Markos v Quin Investments Pty Ltd & Another **[2010] SAIRC 30**

MAGISTRATES COURT OF SOUTH AUSTRALIA
(INDUSTRIAL OFFENCES JURISDICTION)

MARKOS, Ian

v

QUIN INVESTMENTS PTY LTD
First Defendant

and

KUZUB, Nikolai
Second Defendant

JURISDICTION: Prosecution

FILE NO: 2475 of 2008

HEARING DATES: 23, 24, 25, 26, 27, 30 November 2009, 2, 3, 4, 7, 8, 9, 10, 11, 15, 16, 17, 18, 21 December 2009, 8, 9, 10, 11, 12, 16, 18, 19 February 2010; written submissions 1, 5 March 2010.

JUDGMENT OF: Industrial Magistrate M Ardlie

DELIVERED ON: 24 June 2010

CATCHWORDS:

*Prosecution – Plea of not guilty – **As against the first defendant**: One count – Alleged that contrary to s 19(1) of the Occupational Health, Safety and Welfare Act 1986 that the first defendant being an employer failed to ensure so far as was reasonably practicable that its employees were, whilst at work, safe from injury and risks to health – The first defendant operated an explosives manufacturing facility near Gladstone – Employees were performing work duties in relation to the manufacture of a packaged explosive in and around a facility known as Factory No. 1 – The employees were exposed to risk of injury, three employees being killed and two employees being injured as a result of an explosion that occurred in Factory No. 1 – Alleged that the first defendant failed to provide and maintain so far as was reasonably practicable plant in a safe condition in that it: Failed to undertake proper and sufficient maintenance and repair of the critical items of plant in the factory, including a powder blending machine known as the ribbon blender – Failed to provide and maintain any, or any adequate, design details, drawings or manufacturers instructions in relation to the critical items of*

plant in the factory – Failed to keep any, or any adequate, records of maintenance in relation to the critical items of plant in the factory – Further alleged that the first defendant failed to provide and maintain so far as was reasonably practicable a safe working environment in that it, whilst explosives were being manufactured in the factory: Stored approximately 4,500kg of cast TNT explosives product in close proximity to the factory – Stored approximately 20,000L of caustic methanol or "methoxide" in close proximity to the factory – Stored approximately 20,000L of methanol in close proximity to the factory – Was cooling a cast of molten TNT on the loading platform of the factory – Was melting cast TNT in the factory – Permitted the use of a critical item of plant namely the ribbon blender to be operated whilst it was in a state of disrepair – ***As against the second defendant****: Alleged that contrary to s 61(3) of the Occupational Health, Safety and Welfare Act 1986 that the second defendant being the responsible officer of a body corporate, namely the first defendant, failed to take reasonable steps to ensure compliance by the first defendant with its obligations under s 19(1) of the Occupational Health, Safety and Welfare Act 1986 – The second defendant was the responsible officer of the first defendant which carried on the business of manufacturing and storing explosives – The first defendant failed to ensure that its employees so far as was reasonably practicable were safe from injury and risks to health in that it failed to provide and maintain plant in a safe condition and a safe working environment – Alleged that the second defendant failed to take reasonable steps to ensure compliance by the first defendant with its obligations under s 19(1) – Alleged that this offence contributed to the commission of the count alleged against the first defendant –* ***Held****: Onus of proving all charges beyond reasonable doubt discharged – S 19(1), 61(3) Occupational Health, Safety and Welfare Act 1986, Summary Procedure Act 1921, Summary Procedure (Industrial Offences) Regulations.*

Dinko Tuna Farmers Pty Ltd v Markos (2007) 98 SASR 96
Jago v The District Court of New South Wales and others (1989) 168 CLR 23
Penney v R (1998) 155 ALR 605
Diemold Tooling Services Pty Ltd v Oaten; Santos v Markos (2008) 101 SASR 339
Kirk v Industrial Relations Commission [2010] HCA 1
Arrowcrest Group Pty Ltd v Stevenson (1990) 57 SAIR 368
James v Keogh [2008] SASC 156
National Justice Compania Naviera SA v Prudential Assurance Co Ltd (The Ikarian Reefer [1993] 2 Lloyd's Rep 68
Meadow v General Medical Council [2006] 2 AllER 329
R v Harris [2006] 1 CrAppR5;
Southern Equities Corporation Ltd (In Liq) v Arthur Andersen & Co (No 9) [2002] SASC 118
Dayman v Simpson (1935) SASR 320

REPRESENTATION:

Counsel:
Complainant: Ms L Chapman with Mr K Lesses
Defendant: Mr G Germein with Mr W Duddy
Solicitors:
Complainant: Crown Solicitor's Office
Defendant: Duddy Shopov

Introduction

1 The first defendant operated an explosives manufacturing facility near Gladstone in the State of South Australia.

2 On the day of the incident namely 9 May 2006 there were five employees working in and around a factory at the defendant's facility known as Factory No. 1 ("the factory"). At about 12.10 pm an explosion occurred inside the factory killing three of the employees and injuring two. The three employees who died were Darren Millington, Damian Harris and Matthew Keeley. The two employees injured were Cameron Edson and Damian John.

3 The five employees all commenced work at 7.30am and after a meeting was held at the administrative area they then journeyed in various vehicles into the compound to the factory.

4 All five employees were engaged that morning in making a water gel explosive. As part of the production of that explosive dry ingredients were mixed together to make premix. Also separately prepared was a liquid solution. All preparations took up until the scheduled lunch break at 11.30am. All employees then left the factory and either went to the lunchroom in the administrative area outside the compound or to private residences to have lunch.

5 The plan after lunch was to add the liquid solution to the premix in order to form the cartridge explosives.

6 Shortly after all of the employees had arrived back at the factory, following the lunchbreak, an explosion occurred. The explosion was significant. Debris was collected over a large area. An item of plant was located some 620m from the factory floor. The factory building was completely demolished and items of equipment were thrown about the area.

Plea of not guilty – Complaint and summons

7 Counsel for the defendants entered a plea of not guilty on behalf of the defendants.

8 The first defendant was charged on the complaint and summons:

> "Count 1
>
> On 9 May 2006, near Gladstone in the State of South Australia, the first defendant, being an employer, failed to ensure so far as was reasonably practicable, that its employees, namely Damian Harris,

Darren Millington, Matthew Keeley, Cameron Edson and Damian John (the employees), were whilst at work, safe from injury and risks to health.

Contrary to section 19(1) of the *Occupational Health Safety and Welfare Act* 1986.

This is a summary offence

Particulars

1.1 At all material times the first defendant operated an explosives manufacturing facility on Bundock Parade, near Gladstone in the said State ('the facility').

1.2 At all material times the first defendant held a licence to manufacture explosives and store explosives, being the holder of licence no. 74935 (formerly known as licence no. 13) pursuant to the *Explosives Act* 1936.

1.3 On 9 May 2006, the employees were performing work duties in relation to the manufacture of a packaged explosive in and around the factory at the facility known as Factory No. 1 ('the factory'), during the course of which they were exposed to risk of injury and Damian Harris, Darren Millington and Matthew Keeley were killed as a result of an explosion that occurred in the factory and Cameron Edson and Damian John were injured as a result of the said explosion.

1.4 The first defendant failed to provide and maintain, so far as was reasonably practicable, plant in a safe condition in that it:

(a) Failed to undertake proper and sufficient maintenance and repair of the critical items of plant in the factory, including a powder blending machine known as the ribbon blender.

(b) Failed to provide and maintain any, or any adequate, design details, drawings or manufacturer's instructions in relation to the critical items of plant in the factory.

(c) Failed to keep any, or any adequate, records of maintenance in relation to critical items of plant in the factory.

1.5 The first defendant failed to provide and maintain, so far as was reasonably practicable, a safe working environment, in that it, whilst explosives were being manufactured in the factory:

(a) Stored approximately 4,500kg of cast TNT explosives product in close proximity to the factory.

(b) Stored approximately 20,000 litres of caustic methanol or 'methoxide' in close proximity to the factory.

(c) Stored approximately 20,000 litres of methanol in close proximity to the factory.

(d) Was cooling a cast of molten TNT on the loading platform of the factory.

(e) Was melting cast TNT in the factory.

(f) Permitted the use of a critical item of plant, namely the ribbon blender, to be operated whilst it was in a state of disrepair."

9 Section 19(1) states:

"19 – Duties of employers

(1) An employer must, in respect of each employee employed or engaged by the employer, ensure so far as is reasonably practicable that the employee is, while at work, safe from injury and risks to health and, in particular –

(a) must provide and maintain so far as is reasonably practicable –

(i) a safe working environment;

(ii) safe systems of work;

(iii) plant and substances in a safe condition; and

(b) must provide adequate facilities of a prescribed kind for the welfare of employees at any workplace that is under the control and management of the employer; and

(c) must provide such information, instruction, training and supervision as are reasonably necessary to ensure that each employee is safe from injury and risks to health.

Maximum penalty:

(a) for a first offence – Division 2 fine;
(b) for a subsequent offence – Division 1 fine."

Elements of the offences

10 The Full Court of the Supreme Court considered the elements of the offence created by s 19(1) in *Dinko Tuna Farmers Pty Ltd v Markos*:[1]

[1] (2007) 98 SASR 96.

> "The elements of the offence created by s 19(1) are to be found within the statutory provision. The obligation on the employer is to ensure safety so far as is reasonably practicable. That is an element of the offence".[2]

11 Section 19(1) by its express terms provides that:

- the duty is owed only by employers;
- the duty imposed is in respect of each employee employed or engaged by the employer, while that employee is at work;
- the duty is to keep the employee safe from injury and risks to health; and
- the employer is to ensure that the employee is safe from injury and risks to health, whilst at work, so far as is reasonably practicable.[3]

12 In *Dinko* (supra) at para 40 per Gray J:

> "Liability under s 19(1) should be determined by reference to the terms of the statutory provision. The statute obliges an employer to ensure – to make sure – that the employee is safe. The statutory duty is expressed in terms of reasonable practicability. The word 'ensure' carries with it a heightened obligation for an employer under the statute."

13 The second defendant was charged on the complaint and summons:

> "Count 2
>
> On 9 May 2006, near Gladstone in the State of South Australia, the second defendant, being the responsible officer of a body corporate, namely the first defendant, failed to take reasonable steps to ensure compliance by the first defendant with its obligations under section 19(1) of the *Occupational Health Safety and Welfare Act* 1986.
>
> Contrary to section 61(3) of the *Occupational Health Safety and Welfare Act* 1986 ('the Act').
>
> This is a summary offence.

[2] (2007) 98 SASR 96 at [41].
[3] (2007) 98 SASR 96 at [26].

Particulars

2.1 At all material times the second defendant was the responsible officer of the first defendant, which carried on business manufacturing and storing explosives.

2.2 The first defendant failed to ensure that its employees, so far as was reasonably practicable, were safe from injury and risks to health in that it failed to provide and maintain:

(a) Plant in a safe condition; and

(b) A safe working environment.

The particulars of which are set out at 1.1-1.5 above.

2.3 The second defendant failed to take reasonable steps to ensure compliance by the first defendant with its obligations under section 19(1) of the Act.

AND IT IS FURTHER ALLEGED that this offence contributed to the commission of count 1 by the first defendant."

14 Section 61(3) states:

"(3). A responsible officer must take reasonable steps to ensure compliance by the body corporate with its obligations under this Act.

Maximum Penalty:

(a) in a case where paragraph (b) does not apply – Division 6 fine.

(b) where the court is satisfied that the offence has contributed to the commission of an offence by the body corporate – a fine not exceeding the fine that is prescribed for the offence committed by the body corporate."

15 The elements of the offence created by s 61(3) are:

- the person charged must be the responsible officer of the body corporate (the first defendant);[4]

- the duty imposed upon the responsible officer is to take reasonable steps to ensure compliance by the body corporate with its obligations under the Act;

[4] The second defendant admitted he was the responsible officer of the first defendant; see Exhibit C32 p 11, Line 35.

- the failure on the part of the responsible officer to take reasonable steps to ensure compliance by the body corporate with its obligations contributed to the commission of an offence by the body corporate.

16 This proceeding is a criminal prosecution in the strictest sense of that term. The prosecution bears the onus of proving beyond reasonable doubt each element of the offences charged. The defendant does not have to prove anything.

Agreed facts

17 The parties agreed the following facts:[5]

"Agreed Facts

1. On 9 May 2006, there was an explosion at the Factory No. 1, Bundock Road, Gladstone South Australia ('the explosion'). The Factory No. 1 was on a site occupied by Quin Investments Pty Ltd ('the Gladstone site').

2. As at 9 May 2006, there was a Factory No. 1, a Bulk Explosives Factory, Magazines[6], Sheds and an Administration Building area on the Gladstone site. They are all marked on the two 'Quin Investments Pty Ltd – Gladstone Site Detail' plans.

Quin Investments Pty Ltd and Nikolai Kuzub

3. On 15 April 1994, Quin Investments Pty Ltd ('Quin') registered as a company with ABN 87-64-14802. On 25 October 1995 Nikolai Kuzub was appointed as a Director of Quin Investments Pty Ltd and Madeleine Ann Kuzub was appointed Director and Secretary. On 15 July 1999, David Kerr was appointed as a Director of Quin Investments Pty Ltd. They all held those positions up to and including the day of the explosion.

Explosives licence

4. On 10 January 1984, a licence to manufacture vorlite at the Gladstone site was issued on application by Explosives Technical Services (ETS). Mr Kuzub was in charge of that company. The licence allowed small scale manufacture of dry ammonium nitrate mixtures.

[5] See Exhibits C5, C95.
[6] 16 buildings licensed as Explosives Magazines (buildings 16, 17, 18, 20, 21, 24, 27, 28, 29, 34, 35, 37, 41, 42, 43, 44); 9 buildings licensed as Factory Magazines on the Explosives Manufacture Licence (buildings 25, 26, 30, 21, 32, 33, 36, 39, 40)

5. On 30 June 1986, a further licence was issued on application by ETS. It allowed a larger scale production of ammonium nitrate mixtures and the production of boosters.

6. In 1989, ERT Explosives Australia Pty Ltd ('ERT') replaced ETS. Mr Kuzub was the manager.

7. On 21 December 1989, a licence was issued on application to ERT. It permitted the manufacture of a Watergel – slurry plant explosive.

8. On 27 September 1996, Quin Investments Pty Ltd was granted a licence for the activities previously undertaken by ERT. It was issued pursuant to Schedule 1, Regulation 3.06(b) Explosives Act 1936 – 1974 and permitted Quin to manufacture specified ammonium nitrate mixtures and boosters. The conditions for the licence detail Factory No. 1 (package plant) and Factory No. 2 (bulk plant).

