Coroners Act, 1996
[Section 26(1)]

Western ***Australia***

RECORD OF INVESTIGATION INTO DEATH

Ref No: 33/13

I, Dominic Hugh Mulligan, Coroner, having investigated the death of ***Barkad Ahmed Muse****, with an Inquest held at Albany Coroners Court on 25 July 2013, and Perth Coroners Court on 29 July & 19 - 23 August 2013, find that the identity of the deceased person was* ***Barkad Ahmed Muse*** *and that death occurred on 20 July 2012, at 282 Middleton Road, Centennial Park, Albany, as a result of* ***Crush Asphyxiation****, in the following circumstances;*

Counsel Appearing:

Sergeant L. Housiaux assisted the Coroner
Mr J. Misso (State Solicitors Office) appeared for the Energy*Safety* Division of the Department of Commerce
Mr P. Mendelow of Counsel (instructed by K & L Gates) appeared for ATCO Gas Australia Pty Ltd
Mr D. Bourke (Clayton Utz) appeared for Stockbrands Pty Ltd

Table of Contents

Introduction 2
The History Of The Albany Gas Network 11
The Albany Lpg Distribution Network 12
The History Of The Gas Mains Near 280 Middleton Road 13
Unaccounted For Gas 17
Stockrands Bolted Compression Couplings (SBCC) 20
Testing Of The Sbcc After The Explosion At 282 Middleton Road 21
Functional Design And Installation Issues With The Sbcc 26
What Was The Design Tolerance For Misalignment Of The Two Pipes Enteringthe SBCC? 27
The Development Of The SBCC 29
The Regulatory System 44
Recommendation No. 1 49
Odorant 50
Do The Current Regulations Require Gas That Has Passed Through A Large Body Of Soil To Be Odorised So That A Person In Ms Muse Farah's Situation Would Be Forewarned Of The Presence Of A Large Body Of Gas Pooled Beneath Her? 53
Recommendation No. 2 56
Recommendation No. 3 57
Summary 58

INTRODUCTION

1. Barkad Ahmed Muse (the deceased) was born in Somalia on 2 May 1994. He was born at a time when civil war was raging in his country. The war began in 1991 and cost the lives of many of its citizens.

2. The deceased lived with his mother, father, his older brother Mowlid and two younger sisters, Hawa and Bisharo.

3. The deceased's father owned a small food shop.

4. When the deceased was still a small boy his father was attacked and stabbed to death.

5. The deceased's mother eventually remarried. As is the custom in Somalia, she left her children in the care of her father, the children's grandfather. After being married for a short time the deceased's mother tried to travel to Yemen by boat. The journey is notoriously dangerous. During the course of the journey the boat on which she was a passenger capsized and it is believed the deceased's mother drowned.

6. The deceased and his siblings remained in the care of their grandfather.

7. In July 2011 a tsunami struck Somalia and some of the deceased's close family members were washed away and killed.

8. The deceased's grandfather later died and this left the deceased and his siblings without anyone to care for them.

9. Fortunately for the deceased and his brother and sisters one of their father's sisters, their aunt, Halimo Muse Farah, had moved to Australia on 23 May 2000 under a migration programme. She subsequently became an Australian Citizen.

10. Ms Muse Farah managed to locate the deceased and his siblings and she began proceedings to sponsor their move to Australia. In order for this to happen, the children were moved to Kuala Lumpur in Malaysia so that the migration process could be undertaken. It could not be undertaken in Somalia as there was no Australian Embassy in the country. The application to sponsor the deceased, his brother and sisters was initially rejected, but upon appeal their application was successful and they were allowed to travel to Australia and remain in the country indefinitely.

11. Ms Muse Farah travelled to Kuala Lumpur and escorted the deceased and his siblings back to Perth. They arrived in Perth on 14 March 2012. They then travelled to Albany

where they planned to live in a rented property located at 282 Middleton Road, Centennial Park, Albany.

Exhibit 1, Volume 5, Tab 58, Page 19

12. In the short time the deceased lived at the property he began to build a life for himself. He went to TAFE to learn English. He began to have swimming lessons. He did part-time work in local community gardens and he, together with his brother, had a community newspaper round. He enjoyed reading, studying, cooking and was described as a sensible and gentle man.

13. 20 July 2012, was a day much like any other in the deceased's house, except to the extent that the date fell within the holy period of Ramadan. This meant the deceased and his family did not eat during the hours of day light.

14. At about 7:30pm the deceased cooked a meal which he, his aunt, his brother and two sisters ate. After dinner, at about 9:50pm, three of the children, Mowlid Muse, Hawa Muse and the deceased were in an upstairs sitting room. The deceased's sister Bisharo was in a games room downstairs and the deceased's aunt, Ms Muse Farah, walked into the front lower bedroom of the property, the room she shared with the two young girls.

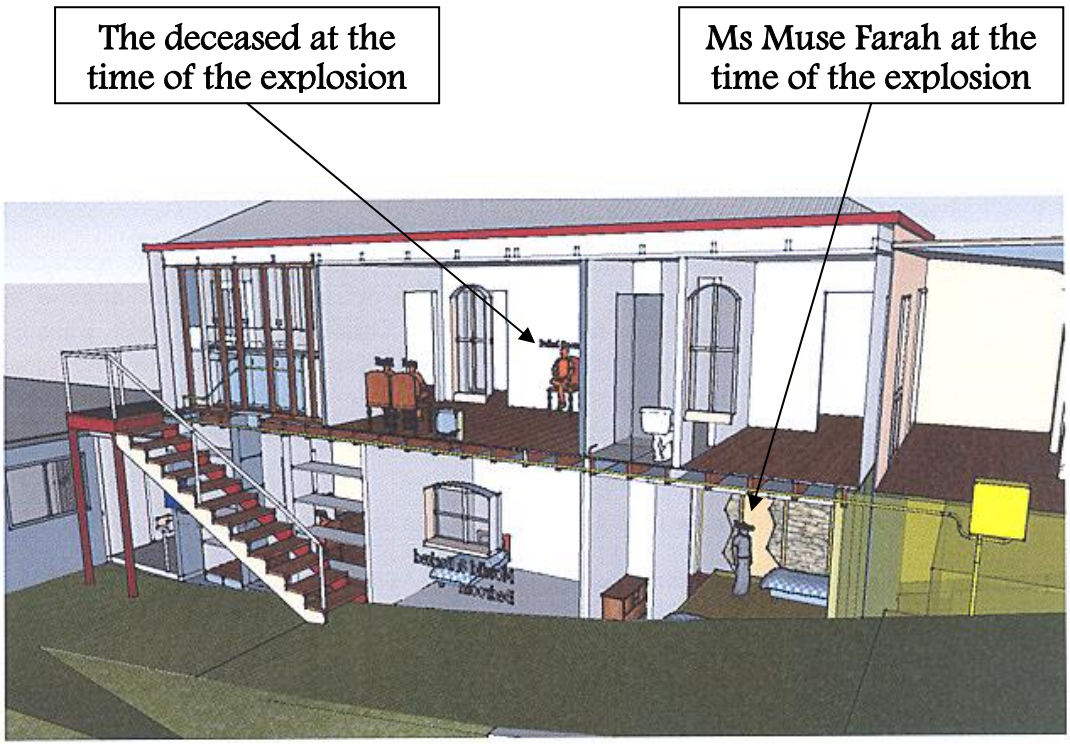


Exhibit 1, Volume 5, Tab 58, page 23

15. As Ms Muse Farah entered the room she did not smell anything unusual. In particular she did not smell any gas in the air.

16. As a matter of fact there was a significant quantity of liquefied petroleum gas (LPG) in the room. Between 1-4kg, or 0.5m^3 - 2m^3 of gas was pooled in or below the room.

17. As LPG is more dense (heavier) than air it does not rise and disperse readily, but tends to pool in the absence of air flow which would otherwise move and disperse it.

18. An unknown ignition source caused the significant quantity of LPG to explode. The explosion and subsequent fire caused extensive damage to the property.

19. Ms Muse Farah received life threatening burns to a large proportion of her body. She was subsequently taken by Royal Flying Doctors Service to Royal Perth Hospital. She was cared for in the Burns Unit where she received and continues to receive treatment for the terrible burns she received. These injuries and the scarring caused by the burns will affect the quality of her life, for the rest of her life.

20. The upstairs sitting room, in which Mowlid, Hawa and the deceased were sitting, was destroyed by the explosion. The force of the explosion threw Mowlid and Hawa out of the house and they landed in the rear yard of an adjoining property, 284 Middleton Road. They were very fortunate and received only minor physical injuries.

21. The deceased was not so fortunate. He was seated in an arm chair at the time of the explosion. Following the explosion a large part of a brick wall, which formed part of the internal chimney, fell and crushed the deceased as he sat in the chair.

Exhibit 1, Volume 2, Tab 46, Photo 40
The room in which the deceased died

22. Rescuers could not initially get to the deceased's location because of the precarious condition of the house after the explosion.

23. By the time rescuers were able to reach the deceased he had died.

24. On 23 July 2012, a post mortem examination was performed on the deceased by the Chief Forensic

Pathologist, Dr Clive Cooke, who after receiving the results of further investigations on 26 October 2012, formed the opinion that the cause of death was crush asphyxiation.

25. The gas which pooled under the bedroom Ms Muse Farah shared with her two nieces came from a gas main located about 15 metres away. At that location the 155mm gas main which ran along the southern verge of Middleton Road connected with an 80mm gas main which ran at 90° to the Middleton Road main, and travelled down Douglas Street.

