

Watergel Plant Detonation

Gladstone - South Australia

May 2006

The Power
of Partnership

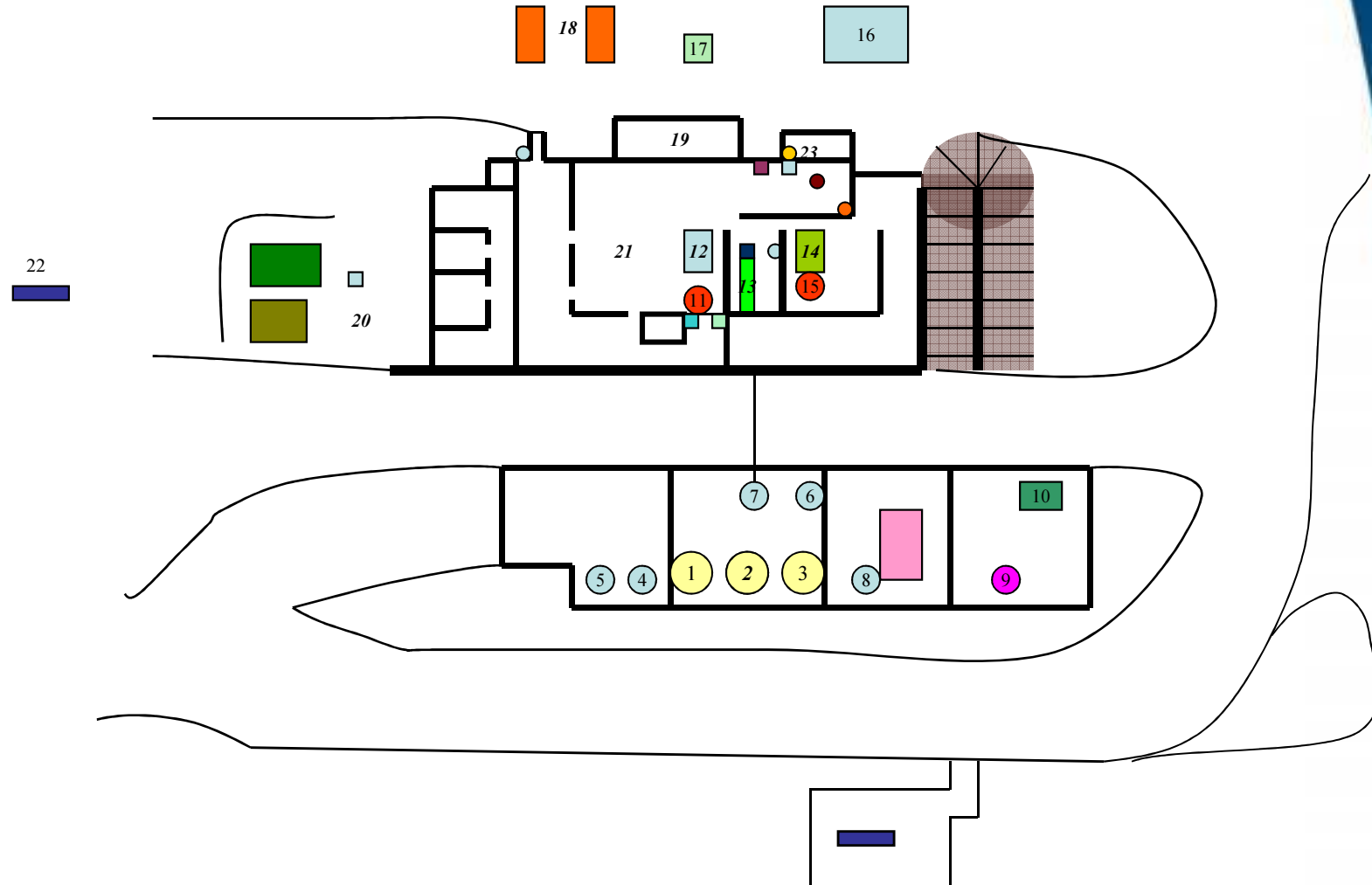


The Plant

Quins Investment is a multi-purpose site that undertakes a number of explosives manufacture and storage activities at its site in Gladstone, South Australia including:

- Toll manufacture of watergel explosives
- Specialty TNT castings
- Bulk explosives manufacture and delivery