Employees

9. On 9 May 2006, five employees were working at the Factory No. 1. They were

    a. Matthew John Keeley (dob 13/03/84; employed since 20/03/06);

    b. Damian Paul Harris (dob 25/12/75; employed since 13/9/96);

    c. Darren Bruce Millington (dob 6/1/61; employed since 22/3/99);

    d. Damian Marcus John (dob 17/01/83; employed since 27/10/02); and

    e. Cameron John Edson (dob 24/01/81; employed since 23/04/01).

    Matthew Keeley, Damian Harris and Darren Millington died as a result of the explosion.

    Damian John and Cameron Edson were injured and hospitalised as a result of the explosion.

10. The body of Damian Harris was observed by police on 9 May 2006 and then recovered on 10 May 2006 at about 5pm amongst debris of the factory toilet block by members of the SAPOL Explosives Coordination Section.

11. Body parts of Darren Millington were located on 9, 10-12, 15, 17 and 24 May 2006 on the slope south of the factory. Those parts were collected by Brevet Sergeant Costello.

    During the post mortem, the variable speed control knob of the Chub Machine was located in the pelvic region of Darren Millington's torso.

12. The body of Matthew Keeley was located on 5 June 2006 by SAPOL officers Snr Constable Clonan and Snr Constable Costello. His body was located lying face down amongst blue drums in a steel and wire compound at the front of the factory site.

Collection of debris

13. On 13 May 2006, SafeWork SA officers were divided into teams and allocated search areas as set out in:-

    (1) the plan 7-6-1 'Gladstone Outer Evidentiary Collection Zones' as follows:-

- Area A — Immediately North of the factory
- Area B — Immediately South of the factory
- Area C — The Olive Grove East of the site
- Area D — Immediately West of the factory
- Area E — North of Area A
- Flavels Paddock — Landholder to the East of the site
- Pearces Field — Landholder to the East of the site
- Paynes Paddock — Landholder to the East of the site
- Extended Grid — South of Area B and West of Areas D and E
- Building Survey Zone — The site buildings outside of the compound

(2) the plan 7-6-2 'Factory Evidentiary Collection Zones' as follows:-

- Tank Farm Road (TFR) — The access road North of the factory
- Upper Tank Area (UTA) — The factory tank farm (four sub zones: 1/4)
- Factory Floor (FF) — The pre mix (sic) plant level
- Stobie Pole West (SPW) — The area West of the factory
- Stobie Pole East (SPE) — The area East of the factory
- Caustic (C) — The loading level of the factory
- TNT — The lower level to the West of (C).

14. Approximately 1 square kilometre of ground around the floor of Factory No 1 was line searched by SafeWork SA officers.

15. From 13 May 2006 to 21 September 2006, each of the 2170 items of debris located by SafeWork SA officers in those search areas were photographed in situ; its location was recorded using a handheld GPS; a label was affixed with a unique identifying number[7]; and the item was recorded on a spreadsheet with a brief description of it. Toward the end of each day, the items were delivered to Inspector Simon Ridge, SafeWork SA at a dedicated sea container on site. All items of debris were secured onsite at a dedicated sea container by Mr Ridge.

Aerial photos

16. Aerial photos of the Gladstone site were taken by Aerometrex Pty Ltd on 13/5/2006. These form the basis for the scatter plans.

[7] Items in the Outer Evidentiary Collection Zones were labelled starting with A, B, C, D, E, FP, PF, PP according to the area in which they were located; items labelled NS and RAR were found in Area A. Items in the Factory Evidentiary Collection Zones were labelled TFR, UTA, FF, SPW, SPE, C and TNT according to the area in which they were found; items labelled BTA and TFF were found in the UTA area; items labelled LBL were found in the Caustic or TNT area.

Production of scatter plans

17. Data from the collected items of debris, including the item description and its GPS location, was entered into a software programme by SafeWork SA inspectors in order to produce 'scatter plans' of the debris on the aerial photos.

18. Debris from Factory No 1 was scattered within a 1km radius by the explosion as shown on 7-2-5 'Quin Investments Pty Ltd – Gladstone Site Detail' plan.

Forensic testing of premix ingredients, premix and batches of explosives

19. On 4 July 2006, Simon Ridge and Darren Kite used a metal detector to examine all stocks of pre-mix ingredients in Shed 2 on the Gladstone site and all stocks of pre-mix ingredients collected from the Gladstone site and placed in the dedicated sea container. No evidence of tramp metal contamination was identified.

20. The Defence Science and Technology Organisation, Department of Defence ('DSTO') conducted a number of tests on (1) a sample of premix taken from the Gladstone Site ('Quin Premix') and (2) a DSTO-prepared premix made from premix ingredients taken from the Gladstone site ('DSTO Premix').

    The Quin Premix was sampled from magazine 28 on 10 July 2006 by Inspector Ray Clifford. See photo 155 of 'Ex Tech Large' bag taken by D Adams. The date of the manufacture and batch number were unknown.

    The DSTO Premix was made up of the following ingredients:-

Procol Guar Gum V1	3.00g
Procol Guar Gum G2	3.50g
Maize Starch	3.60g
Q-cell microspheres	1.75g
Aluminium Powder	9.00g
DW7	0.04g
Ammonium Nitrate	150.00g

    All of the ingredients used by DSTO to prepare the DSTO Premix were sampled and taken from the Gladstone site by

officers of SafeWork SA during May – July 2006 and delivered to DSTO on 18 August 2006.

The Procol Guar Gum V1, Procol Guar Gum G2 and Maize Starch was sampled from marked 25kg bags in building 2 on 13 June 2006 by Inspector Dave Adams. The Q-cell microspheres were sampled from building 2 on 4 July 2006 by Inspector Ray Clifford. The Aluminium powder was sampled from building 13 on 14 June 2006 by Darren Kite. The DW7 was sampled from building 2 on 26 June 2006 by Inspector Tim Harris. Five samples of Ammonium nitrate were taken by Darren Kite on 22 May 2006 and one sample was taken by Inspector Adams from building 55 (see Adams photos 79 & 80).

The DSTO Premix was prepared in order to confirm that the behaviour of the Quin Premix was not atypical and to provide sufficient standardised material from which to prepare contaminated samples.

There were some slight differences in the sensitiveness of the Quin Premix and the DSTO Premix with the DSTO Premix being slightly less sensitive. It is most likely that the subtle differences can be attributed to the detailed methods of preparation or due simply to experimental variations. Both the Quin Premix and the DSTO Premix were tested for sensitiveness to impact, friction, electrostatic discharge and thermal stability. The results for the tests on the Quin Premix and the DSTO Premix were very similar such that both can be described as being insensitive to impact, friction, electrostatic discharge or heat.

Various contaminants [Napthalene, RDX, TNT, extra Q-cell Microsphere, Sodium Nitrite, Ammonium Perchlorate, Adipic Acid and Hydraulic oil] were added to DSTO Premix to determine the effect of the contaminant on the sensitiveness of the premix to impact, friction, electrostatic discharge and thermal stability. The DSTO Premix was contaminated with 5% of the selective additive and carefully mixed. It was recognised that contamination at that level would be probably unlikely, however, any effects on sensitiveness or stability should be apparent.

Napthalene manufactured by REOCHEM was purchased by Ray Clifford from Coles Supermarket. The sodium nitrite was sampled by Ray Clifford on 4 July 2006 from a 25kg bag found unopened in the sodium nitrite store on 25 May 2006 – see Trotta photo 15. Hydraulic oil was sampled by Inspector Froscio from the hydraulic reservoir tank on 21/6/06. The remaining contaminants were provided by DSTO.

Results of the tests were as follows:-

Contamination with naphthalene or adipic acid did not significantly influence any of the sensitiveness results for the premix.

None of the contaminants increased the sensitiveness of the premix to electrostatic discharge.

Contamination with additional glass microballoons caused a slight increase in impact and friction sensitiveness but not sufficient to cause concern.

Contamination with TNT slightly increased the sensitiveness to impact and friction but the increase was not significant.

Contamination with RDX caused a marked increase in impact sensitivity (either because the RDX sensitises the Premix or the Premix sensitises the RDX by acting as a grit increasing friction during the impact) but the gas evolution (ie the explosive effect) was low (which could be due to the Premix diluting the effect of the RDX).

Contamination with sodium nitrite reduced the temperature of ignition of the premix to 191C and also significantly increased the sensitiveness of the premix to impact and, to a lesser extent, to friction.

Contamination with ammonium perchlorate had a similar effect upon the premix as that of sodium nitrite, with sensitiveness to friction further increased.

Contamination with hydraulic oil had no influence on sensitiveness to impact or friction but it reduced the temperature of ignition of the premix to 184C. Uncontaminated premix has an ignition temperature of over 400C.

The results showed that premix contaminated with the various contaminants could not be considered unduly sensitive and could not have caused the event.

21. Ammonium nitrate samples (marked samples 11 – 15 and sample 28) were taken from the Gladstone site and delivered on 9 February 2007 to Professor Stewart Walker, Flinders University for analysis.

Samples marked 11 – 15 were taken by Darren Kite from the Gladstone site on 22 May 2006. Sample 28 was taken on 14 June 2006 from one of the two bags of ammonium nitrate located in building 55 (see D Adams photos 79 & 80).

Tests conducted by Associate Professor Walker of Flinders Uni did not identify any contaminants (including chloride, chlorate, and perchlorate) that could have caused the event.

22. Samples of cartridge explosives were taken from magazines 25 and 31 on 6 June 2006 by D Adams and marked samples 1–7 as follows:-

1	Explosive – Riogel G Batch 2356	Sampled from magazine 25 on 6 June 2006 by Dave ADAMS see notebook page 23. Date of manufacture 1/2/2006, 75x400mm.
2	Explosive – Riogel G Batch 2355	Sampled from magazine 25 on 6 June 2006 by Dave ADAMS see notebook page 23. Date of manufacture 31/1/2006, 75x400mm.
3	Explosive – Riogel G Batch 2359	Sampled from magazine 25 on 6 June 2006 by Dave ADAMS see notebook page 23. Date of manufacture 2/2/2006, 55x400mm.
4	Explosive – Riogel G Batch 2360	Sampled from magazine 25 on 6 June 2006 by Dave ADAMS see notebook page 23. Date of manufacture 7/2/2006, 65x400mm.
5	Explosive – Riogel G Batch 2348	Sampled from magazine 31 on 6 June 2006 by Dave ADAMS see notebook page 23. Date of manufacture 23/1/2006, 26x200mm.
6	Explosive – Riogel G Batch 2393	Sampled from magazine 25 on 6 June 2006 by Dave ADAMS see notebook page 23. Date of manufacture 24/3/2006, 55x400mm.
7	Explosive – Riogel G Batch 2353	Sampled from magazine 25 on 6 June 2006 by Dave ADAMS see notebook page 23. Date of manufacture 30/1/2006, 75x400mm.

Samples of explosive were taken from magazine 28 by Ray Clifford in July 2006 as follows:-

8	Explosive – Taken from blue ½ drum	Sampled from magazine 28 on 4 July 2006 by Ray CLIFFORD see notebook page 14. Date of manufacture unknown.
9	Explosive – Red X	Sampled from magazine 28 on 4 July 2006 by Ray CLIFFORD see notebook page 14. Date of manufacture unknown, batch number unknown.
10	Explosive – Premix, EXTECH Large	Sampled from magazine 28 on 10 July 2006 by Ray CLIFFORD see notebook page 14. See D ADAMS notebook page 35. Date of manufacture unknown, batch number unknown.

The samples 1 – 10 were delivered to Forensic SA on 22/8/06 where they were analysed by Dr P Pigou.

None of the samples contained camphor, TNT or RDX.

Napthalene (sic) was not detected in samples 1 – 5.

Low levels of naphthalene (0.5 to 2ppm) were detected in samples 6, 7, 9 and 10.

Napthalene (sic) (approximately 14ppm) was detected in sample 8.

Forensic testing of equipment

23. On 11 July 2006, the Hydraulic Power Pack pressure gauges were forwarded to Abstec Calibrations for forensic testing to determine whether they were operative at the time of the explosion. The forensic testing could not determine conclusively whether or not the hydraulic power pack was operating at the time of the explosion.

24. On 19 August 2006, the Chub Machine Ammeter and Compressed Air Pressure gauge were forwarded to Abstec Calibrations for forensic testing. The forensic testing could not determine whether or not the Chub machine or the compressed air supply was switched on at the time of the explosion.

25. On 9 June 2006, Inspector Simon Ridge conducted pH tests on residues collected from the inside of the Ribbon Blender, Hammer Mill, Dust Collector and Small Auger. The tests were conducted to see whether there was any evidence of caustic methanol in those items. Caustic methanol would give a high pH result. There was no evidence of caustic methanol in those items.

TNT

26. On 3 May 2006, Quin delivered to the Department of Defence, Woomera, 16 TNT Charge sectors and one Composition B booster. This was part of a contract whereby Quin would supply 32 Charge sectors and two Composition B boosters. The remaining items were due to be delivered approximately mid May 2006. They were never delivered.

Methanol/Methoxide

27. In early 2006, Quin had an agreement to do work for Mintech Chemical Industrial Pty Ltd ('Mintech'). Under the agreement, Mintech supplied raw material to Quin in the form of bulk quantities of methanol and potassium hydroxide (KOH). The work undertaken by Quin involved the mixing of 70% liquid methanol with 30% KOH flake to produce 'methoxide'. Methoxide is used in the production of bio-diesel fuel. Production was scheduled to commence on 8 March 2006.

    The following methanol (liquid) and KOH (flakes) were delivered to Quin by Mintech on the approximate dates indicated:-

Methanol Deliveries to Quin Investments

Approximate Dates	
11/3/2006	18276
20/03/2006	18700
27/03/2006	17815
31/03/2006	18620
31/03/2006	18520
3/04/2006	18173
Total	**110104 Kg**
Potassium Hydroxide Deliveries to Quin Investments	
Approximate Dates	
23/02/2006	34000
24/02/2006	34000
24/02/2006	32000
Total	**100000 Kg**

Between 11 March 2006 and 4 April 2006, Quin delivered approximately 99,820kg of methoxide to Mintech.

On 24 and 25 May 2006, Mintech was able to recover 63 tonnes of KOH from Quin.

On 30 May 2006, Mintech removed from the Quin site the 'EXSIF' euro tanker containing 19,125kg of methanol.

The damaged 24,000 litre euro tanker remained on site

28. A sample was taken from the 'methoxide' tanker located at the front of the factory on 16/8/06 by Mr Simon Ridge. It was tested at the Forensic Science Centre and confirmed to be a mixture of methanol and KOH.