26. The gas leak came from a device known as a Stockbrands Compression Coupling (SBCC), a device used to connect two pieces of the 80mm uPVC gas mains that ran from Middleton Road down Douglas Street. The leak occurred very close to the 155mm main that ran along Middleton Road.

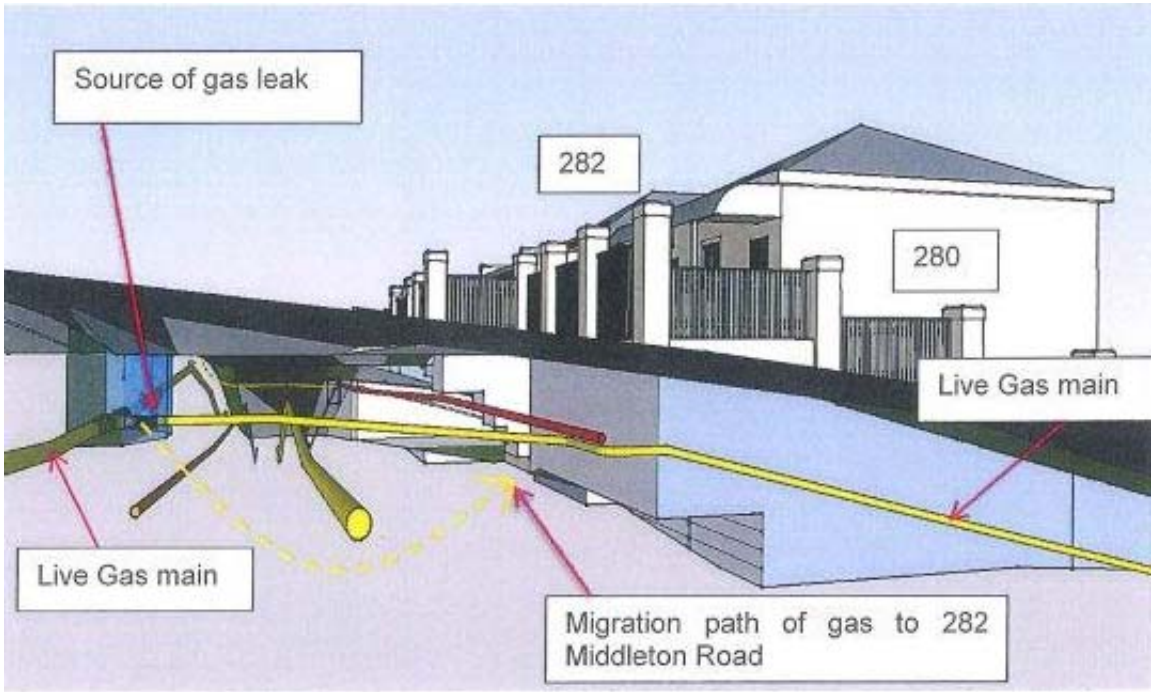


Exhibit 1, Volume 2, Tab 55, Page 15

27. Near the connection of the 80mm gas main to the 155mm gas main which ran along Middleton Road a device known as a Stockbrands bolted compression coupling (SBCC), was installed. This was likely installed in about November 1993.

28. The coupling was located in front of 280 Middleton Road about 15m from Ms Muse Farah's bedroom. The SBCC was located approximately 3.54m above the floor void beneath Ms Muse Farah's bedroom.

29. For reasons I will touch upon later in this finding the regulator, the Department of Commerce, Energy*Safety* Division (Energy*Safety*) considers the SBCC fitting unfit for purpose.

30. Energy*Safety* believed when the SBCC was first installed in front of 280 Middleton Road it was not tightened to an adequate degree (insufficient torque was applied) and that due to a combination of other circumstances a leak developed sometime after 11 February 2012 when two ATCO employees repaired a minor gas leak near to the location of the SBCC. The disturbance of the soil around the SBCC is likely to have lead to some movement of the 80mm gas main after the repair works were complete and lead to some movement of the SBCC which caused an increase in a misalignment of the SBCC and which lead to an escape of gas from the SBCC at an estimated rate of approximately 2.5m^3 per hour.

31. The topography of the land and the density of liquefied petroleum gas meant the LPG migrated through the soil towards the basement of the properties located at 280 & 282 Middleton Road, where it pooled.

32. The property located at 280 Middleton Road had a vapour barrier which prohibited the entry of the LPG into the property.

33. The house at 282 Middleton Road did not have a vapour barrier.

34. The lack of the vapour barrier allowed gas to enter through the walls and/or enter from beneath the timber floor boards of Ms Muse Farah and pool at, or near, floor level in the room.

35. The gas accumulated within the room due to the low rate of air exchange within the room. Eventually the volume of gas exceeded the lower explosive limit for LPG and the mixture of gas in air, when ignited, caused a non-seated explosion and deflagration.

36. The source of the ignition has not been positively determined but it could have been related to a heater within the room (which was not turned on) or to a power socket.

THE HISTORY OF THE ALBANY GAS NETWORK

37. The network was established in 1981 by the Colonial Gas Association of Victoria.

38. It was bought in 1951 by the State Energy Commission of Western Australia (SECWA).

39. It was converted to supply tempered liquefied petrol gas in 1969.

40. In 1995 Alinta Gas and Western Power came into existence as the successors of SECWA.

41. In 1999 The Albany network was converted to carry liquefied petroleum gas (LPG) by Alinta Gas.

42. In 2000 Alinta Gas was sold by the WA Government to private shareholders/owners.

43. A variety of private owners have been responsible for maintaining the Albany network since 2000 including Alinta Gas (private) Alinta Asset Management, Alinta Network Services, WestNet Energy and WA Gas Networks.

44. It is currently owned by ATCO Gas Australia (ATCO).

45. ATCO[1] acquired the WA Gas Distribution Network in July 2011.

46. There has been a significant increase in the number of people connected to the Albany network. In 1999 the Network supplied approximately 3000 consumers. The Network currently supplies approximately 7000 customers.

THE ALBANY LPG DISTRIBUTION NETWORK

47. The Albany region is supplied with LPG via the Albany distribution network, fed by the Albany LPG storage facility which currently has six active and two inactive, 45kL LPG storage tanks.

48. The Albany distribution network feeds the Albany area via a pressure reduction station operating at a set point of 8kPa through approximately 159km of mains, ranging in size from 40-200mm diameter of predominately unplasticised polyvinyl chloride (uPVC) construction, with some galvanised iron, steel and medium density polyethylene.

49. The Albany distribution network[2] is a stand-alone network which commences at the Albany LPG storage facility. LPG is supplied to the Albany community LPG storage facility via

[1] Exhibit 11, Page 2
[2] Volume 8, Tab 67, Page 34, Section 2.1.2

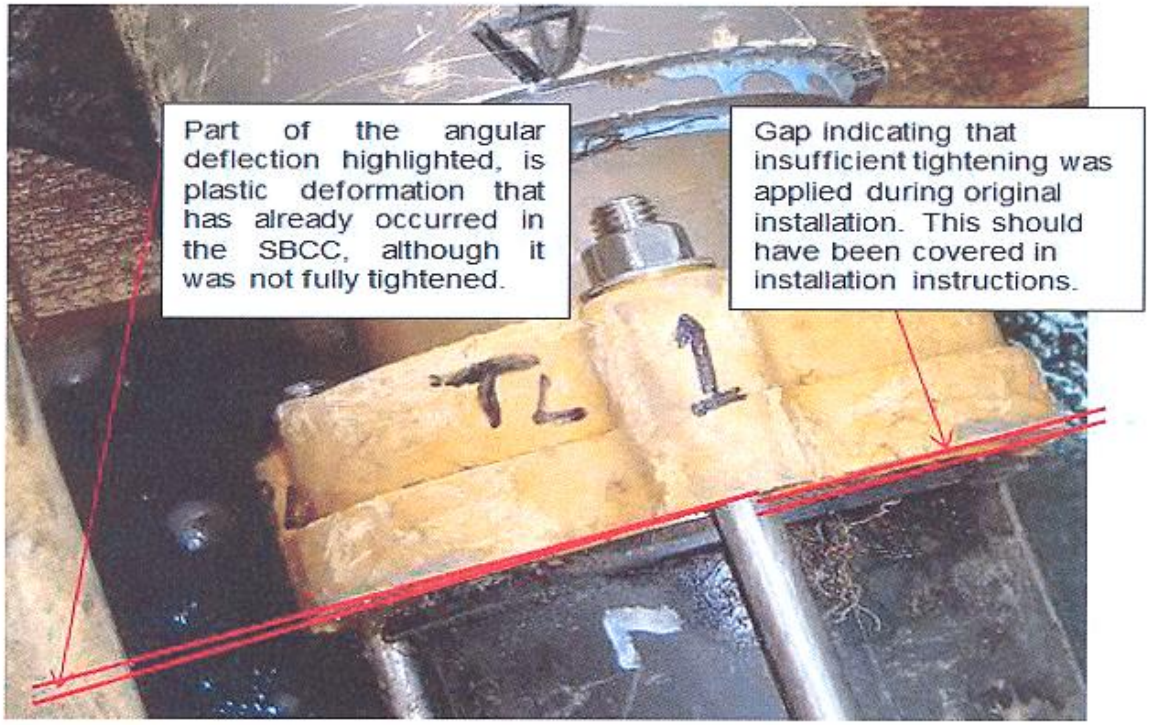
road tanker. The LPG used in Albany emanates from the metropolitan area.

