station attendant, the petrol tanker driver and the drivers of the two cars at the fuel pumps. During the process of transferring fuel from the road tanker to the service station underground fuel tanks, a fire was observed in the area of the underground tank fuel points. Almost instantaneously the fire grew rapidly in size, extending to the area beneath the roof of the forecourt awning. All persons, including the service station attendant fled from the service station as the fire began to rapidly increase in size and intensity. At the same time, numerous nearby members of the public could see the fire growing and began to call ‘000’ to report the fire. The service station attendant reported the fire had taken hold so rapidly she did not even have time to operate the emergency fuel pump shut off switch before fleeing from the service station.

Initial Call and Response:

At 2218 hours on Friday 24th February 2023, FRNSW Fire Communications received the first of numerous ‘000’ calls reporting a building fire at 104 Lindesay Street, Campbelltown. CAFS Pumper 88[1], CAFS Tanker 88 and CAFS Aerial Pumper 92 were assigned to the call. Almost immediately, staff at Fire Communications increased the response to a structure fire 2nd Alarm, due to information form the service station attendant, reporting the nature of the fire.

1. Appliance CAFS Pumper 88 was a Service Exchange Vehicle (SEV) non-CAFS pumping appliance.

CAFS Pumper 88 under the command of Station Officer Frank Rodriguez, was just leaving the station, less than one kilometre from the reported fire, when the appliance mobile data terminal (MDT) updated the crew of a change in incident conditions. 88 Station firefighters were familiar with the call address (Lindesay and Dan Streets, Campbelltown) which has been a frequent source of fire calls on previous occasions (such as bin fires, rubbish fires, grass fires etc). However, as the appliance pulled out of the engine bay, the MDT sent a message stating the response had been changed to a Structure Fire 2nd Alarm and the incident changed to a petrol station alight.

CAFS Tanker 88, under the command of Captain Anthony Mosley, had just returned from a call and were at the station when CAFS Pumper 88 was assigned to the incident. CAFS Tanker 88 responded to the call with CAFS Pumper 88. From 88 station, firefighters could see flames extending into the sky. Both appliances drove approximately 120 metres before turning into Lindesay Street, where a large column of black smoke extended upwards for hundreds of metres. Within the smoke column bright orange flames were visible, exploding and extending upwards.

First Crews Arrive on Scene:

CAFS Pumper 88 and CAFS Tanker 88 were on scene within approximately one minute after leaving the station. On arrival firefighters observed a wall of intense flames from one end of the service station to the other. Heavy flames were rolling out from beneath the service station forecourt overhead awning on all sides. A petrol tanker located beneath the awning was totally involved in fire. Firefighters could see two cars located beneath the awning also totally involved in fire. The retail shop at the rear of the service station was well alight. The tyres of the tanker were exploding.

The fire was producing an enormous roar, the radiant heat was ferocious and numerous small explosions were occurring. Fierce flames were travelling outwards beneath the steel forecourt awning in all directions and rolling upwards under high velocity and high pressure into the venting smoke plume. The smoke plume consisted of extremely turbulent, rolling superheated thick black smoke. As the hydrocarbon laden super-rich smoke plume mixed with air, large flames, appearing as erupting fireballs, were produced 30 – 50 metres above the service station within the smoke column. Video taken by onlookers showed flame height that exceeded 100 metres.

Fire conditions were ferocious. S.O. Rodriguez directed CAFS Pumper 88 to be positioned on Lindesay Street to the west of the service station in front of a shop, to provide protection to the appliance from the intense radiant heat and extreme fire conditions. S.O. Rodriguez assumed the role of Incident Commander, established a Command Point and at 2222 hours sent the following initial arrival message:

“FIRE COMS CP88 RED! RED! RED! CODE 3, FROM LINDESAY STREET CAMPBELLTOWN, WE HAVE A SERVICE STATION AND A PETROL TANKER WELL

ALIGHT. THERE ARE ALSO SEVERAL CARS WELL ALIGHT. INCREASE RESPONSE TO A STRUCTURE FIRE THIRD ALARM, OVER."

Life Risk:

An initial concern of the I.C. was the life risk present. A visual scan of the service station did not show the presence of any persons. S.O. Rodriguez liaised with a Police officer, who stated all persons within the service station, consisting of the service station attendant, the tanker driver and two motorists had been evacuated to safety at the edge of the exclusion zone, 100 metres to the west at the intersection of Chamberlain Street. Police had also evacuated all persons from Exposure Delta shops.

Structural failure of Forecourt Awning:

The flame temperature of the burning petroleum exceeded 1,000°C, causing the extremities of the forecourt steel awning to begin sagging and folding downwards. Two to three metres of horizontal roofing near the awning sides had now folded downwards into an almost vertical position, acting as a barrier, preventing firefighting streams from reaching the burning tanker. The unprotected steel columns supported the awning had also lost tensile strength, resulting in the awning collapsing downwards onto the tanker.

Initial Firefighting Operations:

Ferocious radiant heat from the burning tanker was causing the release of pyrolysis gases from the western wall of the Exposure Delta 1 building, which was now under heavy threat of igniting. The entire row of 12 shops to the west of the service station were now in danger of becoming involved in fire. The I.C. believed little could be achieved conducting a direct attack on the fully involved tanker and service station, with the limited resources on scene. The priority of S.O. Rodriguez was to protect Exposure Delta 1 and stop the fire spreading into the row of shops. The I.C. tasked firefighters to commence protection of the Delta 1 wall with a 70 mm cooling stream.

Initial Size-Up and Incident Critical Factors:

The I.C. then began to conduct a 360° size-up of the fire ground to identify incident critical factors. In addition to the fiercely burning petrol tanker, service station building and cars located on the service station forecourt, S.O. Rodriguez made the following observations:

a. A bank of 210 kg LPG cylinders located near the Charlie/Delta corner of the site were being impacted by fire and beginning to vent.

b. An 8,000-litre bulk LPG storage tank on the Bravo side of the service station was being heavily impacted by radiant heat and fire.

c. A residential house near the Bravo/Charlie corner was being impacted by radiant heat.

d. Timber power poles supporting high voltage powerlines were located immediately in front of the service station. The powerlines were in danger of dropping.

e. Fuel from the tanker was spilling onto the forecourt surface and spreading to the gutter. The fuel was alight and a running fuel fire had started in the gutters and drains, travelling in a north easterly direction along Lindesay Street.

Running Fuel Fire:

Realising the incident had the potential to significantly expand because of the running fuel fire now travelling along Lindesay Street, S.O. Rodriguez tasked CAFS Tanker 88 to control the running fuel fire. CAFS Tanker 88 went to the corner of Lindesay Street, where escaping fuel was burning in the gutters of Lindesay and Ronald Streets and was entering the drains. The tanker was positioned on an uphill section of road, protecting the appliance from the running fuel. CAFS Tanker 88 firefighters successfully used a dry chemical powder portable handheld extinguisher to attack and extinguish the running fuel fire.

Overhead Powerline Hazard:

S.O. Rodriguez had earlier observed that the timber poles supporting the overhead high voltage power lines were being impacted by extreme levels of radiant heat and beginning to pyrolyze. As well as the danger of the poles igniting, the power lines were sagging (due to expansion caused by fire heat). The hydrants on Lindesay Street in proximity to the service station were located directly beneath the overhead power lines. There was a significant possibility of the powerlines falling, severely endangering any firefighters attempting to obtain water supplies from the hydrants at this location. This danger forced S.O. Rodriguez to declare an exclusion zone beneath the powerlines, requiring firefighters to obtain water from an alternate supply. At the same time the exclusion zone was established, S.O. Rodriguez sent a message for the urgent attendance of the electricity authority to cut all power in Lindesay Street, because of the powerline fall risk.

N.B., In addition to the 415 Volt lines, 22kV high voltage lines were also located at the top of the poles.

Initial Defensive Firefighting:

CAFS Pumper 88 firefighters were working desperately to protect Exposure Delta 1 and stop the fire spreading into the row of shops, directing the 70 mm protective stream onto the brick wall of the exposure, attempting to cool the wall. CAFS Aerial Pumper 92, under the command of S.O. Brendon Ford and Bulk Tanker 92 arrived on scene. The I.C. was aware that the Bravo side of the fireground was being heavily impacted by fierce fire conditions where residential houses were located and directed Bulk Tanker 92 to go to the Bravo side of the service station and assist exposure protection.

By now CAFS Pumper 88 was beginning to run low on water. A 70 mm supply line was connected from CAFS Aerial Pumper 92 to CAFS Pumper 88 and the water within the CAFS

Aerial Pumper 92 appliance tank was transferred to CAFS Pumper 88, extending the time firefighters could keep operating the 70 mm attack line. Hazmat Pumper 87, under the command of S.O. Kevin Males arrived on scene.
The crew of Hazmat Pumper 87 went to the assistance of firefighters attempting to establish a water supply to CAFS Pumper 88. A hydrant was located on the 100 mm Lindesay Street main to the west of the powerline fall exclusion zone and firefighters began to lay 70 mm collector lines from the hydrant back to CAFS Pumper 88.