Plant Layout



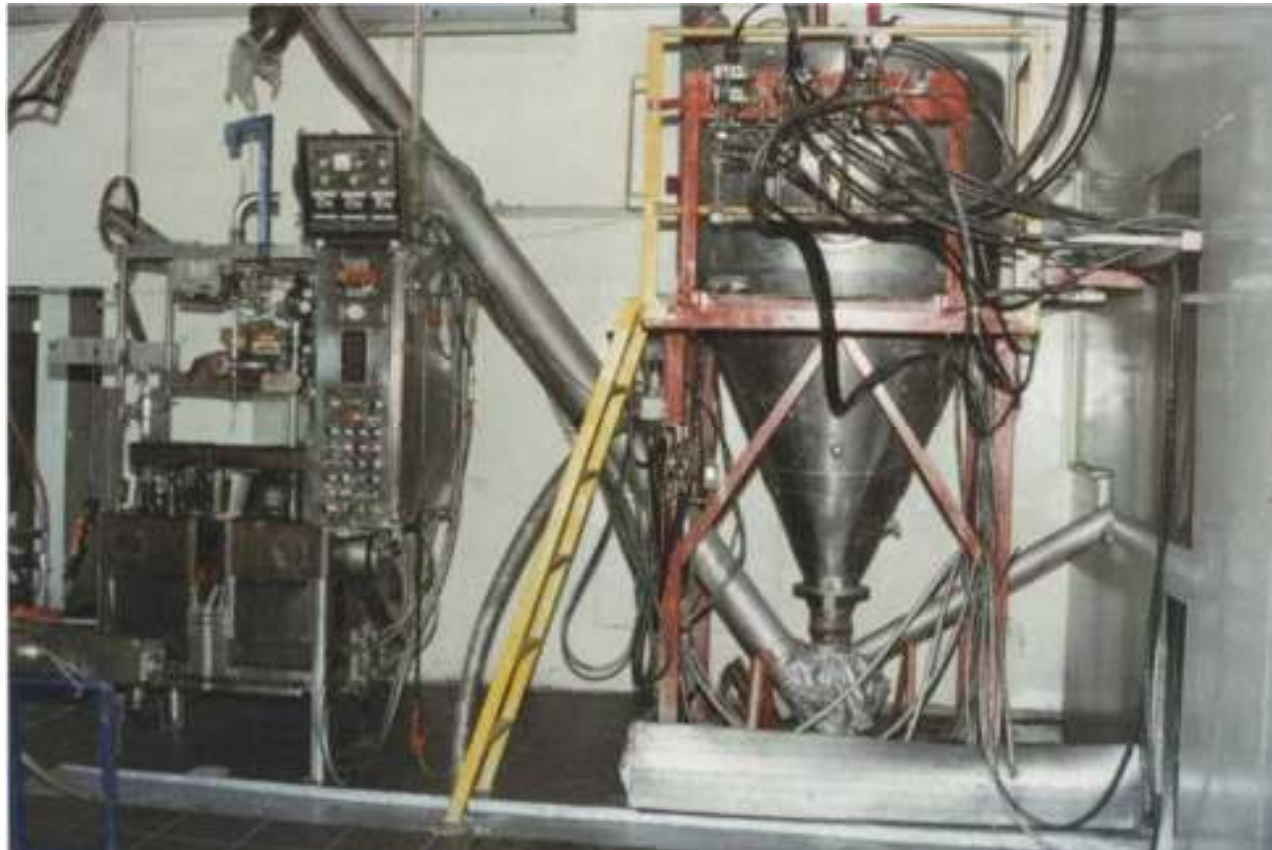
AN Crushing Equipment



Pre-Mix Blender



Pre-mix Hopper and KP Machine



Packing Room



Loading Platform



Transformer and Air Conditioning



ANS & Nitric Acid Tank Farm



TNT Storage



TNT Melting Pots



TNT Casting



The Incident: 26 May 2006

- The team in the Watergel Plant had spent the morning completing two weeks of TNT castings, and preparing a batch of pre-mix (a mixture of paint grade aluminium, crushed AN and a mixture of gums) prior to restarting manufacture of packaged watergel.
- Several batches of pre-mix were stored in the pre-mix hopper ready for a production run after lunch.
- After returning from an early lunch, the team began to get the plant ready.
- A large explosion took place just after the first operator entered the packaging room.