THE HISTORY OF THE GAS MAINS NEAR 280 MIDDLETON ROAD

50. In about February 1991 a 155mm uPVC gas main was laid along Middleton Road. This included the section in front of 280 and 282 Middleton Road.

51. In about November 1993 an 80mm uPVC gas main was connected to the 155mm gas main in front of 280 Middleton Road. The 80mm uPVC gas main ran from outside 280 Middleton Road and down Douglas Street. Near to the connection of the 80mm gas main to the 155mm gas main a 80mm SBCC was used to connect to 80mm uPVC gas pipes. This SBCC was likely installed in November 1993 when the 80mm gas mains were installed.

52. When the SBCC was first installed in front of 282 Middleton Road it was not tightened to an adequate degree (insufficient torque was applied). The fact the SBCC was not adequately tightened allowed a misalignment of the two pipes entering the SBCC to occur with a total misalignment of approximately 6.4°.



Photograph No 15

Exhibit1, Volume 5, Tab 58, Page 36

53. The SBCC remained undisturbed and apparently leak free until sometime after leaks were repaired near to the SBCC in February 2012.

54. On 13 September 2011 a gas leak was detected near the gas main above 280 Middleton Road.[3]

[3] Exhibit 1, Volume 2, Tab 55, Page 15

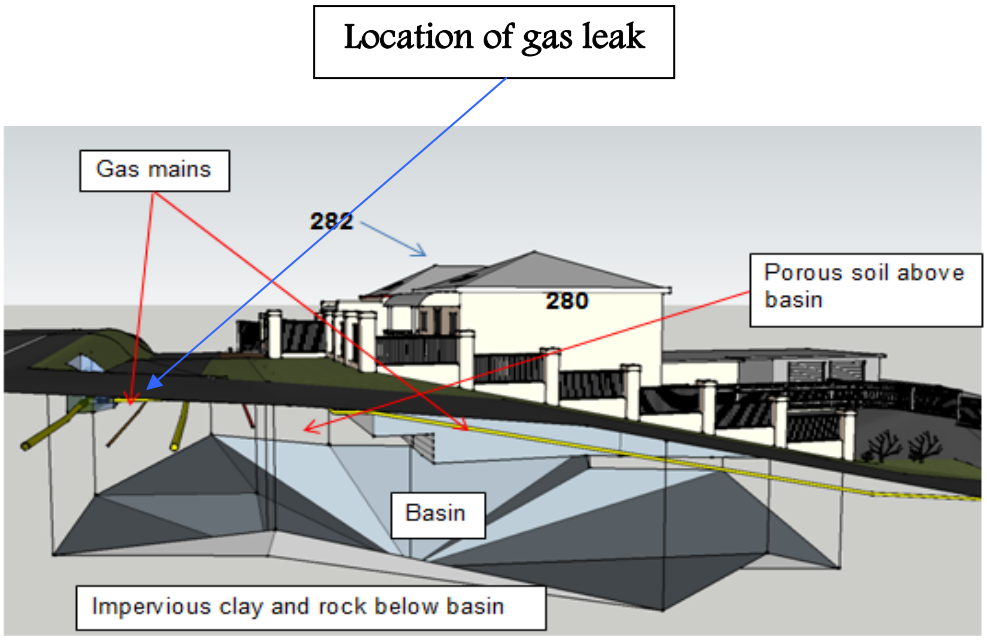


Exhibit 1, Volume 2, Tab 55, Page 14

55. On 11 February 2012 a leak repair team employed by ATCO were dispatched to the area and asked to identify and repair the gas leak.

56. The two distribution officers sent to undertake the repair were Mr Kevin Jones and Mr Darren Bevington. Both men were very experienced and capable workers. They had significant experience in the field. They both began their careers in the UK before coming to Western Australia, where they worked for previous network owners and ATCO.

57. The two gas distribution officers went to the location of the 155mm gas main in front of 280 Middleton Road. They then took readings in the area to confirm the presence of gas and the general location of the suspected leak.

58. Having determined the general area of the leak they excavated the area and exposed the pipe work. In exposing the pipe work they exposed not only a large portion of the 155mm gas main, but also a small portion, including the SBCC, of the 80mm gas main.

59. After identifying the area of the leak Mr Jones and Mr Bevington found the leaks on the mains by using a soap test. This test involved brushing a soapy liquid over the surface of the pipe work. In the event of a leak bubbles form in the soapy liquid.

60. The two men located leaks on the 155mm gas main in the area where two tapping bands were located. Tapping bands are a mechanical device used to seal the site of earlier work on the main.

61. The 80mm SBCC was also examined and soap tested. Nothing untoward was detected in this process. Neither man noted the SBCC to be misaligned. This is not surprising as the SBCC showed no evidence that it was leaking and the degree of misalignment though significant in terms of the potential to cause a leak, was visually very difficult to detect.

62. In examining the SBCC the gas distribution officers necessarily were required to dig around and beneath the SBCC, so that they could properly examine and test all of it.

63. After completing the repair to the two leaks Mr Bevington and Mr Jones replaced the soil and returned the site, as close as possible, to its original state. As they replaced the soil into the trench the two men were careful to compact the soil so as to minimise the potential for any pipe movement.

64. It should be noted that Mr Bevington and Mr Jones undertook their work in accordance with their normal practise and in accordance with the training provided by ATCO.

65. At some stage after Mr Bevington and Mr Jones completed their work the SBCC moved a small amount which caused the 6.4° misalignment within the SBCC to grow. As a consequence of that growth in the misalignment a leak developed.

66. The leak likely allowed approximately 2.5m³ of gas per hour to escape from the network.

67. The leaking gas then migrated downwards, through the soil and pooled beneath 280 and 282 Middleton Road.

UNACCOUNTED FOR GAS

68. Gas networks are inherently susceptible to the problem of lost gas. Unaccounted for Gas (UAFG) is the difference between the sums of the metered LPG inputs into the

network and all metered LPG outputs from the network over a period of time.

69. There can be a number of reasons why gas can be lost. These factors can include;

    i. The type of gas involved (i.e. LPG verses natural gas)
    ii. Metering errors of input and output meters
    iii. Incorrectly sized meters
    iv. Gas quality in measurement errors
    v. Small loads being undetectable at individual outlet meters but summed up they are detectable at the input meters
    vi. Numerous small leaks
    vii. Gas lost during normal commissioning (controlled air/gas purging) operations
    viii. Gas lost from gas pipe breaks as a result of third party damage
    ix. Or, as in this case, from long standing and sizable gas leaks.

70. In 2007/2008 approximately 25% of the gas injected into the Albany Gas Network was lost as unaccounted for gas.

71. By any standard a loss of 25% of the LPG injected into the network is a very significant loss.

72. ATCO, the current owner of the Gas Network, have taken significant steps to decrease the amount of gas lost in its network. By the end of March 2013 the UAFG figure had fallen below 11.5% and its expectation was that by June 2013 the figure would have fallen to around 9% UAFG.[4]

[4] Exhibit 11, Page 6

73. A number of surveys have been undertaken in the recent past in order to identify and repair leaks in the gas network.

74. In 2008-2009 a survey revealed 761 leaks, which were then repaired. Of those, 38 leaks related to compression couplings (equating to approximately 5% of the total number of leaks).

75. A further survey was completed in December 2011 and it detected 674 leaks. Of those, approximately 30 leaks related to bolted compression couplings (again approximately 5% of the total number of leaks).

76. According to Mr Dean Solmundson, the Senior Manager, Engineering and Compliance who gave evidence during the course of the inquest, the number of leaks ATCO found on the Albany network in 2011 was very high compared to ATCO's natural gas network for Perth.[5]

77. After the death of the deceased, ATCO undertook a survey of locations where it was believed bolted compression couplings had been installed. The survey identified 640 possible locations where compression couplings had been used.

[5] Exhibit 11, Paragraph 50

78. ATCO found leaks at 122 of the 640 potential compression coupling locations, of which 16 were Stockbrands compression couplings.

79. ATCO expects to have completed the repair and replacement of these locations by December 2013. ATCO then intends to replace all of the locatable SBCCs on its Albany Gas Network. It expects to have completed this work by December 2015.[6]

STOCKRANDS BOLTED COMPRESSION COUPLINGS (SBCC)

80. A compression coupling is a device used to join two separate pieces of uPVC pipe which comprise a gas main. A variety of bolted compression couplings are manufactured and used throughout Australia.

81. One brand of compression coupling is manufactured by a company known as Stockbrands.

82. The coupling has three components;

    1) A black plastic central sleeve into which each end of two pipes are inserted, so that a join can be made between them. The sleeve has small protrusions near each end of the sleeve which are intended to abut the yellow collars when the device is in place and are properly tightened.

[6] Exhibit 11, Paragraph 107

2) Two yellow plastic collars which sit at either end of the black central sleeve. The collars each contain a plastic O-ring which when placed under tension creates a gas tight seal intended to prevent gas leaking from the tightened compression coupling.

3) Three sets of bolts, washers and nuts which pass through each yellow collar and are tightened to create a gas tight fit so that the compression coupling effectively joins the two ends of the separate pipes in a gas tight manner.

83. To be correctly fitted and in order to work effectively the yellow collars must be tightened so that they come into contact with the protrusions at either end of the black central sleeve.