LPG Cylinders Begin to Vent:

Radiant heat from the fire was ferocious and fire conditions were worsening. As the fire continued to intensify, fierce jets of flame began to vent from a bank of seven 210 kg LPG cylinders located at the front of the retail shop and shipping containers. The venting cylinders were producing a deafening roar, described by firefighters as being similar in sound to the blast of jet engines. CAFS Pumper 88 firefighters redirected their 70 mm stream onto the cylinder bank in an attempt to cool the pressurised gas cylinders as the cylinder pressure relief valves continued to operate.

The I.C. was discussing with S.O. Ford and CAFS Aerial Pumper 92 pump operator Senior Firefighter Nick Richards the most effective use of CAFS Aerial Pumper 92. At this time, the incident was still in the expanding phase, fire conditions were extreme and it was possible appliances may need to be relocated. The presence of the overhead high voltage powerlines restricted the operation of the aerial appliance. Both officers formed the view that under these conditions the operation of an aerial appliance was considered too hazardous and the decision was made to continue attacking the fire with handlines.

Major LPG Cylinder BLEVEs Occur:

Firefighters had only been on scene a relatively short time. Fire conditions were horrendous, the scene was deteriorating and firefighters were still trying to secure a water supply when suddenly, a very large BLEVE (Boiling Liquid Expanding Vapour Explosion) occurred involving one of the 210 kg LPG cylinders. The overpressure of the cylinder caused the steel casing of the cylinder to open along a weld seam near the base, propelling the cylinder with immense force horizontally through the front (Alpha Side) brick wall of the retail shop, through the shop and out the Bravo side of the shop through a second brick wall. Both brick walls were completely demolished and bricks were displaced over 30 metres to the east onto Ronald Street. As a result of the cylinder rupturing, the compressed liquid within the cylinder expanded (to 1,700 times the contents of the liquid) and mixed with air, forming a very large flammable cloud. Instantaneous ignition of the flammable cloud occurred, resulting in a flame height that extended approximately 60 metres high. The shockwave produced by the explosion shook fire appliances.

A short time after the first BLEVE, a second BLEVE involving another 210 kg LPG cylinder occurred, producing a large flame approximately 60 metres high above the service station. The force of the explosion was so severe a large amount of debris was displaced upwards and showered across a distance that exceeded 30 metres in all directions.

Some of the displaced debris included roof rafters from the retail shop that landed 30 metres away on the (Lindesay Street) road surface, a section of wall cladding from the retail shop that landed on the top of a power pole across three high voltage lines and a large refrigeration unit used for dispensing ice displaced approximately five metres away from the wall. Similar to the first BLEVE, the shockwave produced by the explosion shook the ground and all fire appliances at the scene. Pieces of the building and the shop roof were showered across all parts of the fireground.

Immediately following the two LPG cylinder BLEVE's, the I.C. directed the crew of CAFS Pumper 88 to direct their cooling stream onto the remaining bank of five 210 kg LPG cylinders. CAFS Pumper 88 firefighters connected a single inlet monitor to the 70 mm line and continued to direct a cooling stream onto the gas cylinder bank. By now a hydrant supply had been established for CAFS Pumper 88, however water pressure within the main was extremely poor. Despite two 70 mm delivery lines being laid from the hydrant to the pumper, the CAFS Pumper 88 pump operator continued to experience poor water pressure and was over-running supply, despite operating a single 70mm attack line.

The I.C. directed S.O. Ford to place a 70 mm line in operation from CAFS Aerial Pumper 92 and direct the stream onto the 210 kg LPG cylinders. Aware of the problems being experienced by the crew of CAFS Pumper 88, S.O. Ford located a 200 mm main approximately 90 metres to the east of Chamberlain Street. Firefighters laid a 70 mm supply line to CAFS Aerial Pumper 92 from the 200 mm main, establishing a secure water supply.

Shortly after CAFS Aerial Pumper 92 firefighters began operating this line, S.O. Ford observed the attack stream was not reaching the gas cylinders. The level of radiant heat from the fire was so intense that the water from the attack stream was vaporising and turning to steam before it reached the cylinders. Firefighters changed the attack line branch from a diffuser nozzle to a stack tip branch, increasing the penetration and strength of the attack stream, resulting in the cooling stream being able to reach the cylinders. The CAFS Aerial Pumper 92 stream being directed onto the gas cylinders was changed from water to CAFS to increase the cooling of the cylinders.

Overhead Powerlines Fall:

The overhead high voltage power lines located in Alpha Sector were being impinged by direct flame impact and intense levels of radiant heat. Exclusion zones had been established beneath the powerlines. Within minutes of firefighters arriving on scene, the powerlines fell to the ground. The exclusion zones were maintained until electrical authority staff confirmed power isolation and disconnection of all lines. Electricity Authority operators informed the I.C. they had tested the lines, confirming they were no longer live.

Direct Attack on Main Fire:

CAFS Tanker 88 positioned near the Alpha/Bravo corner, where Captain Mosley used the appliance front monitor to direct CAFS on a medium/wet setting onto the fire. The monitor was fitted with a stack tip for the CAFS application. The CAFS stream was being directed onto the retail shop and the tanker. Captain Mosley advised the numerous gaps had opened in the metal sheeting that formed the awning due to the impact of heat from the fire, allowing parts of the CAFS stream to penetrate through to the tanker. The monitor was operated on an automatic oscillating setting, resulting in the stream sweeping backwards and forwards across the fire area. Water supply for CAFS Tanker 88 was obtained with a single supply line from a street hydrant in Ronald Street. As the appliance concentrate tank began to run low, firefighters refilled the tank with additional drums of concentrate. By this time, most of the remaining fuel in the tanker had burnt off. Captain Mosely reported on the effectiveness of the CAFS attack:

"There was an instant change in fire behaviour the moment CAFS started going onto the fire. Within five minutes of commencing the CAFS attack, there was a significant diminishing of fire conditions, to the point I would describe that fire control had been gained".

Pumper 248, under the command of On-Call Firefighter Alex Mansueto, was responding to the fire when OCF Mansueto overheard a message from the I.C. for all incoming appliances to approach the fireground from the north. Pumper 248 negotiated a number of back streets and arrived on Lindesay Street near Ronald Street, in Sector Bravo. Pumper 248 was tasked to conduct a direct attack on the fire. Four firefighters wearing SCBA deployed two 38 mm attack lines and commenced firefighting operations, directing attack streams onto the tanker and the involved retail shop. Water supply for Pumper 248 was obtained from a street hydrant to the north and two 70 mm lines supplied water to the appliance.

Transfer of Command:

Duty Commander MS3 Inspector Bruce Fitzpatrick arrived on scene. Following a handover briefing, command was transferred to Inspector Fitzpatrick and S.O. Rodriguez appointed Operations Officer. S.O. Ford was appointed Alpha Sector Commander.

Gas Cylinders Continue to Pose a Threat:

Intermittent venting of the LPG cylinders was continuing to occur, producing loud, intense jet-like flames as the cylinder pressure relief valves opened and closed every few seconds. Firefighters were continuing to direct cooling streams onto the cylinders and monitor the external cylinder temperatures with thermal imaging cameras. Eventually, as the main fire was brought under control and less heat was being released, cylinder venting stopped. Firefighters continued to cool and monitor the temperature of the cylinders.

Protection of Exposure Bravo Residential Houses:

The I.C. earlier tasked Bulk Tanker 92 to deploy to the Bravo side of the service station and establish protection of houses under threat at that location. The crew of Bulk Tanker 92 were using the front monitor of the appliance to direct a CAFS stream set at 0.3% wet/medium towards Bravo exposures, which were being heavily impacted by radiant heat. This operation successfully protected the Bravo exposure houses. Bulk Tanker 92 was also directing the attack stream onto the involved retail shop.

Pumper 248 firefighters directed a 38 mm cooling stream onto the Bravo exposures. The house closest to the service station at 3 Ronald Street was being impacted by intense radiant heat and wall cladding was beginning to melt. CAFS Tanker 88 was located at the Alpha/Bravo corner and used the appliance front monitor stream to protect the threatened Bravo exposures, including the residential house at 3 Ronald Street. These combined cooling operations successfully protected the house from ignition and any further heat damage. CAFS Tanker 88 firefighters also extinguished a fire burning at the base of a timber pole. Despite the impact of ferocious fire conditions, the combined efforts of firefighters working in Bravo Sector halted any fire spread on the Bravo side of the service station.

Protection of Delta Exposure:

From Alpha Sector, firefighters were using a single inlet ground monitor stream to sweep along the wall of the northern side of the Exposure Delta 1 shop, protecting the building from intense radiant heat. The crew of Hazmat Pumper 87 were tasked by the I.C. to make entry into Exposure Delta 1 and conduct protection of the exposure. All shops within the local shopping centre continued to remain under threat. Firefighters used the Rapid Intervention Kit (RIK) and a Halligan tool to gain entry through a single glass door of Exposure Delta 1. After gaining entry, firefighters used a thermal imaging camera to search through the smoke-filled shop looking for signs of heat and fire spread. This search did not identify signs of fire spread.