Statement of N Kuzub

29. On 10 May 2006, Mr Nikolai Kuzub gave a statement to Detective Brevet Sergeant Gavin Mildrum from the SA Police.

30. In relation to agreed fact number 20 in Exhibit C5, it is agreed that there would be no significant effect upon the tests conducted on the DSTO Premix if Q-cell microspheres were not included as an ingredient of the DSTO Premix.

31. In relation to agreed fact number 8 in Exhibit C5, it is agreed that in the licence,

    a. 'Plant No 1' refers to the site which was destroyed in the explosion on 9 May 2006;

    b. 'Plant No 2' refers to the site where the Bulk Plant was located; and

    c. Danger Building No 54 refers to the two sea containers located approximately 15.6 metres to the south of Plant No 1."

The factory – 9 May 2006

18 The task of the five employees on 9 May 2006 was to produce a large diameter explosive known by various brand names (RDX, Riogel, AUSX). The end product as it came out of the Chub Machine would look essentially like a stick of fritz.

19 **Cameron Edson** ("Edson"), one of the survivors of the incident, was employed by the first defendant at the time of the incident as a Quality Control Officer. He said a large floor plan signed and identified by him represented to him how the floor plan of the factory, the tank farm, and

surrounds was at 9 May 2006[8]. Edson described the features around the factory at the date of the incident. He identified the methoxide container at the front of the factory. He was not sure how long it had been there prior to 9 May 2006. The bulk tanker to the right of the tank farm area looking northeast had been there for at least a week before the date of the incident. He did not know what was in the bulk tanker save that it was involved in the production of methoxide. At the time of the incident the two sea containers were present and contained a quantity of TNT. He said that when he went to lunch at about 11.30am on the day of the incident on the smaller loading platform there was a TNT mould on a pallet that was still setting. He said this mould had been there for the entire morning and was in the process of being filled.

[8] See Exhibit C11, reproduced herein.

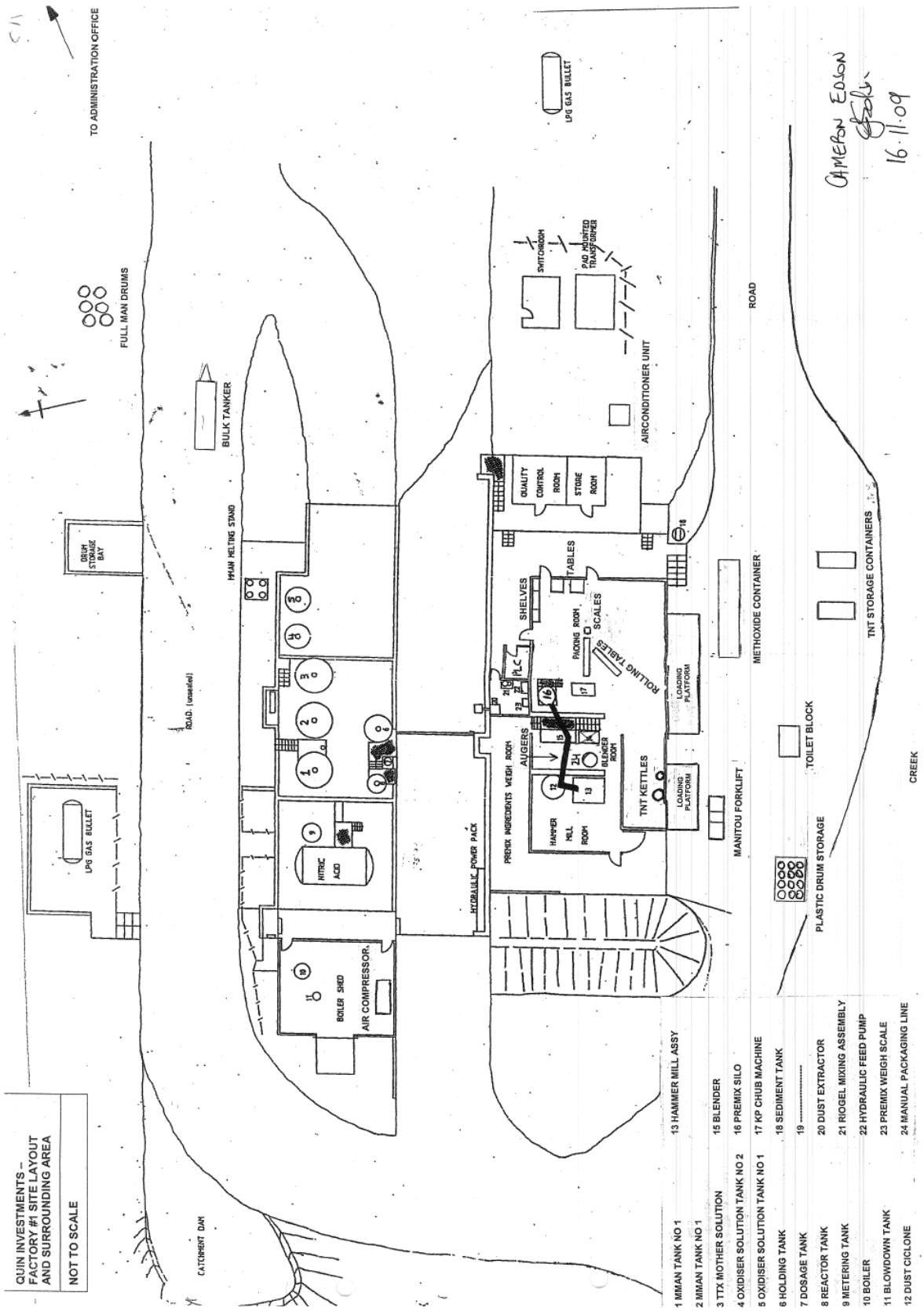
QUIN INVESTMENTS – FACTORY #1 SITE LAYOUT AND SURROUNDING AREA
NOT TO SCALE
TO ADMINISTRATION OFFICE
FULL MAN DRUMS
DRUM STORAGE BAY
BULK TANKER
MMAN MELTING STAND
ROAD (unsealed)
LPG GAS BULLET
BOILER SHED
AIR COMPRESSOR
NITRIC ACID
HYDRAULIC POWER PACK
PREMIX INGREDIENTS WEIGH ROOM
AUGERS
HAMMER MILL ROOM
BLENDER ROOM
TNT KETTLES
LOADING PLATFORM
MANITOU FORKLIFT
PACKING ROOM
SCALES
ROLLING TABLES
SHELVES
TABLES
QUALITY CONTROL ROOM
STORE ROOM
SWITCHROOM
PAD MOUNTED TRANSFORMER
AIRCONDITIONER UNIT
ROAD
METHOXIDE CONTAINER
TOILET BLOCK
PLASTIC DRUM STORAGE
TNT STORAGE CONTAINERS
CREEK
CATCHMENT DAM
1 MMAN TANK NO 1
2 MMAN TANK NO 1
3 TTX MOTHER SOLUTION
4 OXIDISER SOLUTION TANK NO 2
5 OXIDISER SOLUTION TANK NO 1
6 HOLDING TANK
7 DOSAGE TANK
8 REACTOR TANK
9 METERING TANK
10 BOILER
11 BLOWDOWN TANK
12 DUST CICLONE
13 HAMMER MILL ASSY
15 BLENDER
16 PREMIX SILO
17 KP CHUB MACHINE
18 SEDIMENT TANK
19 ----------
20 DUST EXTRACTOR
21 RIOGEL MIXING ASSEMBLY
22 HYDRAULIC FEED PUMP
23 PREMIX WEIGH SCALE
24 MANUAL PACKAGING LINE
AMEAN EDSON
16.11.09

Exhibit C11

20 Edson described the process of making premix. The hammer mill would be used to mill or crush ammonium nitrate. When completed the ammonium nitrate would then be augered into the ribbon blender. Depending on the product being made other ingredients such as gums, starch, aluminium, DW7 and naphthalene flakes would be added via a lid on the top of the ribbon blender. The operator would carry out the task of adding the ingredients from a platform adjacent to the ribbon blender. The mixing process after the last ingredient had gone in would take at least fifteen minutes. When complete the premix was then augered into the premix silo.

21 Edson said he was in charge of the operation of the tank farm and Darren Millington ("Millington") was overseeing the factory floor.

22 Edson described the process he undertook at the tank farm to prepare the solution that was to be added to the dry ingredients to make the end product. The function that he was involved in, took him until about 11.00am, work having commenced at 7.30am. The lunch break was usually at 11.30am, so between 11.00am and 11.30am he occupied his time by making cardboard boxes. As it was close to lunchtime the production process whereby the solution was added to the premix was not commenced. He said the intention was that after lunch production would be commenced once everyone was in position. He said all of the people working at the factory were required because there were several jobs happening at the time of the making of the explosive.

23 He said at lunchtime the following situation prevailed:

- the premix had been made and had been augured into the premix silo;
- the various solutions that he had prepared in the tank farm were ready to go; and
- as far as he was aware the Chub Machine was ready to go.

24 Everyone from the factory went to lunch at the same time using more than one vehicle. He drove up with Damian John ("John") as a passenger and dropped John off at the Administration area where there was a lunchroom. He drove onto his house and had lunch on his own. He returned to the Administration area about 12.00pm and picked John up and drove to the factory arriving a few minutes after 12.00pm. He said the other employees also returned to the factory a minute or so after he arrived.

25 Edson said the length of time from arrival back at the factory after the lunchbreak and the incident was somewhere between five and ten

minutes. He said that on the return from lunch there was nothing unusual about the factory. Before going to lunch everything was set up to go into production and during the course of the morning leading up to lunchtime nothing unusual had occurred. He said after returning to the factory from lunch he did not turn on any machinery. He did not remember hearing the hydraulics after he returned from lunch. He entered the factory and kept making more boxes. He did not see where John went. He recalled Millington tinkering around with the Chub machine but he could not remember seeing Damian Harris ("Harris") or Matthew Keeley ("Keeley").

26 Edson observed that there were only a couple of boxes to make up left on the pallet and he completed the task. He was aware that there was another pallet full of cardboard to make up boxes outside the factory. He walked through the big doors onto the main landing platform towards a Manitou Forklift, his intention being to use the forklift to pick up the pallet of cardboard boxes from where they were stored and place the pallet onto the platform. The pallet of cardboard boxes was underneath a large covered area between two sea containers, the sea containers being TNT storage containers. As he walked towards the forklift the event happened.

27 **John** the only other surviving worker described his role on the morning of the day of the incident. He said two batches of premix were made up and had been augured into the premix silo by lunchtime. He said he did not notice anything unusual during the course of the morning. He said at lunchtime as a rule, all hydraulics are turned off. He thought on the day of the incident that when he came back from lunch the agitator for the TNT kettle was still turning so there must have been a motor left on as well as the air-compressor. He said everything else was switched off except the boiler.[9]

28 On his return to the factory after lunch shortly after 12.00pm he recalled putting a pair of overalls on a table, making up a couple of cardboard boxes, having a conversation and then checking the TNT kettle. He said he had been asked to do this by Nikolai Kuzub (the second defendant). He said he was supposed to top up the TNT moulds which were on the smaller loading platform. He checked on the large kettle and his recollection was that it was about half full and the TNT had not completely melted. He said he used a stoker to break up some of the bigger lumps and when he had finished doing that he went to go outside to check the moulds on the platform. The next thing he remembered was waking up on the ground. He thought he had been back in the factory after lunch for between ten to fifteen minutes.

[9] tr 241.

29 He was aware of the methoxide container located in front of the factory. He said that he had been involved in making a few batches of methoxide and this was pumped from the bulk tanker located in the tank area along the gutter of the factory and into the methoxide container.[10] He thought the methoxide was made up in the weeks before the incident.

30 By reference to the floor plan of the factory the location of the TNT kettles was where the TNT was melted. The moulds were kept on the small platform at the front of the factory. The completed moulds of TNT were placed in the sea containers depicted on the plan.

Particular 1.5 – Failure to provide and maintain a safe working environment

31 Edson and John consistently described the features located in the surrounds of the factory. Particular 1.5 of both counts refers to a failure to provide and maintain so far as was reasonably practicable a safe working environment in that whilst explosives were being manufactured in the factory the defendants allowed the melting of cast TNT to continue in the TNT kettle and also on the smaller loading platform a cast of molten TNT was cooling. In addition the sea containers had stored in them a quantity of cast TNT explosive in proximity to the factory. Also the bulk tanker containing methanol was located in proximity to the factory as well as a container containing methoxide. These particulars underpinned the failure to provide a safe working environment leaving aside the further particular that referred to a critical item of plant, namely the ribbon blender.

32 **Professor Alan Bailey** ("Bailey") was called by the complainant as an expert witness.[11] He provided[12] responses to technical questions relating to the explosion.[13]

33 Bailey said he was a Professor of Applied Chemistry. His specialty is explosives and explosives engineering, in particular the safety of explosives, initiation of explosives and the investigation of accidents involving explosives.

34 As regards the two operations occurring in the factory on the date of the incident, namely the premix operation and the TNT operation, his position was that this was extremely bad practice.[14]

35 He further commented upon the presence of the methoxide container. He said methoxide has no application as far as the manufacture of the

[10] tr 253.
[11] See Exhibit C85.
[12] (in conjunction with Dr M Cartwright).
[13] See Exhibit C86.
[14] tr 927.

premix is concerned. It is a flammable substance. Good practice is to remove all flammable items from the area where explosives are being made so as to reduce the possible risk of external fire affecting the explosives operation. The material is very caustic and corrosive to the skin. It is odd that such a container should be so close to operations involving TNT. Caustic potash interacts with TNT.[15]

36 He also said that if there were a leak of methoxide, methol alcohol would be spilled which would readily vaporise. It is highly flammable and a fire could follow which could lead to the ignition of the TNT. It could also lead to a fire in the premix factory and could conceivably explode the premix if the premix bin was exposed to fire.

37 The storage of TNT in such inappropriate containers so close to the factory is incredible.[16] He said a safe distance was 140 metres between such containers and the factory itself. This was to mitigate the effects of an explosion so it would not start a sympathetic explosion in the factory as well as protect the workers in the factory from an explosion in the TNT store. He stated that the whole tenet of explosives operations is to make risks as low as reasonably practicable (ALARP process). All flammable and non-essential materials should be well removed from the factory. Two operations should not be taking place independently at the same time at the same factory.

38 The methanol stored in the bulk container is methol alcohol, a highly flammable material. It is more flammable than methoxide and the bulk tanker containing methanol should not be present whilst operations are occurring.[17]

39 If the container of premix exploded then fragments could well impact upon the TNT storage and could lead to a shock detonation of the TNT. If the TNT were to detonate then it could project fragments back towards the premix bin. There is a mutual hazard from both the explosives stockpiles. A lower velocity fragment if it penetrated the TNT could give rise to an ignition rather than a detonation and there would be a fire. The matter becomes even more complicated if the TNT is on fire given the proximity of the methoxide container.[18]

40 In order to reduce the risks to the employees involved in making premix the following steps could have been taken:

[15] tr 928.
[16] tr 929.
[17] tr 930, 931.
[18] tr 931, 932.