TESTING OF THE SBCC AFTER THE EXPLOSION AT 282 MIDDLETON ROAD

84. Following the explosion at 282 Middleton Road, the Police, Energy*Safety* and ATCO began investigations in order to try and determine what had led to the explosion.

85. In order to facilitate an adequate examination of the SBCC, it, together with a portion of the 155mm mains was removed from the ground above 280 Middleton Road.

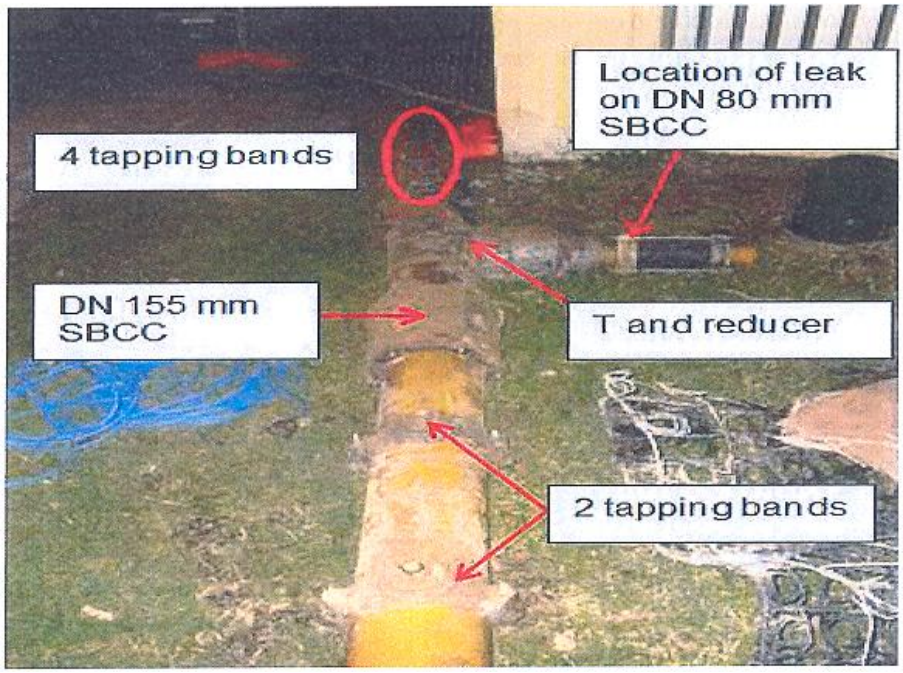


Exhibit 1, Volume 5, Tab 58 Page 31

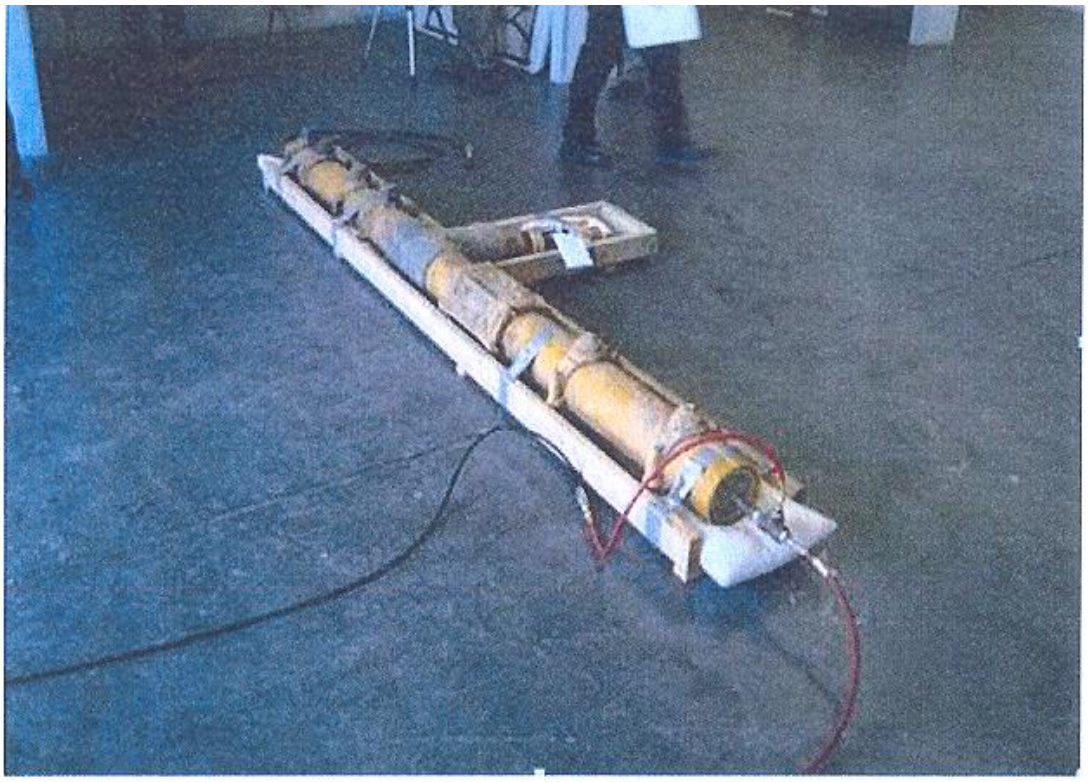


Exhibit 1, Volume 5, Tab 58, Page 35

86. The portion of the mains was taken to ATCO's Jandakot Depot where it was subjected to a number of tests. The first test sort to determine the flow rate of gas leaking from the

SBCC when it was in situ at 280 Middleton Road prior to the explosion.

87. In order to determine the rate of leakage the pipe work was pressurised and the SBCC placed under pressure to cause a deflection which allowed the SBCC to leak from the point where the leak occurred during the time it was under the ground at 280 Middleton Road.

88. Mr Carl Diamel and Mr Peter Farrell, who had heard the sound of the leak whilst the pipe was being unearthed at Middleton Road compared the sound of the leaking gas to that which was being replicated at the ATCO Jandakot Depot. Their shared view that the sound they heard on Middleton Road equated to a flow rate of approximately 2.5m^3 per hour.

89. Further analysis of the SBCC conducted at ATCO's facility on 28 August 2012, showed a degree of discolouration of the pipe beneath the collar which had been leaking. The discolouration showed that the pipe was originally installed with a measured misalignment of approximately 6°.

90. On 16 October 2012, a further analysis was undertaken on the two pipes which had been secured within the SBCC which had leaked and caused the explosion at 282 Middleton Road.

91. They were examined by Mr Dean Solmundson (of ATCO) and Mr Cornelis de Groot, the Principal Engineer, Gas Supply at Energy*Safety*. They found typical light and dark staining present on the uPVC gas pipe sections along well defined circumferential lines indicating which areas had been exposed to clean gas environment inside the uPVC gas pipe compared to a dirty soil environment on the outside of the coupling. The contact angles between these pipe ends and the subject coupling were calculated from length measurements made using a simple white paper wrap around the pipe as a perpendicular reference line from the lowest edge of the colour line and the measuring offset lengths to the highest edge of the colour line on the opposite side of the pipe.[7]

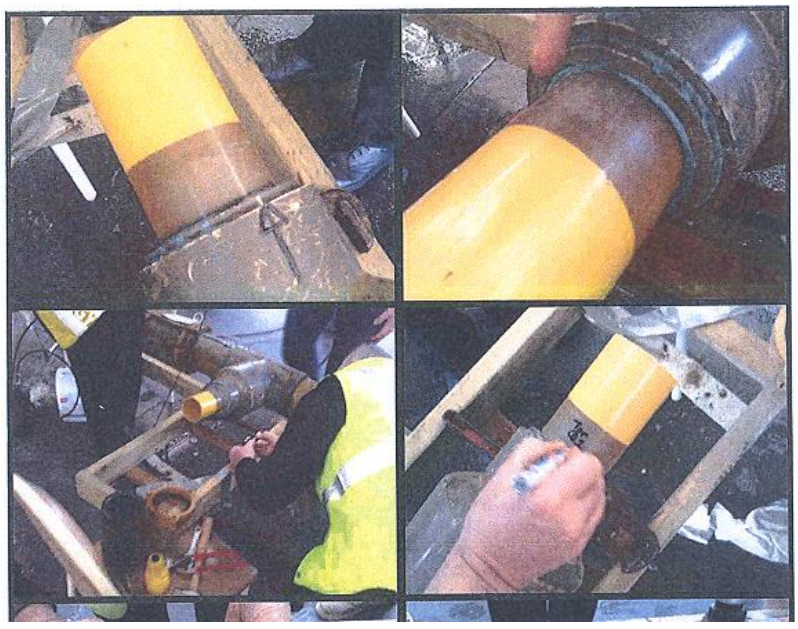


Exhibit 1, Volume 5, Tab 58, Attachment 3c, Page 19

[7] Exhibit 1, Volume 5, Tab 58, Attachment 3c, Page 19

92. The results of the measurement were as follows;[8]

	DN80MM PIPE1	DN80MM PIPE2
Outside Diameter of pipe (equivalent to Adjacent triangles side of Tangent cals)	**89.1mm**	**89.1**
Measured maximum length off perpendicular along pipe (equivalent to Opposite triangle side for Tangent calc)	**~5mm**	**~5mm**
Angle = ((TAN^{-1}) (OPPOSITE/ADJACENT))	**~3.2 degrees**	**~ 3.2 degrees**
Total angle across pipes	**~ 6.4 degrees**	

93. The measurements found that both pipes were off square by approximately 3.2° each with a total angle of misalignment across both pipes of approximately 6.4°.