Protection of Bulk LPG Storage Tank:

Firefighters noticed pyrolysis gases coming from the external surface of the 8,000 litre vertical LPG bulk storage tank, near the Alpha/Bravo corner of the service station. CAFS Tanker 88 was located at the Alpha/Bravo corner and was able to direct a cooling stream onto the bulk storage tank. As soon as the cooling stream reached the cylinder, steam began to pour from the surface of the tank, indicating the impact of significant radiant heat on the storage tank. The crew of Pumper 248 used a 38 mm line to direct a cooling stream onto the surface of the storage tank, reducing the temperature of the tank. The cooling stream was directed across the entire surface of the tank, ensuring equal cooling of the tank to prevent a temperature differential of the casing occurring, that could lead to overstress of the steel casing and tank failure. Firefighters continued to maintain protection of the storage tank for the duration of operations.

Attack From Charlie Sector:

Rescue Pumper 93 deployed to McLean Road to the south of the service station, which was now Charlie Sector. Water supply for Rescue Pumper 93 was obtained from two 70 mm lines connected to a street hydrant, however water supply within the elevated Mclean Road 100 mm main was poor. From Charlie Sector firefighters were able to deploy a 70 mm attack line to an elevated position at the rear of the service station. The main priority of Rescue Pumper 93 firefighters was to direct the cooling stream onto the bank of 210 kg LPG cylinders, which were intermittently venting due to the intense heat present. Firefighters were also directing the stream onto Exposure Delta 1, which continued to be impacted by flame impingement and explosions. From their elevated position, firefighters were also able to attack fire burning within the retail shop, the service station and shipping containers. After approximately 10-15 minutes, Rescue Pumper 93 firefighters began to lose water supply, forcing them to change to a 38 mm line, however water pressure remained poor.

Tanker Fire Under Control:

Within approximately 15-20 minutes of firefighters arriving on scene, the remaining fuel in the tanker had burnt off, allowing firefighters to direct firefighting streams onto the burning shop, truck, cars and other materials and objects alight within the service station. CAFS Aerial Pumper 92 firefighters used the 70 mm CAFS attack stream to extinguish fire burning in the three cars at the service station. A cooling stream was maintained on the LPG gas cylinders and the side wall of Exposure Delta. Duty Commander ME3 Inspector Gary Meagher arrived on scene and was appointed Safety Officer by the I.C.

Aerial Placed in Operation:

Once fire control had been established, the I.C. requested CAFS Aerial Pumper 47 be placed in operation as an aerial reconnaissance platform. CAFS Aerial Pumper 47 was positioned in Alpha Sector on Lindesay Street, near the Bravo corner. Hydrant lines that were supplying water to Pumper 248 were diverted to CAFS Aerial Pumper 47. Although electricity authority staff confirmed the overhead powerlines were completely dead, the aerial crew treated the lines as if they were still live. CAFS Aerial Pumper 47 operator Senior Firefighter Peter Stibbard elevated the aerial working cage and used the appliance cage thermal imaging camera to survey the fireground for areas of heat. The roof of exposure Delta 1 was cool. Elevated temperatures were detected at the Charlie/Delta corner, in the vicinity of the shipping containers. This information was relayed to the I.C., who directed CAFS Aerial Pumper 47 to direct an aerial stream onto this area.

The CAFS Aerial Pumper 47 elevated aerial stream was directed onto the area of heat registration in proximity to the shipping containers. Despite the application of the aerial stream onto the area of the shipping containers, elevated temperatures continued to register in this area, indicating the heat source was coming from inside the shipping containers. The

aerial stream was also directed into the retail shop where the roof had been displaced, enabling significant fire extinguishment to occur.

Incident Command Structure:

Duty Commander MS3 Inspector Fitzpatrick had established a robust command structure that was built out as the incident progressed. At this time during firefighting operations, the incident command structure was established as follows:

Incident Commander - Duty Commander MS3 Inspector Bruce Fitzpatrick.
Operations Officer – CAFS Pumper 88 S.O. Frank Rodriguez.
Safety Officer - Duty Commander ME3 Inspector Gary Meagher.
Staging Officer – Pumper 84 S.O. Dan Austin.
Sector Alpha Commander – CAFS Pumper 47 S.O. Brendon Ford.
Sector Bravo Commander – CAFS Tanker 88 Captain Anthony Mosley.
Sector Charlie Commander – Rescue Pumper 93 S.O. Peter Watson.
Sector Delta Commander – Hazmat Pumper 87 S.O. Kevin Males.

Shipping Container Fires Extinguished:

The aerial report from CAFS Aerial Pumper 47 indicated elevated temperatures were still present within the shipping containers, most likely due to fires burning inside the shipping containers. The I.C. liaised with the premises owner and Police to determine what the contents of the shipping containers were prior to opening them. The premises owner advised consumable goods for the retail shop were stored in the shipping container. Firefighters shut down the 70 mm CAFS line connected to CAFS Aerial Pumper 92 and placed a Y breeching and 38 mm reducers on the end of the line. Two 38 mm attack lines were connected to the Y breeching. Firefighters then advanced two 38 mm lines to the shipping containers, where entry was gained and internal fires were extinguished.

Hazmat Operations:

Hazmat Pumper 87 were re-tasked to manage foam run-off. Firefighters used booms, bunding, earth dams and drain blocks to prevent the foam from entering the drainage system. Some fuel had already entered the drains during the early stages of the fire prior to FRNSW arrival on scene. Hazmat crews traced the run-off to a creek and undertook pH readings. Hazmat operations were assisted by crews from Hazmat Pumper 85 and Heavy Hazmat 85. Hazmat crews traced the full extent of contaminant spread and a vacuum truck was organised for the recovery of the spilled fuel, foam and contaminated water run-off, which was contained before entering the wider water course.

Final extinguishment:

After the shipping container fires had been extinguished, firefighters used the 38 mm CAFS handlines to extinguish remaining fires at the service station including a number of small spot fires on the service station forecourt and inside the retail shop. Firefighters extinguished the

remaining fire in the truck cabin. Most of the aluminium tanker shell had melted and only the steel tanker chassis remained, with the exception of the burning rubber truck tyres, which proved extremely resistant to extinguishment attempts.
Eventually firefighters were able to extinguish the tanker tyres. At this time, firefighters protecting Bravo and Delta exposures were able to report there had been no fire spread to these exposures and these exposures were now safe.

Transfer of Command:

Zone Commander MS3, Superintendent Greg Wright arrived at the incident and following a handover briefing, command was transferred to Superintendent Wright and Inspector Fitzpatrick appointed Operations Officer. Mobile Command Centre Bravo arrived on scene and the Incident Command Point was then transferred to the MCC. At 2255 hours, the I.C. increased the response to a structure fire 4th Alarm.

Operations Overnight:

At 0014 hours a fire duty consisting of Pumpers 10, 14, 26 and 42 and CAFS Pumper 67 were assigned to the incident. At 0416 hours the fire duty was reduced to two pumpers. Throughout the night firefighters continued to monitor the fireground for any signs of remaining hotspots or pockets of fire. A number of minor flare-ups were extinguished without incident.

Operations 25th February 2023:

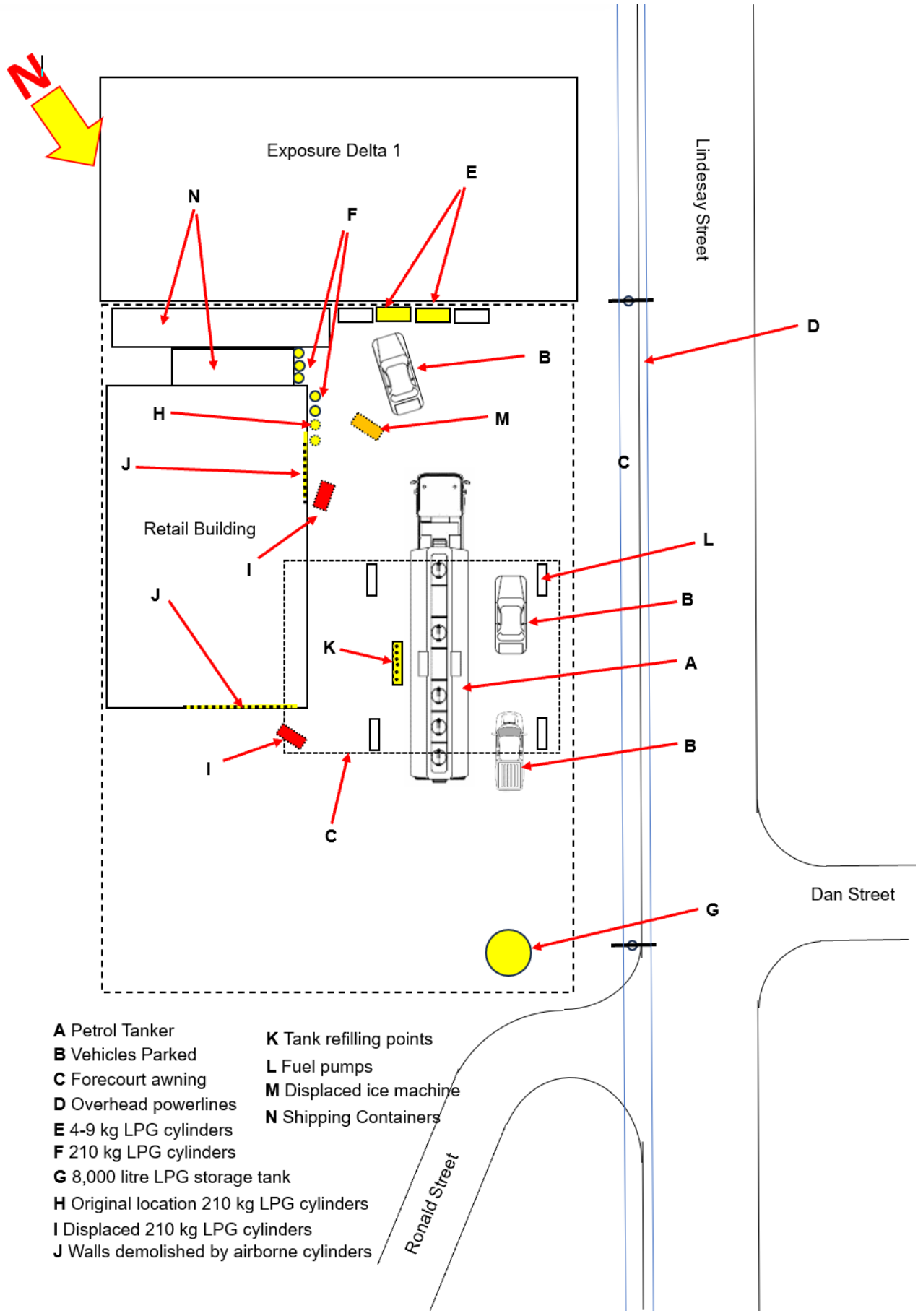
As daylight broke over the fireground there were very little signs of any remaining fire hot spots. Throughout the course of the day a number of FRNSW post fire duties had to be undertaken. For the entirety of these additional operations, at least one FRNSW pumper was in attendance, ensuring safety of all persons who remained at the fireground while the site remained under FRNSW control. FRNSW Fire and Investigation and Research Unit officers, under the command of Inspector Chris Hughes attended the fireground to conduct a scene examination and determine the fire cause and origin.

Technical Rescue 8 attended the incident and used the Leader Sentry laser stability monitor to ensure there was no danger of collapse or structural failure of the heat damaged forecourt awning. This equipment was in position for most of the day however detected no movement.

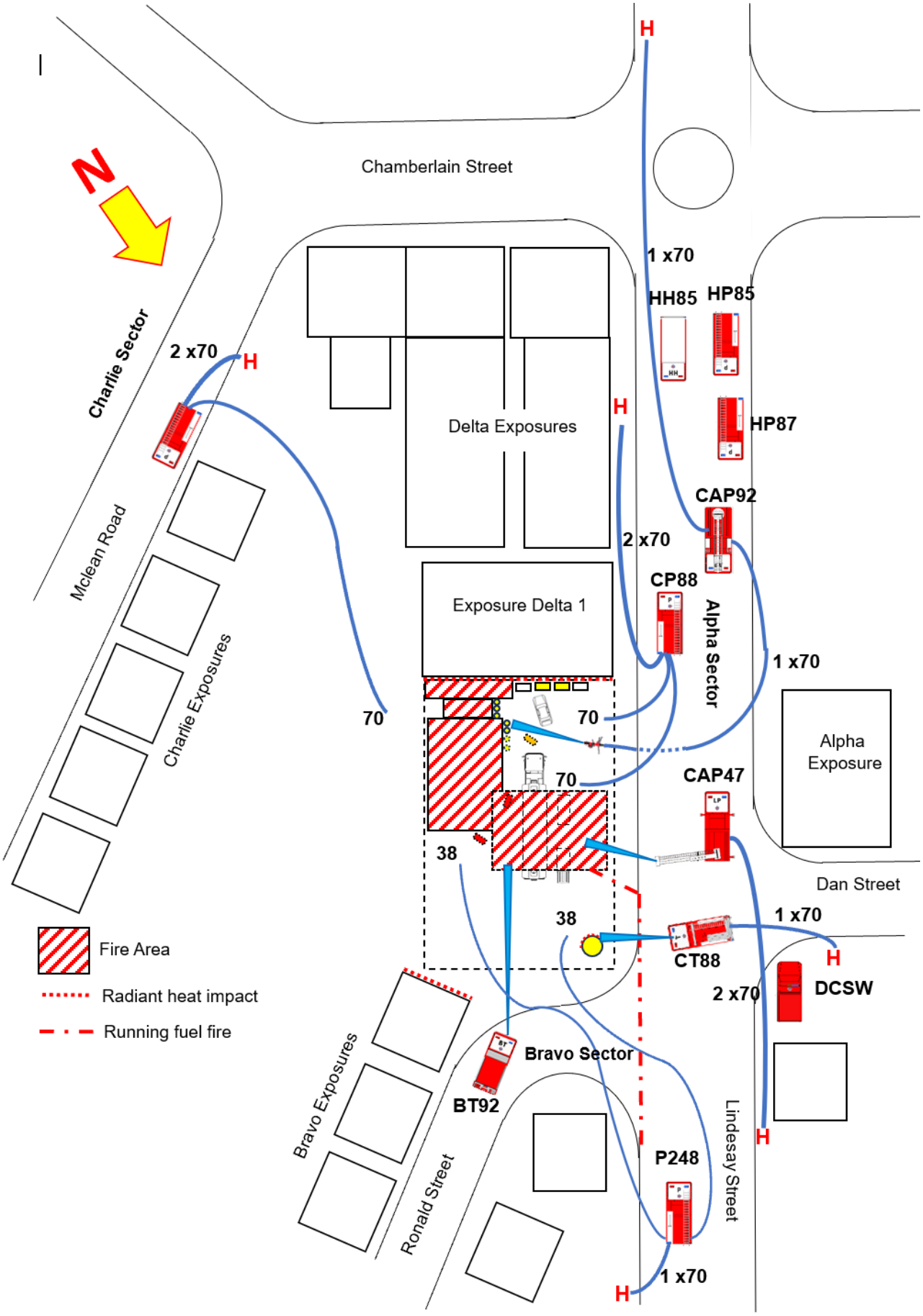
A quantity of fuel product remained in the tank shells of the destroyed tanker. A hazardous liquid waste contractor was tasked with the removal of the remaining liquid, under the supervision of FRNSW hazmat crews.

FRNSW Crews Depart Scene:

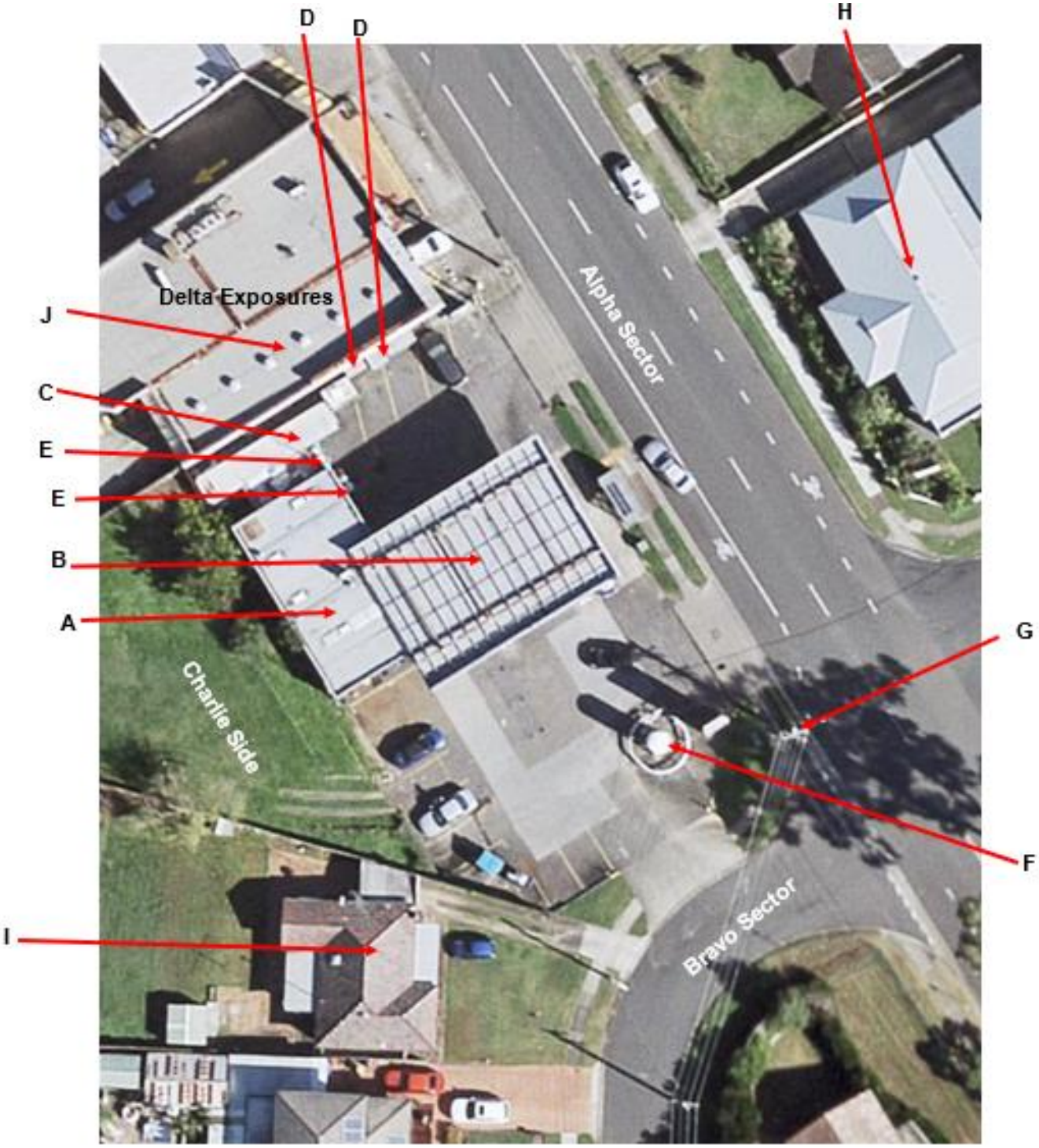
Following completion of FIRU duties and final removal of remaining fuel from the tanker remains, FRNSW handed control of the site over to the premise’s owners. The final FRNSW resource left the scene at 1636 hours.