- there should be no work going on with the TNT kettle or the making of the TNT mould at the time the premix was being made;

- the methoxide container is wrongly sited and presents both a hazard to the premix operation and the TNT storage containers;

- the storage of TNT in that quantity and that style of container should never be allowed; and

- the methanol container should not be left in proximity whilst explosives operations are going on.

41 The defendants did not dispute Bailey's evidence relating to the TNT operation and storage, the presence of the methoxide and the methanol.[19]

Finding – Particulars 1.5(a), (b), (c), (d), and (e)

42 The elements of the offence created by s 19(1) have been referred to above.[20] The first defendant was the employer of the persons engaged in preparation of the water gel explosive. The employees at the factory were engaged in carrying out the work designated to them by their employer. The employees were exposed to injury and risks to health as a result of an explosion. These elements of the offence created by s 19(1) have been established beyond reasonable doubt.

43 As regards a safe working environment did the first defendant do all things reasonably practicable to ensure its employees were safe? The undisputed evidence of Bailey clearly establishes that it did not.

44 I find that the complainant has proved beyond reasonable doubt that the first defendant failed to provide and maintain so far as was reasonably practicable a safe working environment as particularised in particulars 1.5(a), (b), (c), (d), and (e). The remaining subparagraph of particular 1.5 namely (f) relating to the ribbon blender will be considered further.

[19] tr 949.
[20] See paras 10, 11.

Particular 1.4 – Failure to provide and maintain plant in a safe condition

45 Particular 1.4 of both counts refers to a failure to provide and maintain so far as was reasonably practicable plant in a safe condition. It is alleged that the defendants failed to provide and maintain any, or any adequate, design details, drawings or manufacturer's instructions in relation to the critical items of plant in the factory and failed to keep any, or any adequate, records of maintenance in relation to the critical items of plant in the factory. It was also alleged that there was failure to undertake proper and sufficient maintenance and repair of the critical items of plant in the factory including a powder-blending machine known as the ribbon blender. The ribbon blender will be considered separately, below.

46 The defendant had a quality assurance manual and a site safety handbook in existence at the date of the incident.[21]

47 No files were produced for items of plant, nor any information relating to specifications, the maintenance history and any alterations carried out to items of plant. There was no maintenance schedule produced in relation to items of plant.

48 Negligible documentation was produced in relation to maintenance. Edson said that if something needed fixing he would let **Lionel Stringer** ("Stringer")[22] know and Stringer would attend to it. He said the majority of the problems were with the Chub machine. He did recall that he had some trouble with components in the tank farm. He would not attempt to fix any problem. He would call Stringer. He referred to the hydraulics leaking oil, in particular around the end of the ribbon blender. This was on one occasion only and he said he put a drum underneath to catch the oil until it was fixed.

49 Edson said one of his first jobs was making premix which he did for approximately two years. He did not see any premix leaking from the ends of the ribbon blender.

50 He said there was a shutdown every Christmas and maintenance would be performed. He said he was last present at the Christmas shutdown in 2004/2005. His job involved cleaning the dust extraction system and generally cleaning up. He said there was a checklist which he followed. He did not perform work on any items of plant. It took roughly a week to

[21] See Exhibit C40.
[22] Stringer was a boilermaker by trade and in charge of maintenance at the factory.

clean and tidy up. He said during the shutdown Stringer would be working on plant.

51 The checklist he followed when cleaning the dust extraction system was ticked off and when completed he thought the checklist went to the administration office.

52 John gave evidence along the same lines as Edson and said if something needed to be fixed Stringer or **Marcus Cleggett** ("Cleggett")[23] would be contacted. He was aware there was an annual shutdown. He did not work over that period. He recalled on one occasion, not during a shutdown that he was asked to pull apart the dust extraction system and clean it. He said the dust extraction system was cleaned every year at the end of the year.

53 He said there was an oil leak in the hammer mill room and sawdust was put onto the floor to soak it up and it would be changed once a week. There were also oil leaks in the ribbon blender room. He recalled cans being placed to catch the oil just underneath the hydraulic hoses. He was uncertain if the cans were still there on the day of the incident. He said approximately a month before the incident there appeared to be a leak on top of the ribbon blender. He said he saw oil on the lid and checked to make sure it had not leaked into the blender. On the day of the incident there was oil on top of the ribbon blender and he checked to see that it had not gone into the blender. He opened up the small lid and took a look inside.[24]

54 John said there was leakage of premix at the ends of the ribbon blender.[25] He thought the leakage from the ends of the ribbon blender was not there when he first started work. The premix was coming out from the point where the shaft went into the bearing. The premix landed on the ground and a blue drum cut in half was put in position to catch the premix.

55 **Simon Ridge** ("Ridge") was the lead investigator on behalf of SafeWork SA in relation to the incident. He requested copies of documentation and records including "all maintenance records for the plant involved in the incident from the start of December 2005 shutdown" by written notice dated 15 May 2006.[26] Ridge said the response to this written request for maintenance records for the plant involved in the incident was a series of invoices.[27] The bundle of invoices for parts contained in Exhibit C52, are not maintenance records.

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[23] Cleggett is a fitter and turner by trade and assisted Stringer with maintenance.
[24] tr 262.
[25] tr 264.
[26] See Exhibit C39.
[27] See Exhibit C52 and tr 576, 577.

56 During the course of the interview[28] advice was given that during the annual shutdown for maintenance, all maintenance carried out would be recorded in timesheets and also in diaries.[29]

57 Ridge requested the timesheets and diaries. Seven diaries and various timesheets were supplied. The timesheets and diary entries relating to annual shutdown periods were extracted.[30] The extracted timesheets and diary entries to coincide with end of year periods when there is no recorded production in the factory reveal very little detail about maintenance. There is reference to plant maintenance but no detail. On a handful of occasions there is some detailed reference to the actual work carried out.

58 Cleggett and Stringer were the persons entrusted with the maintenance at the worksite. Cleggett is a fitter and turner by trade. He said he never really kept any record of what he did during the annual shutdown.[31] He thought that he was meant to have kept a record in his diary and was also given a diary, but he was hopeless with diaries.[32]

59 He recalled that on one occasion he changed the gland packing at both ends of the ribbon blender and described how that was carried out.[33] During the annual shutdown he and Stringer would perform whatever jobs were requested. The annual shutdown related to the factory and could involve replacement of bearings, changing hydraulic hoses and so on.

60 Stringer was a boilermaker by trade. He was involved in manufacturing things, repairing things and maintenance of the plant at the worksite. As far as day-to-day maintenance work was concerned it was a matter that if there was a problem someone would inform him and he would go and attend to it. He was contactable around the worksite either by radio or phone. He said Cleggett was involved in maintenance activities. Cleggett had more to do with hydraulics and machinery than he did. He said there was no scheduled maintenance in relation to items of plant. Maintenance was on a needs basis. There was no procedure in terms of inspection and maintenance of various items of plant within the factory before production recommenced.

61 He said maintenance in relation to the ribbon blender was confined to the gland packing. The bearings had never been a problem to his knowledge. As far as greasing the ribbon blender was concerned, he said the production crew greased the bearings of the ribbon blender.

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[28] See Exhibit C32.
[29] See Exhibit C32, p 84, 85.
[30] See Exhibits C62, C63.
[31] tr 513.
[32] tr 513.
[33] tr 518.

62 In the course of the annual shutdown he said the main job was to pull the Chub machine apart and check it inside. He said it had to be dismantled to look inside. As far as the ribbon blender was concerned he did not have to do anything with that. There was no scheduled maintenance associated with the ribbon blender. Any maintenance was on demand. The ribbon blender was not checked prior to production runs but more so as production was taking place.[34]

63 As far as the hammer mill was concerned he did not recall doing anything in relation to it during the annual shutdown. He said there was no maintenance activity undertaken by him during the course of annual shutdown in relation to either the premix silo or the dust extraction system.

64 With respect to recording work that he was doing he said this was done on timesheets and he might have put something in his diary. It was not his practice to detail maintenance activity undertaken by him.[35]

65 He was not able to say when the gland packing on the ribbon blender was replaced. He said he had no system of writing things down. By reference to his 2005 diary he could find no entry in relation to gland packing as far as the ribbon blender was concerned.[36] When he wrote plant maintenance in the diary this did not necessarily relate to the factory. It could relate to the bulk plant. During the annual shutdown most of his time was spent working on the Chub machine. At the annual shutdown there was no routine servicing or maintenance schedules. The main thing was to look at the Chub machine.

66 Sometimes he would receive a written request from workers when something needed fixing. This written request was only used when he could not be contacted by radio or by telephone.

67 **Andrew Begg** ("Begg") was called by the complainant as an expert witness.[37] He provided a report in response to a series of questions regarding the incident at the defendants' worksite.

68 Begg described his occupation as Safety Consultant in Explosives. He said that his area of expertise is in safety and management systems for explosives factories.

69 He described a long history of working with ICI (Imperial Chemical Industries) which was a large chemical company based in the United Kingdom. ICI had a number of different business divisions one of which was explosives. One of his roles at ICI was to look at the safety

[34] tr 1289, 1290.
[35] tr 1290.
[36] tr 1313.
[37] See Exhibit C87 – Report of Begg with CV attached dated 30 March 2008.

performance of the whole business internationally and this involved doing plant safety assessments and plant safety inspections. This saw him attending at various plants and looking at the plant, the condition of the plant, how it operates, how it has been maintained and checking to see if personnel followed operating instructions.[38]

70 In 2004 he retired from ICI and is now a director of EXSAR Consulting Ltd, which provides support to the explosives industry. Whilst it is all aspects of operational support, 90 per cent is safety and safety support. Begg travels widely internationally. His initial task is to be involved in a safety assessment, making recommendations and from there training personnel. A large part of his work has been in relation to developing and implementing safety management systems.

71 At p 3 of his report[39] under the heading "**Safety in Explosives Operations**" he discusses the key principles of safe explosives operations namely:

- identify and understand the hazards;
- design out the hazards; and
- manage the residual hazards by implementing robust safety systems and procedures.

He then goes on to say, "maintenance is one set of systems and procedures that should be implemented to manage the residual hazards and help assure ongoing safe operation of an explosives operation."

72 He referred to several types of maintenance namely, as needs, repair and preventative maintenance.

73 He said that preventative maintenance is particularly important in an explosives factory. You do not want a piece of equipment to fail suddenly because if it does fail it may create a situation which could initiate an explosion. He would expect to see on site a list of all the equipment. There should be some form of register that would specify the kind of inspection and maintenance to be carried out. As far as critical machines are concerned they would be subjected to an even more regular level of inspection than normal plant equipment. For each piece of equipment there would be some form of document that would describe the item, where it is located, what it is for, what the maintenance requirements are over a period of time and how often such maintenance should be done.[40]

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[38] tr 971, 972.
[39] See Exhibit C87.
[40] tr 977, 978.

74 In an explosives plant just because plant is operating you cannot assume that it is operating in a safe condition. In fact if it is operating and there is a fault it is probably highly unsafe because it is still delivering energy.[41]

75 He was asked as at the date of the incident whether the plant described at the defendants' worksite required maintenance. His report details what plant required both immediate, "as needs" maintenance and preventative maintenance. He makes the comment that the only piece of plant that received any regular form of maintenance was the Chub (KP) machine and this was carried out once a year during the annual shutdown. However there were no records of what maintenance was carried out on this machine. The only documentation in existence that indicated a regular inspection, testing and approval on a routine basis was in relation to the boiler and compressor. No other items of plant or equipment appeared to have current certificates or documentation confirming maintenance or condition of fitness for purpose. He then goes on in his report to detail what steps should have been taken.

76 Begg said that he did not believe that premix should be leaking from either end of the ribbon blender. Part of what was being mixed is paint fine aluminium which is a very fine powder which in its own right has certain hazards. That powder should be contained within the blender and should not be escaping.

77 Whilst packing glands had been widely used for a number of years they have been associated with a number of incidents and the recommendation is that packing glands should not be used as they can become contaminated.[42] There are alternative methods for sealing the shafts of the ribbon blender. The most common alternative is a lip seal or a mechanical seal.[43] He said that it was not good practice if you had a leaking gland in an explosives factory to simply tighten the gland.[44] He would expect that the packing gland would be replaced with a lip seal or mechanical seal as per the industry recommendations. Gland packing is still used in some applications but only under very strict maintenance regimes.[45] There are various industry guidelines indicating that packed glands should not be used and should be replaced with lip seals such as the National Resources Canada 1988, Western Australia dated 22 August 1994 and from South Australia[46] dated 4 September 2003.[47]

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[41] tr 978.
[42] tr 980.
[43] See p 38, 39 of his report – Exhibit C87.
[44] tr 982.
[45] See p 44 of his report – Exhibit C87.
[46] See Exhibit C88 – Technical note 56 Workplace Services, Government of South Australia, 4 September 2003.
[47] tr 983.

78 He held the view that if the packing glands were changed and premix still leaked this would imply that there is additional space between the shaft and the packing gland housing or the body of the mixer which is not being covered by the packing gland. He would have expected this to be investigated further. This would involve physical investigation of the shaft assembly coming through the mixer. Leakage is not something that should be put up with.[48]

79 He was asked to assume that the ribbon blender shaft was rubbing against the end plate. His view was that this would appear to be a significant source of friction. If preventative maintenance was in place that sort of situation should not arise. An inspection would reveal wear on the shaft and corrective action would be taken. At p 28 of his report[49] he sets out a maintenance schedule for a ribbon blender undertaken by Orica Mining Services. One of the yearly checks is to check the main shaft clearances. Stringer indicated that at no stage during the time he was engaged in maintenance did he check the shaft.

80 In reference to the defendants' document dealing with safety[50] he said that the document is the foundation for a safety system but there was no practical application of the document.[51] He did not consider that records of maintenance work that were kept on timesheets or in a diary by the person who performed it were adequate. He had looked at some of the documents presented to him and they contained no detail of what had been done.[52]

81 He was not telling the Court what the worlds best practice was in an explosives factory. The examples he sited from Orica are typical of what you would expect to see in the explosives industry. His report was based on what was supplied to him and it focuses on maintenance of plant and equipment.[53] The preferred route is to have preventative maintenance so that faults do not develop in the first place.