94. Subsequent testing of other used bolted compression couplings removed from various locations on the ATCO Gas Australia Network, along with some new couplings, was completed on 6 February 2013 by ATCO Gas Australia and Energy*Safety*.

95. A 100mm SBCC with older type O-ring seals (very similar to the 80mm SBCC which leaked outside 280 Middleton Road) was physically manipulated. It did not leak at a total (two pipe) offset angle of approximately 6° but did leak at a rate of approximately 10m^3/hr when further pushed to approximately 7°. Approximately 90kg (body weight) was necessary to force the coupling to the maximum 7° misalignment.

[8] Exhibit 1, Volume 5, Tab 54, Page 8

96. This experiment indicated that forcing this type of Stockbrands O-ring seal coupling past specific angular limits increases the potential for leaks.

97. This test confirmed the results of earlier analysis which showed the SBCC's potential to leak if the angle of misalignment exceeded 6.4°.[9]

FUNCTIONAL DESIGN AND INSTALLATION ISSUES WITH THE SBCC

98. Following the death of the deceased Energy*Safety* considered the design and installation issues associated with the SBCC. They found that in order to prevent misalignment of pipes, the SBCC must be tightened sufficiently so that the yellow collars met the protrusion on the black sleeve.

99. However, full tightening of the coupling caused permanent and severe deformation of the yellow plastic collars on the coupling.[10]

100. In the absence of specific installation instructions this phenomenon may have caused an installer to cease tightening of the SBCC before it was fully tightened.

[9] Exhibit 1, Volume 5, Tab 54, Attachment 3c Pages 7-8
[10] Exhibit 4

101. In the event the SBCC was not adequately tightened, then it would be prone to misalignment and prone to potentially leaking if the degree of misalignment was more than 6.4°.

WHAT WAS THE DESIGN TOLERANCE FOR MISALIGNMENT OF THE TWO PIPES ENTERINGTHE SBCC?

102. Owners of the Albany Gas Network (and other network owners) need to know and understand the design parameters, design tolerances and the proper methods of using important components which comprise their mains system.

103. Distribution officers tasked with fitting or replacing important components like 80 mm SBCCs need to be informed of the proper method for installing the component, the appropriate torque level to be applied to the nuts and bolts securing the two yellow collars to the sleeve and the degree of misalignment which is permissible when installing and SBCC.

104. In the event network owners and their distribution officers have the relevant information relating to the appropriate use of an important item like an SBCC, they are enabled to correctly use the device and minimise safety risks to themselves and the public. Additionally the correct use of items like the SBCC will likely reduce the incidence of lost or unaccounted for gas.

105. In this case it has not proved possible to obtain a complete picture relating to the design parameters, design tolerances and proper method of employing the SBCC.

106. During the course of the inquest Stockbrands were asked[11] '*what tolerances were permissible in terms of the misalignment of the two uPVC pipes it was connecting? 0°? 6°? Some other tolerance?*'.

107. Stockbrands answered the query in two parts.

108. The company firstly replied in the following terms[12];

> Deflection and Misalignment
>
> The terms 'deflection' and 'misalignment' mean two different things.
>
> Misalignment means the pipe is not entering the fitting/socket parallel.
>
> A pipe may be 'deflected' to enable to deviate around a corner or object. For example, the water industry commonly use unplasticised polyvinyl chloride (or uPVC pipes) and that tolerates little bending over a 6m length of rubber joint ring pipe. Therefore, socket joint fittings are manufactured to suite this requirement: e.g; pre-tap connectors in the water industry have a three degree deflection at each end allowing a maximum of 6° deflection between two pieces of pipe.
>
> The SBCC does not *facilitate* deflection but it can *tolerate* it.
>
> Some compression couplings are specifically designed to facilitate deflection.

[11] Exhibit 1, Volume 8, Tab 64, Page 4 & 2
[12] Exhibit 1, Volume 8, Tab 64, Page 2

109. The second part of the Stockbrands answer was[13]:

> The SBCC was not designed to have misalignment.
>
> Instructions (see page) show that both pipe ends were required to be aligned and locator marks to be made prior to installation. However we understand that subsequent testing by ATCO and Energy*Safety* has shown SBCC tolerated a misalignment of up to 6.4°.

110. It has not been possible to source any documents from SECWA which speak to its understanding of the design parameters of the SBCC and its ability to tolerate this alignment of the two pipes being connected by the compression coupling.

111. It appears unlikely that any testing carried out on the SBCC at the time of its manufacture established a safe degree of misalignment permissible when installing an SBCC.

THE DEVELOPMENT OF THE SBCC

112. It has not been easy to determine how the SBCC came into existence.

113. The manufacturer of the SBCC (Stockbrands) no longer has records for the relevant period (1990) in which the SBCC came into existence.

[13] Exhibit 1, Volume 8, Tab 64, Page 5

114. However it appears the SBCC was designed by SECWA and then built to that design by Stockbrands. In this regard Mr Cornelis de Groot, the Principal Engineer, Gas Supply at Energy*Safety* gave evidence to the following effect:[14]

> **Mr Bourke:** and you no doubt agree with a statement which was made in a letter from the State Solicitors Office to the Coroners Court That in fact Energy*Safety* inspectors believe that the gas branch of SECWA was responsible for the functional design and I think you've just used those words, of the SBCC, i.e. issues such as material selection, seal arrangement, strength and installation, and that Stockbrands attended to the manufacturing aspect of the design such as die material, die strength, die accuracies and injection location?
>
> **Mr de Groot:** Yes, that's absolutely correct. I stand by that, thank you.

115. Similarly, the government organisation which commissioned the SBCC, the State Energy Commission of Western Australia (SECWA) is no longer in existence and its records relating to the design and testing of the SBCC have been lost.

116. ATCO helpfully searched records available to them and they were able to locate some documents which helped to understand how the SBCC came into development.

117. It appears most likely that SECWA approached Stockbrands in 1990 and asked Stockbrands to design a compression coupling based on a rival design known as a Gatic Milne coupling. The Gatic Milne coupling was

[14] Transcript Page 597

manufactured using non corrosion protected cast iron or steel alloys. These alloy couplings tended to deteriorate at a rapid rate. For reasons of economy, the desire to buy a local product and the ability to influence the design of the SBCC, SECWA sought to have the product made by a local company, Stockbrands Pty Ltd.

118. By 16 November 1990, a prototype of the SBCC 80 mm uPVC mechanical pipe coupling had been developed and tested by SECWA. By letter dated 16 November 1990, SECWA wrote to Stockbrands and said;

> After testing the latest prototype of the above coupling, I confirm that they are acceptable by SECWA for use on the gas distribution system, subject to the following;
>
> - A detailed engineering drawing of the coupling, in the format that will be supplied to SECWA, is to be provided for our records.
> - A test certificate is provided, indicating the testing carried out on the coupling and the results.
> - A stainless steel washer be provided with each nut.
> - Consideration be given to modifying the design from a 3-4 stud bolt coupling.
> - Assembly instructions accompany each coupling.

119. It has not proved possible to discover a number of the documents referred to in the letter of 16 November 1990. The original drawings have not been located. The test certificate, indicating the tests carried out on the coupling and the results, has likewise not been discovered.

120. By 4 September 1991 the SBCC was in production and was being held by SECWA for use on its networks.

121. By letter dated 4 September 1991 (Volume 7, Tab 62, Sub Tab 9) SECWA wrote to Stockbrands requiring the company to provide an instruction sheet detailing the assembly procedure with each coupling. The SECWA advised that;

> If this request is not acted upon before 1 October 1991, I will have no alternative but to instruct the Stores QA Section to reject all couplings which fail to display assembly instructions.

122. On 1 July 1992[15], Stockbrands provided SECWA with details confirming the O-ring used on the SBCC to be made as a rubber compound as a high grade, 100% Nitrile Rubber based material.