N
Exposure Delta 1
Lindesay Street
Dan Street
Ronald Street
Retail Building
A Petrol Tanker
B Vehicles Parked
C Forecourt awning
D Overhead powerlines
E 4-9 kg LPG cylinders
F 210 kg LPG cylinders
G 8,000 litre LPG storage tank
H Original location 210 kg LPG cylinders
I Displaced 210 kg LPG cylinders
J Walls demolished by airborne cylinders
K Tank refilling points
L Fuel pumps
M Displaced ice machine
N Shipping Containers

Fireground Features – drawing not to scale.



Fireground Lindesay Street, Campbelltown – Drawing not to Scale



A Retail building
B Forecourt awning
C Shipping Containers
D 4-9 kg LPG cylinders
E 210 kg LPG cylinders
F 8,000 litre LPG storage tank
G Overhead powerlines
H Exposure Alpha
I Exposure Bravo
J Exposure Delta 1

Features of fireground Lindesay Street, Campbelltown – Aerial View

Incident Outcomes:

The following incident outcomes were achieved:

1. All persons on the service station site were evacuated to safety.

2. Persons within the surrounding area were removed to safety.

3. Exposures under direct threat were protected and saved.

4. The running fuel fire was extinguished, preventing remote via fire spread via the drainage system.

5. Contaminated water runoff was prevented from entering the water course, minimising environmental impact.

6. Cooling of the bulk LPG storage tank prevented a catastrophic BLEVE (Boiling Liquid Expanding Vapour Explosion) occurring.

7. The fire was contained, controlled and extinguished.

Fire Behaviour Considerations

The following fire behaviour considerations are of note:

1. Ignition of petroleum shortly after the outbreak of fire resulted in extreme and intense fire conditions. Properties of the fire associated with the burning petroleum within the tanker included:

a. The flame temperature of petroleum is approximately 1,026°C.
b. The radiant heat produced from the burning petroleum was approximately 44 MJ/kg.
c. The average heat flux density for burning petroleum is approximately 3.5 kW/m^2.
d. The average heat release rate for burning petroleum is approximately1670 kWm^2
e. Petroleum will commence to release flammable vapours at temperatures as low as - 43 °C.

2. Within a very short time following ignition of the tanker contents, the fire began to create its own atmosphere, drawing air into the base of the fire (creating the fire's own wind) and producing a strong thermal updraft and convective plume.

3. The burning fuel produced large volumes of thick and black hydrocarbon-rich smoke. The smoke column contained significant thermal energy, creating buoyancy that caused the column to extend to at least 1,000 metres. As the hydrocarbon enriched smoke was drafted into the superheated convective column and mixed with air it ignited, creating the appearance of “fire balls”. Large flames vented from the burning fuel. A combination of flames and unburnt hydrocarbon ignition within the convective plume resulted in flame heights of 60 metres. At the time of the fire, winds were calm at 0 km/h, allowing the smoke column to travel directly upwards.

4. Intense radiant heat from the surface fuel fire attacked the single skin (5 mm thick) aluminium shell of the tanker barrel (the tanker barrel was divided into six 7,000 litre compartments). The weakest part of the tanker was the ullage space near the top of the tank where the aluminium was not being cooled by the liquid contents of the tanker. An unprotected aluminium tank shell will begin to melt at around 660°C (remembering that the flame temperature of petroleum is approximately 1,026°C.). Within a short time the section of tank shell above the liquid line began to melt down to the level of the burning liquid. The tanker barrel became exposed above all six compartments, releasing flammable vapours from the petroleum contents, which then ignited, resulting in a fire involving the remaining fuel load of the tanker.

5. The risk of a BLEVE (Boiling Liquid Expanding Vapour Explosion) of a *petrol* tanker is unlikely. The tanker shell is formed of very lightweight aluminium and has very low resistance to heat. In the event of a fire impacting the tanker, the shell is designed to fail (causing pressure to be released), to prevent an “overpressure” situation occurring.

N.B., **LPG tankers** on the other hand are formed of solid steel, product is stored at high pressure and these tankers can (and do) BLEVE.

6. Following ignition of the tanker contents, only the surface of the fuel was involved in fire. Petroleum will burn downwards at a rate of approximately 30 cm per hour. The tanker was unloading fuel at the time the fire broke out. It is not known what quantity of fuel remained in the tanker at the time the fire broke out.

N.B., As the surface of the flammable liquid continues to burn downwards and the sides of tanker shell progressively melt, the width of the surface area of the burning area will continue to broaden, resulting in an increased area of fire.

7. Fuel continued to pour from the tanker and flow along the road and into the drains. Escaping fuel ignited almost as soon as it reached the road surface, resulting in a running fuel fire, that entered the drain system and continued to burn for an unknown distance. The drains contained large quantities of flammable vapour that continuously ignited when the air mixture came within the flammable range. The confined space of the underground drains resulted in significant explosions occurring.

8. Unburned fuel that enters the drain system can create significant problems. Flammable vapours released from the spilled fuel will result in the formation of a flammable gas cloud. The expansion rate of petroleum to vapour is approximately 800. The flammability range for petroleum is of 1.3% – 7.1%. As the vapour cloud expands and begins to mix with air, the increased volume of the cloud will enter the flammable range, causing explosions and fire to occur. The confined space of a drain will increase the magnification of an explosion. These types of events could potentially occur remote from the service station (up to several kilometres away).

9. The structure supporting the awning forecourt was formed from unprotected steel and rapidly began to fail, resulting in a slow progressive collapse of the iron sheet awning onto the tanker. Structural steel begins to lose tensile strength at around 300°C. At this temperature, the steel will begin to soften. Significant loss of strength rapidly occurs after 400°C. At about 550°C, steel will lose half its load bearing capacity. At about 1,000°C, steel will only have about 10% or less of its load bearing capacity. The flame temperature for the burning petroleum was in excess of 1,000°C, resulting in significant failure of the unprotected structural steel and subsequent collapse.

10. Radiant heat from a fire can be absorbed by an exposure, causing the material the exposure is formed from to increase in temperature. If the source of radiant heat is large enough and nothing is done to cool the exposure, eventually the temperature of the material being impacted by the radiant heat will reach it's "*fire point*" or "*self-ignition*" temperature and ignite, becoming involved in fire. The amount of radiant heat released from a fire is directly related to the intensity of the fire.

11. The radiant heat source of the Campbelltown tanker fire could be described as an "*area source*", a situation where the flame front has significant height and width. Although radiant heat intensity from an area source diminishes with distance, the level of diminishing is not great because distances are small compared to the height and width of the flame source.

12. Severe radiant heat from the burning petroleum impacted LPG cylinders located at the site. The cylinders ranged in size, including 4 and 9 kg cylinders stored in cages, seven 210 kg cylinders and one 4 tonne 8,000 litre bulk LPG vertical storage tank. LPG is formed of propane and butane. Liquid propane has a boiling point of ¯42°C. The auto-ignition temperature of propane is 470°C. Radiant heat from the burning petroleum impacted the steel casing of LPG cylinders, causing the steel to increase in temperature. The rise in temperature of the steel cylinder casings was transferred to the internal liquid within the cylinders, causing the temperature of the liquid to rise, resulting in the **liquid boiling** and an increase (**expansion**) in gas vapour within the headspace of the cylinder. As the volume of gas inside the cylinder increased, pressure inside the cylinder headspace increased, causing the cylinder pressure relief to operate, resulting in gas being released from the cylinder, producing a highly visible flame jet. The release of gas was described by firefighters as being similar to roaring jet engines.