82 He was critical of the defendant expecting the fitter to do what was needed to be done during the annual maintenance. He said that a checklist needed to be in place following upon a hazard identification and risk assessment to remind the fitter what he needs to do so that a supervisor or a manager responsible for the facility would know that the fitter has been trained, or should have been trained, as to what was required of them when they carry out annual maintenance.[54]

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[48] tr 980, 981.
[49] See Exhibit C87.
[50] See Exhibit C40 and p 37 of his report – Exhibit C87.
[51] tr 1001-1003.
[52] See Exhibit C63 being documents reviewed by him.
[53] tr 1007.
[54] tr 1012.

83 **Professor John Price** ("Price") was called by the complainant as an expert witness.[55] He stated that his occupation was a mechanical and materials engineer. In relation to the type of inspections that were needed in an explosives factory as regards the ribbon blender he said that such a machine should be subject to a maintenance schedule, which involves regular maintenance at particular intervals, including inspections of areas of concern such as the interface between the shaft and the glands. There should be an inspection of the entire machine. There should be a document stating which components will be inspected and how often a year they would be inspected.[56] The inspection would pertain to all the bearings, all the structure of the shaft, the alignment of the shaft and the packing glands. Any faults associated with the machine such as leakages, spills of hydraulic fluid and so on should have been recorded, registered and maintenance adjusted so that it did not happen. All areas of potential wear should be inspected. This would involve cleaning the machine and illuminating it properly and gaining clear access to all parts.[57]

84 The interview[58] conducted by SafeWork SA with the second defendant, leaves the impression that the defendants had no real knowledge of what maintenance work had been done at any relevant time. No records were produced to enable them to inform themselves in that regard.

85 When asked about the maintenance shutdown at Christmas 2005[59] the second defendant, as responsible officer of the first defendant, did not know what plant was actually maintained in relation to the factory. He said that he would expect the bearings to be changed on all the augers. He was not sure if anything was done in relation to the ribbon blender except that they would maybe have replaced the gland packing. There were no specific records of the work carried out other than what was contained on the timesheets.[60]

Lack of documentation in relation to critical items of plant

86 Ridge requested by notice dated 15 May 2006 "*copies of individual plant item construction plans"*, as well as "*copies of the most up-to-date blueprints of the plant involved including the general layout, power reticulation, fluid-service reticulation and infrastructure"*. The defendant provided certain documents.[61] There was a folder entitled "Service Manual" relating to the Chub machine together with a diagram detailing surrounding landholders, laboratory and storeroom layout and a

[55] Exhibit C71 – CV of Professor John Price and Exhibit C73 – Book of reports of Professor John Price.
[56] tr 812.
[57] tr 812.
[58] See Exhibit C32.
[59] See Exhibit C32 p 118 and following.
[60] See Exhibit C32 p 120.
[61] See Exhibit C43.

series of copy diagrams distributed by BL Shipway Industrial relating to the Riogel mixer, slurry pump, lock valves, and premix auger valve. There were also various drawings or blueprints relating to the Chub machine and Riogel plant, a survey of the land, plant layout, site plan, and assembly plan of inclined screw conveyor. Absent are any details, drawings or manufacturer's handbooks in relation to the ribbon blender.

87 When asked whether the ribbon blender had any documentation or maintenance recommendations the response was that the ribbon blender was purchased second hand in 1984 and no documentation was provided[62]. The defendant did not have any diagrams or blueprints or plans in relation to the ribbon blender. No attempt was made to obtain any operating manuals or service guides or maintenance schedules from the manufacturer. The defendant's response was "it's a very simple machine to operate".[63]

88 Begg indicated a need for there to be documentation in relation to each piece of equipment, fully descriptive of that equipment indicating where the equipment was located, what it was to be used for and the maintenance requirements including frequency of such maintenance.[64]

89 Begg said at the time the ribbon blender was purchased, second hand, details of the history should have been obtained from the previous owner including what the ribbon blender had been used for and how often it had been used. The ribbon blender should have been accompanied by a list of what had been done in terms of inspection and checks.[65]

90 Price also commented upon the need for drawings or plans in relation to the ribbon blender. In particular as decisions had been made to modify the ribbon blender there should have been updated drawings of all the modifications carried out. There were no drawings available in relation to the ribbon blender.[66]

Finding – Particulars 1.4(b) and (c)

91 As regards maintaining plant in a safe condition did the first defendant do all things reasonably practicable to ensure its employees were safe? The undisputed and collective evidence of Begg and Price, as well as the totality of the evidence on this topic, clearly establishes that it did not.

92 I find that the complainant has proved beyond reasonable doubt that the first defendant failed to provide and maintain so far as was reasonably

[62] See Exhibit C32 p 123.
[63] See Exhibit C32 p 143.
[64] tr 977.
[65] tr 1004, 1005.
[66] tr 808.

practicable plant in a safe condition as particularised in particulars 1.4(b) and (c).

The ribbon blender

93 Particular 1.5(f), in the context of a failure to provide a safe working environment, states that the defendant "permitted the use of a critical item of plant, namely the ribbon blender, to be operated whilst it was in a state of disrepair". Particular 1.4(a) in the context of a failure to provide and maintain plant in a safe condition states that the defendant "failed to undertake proper and sufficient maintenance and repair of the critical items of plant in the factory, including a powder blending machine known as the ribbon blender".

94 The complainant in its opening[67] said that in regards to the ribbon blender the shafts at each end were worn. So too was the bowl of the ribbon blender where that shaft rotated. The contact between the shaft and the bowl of the ribbon blender caused friction resulting in heat transference to the pre-mix. The lack of maintenance of the ribbon blender and its poor condition played a significant role in triggering the events that lead to the explosion.

95 The complainant says that the state of affairs that existed on the day of the incident was such that there was a breach on the part of the defendants whether or not an explosion happened. The breach was a serious one given that there was a risk of death or serious injury to employees working in proximity.

96 The defendants were critical of the investigation process contending that it was focussed on the ribbon blender and unfairly excluded other potential causes of ignition. Further the investigation was not multi-disciplinary was myopic and remains incomplete.[68]

97 The defendants also contended that the complainant did not establish beyond reasonable doubt that the cause of the explosion was due to lack of maintenance of the ribbon blender and its poor condition. In the alternative the defendants say that the complainant has failed to prove beyond reasonable doubt other possible causes for the explosion.[69]

The investigation process

98 Before considering the ribbon blender and issues of causation I will first address the criticism of the investigation process made by the defendants. The High Court in *Jago v The District Court of New South Wales and*

[67] tr p 5
[68] See written submissions of the defendants under the heading "Investigation" 1 March 2010.
[69] See written submissions of the defendants under the heading "Conclusion" 1 March 2010.

others[70] was dealing with an application for a stay of proceedings due to the delay in bringing the matter to trial. In the context of the right of an accused person to receive a fair trial Mason CJ said:[71]

> "… there is no reason why the right should not extend to the whole course of the criminal process and it is inconceivable that a trial which could not fairly proceed should be compelled to take place on the grounds that such a course did not constitute an abuse of process."

Clearly the investigative process is part of the course of the criminal process. The High Court in *Penney v R*[72] considered the consequences of an unsatisfactory investigation. Callinan J with whom McHugh, Gummow, Kirby and Hayne JJ agreed said:[73]

> "There is no general proposition of Australian law that a complete and unexceptional investigation of an alleged crime is a necessary element of the trial process, or indeed of a fair trial. That is not to give any *imprimatur* to incomplete, unfair or insufficient police investigations. Indeed there may be cases in which deficiencies in the investigation might be of such significance to a particular case as a whole that the accused will be entitled to an acquittal or a retrial. But that will all depend on the facts of the particular case."

99 As I understand the conduct of the investigation a number of potential causes were considered and eliminated. Price in his report of December 2007[74] sets out in Table 4 at p 29 a list of possible initiation sources and a commentary thereon. Ridge also referred to consideration being given to potential causes, what evidence there was relating to the potential causes and the elimination of those causes after consideration of the available evidence. Evidence was led from witnesses[75] relating to potential causes. There was nothing to suggest any involvement of the ETSA Utilities equipment or a lightning strike on the day of the incident.

100 Price was shown and he then examined several bags of metal or shrapnel collected by Stringer after the collection process had concluded at the worksite. From those nine bags Price was able to identify approximately five pieces as appropriate to duct work.[76]

101 It was put to Price[77] that the enquiry had not been properly completed and that a lot of material remained on site. Price disagreed with the

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[70] (1989) 168 CLR 23.
[71] At p 29.
[72] (1998) 155 ALR 605.
[73] At p 609.
[74] See Exhibit C73.
[75] Andrew Baghurst re ETSA Utilities equipment, Exhibit C26, Darren Ray Senior Meteorologist, Bureau of Meteorology, Exhibits C21 and C22.
[76] tr 898.
[77] tr 899.

contention that the enquiry had not been properly completed and stated that it had been done very comprehensively.

102 I consider on the totality of the evidence that all possible causes for the incident were investigated properly and, save and except for the ribbon blender, were excluded. There is nothing to suggest that the investigation was so defective that the trial was not a fair trial.

Proof of causation – Insufficient particulars

103 The defendants asserted the complainant did not prove beyond reasonable doubt the cause of the explosion. The complainant in response says that it has proved beyond reasonable doubt what was the cause of the explosion. Further the complainant asserts that it did not have to prove the explosion and resultant deaths and injuries to the employees in order to prove a breach of the statutory command in s 19(1) of the Act. In *Diemold Tooling Services Pty Ltd v Oaten; Santos v Markos*[78] Doyle CJ said:

> "what is in question is a contravention of the statutory command … the offence is the contravention of the statutory command found in the opening words of s 19(1), and a particular contravention may be (but will not necessarily be) the result of a number of acts or omissions"

and at para 25:

> "a number of acts or omissions on the part of the employer may bring about the contravention of the statutory command on a given occasion. One or more of them, taken alone, might suffice to do so."

104 The defendants say that it was for the complainant to particularise all matters in support of the case led by it, which it did not do. The defendants maintain that the lack of particularity relating to the cause and reasonable steps that the defendants failed to take, offends the principles arising from the recent High Court decision of *Kirk v Industrial Relations Commission*[79]. No particulars were provided in *Kirk* and the High Court indicated in the context of the New South Wales Act that it was the act and omissions which had to be identified in the statement of any offence charged under the legislation. The legislation imposed strict liability on an employer. An employer had a possible statutory defence. The defence required an employer to demonstrate that measures it should have taken were not reasonably practicable or it had no control over the events. I accept what the complainant says about the decision in *Kirk* namely that it does not support the defendants' proposition that the cause

[78](2008) 101 SASR 339 at para 22.
[79] [2010] HCA 1.

of the accident has to be particularised in the complaint.[80] The complaint and summons herein contains particulars of the breach of the statutory command.

105 The essence of the offence created by s 19 arises from putting an employee at risk, rather than the injury which might have resulted. Once such a risk has been proved it is not an essential ingredient of the offence for the prosecution to prove precisely how that risk became evident and caused a particular injury.[81] In *Diemold* para 34 Doyle CJ said:

> "I should add that the allegation of a fatal injury to the named employee is unnecessary but legally harmless. The consequence of a contravention of s 19(1) is relevant to the question of penalty, but is not an element of the offence."

Ribbon blender – Maintenance and repair

106 The ribbon blender is described in the particulars as a critical item of plant in the factory. Begg in his report[82] said that some companies adopt the practice of classifying plant items where failure could result in catastrophic consequences as "critical machines". He said as far as the defendants are concerned he would include on the list of critical items the premix blender (ribbon blender), small premix auger, large premix auger, Riogel mixer and Riogel pump. He said these items would all be in relatively regular use and all involved moving parts which will wear with time. These items of plant were not subject to preventative or periodical maintenance when the totality of the evidence advanced by Stringer is considered. Essentially maintenance was on an as needs basis. Much was made of the annual shut down maintenance period. What this boiled down to was maintenance of the Chub machine being the main task. Stringer indicated that he would not check the ribbon blender, the premix silo or the dust extraction system or carry out any periodical checks.

107 Stringer was responsible for the maintenance of the factory. During the annual shutdown he would not check the ribbon blender. There was no scheduled maintenance associated with the blender.[83]

108 He said he was involved in the set up of the ribbon blender and the gearbox assembly when it was originally installed at the worksite. At the time he was employed by a farm machinery business which business was contracted to install the ribbon blender. He could not remember what specifications he followed when he installed the ribbon blender. He said

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[80] Complainant's reply to defendants' written submissions para 4, 5 March 2010 and *Kirk* at para 28.
[81] See *Arrowcrest Group Pty Ltd v Stevenson* (1990) 57 SAIR 368 in particular at 373 – 374.
[82] See Exhibit C87 p 9
[83] tr 1289.

the ribbon blender was all in one piece and it was put in location and he bolted the ribbon blender to the floor.[84]

109 From time to time he put further gland packing at both ends of the ribbon blender. He never inspected the shaft of the ribbon blender. He was never asked to inspect the shaft. As far as he could recall the shaft was never replaced from the time he started working for the defendant.[85] He first became aware of the wear on the shaft when Ridge showed it to him.[86]

110 When the ribbon blender was located in the factory he was not sure who did the alignment of the shaft. He may have done so but could not say for sure. He was asked since commencing work with the defendant who was responsible for making sure the shaft was properly aligned. His response was "well, it has not shifted. So there was no problems with it, so nobody has had to check it".[87]

111 From the time the ribbon blender was installed in the factory (mid-1980s) until the date of the incident, a period of twenty years, there was no inspection of the shaft and no checking of the shaft alignment. Any modifications or repairs were not documented. The shaft of the ribbon blender was worn at both ends. The reason for the wear evident on the shaft is the subject of disputed evidence advanced by Price on the one hand and **William Potts**[88] ("Potts") a consulting mechanical engineer called by the defendant on the other hand. The dispute that exists between Price and Potts on this topic will be considered in more detail below.

112 Begg whose expertise and credentials have been outlined above[89] when talking of preventative maintenance commented that one of the yearly checks as regards the ribbon blender would be to check the main shaft clearances. If a predetermined maintenance schedule is established then the inspections actually carried out should be documented so the person responsible knows that they have been done.[90] If the ribbon blender shaft was in fact rubbing against the end plate this would be a significant source of friction. If preventative maintenance was in place that sort of situation should not arise as wear will be detected from the outset and corrective action could be taken.