123. Also in 1992 a formal drawing came into existence relating to the SBCC 80 mm coupling.

[15] Exhibit 1, Volume 7, Tab 62, Sub Tab 5

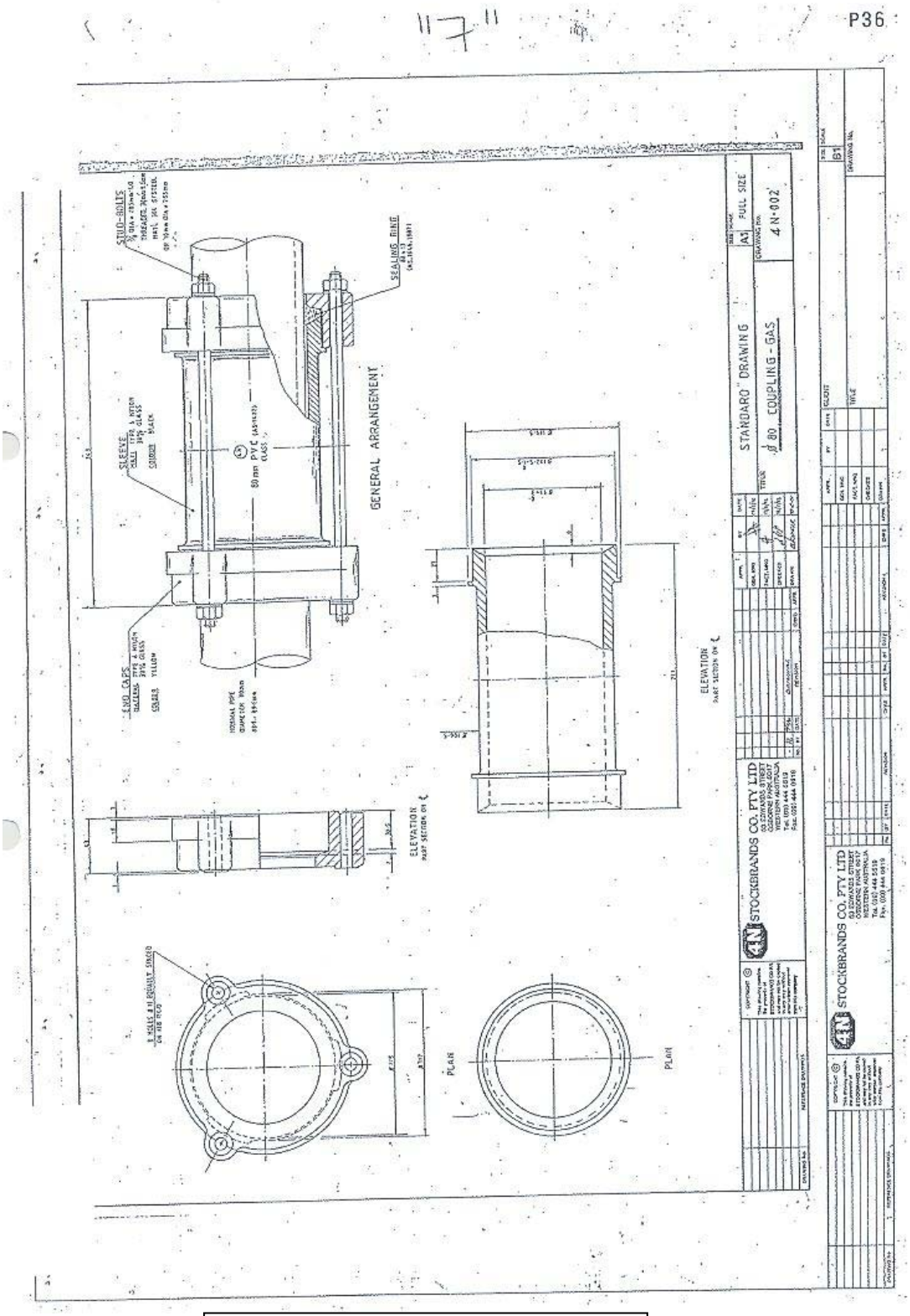


Exhibit 1, Volume 8, Tab 64, Sub Tab 7

124. In 1995 Alinta Gas published a document entitled "*Technical Specification for Compression Fittings*"[16] this

[16] Exhibit 1, Volume 7, Tab 62, Sub Tab 2

document states that '*this technical specification details supply and delivery of compression fittings for use by Alinta Gas*'. Under Section E4.1 of the document which relates to compression couplings of 80mm-200mm in diameter, the document provides;

> This section states the requirements for compression couplings which are used to join PVC to PVC, and PVC to cast iron gas pipes.
>
> E4.1.12 the internal diameter of the coupling shall be sized so that it permits a maximum deflection of 4° between the joined pipes.

125. The document is silent as to whether, or to what degree, misalignment of the pipes within the SBCC was permissible.

126. In or around 2002 the seal design was modified to accommodate a new seal. This was done to eliminate the need to roll the round seals into position which sometimes resulted in twisting of the seals, which affected their effectiveness.

127. Between 1991 and 2002 SBCC were supplied to SECWA and Alinta Gas in packages which contained four or five SBCCs. They were packed in white hessian bags and contained written instructions relating to the proper installation. [17]

[17] Exhibit 1, Volume 8, Tab 64, Sub Tab 14

STOCKBRANDS CO PTY LTD

PROUD TO BE AUSTRALIAN

ABN 27 008 715 044

Installation of Gas Coupling

Step 1 Clean the pipe surface, making it as clean and free of soil, mud and scale as possible in order to enable the coupling "O" rings to successfully seal against the pipe surface. Align the pipes to be joined, hold the coupling centrally across the aligned pipes and draw left and right coupling end locator marks on the pipe.

Step 2 Loosen the nuts sufficiently to the point where the coupling components are all slack and unrestricted. There is generally no need to dismantle the coupling prior to installation. If the "O" Rings appear dry and or adhere to the end flanges or barrel, lubricate all surfaces of the "O" Rings with the approved lubricant as required.

Step 3 Slide the loosely assembled coupling all the way up one of the pipes, bring the other pipe into place. Ensure that both pipe ends are aligned, slide the coupling down over the second pipe to a central position by matching the coupling ends to the locator marks on each pipe.

IMPORTANT: BOLTS MUST BE TIGHTENED ALTERNATELY AND GRADUALLY SO THAT THE FLANGES ARE PULLED DOWN EVENLY – DO NOT OVER TIGHTEN. (10-15ILBS TORQUE)

4N

53 EDWARD STREET
OSBORNE PARK
W.A. 6017

ALL CORRESPONDENCE TO:
P.O. BOX 80
MT HAWTHORN
WESTERN AUSTRALIA 6915

TELEPHONE: 61 8 9444 5519
FACSIMILE: 61 8 9444 0619

Exhibit 1, Volume 8, Tab 64, Sub Tab 14

128. Each SBCC bore a sticker on the sleeve which provided;

> **IMPORTANT** BOLTS MUST BE TIGHTENED ALTERNITIVELY AND GRADUALLY SO THAT FLANGES ARE PULLED DOWN EVENLY – DO NOT OVER TIGHTEN (10-15ft lbs).

129. The installation instructions sheets were placed inside couplings between 1991 and 2004. After that time that practise stopped. This change coincided with the departure of the employee who had been responsible for placing the instruction sheets inside the SBCCs.

130. In or around 2007 the 304 stainless steel hex nuts were changed to a 316 stainless steel hex nut coated with a grey molly bond compound. 316 is a better grade of stainless steel. This was introduced to reduce galling of the threads. Galling is a form of wear caused by an adhesion between sliding surfaces.[18]

131. The nuts were also different to those earlier used in that they were lubricated, whereas the earlier nuts were unlubricated.

132. The difference between using lubricated and unlubricated nuts to tighten the SBCC at first instance appears innocuous and irrelevant to the safe running of the Albany Gas Network.

[18] Exhibit 1, Volume 8, Tab 64

133. In fact the change to lubricated nuts was significant and it demonstrates the need to test the design after changes are made to it in order to ensure that the design remains safe and any necessary operational changes are well understood. This is the case even if the changes seem unlikely to impact upon the safe and proper use of the part in question.

134. In this case the fact the nuts were lubricated meant that the tension transferred to the collars of the SBCC when the bolts were being tightened increased significantly.

135. According to Mr de Groot:[19]

> the original torque value would not break the collar but (if) you introduce lubrication and the torque is now converted to twice the stretch, for want of an (*a better*) word, twice the tension on those lugs, so by lubricating the threads you will be able to have more physical pull in the thread and connection and therefore applying a lot more load in the collar… There's a film of lubrication (*on the nuts*) and that reduces the friction and as the friction is reduced more of the torque is converted into tension rather than off-coming (*overcoming*) friction.

136. If a distribution officer tightened an SBCC with lubricated bolts in accordance with the directions contained on the sticker attached to the SBCC, that is to '*10 – 15 ft-lbs*' the collar would be expected to fracture and fail.

[19] Transcript Page 575

137. This is a phenomenon officers from Energy*Safety* encountered during testing of a number of SBCCs prior to Mr de Groot giving evidence.

138. This phenomenon of lubricated nuts delivering too much tension to the collars of the SBCC was demonstrated in court. During the course of the inquest and SBCC was tightened to 10 ft-lbs. After being allowed to rest for a short period one of the collars, which had already been visibly deformed and discoloured broke.

139. In my opinion the original design of the SBCC and the subsequent change of the designed to allow for lubricated nuts demonstrate an absence of adequate consideration and testing in order to determine how the SBCC would perform and the appropriate limits and tolerances the SBCC could operate within before the part either failed completely or allowed LPG to leak from the mains.

140. The SBCC was designed by SECWA at a time when there was no independent regulator. SECWA acted as its own regulator.

141. It seems entirely unsatisfactory that they did not establish the tolerances in which the SBCC could be expected to safely operate and in particular did not determine, and adequately record, the degree of misalignment the SBCC

could tolerate before it would be expected that LPG leaks would develop.

Exhibit 5 – SBBC 80mm coupling with a piece of 80mm uPVC pipe

142. As can be seen from the photograph above the SBCC bares an inscription 'AS1477' which implies the SBCC complies with the stated Australian/New Zealand standard which is now properly described as AS/NZS 1477.

143. The SBCC does not comply with that standard.

144. After careful analysis Energy*Safety* found that for eight different reasons[20] the SBCC does not currently comply with AS/NZS 1477, nor has it ever complied with any previous version of AS/NZS 1477. Those reasons include the fact that the SBCC was made from different materials to that required under AS/NZS 1477. In this regard AS/NZS 1477 refers to fittings that are made from PVC. The standard states;

> This standard specifies requirements for PVC pipes and fittings for pressure applications for use below ground or above ground, where they are not exposed to direct sunlight.