13. The increase in internal pressure of two of the 210 kg LPG cylinders was greater than pressure could be released at, resulting in an overpressure of the cylinder occurring, causing the steel cylinder to fail at the weld seams. Cylinder casing failure resulted in the rapid release of the cylinder's liquid contents. The escaping liquid was rapidly transformed into an expanding gas cloud that mixed with the surrounding air, producing a large flammable gas cloud that ignited, resulting in a large explosion, known as a **BLEVE** (Boiling Liquid Expanding Vapour Explosion) occurring. BLEVE events are characterised by the sudden release and explosive ignition of cylinder contents. The cylinder was transformed into a violent and destructive projectile, in reaction to the sudden and explosive release of burning flammable product, with sufficient force to travel through two brick walls at the service station.

Conclusion:

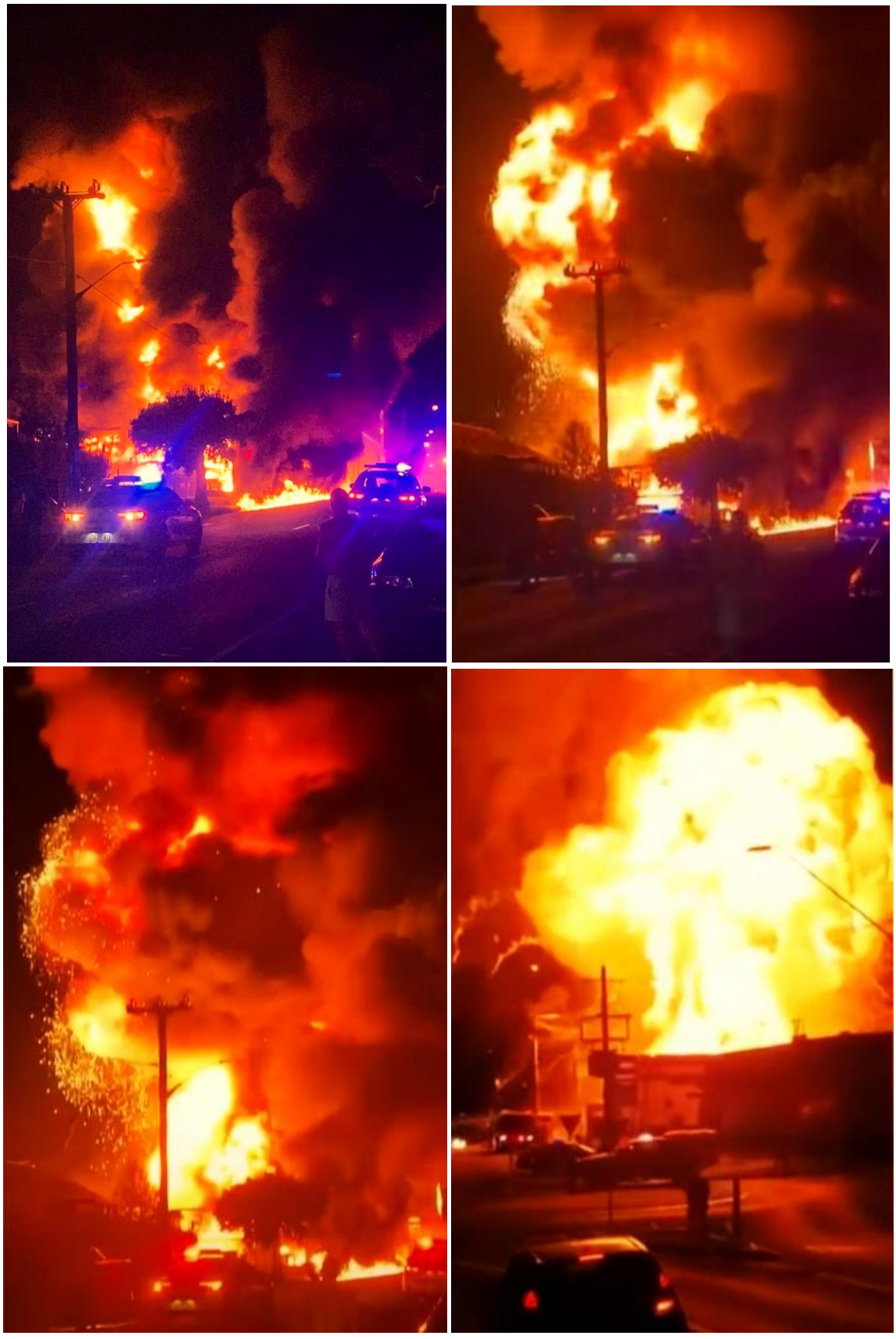
Responding firefighters to Lindesay Street, Campbelltown on Friday 24th February 2023 were confronted with an extreme and expanding fire scenario, containing many complex incident critical factors, including a fully involved petrol tanker, multiple vehicles alight and the service station building containing volatile stored products totally involved in fire. Fuel escaping from the tanker was alight and running towards the drains. The pressure relief valves on numerous stored LPG cylinders located in the fire area were beginning to operate as fire intensity increased, indicating an imminent boiling liquid expanding vapour explosion. Fierce flames were extending beyond 100 metres in height into the night sky. Numerous exposures, including residential houses and a row of shops located in close proximity to the service station were being impacted by extreme levels of radiant heat and were in imminent danger of fire spread. The closest hydrants were located beneath sagging overhead powerlines. As the first firefighters arrived on scene, fire conditions were worsening and the situation was rapidly deteriorating. This was the situation firefighters were met with.

First arriving firefighters laid the foundation that would enable a systematic firefighting operation to be implemented. The first lines placed in operation protected heavily threatened exposures on the Delta side of the fire. Crews were deployed to the Bravo side of the fire to commence protection of threatened Bravo exposures. As further stations arrived on scene, firefighters began to establish containment on all sides of the fire. Once the fire was contained, firefighters commenced operations to establish fire control.

Firefighters encountered significant challenges and hazardous conditions conducting these operations. Water shortage was a significant problem, requiring water being obtained from remote mains and restricting the size of the fire attack during initial operations. Escaping fuel ignited and was flowing towards the drains, expanding the size and scope of the incident. Fire intensity was so severe a number of dangerous LPG cylinder boiling liquid expanding vapour explosions occurred, resulting in cylinders becoming projectiles that knocked down the brick walls of the service station. Numerous other hazardous conditions confronted firefighters, including fire impact to high-voltage overhead powerlines, explosion debris and the involvement of volatile materials within the service station.

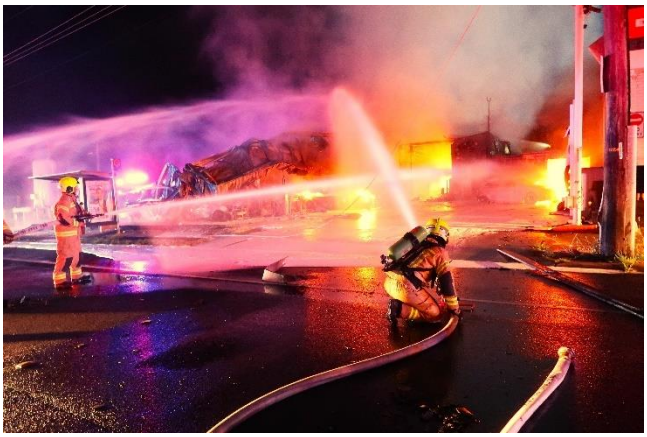
Despite the extreme nature of conditions when firefighters arrived on scene, all exposures under threat were protected and the fire was contained, controlled and extinguished. Firefighters operated with courage, skill and high levels of determination. Fireground commanders displayed outstanding fireground command and leadership. Operations were conducted in a highly disciplined manner in accordance with a systematic firefighting plan. It is highly conceivable that without such effective operations, losses would have been much greater. All FRNSW crews displayed very high levels of firefighting professionalism. There are many positive lessons to be shared from the outstanding operations carried out by FRNSW crews at this very challenging incident.

This photograph was taken by a member of the public shortly after firefighters arrived on scene. The petrol tanker, service station and several vehicles are totally involved in fire as a boiling liquid expanding vapour explosion (BLEVE) of a 210 kg LPG cylinder occurs. A running fuel fire is flowing along the gutter.



Fierce flames light up the night sky as fire and a heavy smoke column erupts from the burning tanker. The results of a 210 kg LPG BLEVE at bottom left Pictures supplied by a member of the public.

The first water goes onto the fire. These photographs taken by members of the public show the initial 70 mm line being placed in operation by the crew of CAFS Pumper 88. Fire conditions are ferocious and Exposure Delta is being heavily impacted by intense radiant heat. The initial operations by CAFS Pumper 88 placed a cooling stream onto wall of Exposure Delta, protecting the first shop in a row of shops from becoming involved in fire.