113 **Professor Martin Braithwaite** ("Braithwaite") who was called by the defendant expressed the view that the ribbon blender was not a critical item of plant. Braithwaite said his background was in chemistry and

[84] tr 1292.
[85] tr 1327.
[86] tr 1328.
[87] tr 1328.
[88] See Exhibit D18.
[89] See paras 68 – 75.
[90] tr 986, 987.

chemical engineering.[91] I find Braithwaite's evidence on this discrete topic somewhat confusing. He agreed he had access to Begg's report and had read what Begg had stated about planned preventative maintenance being fundamental in an explosives factory. He commented to the effect[92] that he had worked with Begg for 25 years, that Begg was an authority on safety health management and that there was nothing Begg would say about the management of safety that he would ever disagree with. He then resiled from this position and did not consider that items of plant were necessarily critical items because it depends on what you have in it. As regards the premix being manufactured on the day of the incident his position was that he would want to know the properties of that premix before he said whether or not a particular piece of equipment was a critical machine. His repeated position was that he wanted to know its deflagration properties and its detonation properties. In other words he wanted to know if a local event such as friction would lead to propagation.[93] This would seem to imply that if a certain batch of premix possessed certain characteristics then the ribbon blender would be a critical item of plant.

114 He further steps back from his initial total agreement with Begg. He said that Begg, as a very experienced safety expert manager, would take the view that you cover all options. Braithwaite however has taken the view that you have to prioritise and if you know a material is not subject to do anything after an insult then it is not a high priority. He then went on to say that the premix was only exposed to friction at quite a small peripheral circumferential velocity. Under those conditions there was a low energy input. He then qualified his position by saying that this was the first ribbon blender that he had looked at and that he did not claim expertise in mechanical engineering aspects of plant.[94] Braithwaite conceded that he had not, unlike Begg, been exposed to factories over the world making premix.[95] Further he agreed that there were many factories around the world making water gel explosives but they did not use him to look at them.[96]

115 Braithwaite in his report[97] when talking about the role of the ribbon blender and in the context of long term rubbing and wear on the shaft and the blender end plates had this to say:

> "Certainly the latter is the more credible source of local heating caused by continuous friction. On any explosive plant, moving components such as bearings and seals on rotary equipment are the

[91] See Exhibit D25.
[92] tr 1394.
[93] tr 1396.
[94] tr 1401, 1402.
[95] tr 1400.
[96] tr 1400.
[97] Exhibit D25 at paras 6.1.

> subject of close and regular inspection: frictional heating of a confined explosive medium can easily lead to local explosion and loss of containment. In the event of frictional heating at the shaft-end plate interface, one would anticipate the possibility of this leading to a deflagration in the mass of material in the blender."

This expressed view contradicts the stance adopted by Braithwaite in his evidence which has been detailed above. I accept what Begg has to say namely that the ribbon blender is a critical item of plant.

116 The content of the interview[98] conducted by SafeWork SA with the second defendant revealed that the ribbon blender was purchased second-hand in the mid-1980s. Little was known about the history of the machine. The machine came with no operating manuals or maintenance schedules. The shaft is the original shaft. The second defendant to his knowledge did not know whether the shaft had ever been examined but expected that it would have been looked at sometime for an inspection.[99]

Ribbon blender – Premix leaking

117 Stringer stated that he preferred the premix to be leaking through the gland packing as this indicated to him that he had not done it up too tightly.[100] As to why he liked the gland packing in a state to enable leakage to occur, he said this was common practice for water pumps and the like. He did not discuss with the second defendant the fact that the gland packing was leaking premix. He could not remember whether the second defendant had said to him that it was designed to leak.[101]

118 He was asked whether he investigated why premix was leaking or did he simply put more gland packing in. His response was that he would just put more gland packing in. This is how he understood it. You need more gland packing as it wears. It is designed to wear out. He said he received no training about this method of sealing the ribbon blender. There were no discussions about using a different seal. He said when it was leaking there were two things that could be done. Firstly he would attempt to adjust the assembly. If adjustment were not possible then more gland packing would be put in. During this process the whole of the gland packing assembly was never removed.

119 Begg was critical of the fact that premix was leaking from the ribbon blender. His evidence has been summarised above.[102] Begg referred to the fact that gland packing had been discouraged for a number of years and that lip or mechanical seals are recommended by the industry bodies.

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[98] See Exhibit C32.
[99] sSe Exhibit C32 at p 153.
[100] tr 1331.
[101] tr 1331.
[102] See paras 76 – 78 inclusive.

120 Price was of the view that premix should not leak. You did not want premix to grind in the interspace between the shaft and the bowl end plates or indeed in the glands. The grinding action creates heat.[103] He said the ribbon blender should not be designed to leak. Premix should not be compacting in the glands or be exposed to the glands at all. Gland packing is used in some industries where there is a high-pressure fluid involved like water pumping.[104] If material were flowing through the gland packing some of it would be left behind and could be subjected to friction. He did not accept that the flow of material was a good idea because material should not be there at all. There were several alternatives to gland packing.[105]

121 Contrary to Begg and Price, Potts expressed the view that gland packing was an ideal solution for the ribbon blender. Contrary to Begg's position, when asked whether he thought increased leakage of premix from the ends of the ribbon blender should mean that a check of the alignment of the shaft take place, he would not really answer this and deferred to the experience of the operators as to whether a closer inspection should take place regarding the alignment of the shaft.[106] He did agree that if the gland packing was repacked and the ribbon blender continued to leak this may warrant a closer inspection of the alignment of the shaft depending on the rate of leakage and the tension at which the gland packing was packed.

122 Braithwaite thought the leaking of premix was good if it was leaked to a safe place and this ensures that it was not getting to a dangerous temperature.[107] Braithwaite had no experience in this area this being the first ribbon blender that he had looked at.[108] He had never investigated a ribbon blender and that he was a research laboratory person rather than a plant person.[109]

123 In light of the evidence reviewed above, I do not accept as plausible evidence, the views of Potts and Braithwaite on the topic of the suitability of gland packing and the leaking of premix from the ribbon blender.

Damage or wear to the ribbon blender shaft and end plates

124 Price in his report[110] refers to several areas of damage seen on components of the ribbon blender which pre-date the incident. These

[103] tr 811, 812.
[104] tr 868 – 870.
[105] tr 870.
[106] tr 1228.
[107] tr 1460.
[108] tr 1402.
[109] tr 1400.
[110] See Exhibit C73 of December 2007 p 43 para 4 The Ribbon Blender.

areas include wear on the shaft and the corresponding wear on the plates at the end of the bowl. (The other areas of wear assumed no relevance). Price said that the wear on the ribbon blender shaft indicates long term rubbing between the rotating shaft and the end plates and perhaps the packing in the glands. Potts does not agree with Price. His opinion is that all the marks, lipping, tearing and distortion of the end plates is explicable by the failure scenario during the subsonic set of hot events. The wear on the shaft he says was due to the normal process of shaft sealing by gland packing inside stuffing boxes.

125 As I have indicated Braithwaite accepts that the contact between the shaft and the end plates of the ribbon blender is a credible source of local heating caused by continuous friction.[111] The creation of hot particles as a result of this friction and the subsequent sequence of events will be considered below.

126 The conflict in the evidence of Price and Potts relating to the cause of damage to the ribbon blender shaft and end plates leads to a consideration of the duties and responsibilities of an expert witness and how those duties and responsibilities are discharged.

127 The duties imposed upon an expert witness were considered in *James v Keogh.*[112] Debelle J indicated that the duties of an expert witness are the same in criminal and in civil trials. The question whether the expert witness has discharged those duties will be determined by reference to the context of the forensic issues at the trial as well as by reference to the obligation of the expert to disclose all relevant material. His Honour referred to various authorities which dealt with the duties and responsibilities of an expert witness.[113]

128 The duties and responsibilities include (but are not limited to):

- Expert evidence should be the independent product of the expert uninfluenced as to form or content by the exigencies of litigation. An expert witness should provide independent assistance to the court by way of objective, unbiased opinion in relation to matters within his expertise and should never assume the role of an advocate.

- An expert witness should state the facts or assumption upon which his opinion is based. He should not omit to consider

[111] See para 115 above.
[112] [2008] SASC 156 at paras 67 – 72.
[113] *National Justice Compania Naviera SA v Prudential Assurance Co Ltd (The Ikarian Reefer* [1993] 2 Lloyd's Rep 68 at 81 – 82 per Cresswell J; *Meadow v General Medical Council* [2006] 2 AllER 329; *R v Harris* [2006] 1 CrAppR5; *Southern Equities Corporation Ltd (In Liq) v Arthur Andersen & Co (No 9)* [2002] SASC 118 at 133.

material facts which could detract from his concluded opinion.

- An expert witness should make it clear when a particular question or issue falls outside his expertise.

- An expert witness must give evidence honestly and in good faith and must not deliberately mislead the court.

- The obligation of an expert to the court overrides the obligation of the expert to the client.

129 Price explained the workings of the ribbon blender. Part of his explanation included a PowerPoint presentation.[114] He explained the role of the glands at each end of the ribbon blender. The shaft of the ribbon blender passes through the end plate or walls of the bowl of the blender. There needs to be a gap to allow this to happen and to avoid metal-to-metal contact. The concept of adding the glands is to prevent leakage of the material inside the bowl to the outside. The glands are supposed to seal the contents from escaping onto the factory floor or into the atmosphere of the factory. The glands are normally used in water pumps. The gland packing goes inside the gland housing and this is flush against the end of the bowl.[115]

130 In his PowerPoint presentation he included a computer graphic indicating the location of the wear on the shaft in relation to the bowl end plates.[116] He stated that the peak wear is at the region where the shaft passes through the ribbon blender end plates.

131 Both ends of the shaft were in Court.[117]

132 Price stated that at both ends of the shaft there are circumferential marks the whole way round indicating that it has been abraded away by rotational grinding as it rotates. In addition there are marks associated with the plumber block and its bearings and there is a further area of wear on the shaft. The depth of the damage on the drive end is 2.5mm and on the non-drive end 3mm. The length of damage is 100mm at the non-drive end and 90mm at the drive end.[118]

133 Why does he say it is metal-to-metal contact?[119] He says there is plenty of evidence of circumferential grinding. He would expect something as hard as a shaft to cause it. Aside from the wear at each end of 2.5mm and

[114] See Exhibit C75 which is a hard copy of the PowerPoint presentation.
[115] tr 798 – 799.
[116] See Exhibit C75 at p 12.
[117] Photo 15 of Exhibit C33 depicts the shaft as a whole with the two cuts in the shaft clearly visible.
[118] tr 802.
[119] tr 802.

3mm there are also surface scratching at both ends. The time taken for the wear on the shaft to have happened depends on how often the ribbon blender was used. It was not operating continuously. To achieve the wear observed would have taken years or all the life of the shaft.[120]

134 Price said that he had also observed wear at each end of the ribbon blender bowl (end plates).[121] Price observed rotational marks in the wear and a lip associated with the wear. The lip associated with the wear is situated at the bottom of both holes in the end plate.[122] There is no lip on the other parts of the hole. The presence of the lip definitely indicates that there has been rotational grinding in that area.[123] His view was that there was relevant movement between the shaft and the end plates of the bowl and this was the cause of the lip because that pushes the material – spreads it out as well as grinding it away – so you have got both actions going on.[124]

135 The lip precedes the explosion. It has nothing to do with the explosion. It is circumferential grinding indicating that it occurred during the shaft rotation.[125] Following the explosion there was damage caused to the holes of the end plates. On those elongated holes there is no lipping.[126] The damage is as a result of the air shockwave. The air shockwave has moved the bowl relative to the shaft. The bowl accelerates first and the shaft, being attached to the gearbox, takes some time to pick up speed. This movement causes the shaft to rip that part of the bowl.

136 Reliable measurements were difficult due to the shaft and ribbon mixer bowl both being bent in the incident. Price maintained that at the non-driven end of the shaft one could see very clear indications of where the bearing was in contact with the shaft. The measurement from that point to the deepest part of the wear is 120mm away from the bearing. The measurement is taken between the ends of the marks representing the end of the plumber block from the end of the bowl. This was about 120mm. Price concludes from those measurements that the maximum wear on the shaft was where the shaft passes through into the bowl.[127] Price said it was not possible to do similar measurements in relation to the driven end of the shaft, as the relationship between the bearings and the ribbon blender are not known, as the gap between the end plate of the ribbon blender and the gear box is an unknown. There were no drawings available therefore there was no information about the distance between the ribbon blender and the gearbox.

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[120] tr 803.
[121] See p 141 of Exhibit C73 Photos of Ribbon Blender End Plates showing scraping and lips.
[122] tr 803.
[123] tr 803.
[124] tr 804.
[125] tr 806.
[126] tr 914.
[127] See Exhibit C77.

137 Price said the only places that the wear on the shaft can happen are between the end plates of the bowl and also inside the gland system.[128] The gland packing alone could not have caused the wear. There was very little knowledge of what the gland housing was.[129] Not all of the wear could have been caused by the gland packing because the wear is 100mm long and the gland packing was something in the vicinity of 30mm.[130]

138 Potts indicated that Price had been misled by his observation of wear on the ribbon blender shaft in that he mistakenly took this to be due to metal-to-metal contact.[131] He says that the wear noticed on the shaft was actually due to the normal process of shaft sealing by gland packing inside stuffing boxes. As far as he was concerned the wear on the ribbon blender shaft was in no way extra-ordinary. He had seen that type of wear before. He would not describe the wear as damage and, in his opinion, it did not constitute a hazard to people working in the factory.

139 Potts said that he had made a very careful measurement which led him to believe that all the wear on the shaft was within the stuffing box.[132] Further this wear was outside the point at which the end plates line up with the shaft. There was no damage evident where the shaft lines up with the end plate other than impact damage.[133] I find this reliance upon measurements by Potts to be without foundation. There was no drawing or blueprint providing measurements of, in particular, the gland packing housing and its location on the shaft. His measurements ignore the effects of the explosion. Price held the view that there were very few reliable measurements possible because the shaft had been bent in the accident and the ribbon mixer bowl had also been bent.[134]

140 Begg's attention was drawn to the two pieces of shaft present in Court.[135] He commented that there was significant wear on both of the end pieces. He said such wear should not be tolerated in an explosives factory. In order to remove that amount of metal it would take considerable energy and was most likely caused by friction on other parts of the mixer assembly.[136]

141 Begg clearly does not regard the wear on the shaft in the same way that Potts did.

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[128] tr 808.
[129] tr 799.
[130] tr 809.
[131] Exhibit D18 p 11 para 8 Conclusion.
[132] tr 1121.
[133] tr 1121.
[134] tr 806, 807, 808 and 809.
[135] tr 1005.
[136] tr 1006.

142 It was put to Begg that over the years the ammonium nitrate and other materials will produce wear on the shaft and after 20 years this will cause the sort of abrasion that he has now observed on the shaft. He did not agree with that proposition and indicated that to him it looked like very aggressive abrasion. The explosive powder concerned is relatively soft and, in terms of the shaft, under normal conditions it would almost be like a polishing compound. Whilst he indicated that it should be left to an expert (metallurgist) it looks to him like very aggressive grinding that has been taking place on those two ends.[137] Begg found it hard to believe that the wear would be confined to the gland packing.