145. Section 2.2 entitled "*Composition*" then reads;

> The material from which the pipes and fittings are produced shall consist of polyvinyl chloride (PVC) together with additives necessary for the manufacture and performance requirements of the standard.

146. The SBCCs do not have any PVC components incorporated in them and instead consist of two collars and a housing sleeve that are made from injected reinforced nylon (CAPRON 8267 G-HS).

147. Other reasons why the SBCC does not and did not comply with AS/NZS 1477 include:

[20] Exhibit 4

i. AS/NZS 1477 is predominately concerned with pipes and fittings that rely on solvent cement for securing and joining.

Both the dimensions of the SBCC's sleeve and the materials used in the SBCC's prevent this pipe jointing technique.

ii. AS/NZS 1477 allows for the use of a rubber O-ring sealed joint that is applied for water pipes and not for gas pipes in Australia. These O-rings are not squashed by collars that are brought together by stainless steel rods but instead reside in a groove that nestles the O-ring in the female spigot of a pipe end so made.

148. Energy*Safety* consider that as there was no compliance in critical areas with AS/NZS the standard is not applicable to the SBCC.

149. Energy*Safety* believe that as[21] '*this fitting does not comply with the standard any such marking is not appropriate'*.

150. It appears clear the SBCC bore an inscription which suggested compliance with AS/NZS 1477. The SBCC plainly did not meet this standard both because of the

[21] Exhibit 4 Page 3

manner of its construction and because of the material used to manufacture the SBCC.

151. It is unclear why the SBCC was designed by SECWA to incorporate reference to AS/NZS 1477 in circumstances where it plainly had no application.[22]

152. The fact that the SBCC bore the inscribed assertion that it complied with AS/NZS 1477 may have given operators of the Albany Gas Network a false sense of security and belief that the coupling had been properly designed, tested and was constructed in accordance with an appropriate Australian/New Zealand standard.

153. As I understand the position SBCCs of the vintage of that which failed outside 280 Middleton Road were considered by Energy*Safety* to be unfit for purpose and were subject to the following faults/limitations:[23]

    i. they bore an assertion that they complied with AS/NZS 1477, when this was not the case.
    ii. the clearance between the sleeve of the SBCC and the gas pipes which it connected was too great to afford the opportunity for the fitting to strengthen the section of pipe under load. This affected the roundness of the pipe in the area of the seals. The load

[22] Exhibit 4 Pages 1 – 3
[23] Exhibit 4

on the pipe could be a result of a deflection/misalignment in relation to the fitting.

iii. if the fitting was being tightened to an appropriate level; that which allowed the two yellow collars to meet the black protrusions on the central sleeve, than the tension on the collars would result in severe deformation of the collars which would likely prevent the gas distribution officer from adequately tightening the SBCC.

iv. if the SBCC was not adequately tightened so that the yellow collars met the protrusions on the central sleeve, the SBCC was prone to misalignment/deflection such that the sealing system would fail to ensure a seal (as was the primary cause for the leak of the SBCC which failed outside 280 Middleton Road).

v. The degree of permissible misalignment between pipes entering the SBCC was never determined. Gas Distribution Officers were never notified of the maximum degree of misalignment beyond which leaks of LPG could be expected.

vi. Gas Distribution Officers were never given adequate tools to be able to determine the

actual degree of misalignment of pipes entering SBCCs they were working on.

154. Later variants of the SBCC were additionally affected by the absence of instructions which should have accompanied the product, and by the incorporation of lubricated nuts which made compliance with the recommended torque settings impossible.

155. All of the issues affecting the SBCCs of the age of the one that failed outside 280 Middleton Road could and should have been identified at the time the SBCC was originally designed by SECWA. Adequate testing should have occurred in order to determine the parameters in which the SBCC could safely be used without it creating risks for Gas Distribution Officers and members of the public.

THE REGULATORY SYSTEM

156. Between 1990, when the SBCC was first designed and 1993, when the SBCC was installed into the mains outside 280 Middleton Road, SECWA designed, constructed, maintained and operated the gas distribution networks in Western Australia.

157. There was no separate technical and safety regulatory body overseeing these activities either within SECWA or external to that organisation. Gas distribution was

"*unregulated*", in the sense that no regulations existed to govern system safety or standards.

158. In 1995, after the disaggregation of SECWA, the Office of Energy assumed limited regulatory functions that had previously been performed by SECWA. These related only to the licensing and regulation of gas fitting on consumers' gas installations (downstream of the gas meter). The Office of Energy had no regulatory mandate or responsibilities with respect to gas distribution systems or network operators.

159. Therefore, between 1995 and 2000, the gas distribution network remained unregulated, as the safety of the network remained the responsibility of the government owned gas corporation, Alinta Gas.

160. The privatisation of Alinta Gas in 2000 ended the State Government's participation in the gas market, and created the need for a means of regulating safety of the distribution network once it passed into private ownership. The regulations, which came into force on 1 August 2000, conferred powers on the Director of Energy*Safety* to regulate the safety of the distribution network.

161. Under the regulatory regime currently in force in Western Australia, it is not part of Energy*Safety's* role to conduct

testing of fittings to verify whether or not they meet the specifications set by the network operator.

162. Rather, the regulatory regime casts an obligation on network operators to manage all risks associated with the operation of the gas distribution network. In accordance with the requirements of the Regulations the Safety Case prepared by the network operator and Australian/New Zealand Standard 4645.1 2008: *"Gas Distribution Networks",* the network operator is required to ensure the safety of the network and of the components used on the network. In particular, the network operator is obliged to ensure that all components meet the required specifications and are technically sound before they are installed. It is the responsibility of the network operator to approve any item used on its network.

163. According to Mr Misso's submissions, on behalf of the Energy Safety Division of the Department of Commerce, Energy*Safety* conducts targeted audits of network operators and their facilities, concentrating on finding evidence that the network operators' processes are adequate and consistent with industry best practice and relevant Australian/New Zealand standards.

164. During the course of evidence[24] Mr de Groot also confirmed that Energy*Safety* as the regulator checked on the adequacy of training given to network employees.

165. I note that the deficiencies in the SBCC were not of ATCO's making. They bought a gas network which included a component (the SBCC) which the regulator, Energy*Safety*, now believes is not fit for purpose.

166. Additionally I note that ATCO has taken a very reasonable and responsible approach to the SBCCs which remain in the Albany Gas Network and are actively removing them (and other forms of compression couplings). The task of removing the remaining SBCCs is significant and I believe ATCO's timeframe to have removed all SBCCs by the end of November 2015, to be reasonable.

167. Mr Mendelow, on behalf of ATCO, advised the court in his submissions that ATCO had taken a number of positive steps to improve the Albany gas network. It has undertaken to:

    a. Create a register of bolted mechanical couplings installed in the future below ground on the Albany network.

[24] Transcript Page 627

b. Conduct "post-repair" surveys at specified intervals following a repair on the Albany network.
c. Provide field trucks with protractors to measure alignment of pipework during the course of repairs in the rare event a mechanical coupling would be installed in the Albany Gas Network.

168. As a consequence of ATCO's actions I make no recommendation in relation to the replacement of compression couplings (including SBCCs) on the Albany gas network.

169. It is of great concern that the SBCC was developed and has been used for more than 20 years in circumstances where it was falsely claimed the SBCC complied with an Australian/New Zealand standard and in circumstances where it has now been found by the regulator that, as a consequence of a number of significant deficiencies, the part is not fit for purpose.

170. As is amply demonstrated by the death of the deceased a leak of LPG can have fatal consequences for innocent members of the public.

171. Risk to public safety should be mitigated by ensuring the components used on the Albany Gas Network have been properly designed, tested and are being used within their known tolerances.

Recommendation No. 1

I recommend that Energy*Safety* undertake an audit of ATCO's training manuals relating to components used in the Albany Gas Network, in order to confirm whether the training provided by ATCO to its employees correctly state the tolerances and limitations in which the components can be safely and properly used and that the correct methods of installing, working on and removing the component in question are taught to employees working on the Albany gas network.

ODORANT

172. LPG is in its natural state both colourless and odourless.

173. An odorant known as ethyl mercaptan is added to the LPG in order to allow consumers, with a normal sense of smell, to detect the presence of the gas.

174. Odorisation of LPG is a requirement under *the Gas Standards (Gas Supply and System Safety) Regulations* 2000. The level of odorant in the LPG is also set in the regulations.

175. Regulation 9 of the *Gas Standards (Gas Supply and System Safety) Regulations* 2000 provides that;

> The LPG must be odorised by the addition to the gas of an odorant that-
>
> a) Is distinctive, unpleasant and non-persistent; and
> b) When the gas is discharged, throughout that discharge indicates a person with a normal sense of smell the presence of gas down to 1/5 the lower explosive limit in air; and
> c) Complies with the requirements contained in the table for LPG gas in schedule 1

176. Schedule 1 of the *Gas Standards (Gas Supply and System Safety) Regulations* 2000 requires that the LPG in the Albany network be odorised at a level between 20 and 100 mg/m^3.

177. Whilst ATCO owned the network, the LPG in the Albany network was odorised to a level which met the regulatory standards.

178. In this regard I note that samples of the gas were taken from the Albany network on a monthly basis. The gas was then subject to independent analysis. The results of the analysis indicated that at all stages whilst ATCO have owned the gas network the levels of ethyl mercaptan were within the levels required by regulation. In fact generally the levels of ethyl mercaptan were towards the upper level required by Schedule 1 of the *Gas Standards (Gas Supply and System Safety) Regulations* 2000 *(WA).*[25]

179. The question arises why it was that the gas which pooled under the downstairs front bedroom of 282 Middleton Road was odourless.