Initial lines were placed in operation in Alpha Sector to protect heavily threatened Exposure Delta 1, cutting the fire off and stopping the fire's progression along Lindesay Street to the south. Firefighters displayed strong determination to contain the southern flank of the fire. "*As goes the first line, so goes the fire.*"

Taken by members of the public these photographs show boiling liquid expanding vapour explosions (BLEVEs) occurring involving 210 kg LPG cylinders. These photographs were taken from a distance of approximately 250 metres from the service station and are indicative of the size and intensity of the explosions.


FIRE + RESCUE
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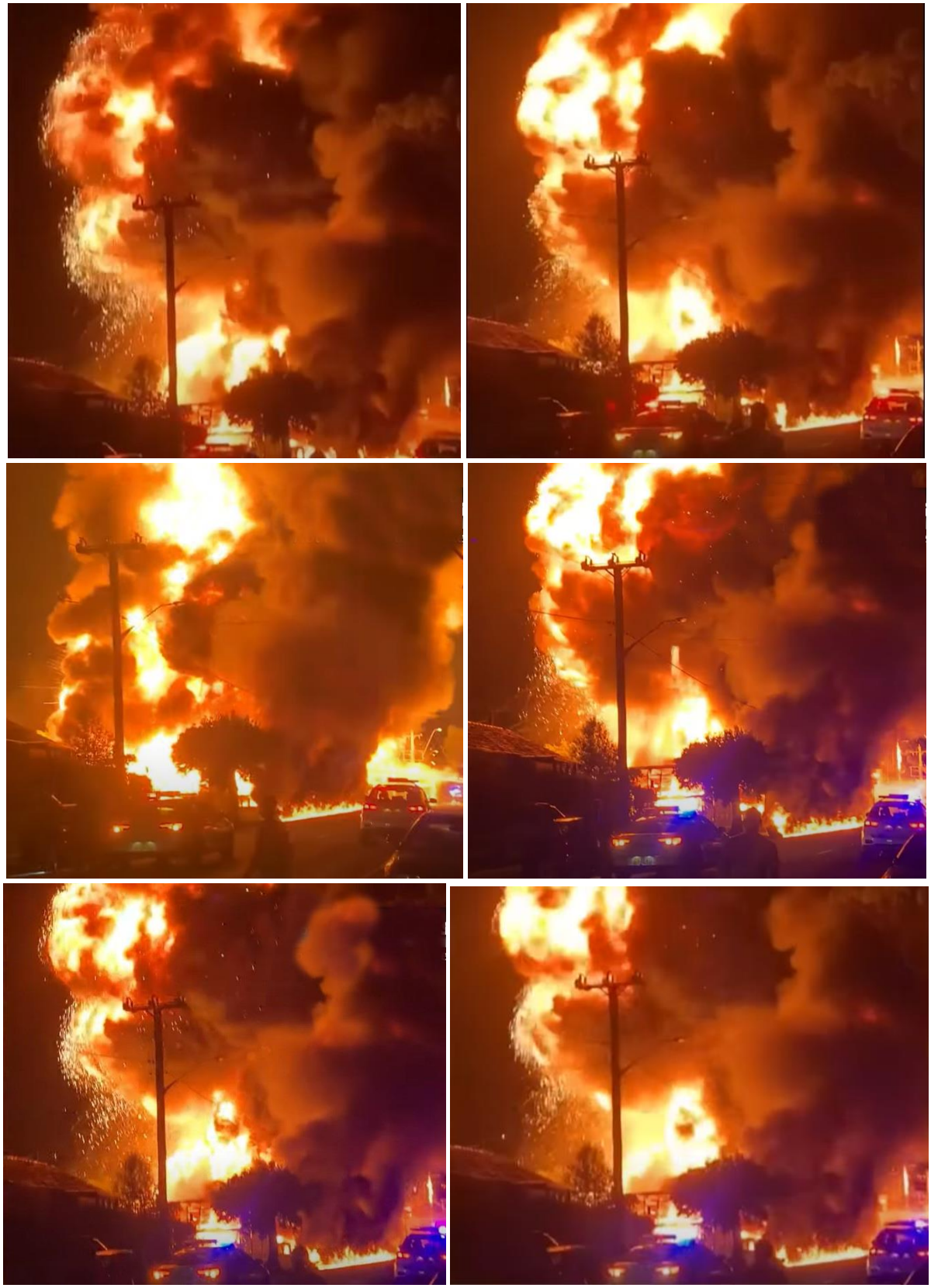
Operations on the Bravo side of the fireground. Firefighters cool the 8,000 litre bulk LPG storage tank that was being impacted by intense radiant heat from the burning tanker fire. Crews also begin to attack the service station fire. The front monitor of CAFS Taner 88 directs a Class A foam stream onto the burning service station. Pumper 248 supplies 38 mm attack lines to crews working in Bravo Sector.

Incredible photographs taken by members of the public approximately 250 metres to the north of the service station capture a boiling liquid expanding vapour explosion of a 210 kg LPG cylinder located at the front of the service station. Firefighters battled this enormously ferocious fire, establishing containment on all sides. Radiant heat presented a significant threat of fire spread.

Command was transferred to Duty Commander MS3 Inspector Bruce Fitzpatrick. During the period Inspector Fitzpatrick commanded operations, containment and control of the fire were established. CAFS Pumper 88 (lower right) placed the first lines in operation, stopping the fire from spreading to heavily threatened exposures on the Delta side of the fire. A short time later crews were also working on the Bravo side of the fire.



Photographs taken by members of the public approximately 250 metres to the north of the service station as fierce flames erupt from the fully involved petrol tanker. A running fuel fire can be seen in the gutter. Despite the extreme ferocity of fire conditions encountered, firefighters established a systematic firefighting plan enabling the fire to be contained, controlled and extinguished. The incredible efforts of responding firefighters enabled all exposures to be protected and saved.



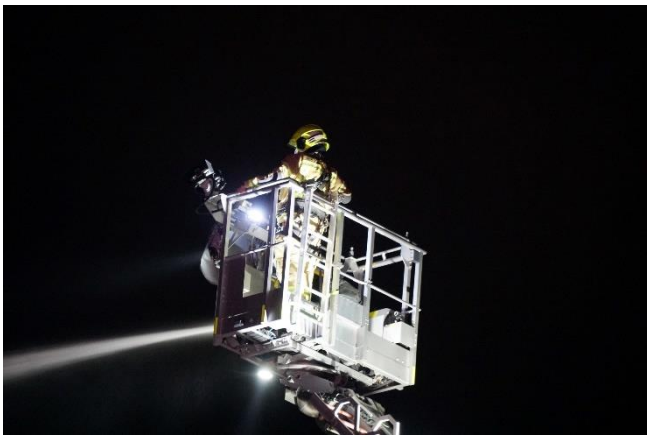


Firefighters were deployed to the Bravo side of the service station where several exposures were under threat from the extreme levels of radiant heat being produced by the fire. A residential house was under severe threat and beginning to ignite when firefighters directed cooling streams onto the walls of the structure, saving the house.

Firefighters protect exposures on the Bravo side of the service station and begin to direct attack lines onto the service station building. Lower left – Rescue Pumper operates on the Charlie side of the fireground. Lower right – Firefighters coll the walls of exposure Delta 1 and direct a cooling steam onto the 210 kg LPG cylinder bank.








Firefighters place CAFS Aerial Pumper 47 in operation as a water tower. The presence of high-voltage overhead powerlines and initial water supply shortages restricted aerial appliance operations. Middle left – Firefighters cool the 8,000 litre LPG bulk stoarge tank.



Top – CAFS Pumper 88 conducted initial fire attack. Middle – As water supplies improved, CAFS Aerial Pumper 47 was placed in operation, directing an aerial deluge onto the fire scene. Lower – FRNSW operations were supported with a strong response from Police and Ambulance.

The tanker was parked beneath the service station awning when the fire broke out. Intense heat from the burning petroleum caused the structural steel supporting the awning to collapse. Steel roof sheets collapsed onto the tanker, acting as a barrier restricting firefighting streams from reaching the fire.