The Incident



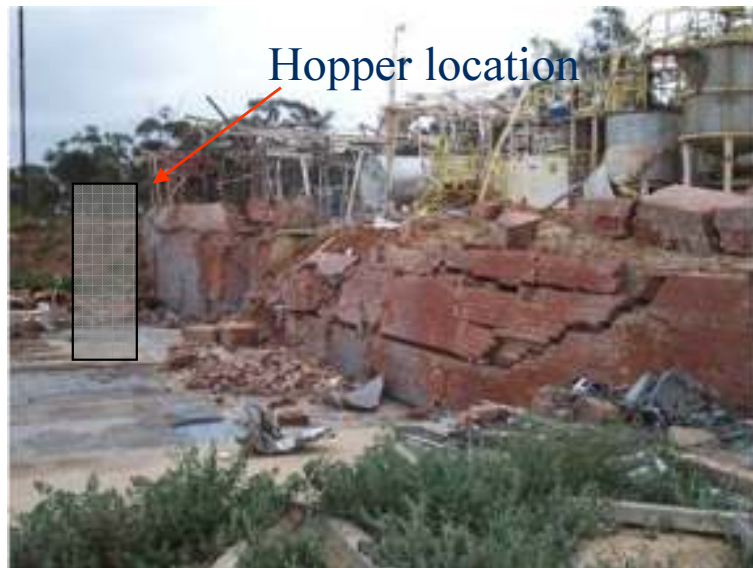
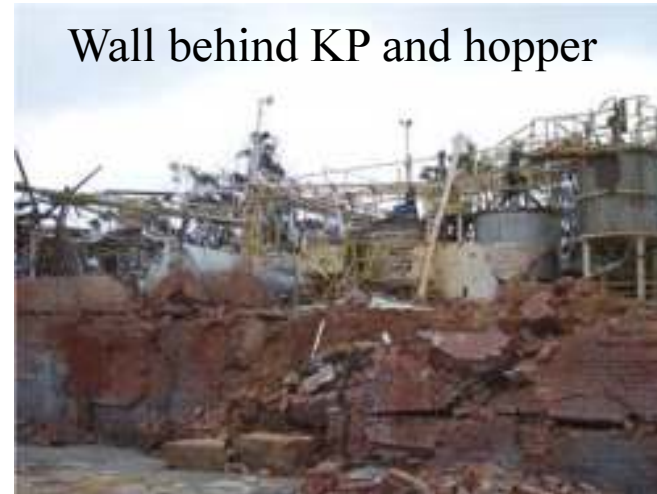
The Incident



The Incident



Area of the Blast



The TNT Fire



The Incident

There were five people present in the plant at the time of the explosion

- Three of the team died
- Two survived



The Incident

Evidence at the scene suggest the explosion took place in the area shown below, with a crater under the site of the pre-mix hopper.



The Incident

The explosion triggered an intense fire in the nearby storage magazines where TNT castings were stored



The Causes

- South Australian authorities have still not released an official report on their investigations.
- The site has been released back to Quin in August 2007.
- The evidence on the site is consistent with the full order detonation of the contents of the pre-mix hopper.
- The movement of material appears to be radially away from the area of the pre-mix hopper as centre.

The Causes

There are several possibilities

- Frictional ignition in either the inlet or outlet augers of the pre-mix hopper, leading to a deflagration to detonation transition.
- Hydrogen explosion caused by evolution of hydrogen from the paint grade aluminium initiating a subsequent dust explosion in the pre-mix hopper.
- Dust explosion in the extraction system that contained both gums and aluminium powder.
- AN decomposition reaction in the pre-mix hopper.

The “Official” Cause of the Incident

Extract from the ‘official’ report produced by Professor Price:

- 1) Poor design, construction and maintenance of the ribbon blender led to long term rubbing and wear of the shaft and the ribbon blender bowl end plate.
- 2) This rubbing produced on the morning of 9 May 2006 by friction a reacting volume of pre-mix.
- 3) This reacting material was then pumped up into the large auger to a location termed in this report Point A (2.8 metres "up the large auger").

The “Official” Cause of the Incident

- 4) The reaction gained strength over a period of about an hour through a process termed "cook off".
- 5) The reaction increased in intensity such that it eventually caused for a few seconds an effect termed "the hot events". The hot events emanated from Point A and caused damage on plant and buildings in the area of the pre-mix line just prior to the main detonation.
- 6) The cook off led to the initiation of the main detonation at Point A.

The Learnings

- The search for bodies was not completed until 21 days later, and some body parts were returned to the family after the formal burial
 - *Include an effective search and rescue plan in your emergency plan, with a clearly designated leader.*
- The TNT facility burned for almost a day, during which no search or rescue effort could be undertaken
 - *Consider the effects of post blast fires in ER plans.*
- The roof of the building was asbestos, with possible contamination complicating search and investigation procedures
 - *Consider building materials and the impact they may have in the event of a blast.*

The Learning

- Knock-on explosion of the nearby 5t TNT would have increased the number of casualties, and would have greatly complicated the subsequent investigation
 - *Minimise explosive inventories around manufacturing plant.*
- The electrical power to the site was lost and then reinstated just prior to the blast
 - *Ensure plant powers down in a safe fashion and cannot restart without intervention.*

The Learning

- Both guar gums and aluminium powder are prone to dust explosions, with only low amounts of energy required for their initiation
 - *Consider controls such as humidity control and earthing in buildings where these materials are used. Regular checks and calibration of these systems are also required.*
- Have up-to-date detailed drawings, especially P&I drawings, for the plant.
 - *As a minimum have in a safe location a photographic record of the all manufacturing facilities.*

Thank You