180. The fact that the LPG had no odour after travelling through the ground and exiting at Ms Muse Farah's bedroom is beyond dispute.

181. Ms Muse Farah did not smell the gas shortly before the explosion.

182. The day after the explosion police and Energy*Safety* officials went into the room where the explosion had occurred. LPG was detected at a high level however the

[25] Volume 7, Tab 63, Sub-tab 4-6

gas contained insufficient odorant to alert those present, to its existence.

183. Similarly Golder Associates undertook a hydro geologic investigation and they also undertook soil gas monitoring. At the conclusion of their investigation they drafted a report dated February 2013[26] in which the report writer noted;

> Laboratory and analytical results for subservice gas samples collected by ATCO and subsequent subservice gas samples by Golder indicate the presence of gases characteristic of LPG beneath the investigation area. Odorant (i.e. ethyl mercaptan or similar) was not detected during the investigation. It is likely that the odorant gas either degraded or was reduced to non-detectable levels.

184. It appears most likely that Ms Muse Farah did not smell the odorant, ethyl mercaptan, because it decayed and was stripped from the LPG as it passed through the clay/silty clay material that lay between it and the area in which the gas pooled beneath 280 and 282 Middleton Road.

185. Mr Cornelis de Groot, the Principal Engineer, Gas Supply at Energy*Safety* gave evidence in relation to the odorisation process. Mr de Groot gave evidence to the following effect:

> 10. Ethyl mercapton and LPG in liquid state are fully miscible particles. In other words, it is physically impossible for ethyl mercapton particles not to mix with LPG particles.
> 11. The process by which gaseous LPG is formed is sufficiently turbulent to ensure that stratification or separation of ethyl mercapton and LPG vapours can not occur. In gas form, LPG and ethyl mercapton are fully diffused and

[26] Exhibit 1, Volume 6, attachment 4, Paragraph 7.1

cannot be physically separated as a result of a leaching process.

12. LPG and ethyl mercapton particles would separate only as a result of a chemical reaction between the ethyl mercapton and the soil.
13. The addition of odorant is designed to ensure that gas is detectable by smell at the site of a gas discharge. To the best of my knowledge, based on a number of scientific publications I have read concerning this issue, non of the known odorants for distributed flammable gases, including those used with natural gas, can sustain a pungent smell in circumstances where the gas travels through a large body of soil.

DO THE CURRENT REGULATIONS REQUIRE GAS THAT HAS PASSED THROUGH A LARGE BODY OF SOIL TO BE ODORISED SO THAT A PERSON IN MS MUSE FARAH'S SITUATION WOULD BE FOREWARNED OF THE PRESENCE OF A LARGE BODY OF GAS POOLED BENEATH HER?

186. Ms Muse Farah went into her bedroom when there was somewhere between 1 and 4kg of LPG pooled beneath her feet. Had the LPG been adequately odorised the smell of the gas would most likely have forewarned her of the danger.

187. The presence of the odorant may have given Ms Muse Farah sufficient warning to leave the room before the explosion occurred.

188. The absence of an odorant in the LPG meant there was no way Ms Muse Farah could have been forewarned of the explosive quantity of LPG in her bedroom before the explosion occurred.

189. Until this incident Energy*Safety* and ATCO were unaware of a circumstance where LPG had migrated downwards through soil, travelled in the order of 15 meters and pooled in explosive concentrations.

190. It is likely the *Gas Standards (Gas Supply and System Safety) Regulations 2000* were not drafted with this possibility in mind, as until this case Energy*Safety* were unaware that LPG could travel such distances through soil and remain at explosive concentrations.

191. Mr de Groot, supported by an opinion from Dr John Bromly, concluded that no existing odorant could be expected to be effective in the circumstances of the present case. Mr de Groot stated:

> If the regulations were interpreted so as to require the gas had to be detectable by smell even after travelling through a large soil body (as in this incident), the consequences would be that reticulation of known flammable gases would have to cease.

192. Mr Mendelow, Counsel for ATCO, in his submissions said that;

65. AGA (ATCO Gas Australia) submits that:

(a) the proper interpretation of r 9 is that sub paragraph (b) is to be interpreted to mean at the point at which the gas is discharged, during the period of the discharge;

(b) sub paragraph (b) could not be interpreted to apply to some other point beyond the point of discharge, as that

would be inconsistent with sub paragraph (a) of r 9 which requires the odorant to be "non-persistent";

(c) there is no ambiguity in the interpretation of the regulation; and

(d) if there is an ambiguity in the interpretation of r 9 (which AGA denies), r 9 is a penal provision with an applicable statutory sanction[172]. In determining the meaning of a penal statute, the ordinary rules of construction must be applied unless the language of the statute is ambiguous.[173] Where the language of the statute creates doubt or ambiguity, the ambiguity or doubt is to be resolved in favour of the most lenient construction.[174]

66. Furthermore, in this respect, AGA refers to the report of Dr John Bromly attached to the supplementary statement of Mr de Groot, [175] and notes the evidence the Dr Bromly is a highly regarded expert in the field.[176] In particular, AGA refers to Dr Bromly's statement that "there is no requirement in the Regulations specifying that the gas should retain a minimum level of odour after passage through soil."[177]

172 The relevant sanction is set out in s 14 of the *Gas Standards Act 1972* (WA)
173 Beckwith v The Queen (1976) 135 CLR 569 at 576; *Deming No. 456 Pty Ltd v Brisbane Unit Development Corporation Pty Ltd* (1983) 155 CLR 129 at 145
174 *Beckwith v The Queen* (1976) 135 CLR 569 at 576, 578; *Deming No.* 456 *Pty Ltd v Brisbane Unit Development Corporation Pty Ltd (*1983) 155 CLR 129 at 145
175 Ex 1.66, Attachment CDG1
176 C J G de Groot, T618.
177 Ex 1.66, Attachment CDG1, p 7.
178 Ex 1.66, Attachment CDG1.

193. Mr Mendelow's argument may well be correct. His argument is strengthened by the fact that at the time the regulations were drafted it was not understood that LPG could travel through soil and remain at explosive concentrations over significant distances. Additionally the fact the odorant would almost certainly be stripped during the passage of the gas through certain types of soil was not understood at the time the regulations were drafted.

Recommendation No. 2

I recommend that the Government reconsider regulation 9 of the *Gas Standards (Gas Supply and System Safety) Regulations 2000* with a view to clarify whether it is intended that the regulation applies in circumstances where LPG travels a significant distance from the point of discharge, through soil, and is consequently stripped of its odorant but remains at explosive concentrations.

194. Since the evidence was heard in this case ATCO has taken steps to investigate additional measures to protect the public in the event of a similar gas leak. Mr Mendelow on behalf of ATCO advised the court, in his submissions, that these measures include:

a. Committing to a research programme to find ways to make the odorant additive in LPG more effective.
b. Requesting that odorant manufacturers and LPG suppliers increase the level of ethyl mercaptan delivered for use in the Albany network.

195. It appears to me that ATCO are doing all it reasonably can to try and solve the problem of un-odorised gas potentially making its way unnoticed into the properties of people living in Albany.

196. Notwithstanding ATCO's intention to try and improve public safety by trying to find ways to make the odorant

more effective in similar circumstances, there remains a significant risk to the community in relation to leaking and un-odorised LPG making its way into similar homes in Albany.

197. According to the Energy*Safety* report[27]*:*

> It became obvious that the construction of the house at 282 Middleton Road was a significant factor in the incident. During the week following the incident, Energy*Safety* raised this aspect in discussion with ATCO and within seven days ATCO commenced a survey to determine the potential likelihood of similar houses in Albany being at risk. The survey identified approximately 2000 residences where a similar situation could potentially occur and is a direct reflection of the older housing stock in Albany and the topography of the land on which these houses are built.

Recommendation No. 3

I recommend that the Government take prompt steps to help customers of the Albany Gas Network potentially affected by the risk of leaking un-odorised LPG making its way undetected into or beneath their properties.

This may include, but is not limited to, publishing advice as to the desirability of adequately ventilating properties without vapour barriers so that LPG will be likely be dispersed rather than being allowed to pool, and other safety advice aimed at informing the Albany community of the risk posed by leaking LPG and the need to report it to ATCO so that the repairs can be undertaken in a timely manner before it can pose a significant risk to the community.

[27] Exhibit 1 Volume 5 Tab 58 Page 34 Section 2.14

SUMMARY

198. On the evidence available to me I am satisfied that at some time after 11 February 2012 a leak developed from an SBCC located above 280 Middleton Road, Albany.

199. The leak allowed LPG to escape into the soil at a rate of about 2.5m^3 per hour.

200. By the evening of 20 July 2012 approximately 1-4kg of LPG had pooled beneath Ms Muse Farah's bedroom at 282 Middleton Road.

201. At about 9:50pm she went into her bedroom Ms Muse Farah could not smell the LPG as its odorant had been stripped as the gas had passed through the soil.

202. Shortly after Ms Muse Farah entered the room the LPG exploded causing significant injury to her and the destruction of the property.

203. The deceased was seated in a room upstairs when the explosion occurred.

204. He was struck by a large piece of masonry which pinned him to the chair and which caused his death by Crush Asphyxiation.

205. I find death arose by way of Accident.

D H Mulligan
Coroner
22 November 2013