143 Potts did agree that the wear on the shaft was as a result of continuous friction at both ends for many years.[138] He said the cause for this was something harder than the shaft being embedded in the gland packing material or embedded in the white metal bearings or in the cast iron of the gland packing or stuffing box.[139] As to what materials or particles would produce the wear, his position was that over the years there would be impurities in the mixture such as sand and clays because ammonium nitrate itself is very soft.[140] The presence of these impurities capable of causing wear on the shaft is contrary to the emphasis upon quality control and the consistency of the ammonium nitrate product.[141] **Darren Kite** ("Kite") who worked for the defendant at the time of the incident had the job of testing the raw materials used. He described sampling the ammonium nitrate and testing it in the laboratory. He said if it failed the test for Riogel then it could be used in the bulk plant subject to further testing and if it failed that test then it would be used for liquid fertiliser. The ammonium nitrate that passed the test for Riogel would be isolated in one spot and marked with a mark indicating that it was suitable for manufacturing that particular product.[142]

144 Potts had no relevant experience with any other explosives factories. Contrary to Begg and to the industry guidelines that have been referred to above he held the belief that the gland packing system was safe to use in an explosives factory.

145 Potts agreed that there was lipping at the bottom of each hole of the end plate.[143] He said there was a circumferential polishing mark and as to how it came to have circumferential marks he said that there had been a rotational process. All of this happened during the event which caused the bowl of the ribbon blender to rotate relative to the fixed location of

[137] tr 1027.
[138] tr 1188.
[139] tr 1188.
[140] tr 1210 and 1211.
[141] See Exhibit C32 p 227 and 228.
[142] tr 333 and 334.
[143] tr 1128.

the ribbon blender shaft. He maintained that the shaft was stationery and the bowl rotates around it. He said that the one rotation has caused the lipping damage at both ends of the bowl.[144]

146 Potts in his report[145] purports to piece together a sequence of mechanical deformation. He says at the outset that the mechanical equipment on view at the warehouse would appear like any other accident-damaged equipment. He states that the auger and the wall between the ribbon blender and the premix bin came at some stage towards the ribbon blender. The auger had to rotate about its connection with the base of the ribbon blender and acted as a lever to the ribbon blender and the shaft remained stationary and the bowl lifted upwards, rotates and hits the shaft. He stated that he kept away from the explosive issue and looked at the sequence of mechanical failure.[146] He said the damage observed by him was ductile failure as if the machine had been put into a press or, as if a moving object had hit it. He stated that the ductile failure must have happened before a detonation. There was no evidence of supersonic high-speed failure of the metal.[147]

147 Whilst he conceded that the force that threw it across the factory to come to rest on the bund could cause the damage to the ribbon blender his position was that it was not necessary for him to go to that stage.[148] Potts has no other explanation for the lipping damage other than his scenario about the auger acting as a lever and moving through various positions.[149] Potts effectively ignores the forces produced by the explosion.[150]

148 Price distinguished between the lipping damage observed in the holes in the end plates of the ribbon blender and the damage caused to the holes as a result of the explosion. He separates out the lipping damage which appears at the bottom of the hole of each end plate as being damage preceding the incident. The observable nature of the peak damage to each end of the shaft, I find, based on the evidence of Price, must have been caused by metal-to-metal contact with the end plate. The lipping at the bottom of each hole again, based on Price's evidence, supports metal to metal contact as being the reason for this damage.

149 I regard the scenario advanced by Potts as implausible. Potts in my view assumed the role of an advocate. He had no relevant experience in investigating the aftermath of an explosive event. He said the forces produced by such an event were not relevant to his modelling. Further

[144] tr 1129.
[145] See Exhibit D18 para 7.
[146] tr 1134.
[147] tr 1135.
[148] tr 1173.
[149] tr 1136 and 1176.
[150] tr 1138, 1139.

certain theories were raised for the first time when Potts gave evidence and supported that evidence with his PowerPoint presentation. Not all of these theories were put to Price in cross-examination.[151] The defendants chose not to challenge certain aspects of Price's evidence in cross-examination and introduced through Potts alternative theories which to some extent contradict the evidence put forward by Price. This failure to cross-examine Price and put the theories advanced by Potts in his evidence (aided by his PowerPoint presentation), would be sufficient to induce an acceptance of the evidence of Price on the topic.[152] For this reason, and also arising from my criticism of the views expressed by Potts above, I reject the evidence of Potts.

150 The evidence is quite clear that the shaft of the ribbon blender was never inspected. The clearly observable damage should have been apparent if proper preventative maintenance had been carried out. The alignment of the shaft had never been checked from the time the machine was installed. The lipping at the bottom of both holes in the end plates and the significant or peak areas of wear on each end of the shaft (2.5mm and 3mm) as Price stated (and I accept) indicated contact between the shaft and the end plates of the ribbon blender. Such an occurrence went undetected during the years of operation.

151 The defendants[153] rely upon the fact that there was no unusual sound associated with the use of the ribbon blender to indicate metal-to-metal wear. The wear to the holes in the end plates and the ends of the shaft I accept as having occurred over a number of years. I also accept as an indicator of this wear the fact that initially no premix leaked from either end of the ribbon blender. Leakage started to occur which I find is an indicator of deterioration in the condition of the ribbon blender. The operatives of the ribbon blender at the time of the incident were accustomed to a machine that leaked premix and no doubt gave forth certain sounds during the course of operation. What Bailey has to say about any sound associated with the friction between the shaft and the end plate is I think a complete answer to why the sounds were not picked up by the employees operating the ribbon blender. Bailey was asked:

> "If there's high localised temperatures, there would be sound associated with that, wouldn't there?"

His response:

> "There could be. Yes, there could certainly be sound. In any frictional event there is sound associated with it. It's a question of whether you can pick that up or not."[154]

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[151] tr 897.
[152] *Dayman v Simpson* (1935) SASR 320.
[153] Written submissions of the defendants 1 March 2010 para 4.
[154] tr 960.

Edson said when the ribbon blender was switched on you could definitely hear it. There was a hydraulic motor but hearing protection was not required. He said when the ribbon blender was started up there was particular noise associated with it that he considered to be normal.[155] The point to be made here is that given the contact between the shaft and the hole of the end plate was something that had endured for a number of years, any noise emanating from this would be part of the normal sounds of the ribbon blender, at the time that it was first operated, prior to the ammonium nitrate being augered into it from the hammer mill.

152 Price, when discussing maintenance, said that in order to perform this task properly everything should be disconnected and the shaft would be rotated by hand absent any noise or other machinery. In that circumstance any sound or vibration could be detected.[156] He further went on to say that there would be other sources of noise in normal operation and that is why it was a maintenance task absent any noise to detect the problems with the shaft and contact with the shaft.[157]

153 It was put to Price that if in fact there was contact between the shaft and end plate, that would create drag and the ribbon blender would have stopped immediately. Price disagreed with this and thought such contact was not a very significant source of drag.[158] He thought the drag from the metal-to-metal contact would be less than one per cent of the power of the machine when comparing the amount of energy required to blend 600kgs of premix.[159] Simply put, the shaft grinding away on the end plates was not going to stall the ribbon blender. The ribbon blender stalled or became bogged if the revolutions of the machine were not sufficiently high at the time of the input of the ammonium nitrate. There was no setting on the speed adjustment, just a shift lever to a certain point.

Detonation – Explosion – The event

154 What is clear from all of the evidence is that the production of the explosive had not recommenced following the return to the factory of the employees from lunch.

155 Edson had made up the remaining boxes in the factory and had left the factory to use the forklift to pick up a pallet of cardboard to make into boxes. He did not turn on any machinery and he could not remember hearing the hydraulics after he returned from lunch. Other employees were not in a position to commence production. John recalled making up

[155] tr 174.
[156] tr 827.
[157] tr 827.
[158] tr 828.
[159] tr 828.

a couple of cardboard boxes and then checking the TNT kettle. Damian Harris had gone to the toilet block. As regards Darren Millington, from the location of his body parts, and the presence of a part of the Chub machine in his torso, this indicated that at the time of the explosion he had been at or close by the Chub machine. Matthew Keeley's body was located outside the factory in a drum enclosure. His body was intact and there were no foreign items located in his body which would indicate he was not close to the origin of the blast.

156 There was no input of energy from any machinery post lunch. The last piece of machinery in use prior to lunch was the large auger which had been used to convey the premix from the bowl of the ribbon blender into the premix silo.

157 I have decided there was metal-to-metal contact between the shaft and end plates of the ribbon blender. This is clearly a source of friction. The complainant's case was that whilst the ribbon blender was operating, particles of premix were exposed to friction (heat) at this trapping point (the shaft and end plates). This friction created a hot spot and the hot spot survived and became self-supporting or self-generating. The hot spot was then augured from the ribbon blender bowl into the large auger to a place of confinement, where it remained over the lunch break.

158 Bailey was asked whether he was familiar with the term "cook-off". He agreed that this was a loose term. It describes an explosion either a detonation or a very rapid deflagration or a mixture of the two. Cook-off is an explosion resulting from heating of the explosive either by external sources or from reaction within the explosive itself doing self-heating. He said that cook-off could be a delayed explosion. A delay could be anywhere from a few seconds through, in his personal experience of one hour and ten minutes, and from literature cook-off reactions occurring after two or three days.[160]

159 He described the reaction process involved. He said that it starts with a hot spot developing as a result of friction, impact or shock – an insult to the explosive generates heat. A hot spot is formed, being a tiny amount of explosive within the bulk of the explosive. The hot spot grows, sometimes slowly, sometimes rapidly, and accelerates. For it to accelerate to an explosion requires confinement. You must have confinement and the explosive itself must be porous. Once a hot spot has been created it does not need any further heat to continue, it can be self-supporting. Not every hot spot has to burn to an explosion.[161]

160 He said it was feasible that a hot spot created in the ribbon blender, and then augered out of the ribbon blender into the large auger, could some

[160] tr 937.
[161] tr 938.

time later result in an initiation of detonation in the larger auger.[162] The conditions for cook-off are confinement and porosity and both are present within the auger itself. The porosity exists because the premix is a granular material and the enclosing outer wall of the auger provides confinement.[163]

161 To create a hot spot the temperature involved could be as low as 145 to 160°C. The lower the temperature that it starts at generally the longer will be the time to cook-off. Given that there was about an hours delay you would be looking at a lower starting temperature of the reaction.[164]

162 It was not necessary in order to create a hot spot to heat the whole of the premix. You only need to heat a small amount of the material. You do not need to heat anything much more than 1mm or 2mm in diameter of material to have the potential to grow to explosion.[165] Bailey held the view that given the contact between the shaft and end plate, a small amount of premix entering into that trapping point could give rise to quite an intense hot spot. It is likely that there were very high-localised temperatures.[166]

163 It was put to Bailey, that given the presence of a small hot spot in a large volume of mix contained in a bowl with metal sides, was not the most likely scenario that the hot spot would cool down. He agreed, but indicated that unlikely events were being discussed and there was a possibility that a hot spot did not cool down but continued to react. He said the hot spot had to maintain itself not necessarily grow.[167] What was being discussed was a hot spot which has been generated and then survives in the mix. This was possible.[168] Heat comes from the hot spot's reaction with the fuel.[169]

164 Bailey explained the sequence of events.[170] The premix extracts heat from an outside source (the shaft contacting the end plate). Once an endothermic reaction exists the exothermic reaction is easy to maintain. Essentially you have to have heat put into the system to start the system off in the first place and the proposal is that that came from friction. As soon as you get the first endothermic reaction the first molecule reacts, it takes in heat, undergoes its endothermic breakdown then it is free to do an exothermic reaction and the heat from that supplies the heat for the next endothermic reaction and so it goes on. It is a chain reaction. He

[162] tr 939.
[163] tr 939.
[164] tr 940.
[165] tr 940.
[166] tr 959, 960.
[167] tr 952.
[168] tr 953.
[169] tr 953.
[170] tr 960, 961.

was asked whether that would be traceable if the correct residues were collected. His response was that it would not be traceable as what is being discussed are very small hot spots within a bulk of material. All evidence would be scattered by the subsequent explosion. There would not be residues at the point of the explosion as the material has been consumed at that point. You use up the material to give the explosion.[171]

165 Braithwaite's conclusion was put to Bailey namely that the hypothesis put forward by Price in regard to cook-off and hot events was not plausible. Bailey's response was:

> "I'm saying the evidence, such as it is, is not inconsistent with Professor Price's proposal. It is not a likely proposal, but we have to look for unlikely events in these circumstances. I think the absolute truth will never be known."[172]

166 Bailey went on to explain what he meant by unlikely events.[173] When looking at the system in an explosives plant the intent is to identify all possible sources of heat or possible sources of initiation of the explosive and devise systems to mitigate each one of those as far as is reasonably practicable to reduce the danger of explosion. If that is not done and there is a source of friction it would not be unusual for hot spots to be created as most accidental explosions are generally due to friction. It is unlikely that hot spots will survive but generate enough of them and one of them will and that is what is meant by a rare event. All previous hot spots did not become self-generating. If they had then there would have been an incident.

167 The defendants rely upon the evidence of Braithwaite.[174] Braithwaite prepared a report,[175] the report being dated May 2009. When giving evidence he referred to a PowerPoint presentation.[176] The material contained in the PowerPoint presentation was not put forward in cross-examination to Bailey to make comment upon.

168 The approach taken by Braithwaite in the presentation of his evidence and comments made in his initial report and arising out of cross-examination were indicators of an expert witness not fulfilling the duties and responsibilities that I have outlined above.[177] For example in his initial report[178] he talks of ammonium nitrate undergoing a number of solid phase transitions ultimately becoming a liquid at about 169°C. Its

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[171] tr 960, 961.
[172] tr 963.
[173] tr 963.
[174] Submissions of the defendants 1 March 2010 para 4 and 5.
[175] See Exhibit D25.
[176] Addendum to Exhibit D25.
[177] Para 127 and 128.
[178] Exhibit D25 May 2009 para 4.

decomposition chemistry, at least in the early stages of reaction, comprises an endothermic path. He then goes on to say that the additional presence of any catalyst or accessible fuel will tend to distort this simple picture and reduce the onset temperature for an exothermic reaction. The critical temperature, which a cook-off can occur, is also dependent on its thermal environment, confinement, state and inventory of reactive material.

169 Braithwaite in his PowerPoint presentation relied upon slide 5 to state that in order to get a hot spot reactive there has to be a temperature of over 400°C. In cross-examination he conceded more than once that he should not have used this slide[179]. It was not a good choice of slide because the hot spots in the scenario depicted in the slide have been created by a shock wave and not a frictional event. This reliance upon a temperature of 400°C is contrary to what he referred to in his report namely a temperature of about 169°C leading to decomposition (endothermic path). Price referred to an article of the Canadian Journal of Hazardous Materials[180] in relation to the onset temperature for the premix[181]. The article refers to early signs of self-heating (self sustaining reaction) being detected at temperatures as low as 145-160°C.