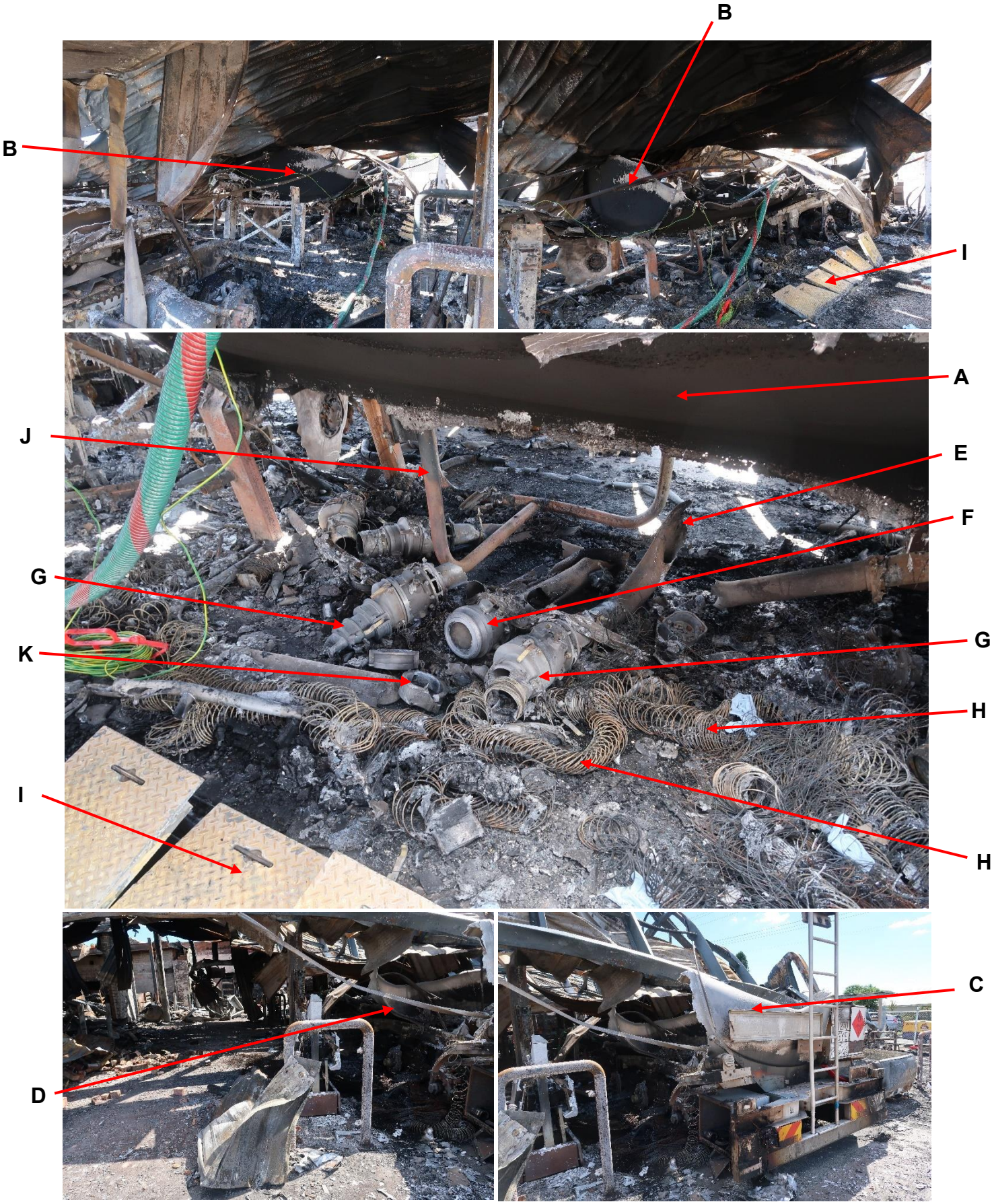
Severe fire damage to the structural steel supporting the service station awning is indicative of the fire intensity. The flame temperature of petroleum is approximately 1,026°C. Structural steel begins to lose tensile strength at around 300°C. At this temperature, the steel will begin to soften. Significant loss of strength rapidly occurs after 400°C. At about 550°C, steel will lose half its load bearing capacity. At about 1,000°C, steel will only have about 10% or less of its load bearing capacity.





Seven 210 kg LPG cylinders were located at the front of the service station retail building and a storage shipping container. The impact of intense heat from the tanker fire resulted in boiling liquid expanding vapour explosions (BLEVEs) occurring to two of the cylinders. Firefighters directed cooling streams onto the remaining cylinders, preventing further BLEVEs from occurring.

As a result of boiling liquid expanding vapour explosions (BLEVEs) of two 210 kg LPG cylinders, the cylinders became projectiles with sufficient force to breach the brick walls of the service station building. These views show where the two cylinders (**A**) came to rest after breaching the walls (**B**) and displacing brick debris 20 metres beyond the wall (**C**).

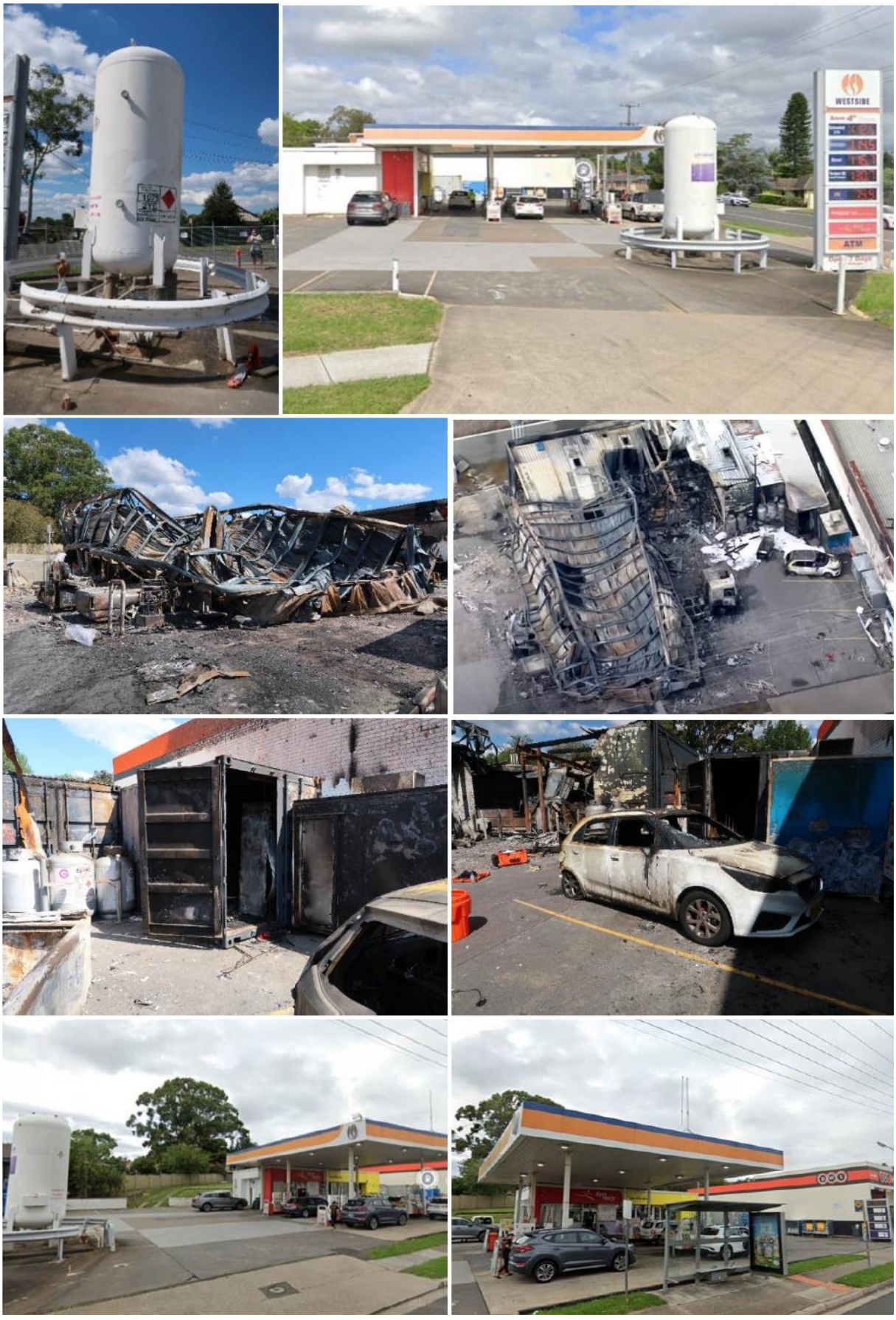


The tanker following the fire: **A** Tanker shell, **B** Tanker shell bulkhead (forward), **C** Tanker shell bulkhead (rear), **D** Internal compartment wall, **E** Pipe from compartment to outlet (x 6), **F** outlet valves fitted with standard camlocks (x 6), **G** Outlet adaptor (x 6), **H** Static lines fitted to tanker unloading hoses (x 6), **I** Underground tank fill point covers (x 6), **J** Unloading valve assembly under-tank collision protection bar, **K** hose coupling.

Most of the aluminium components melted. Steel rims are visible and only the steel belts of the tyres remain on most of the wheels of the prime mover.

Significant damage occurred to the petrol tanker, several motor vehicles, fuel pumps, the service station building and overhead steel awning due to the fire intensity.

Boiling Liquid Expanding Vapour Explosions (BLEVEs) occurred involving two 210 kg LPG cylinders located at (**A**) the front of the service station building. The force of the explosion was so powerful one cylinder demolished (B) a double brick wall before (**C**) coming to rest after breaching the wall and (**D**) scattering debris. The shockwave associated with the BLEVE of a second cylinder caused the displacement of (**E**) an ice making machine. Firefighters used distance and shielding to protect against the effects of the BLEVEs.



Top left: 8,000 litre LPG bulk storage tank. Top right and bottom row: Pre-fire images of service station, showing general arrangement of the site. Mid-upper: view post fire, indicating severity of fire intensity. Mid-lower: The site contained several shipping containers where retail products were stored. The service station attendant's car was also parked on the forecourt and destroyed by the fire.