170 Bailey was not cross-examined about the temperature ranges and requirements. Bailey did however make reference to the article from the Canadian Journal of Hazardous Materials. Bailey stated that the lower the temperature that the reaction starts at, generally the longer time will be involved to cook-off.

171 The evidence by Braithwaite about the temperature of 400°C is also contrary to an extract from Partington's Textbook of Inorganic Chemistry[182] which was put to him whilst he was under cross-examination. His response was "that's an old thing" and "it's not a book that he read". That is an unhelpful response and not in accordance with the role of an expert. Braithwaite did agree that the reaction with ammonium nitrate becomes exothermic as you approach 200°C.

172 Braithwaite in his PowerPoint presentation made reference to a text from Bowden and Yoffe relating to friction velocities.[183] Braithwaite agreed with the suggestion that the material shows that with very small loads to relatively small speeds a temperature of 520-570°C can be achieved.[184] The particular experiment depicted in slide 7 involved rubbing glass against metal. A low velocity of 0.11 metres per second with a load of

[179] tr 1450.
[180] See Exhibit C83.
[181] tr 912, 913.
[182] See Exhibit C100.
[183] Powerpoint presentation slide 7.
[184] tr 1455.

0.95kgs achieved the resultant temperature. Braithwaite, taking into account the scenario where the ribbon blender shaft is rubbing against the ribbon blender bowl such that it causes lipping, accepted that there could be a considerably greater load than 0.95kgs. He thought possibly that stainless steel to stainless steel rubbing would create a more severe friction environment than glass to metal but that he did not have the data to prove it. Braithwaite in his report at para 6.1 said that the contact between the shaft and the end plates was a more credible source of local heating caused by continuous friction. He went on to say "on any explosive plant, moving components such as bearings and seals on rotary equipment are the subject of close and regular inspection; frictional heating of a confined explosive medium can easily lead to local explosion and loss of containment. In the event of frictional heating at the shaft-endplate interface, one would anticipate the possibility of this leading to a deflagration in the mass of material in the blender".[185]

173 The defendants maintain that it is extremely unlikely that a reactive hotspot could be created by low frictional velocity.[186] I reject this submission. Braithwaite does not support this contention when his evidence is analysed. Slide 7 in his PowerPoint presentation supports the attainment of high temperatures being achieved even where there is low velocity and a small load.

174 Braithwaite said that once ammonium nitrate becomes molten it is a lubricant and that you do not have the friction event anymore. Even though the friction event was continuous whilst the ribbon blender was operating his response was that you continuously have ammonium nitrate as a lubricant keeping everything functioning quite satisfactorily. Given the nature of the ammonium nitrate and the melting process he would not unduly worry unless the weight was well in excess of 10kgs. Braithwaite did not know the weight of the shaft. He did concede that the load would be very substantially increased in the ribbon blender by virtue of the shaft and the amount that was being mixed and that there could be a considerably greater load than 0.95kgs.[187]

175 I prefer the evidence of Bailey where it conflicts with Braithwaite. Bailey stated that it was feasible, that a hot spot created by the friction between the shaft and the end plate of the ribbon blender, then in turn augured out of the ribbon blender into the large auger, where it remained over the period of the lunchbreak, could survive and then some time later cause an initiation of detonation. As Bailey indicated the cook-off requirement of confinement and porosity are both present in the auger itself.

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[185] See Exhibit D25.
[186] para 4.2, written submissions of the defendant filed 1 March 2010.
[187] tr 1457, 1458.

176 There are several examples of Braithwaite not properly presenting to the Court as an expert. These have been referred to in detail in the complainant's written submissions dated 16 February 2010 at p 34 and 35. Braithwaite was constantly critical of the testing of the premix properties. However he did not request a copy of the actual report of DSTO.[188] He also put forward the possibility of an aluminium dust explosion on the basis that the dust extractor system was turned on just prior to the explosion. He could not say where he obtained that information from and the evidence is that the dust extractor system was not turned on. He subsequently indicated that his scenario concerning aluminium dust explosion was speculative and had not been considered in terms of the evidence. He also presented in court an alternative scenario for an aluminium dust explosion which involved tipping material into the ribbon blender seconds before the explosion. Again there was no evidence for that and he had not bothered to find out where the bucket in question was following the incident.

177 He also put forward opinions on matters outside his expertise regarding damage to flutes and also to the crater underneath the premix silo. I have made previous reference to the fact that he stated that he would never disagree with Begg and then began to disagree with Begg. His lack of objectivity is demonstrated in his description of Bailey as an "administrator".[189]

178 The defendants dispute the significance of Point A.[190] Potts did not disagree with Price's evidence that the detonation initiated at Point A in the large auger.[191]

[188] tr 1435, 1436.
[189] tr 1451.
[190] Written submissions of defendant 1 March 2010, p 8, para 3.
[191] See Figure 9 Exhibit C73 at p 36, reproduced herein.

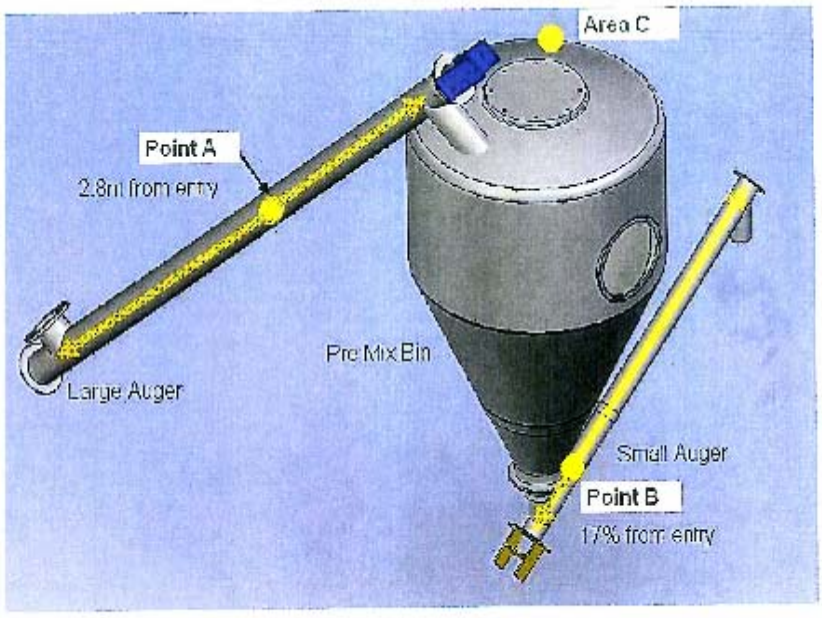

Figure 9 The three vessels in which detonation occurred.

179 Braithwaite in his PowerPoint presentation reproduced part of an article relating to an explosion of premix plant of slurry explosive, in Norway, in 1973, which showed the central screw part of an auger. The full discussion of that explosion[192] (which was not part of Braithwaite's presentation) indicated that the explosion occurred inside the steel tube surrounding the screw. The report stated, that once the steel tube had been removed, this revealed the screw rings, which had been deformed bi-directionally as if an explosion in the central part had expanded violently in both directions. Braithwaite did concede that the bi-directional nature of the flutes at Point A was a strong indication of the location of the centre of the explosion after the production of the full extract contained in Exhibit C99. The explosion discussed in Exhibit C99 was a much lesser explosion than here. The outer shell of the auger remained intact. Debris was only scattered up to a maximum of 75m from the explosion site. Braithwaite was shown photograph 19 in Exhibit C74 which was a photograph of the screw of the large auger. He was referred to the flutes going in two different directions. Whilst he had not heard of the expression "bi-directional deformation of the screw wings from the explosion centre" he thought that it seemed consistent with the photograph. As to whether this would be a strong indication of the explosion having initiated at that point given the bi-directional deformation of the screw wings, his response was: "I see no reason why you would not say that".[193]

[192] See Exhibit C99.
[193] tr 1415.

180 Price referred to the flutes at Point A being bent away from the position in each direction. At that point there was sufficient reacting material to lead to a detonation. Bailey referred to the requirement for cook-off being both confinement and porosity and those requirements being present in the auger. The location of Point A was based on an inspection of the screw part of the auger and had nothing to do with the clamps or support. The large auger linked the ribbon blender with the premix silo.

181 Price stated that there was strong evidence that the initiation was at Point A. The final three photographs in the bundle of photographs taken on 2 December 2009[194] indicate that from Point A the flutes move in opposite directions. In particular in photograph 19 the flutes towards the top of the page are moving upwards and the flutes towards the bottom of the page are moving downwards. The point of detonation is somewhere in the middle and the event goes up and down the auger at the same time. If the event commenced at one end only the flutes would all have been bent in the same direction and the expectation would have been that the gas wash marks would also be in one direction.[195]

182 I accept from the brief summary of the evidence referred to above (and there are numerous further references consistent with the same conclusion) that the complainant has established beyond reasonable doubt that the detonation occurred at Point A. The critical piece of evidence is the screw flight of the large auger showing bi-directional bending of flutes away from the position of Point A together with the gas wash marks coming away from that position. Further the encasing shell of the large auger was completely fragmented.

183 I find that a hot spot(s) was created as a result of friction due to the contact between the end plates and the shaft of the ribbon blender. A hot spot(s) was conveyed into the large auger (Point A) where it remained and, over the lunch break being self-supportive, slowly developed to initiation of detonation.

Finding – Particulars 1.4(a) and 1.5(f)

184 I find, for the reasons expressed above, that the complainant has proved beyond reasonable doubt that the first defendant failed to properly maintain and repair the ribbon blender (it being a critical item of plant).

185 I further find that the complainant has proved beyond reasonable doubt that the first defendant permitted the use and operation of a critical item of plant, namely the ribbon blender, whilst it was in a state of disrepair.

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[194] See Exhibit C74.
[195] tr 762, 763.

Count two – Second defendant charged with a breach of s 61(3) of the Act

186 The details of the charge are contained in para 13 above. The elements of the offence created by s 61(3) are referred to in para 15 of this decision.

187 There is no doubt that the second defendant is the responsible officer of the first defendant. The second defendant has admitted this.[196]

188 Did the second defendant, as responsible officer, take reasonable steps to ensure compliance by the first defendant with its obligations under the Act?

189 The totality of the evidence leads me to find that the second defendant took no reasonable steps to ensure that the first defendant provided and maintained plant in a safe condition. Whilst the defendant had created a document relating to safety management systems,[197] there was no evidence of any practical application of the document. Records of maintenance work that were kept on timesheets or in diaries were few and far between and were totally inadequate.

190 Begg detailed the preferred approach as regards maintaining plant in a safe condition in an explosives factory. There was no system of preventative maintenance in place at the factory. Maintenance was on an as needs basis.

191 Maintenance periods during the closure over the Christmas/New Year period were essentially confined to the Chub machine. The rest of the work activity was a cleaning up operation. Stringer as the person in charge of maintenance had never been asked to look at components of the ribbon blender during the entire period he was working with the first defendant.

192 The second defendant took no reasonable steps to ensure that the first defendant provided to employees a safe working environment. He took no steps to prevent the manufacture of TNT occurring at the same time premix was being prepared. John was asked by the second defendant to check on the TNT kettle after the lunchbreak, and if the melting process had been completed, John was supposed to top up the TNT mould which was cooling on the smaller loading platform.

193 Both Edson and John described the features around the factory on the day of the incident. Present was the methoxide tanker, the methanol tanker, cast TNT cooling on the small landing, TNT melting in the kettle in the factory and a large quantity of TNT stored in sea containers in

[196] See Exhibit C32, p 11, line 35.
[197] See Exhibit C40.

proximity to the factory. The second defendant did not take reasonable steps to ensure that the first defendant removed these items or ceased production of the TNT whilst the factory was in operation. The second defendant has failed in his duty to take reasonable steps to ensure compliance by the first defendant with its obligations under the Act and such failure contributed to the commission of an offence by the first defendant.

Finding – Particulars 2.1, 2.2 and 2.3

194 I am satisfied that the charge against the second defendant has been proved beyond reasonable doubt. I am also satisfied that the offence committed by the second defendant has contributed to the commission of an offence by the first defendant.

Summary

195 The complainant has proved beyond reasonable doubt as against the first defendant the offence as charged in count one. The first defendant as employer had an obligation to ensure the safety of its employees so far as was reasonably practicable. It failed to do so. In particular it failed to provide and maintain so far as was reasonably practicable plant in a safe condition.

196 There was a failure on its part to undertake a system of maintenance of critical items of plant, one such critical item being the ribbon blender. The ribbon blender played a key role in the devastating event that occurred on 9 May 2006. The clear evidence was that the ribbon blender had not been properly maintained, in particular the shaft and end plates of the ribbon blender had never been inspected during the long period of its operation at the factory. A hot spot in the premix was created as a result of friction due to the contact between the end plates and the shaft of the ribbon blender.

197 There were either no records or inadequate records of maintenance in relation to critical items of plant and there were either no or inadequate drawings or manufacturer's instructions in relation to critical items of plant.

198 The environment around the factory on the day of the incident was heavily criticised by the experts called on behalf of the complainant.[198] The unsafe working environment resulted from:

- the storage in close proximity to the factory of approximately 4,500kgs of cast TNT;
- the storage in close proximity to the factory of approximately 20,000 litres of caustic methanol or "methoxide";
- the storage in close proximity to the factory of approximately 20,000 litres of methanol;
- the process of melting cast TNT in the factory at the same time the factory was being used to produce premix explosive;
- there being on a loading platform of the factory a cast of molten TNT undergoing a cooling process; and

[198] See generally the evidence of Begg, Bailey and Price.

- the continued use of a critical item of plant, namely the ribbon blender, whilst it was in a state of disrepair.

199 The second defendant as the responsible officer failed to take reasonable steps to ensure compliance by the first defendant with its obligations under the Act. Such failure contributed to the commission of an offence by the first defendant.

200 The business conducted by the first defendant on 9 May 2006 at Gladstone was the manufacture of explosives. The bad practices of allowing the premix operation and the TNT operation to occur at the same time, as well as the storage of methoxide, methanol and TNT in close proximity to the factory, clearly indicates that the defendants did not take any positive steps to make risks as low as reasonably practicable. The end result was that employees engaged in the factory on 9 May 2006 were put at risk. Tragically as a result of an explosion that occurred in the factory Damian Harris, Darren Millington and Matthew Keeley were killed and Cameron Edson and Damian John were injured.

201 Having found the defendants guilty as charged, I will hear the parties' submissions as to the penalties to be imposed.