SOLAR

Safety • Quality • Reliability

Permitted Explosives for Underground Coal Mines in Australia

Ryan Brogden
Manager Safety, Security and Compliance

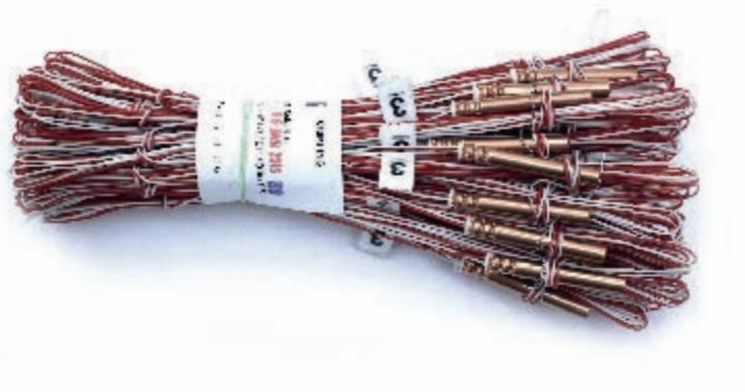
4th ISEE Australia Conference
8-9 November 2018

INTRODUCTION

- What, Where, Why, How - permitted explosives
- Australian testing requirements
- Current problems with permitted
- Approaches to fix the problems

WHAT ARE PERMITTED EXPLOSIVES

- Permitted explosives (permissible in USA)
  - Tested and approved for coal mines where risk of igniting combustible gases or coal dust



WHERE PERMITTED EXPLOSIVES USED

- Underground coal mines with a risk of methane or coal dust explosion
- In Australia potential 100 tonnes p.a. (5000 tonnes p.a. for India)
- Qld and NSW (~14 U/G coal mines)

WHY PERMITTED EXPLOSIVES

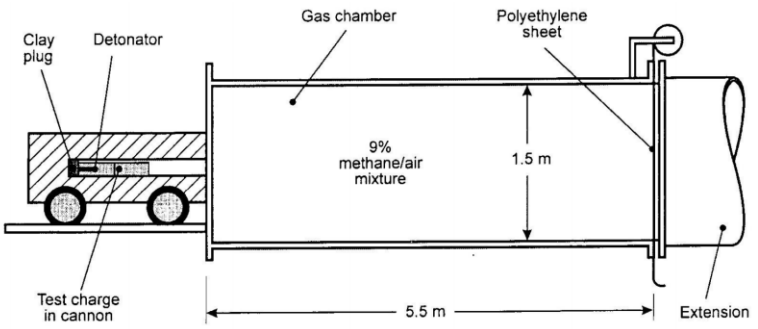
- Permitted explosives prevent:
  - Ignition of methane by the explosive
  - Ignition of coal dust by the explosive
  - Burning explosives that ignite methane liberated by or during the shot

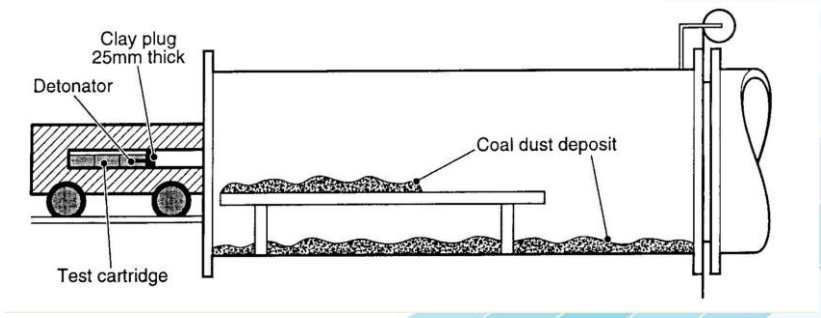
HOW PERMITTED EXPLOSIVES WORK

- Important elements for permitted:
  - minimum possible quantity of NOx gases
  - flame lower temperature and shorter duration
  - cooling agents – e.g. ammonium nitrate and sodium chloride

TESTING REQUIREMENTS

- HSE Buxton Gallery test (first developed 1877)
  - TM2 for packaged explosive
  - TM13 for detonators
- Similar tests in other countries
  - UK, USA, India, Europe, China, Japan etc.





TEST MEMORANDUM TM 2

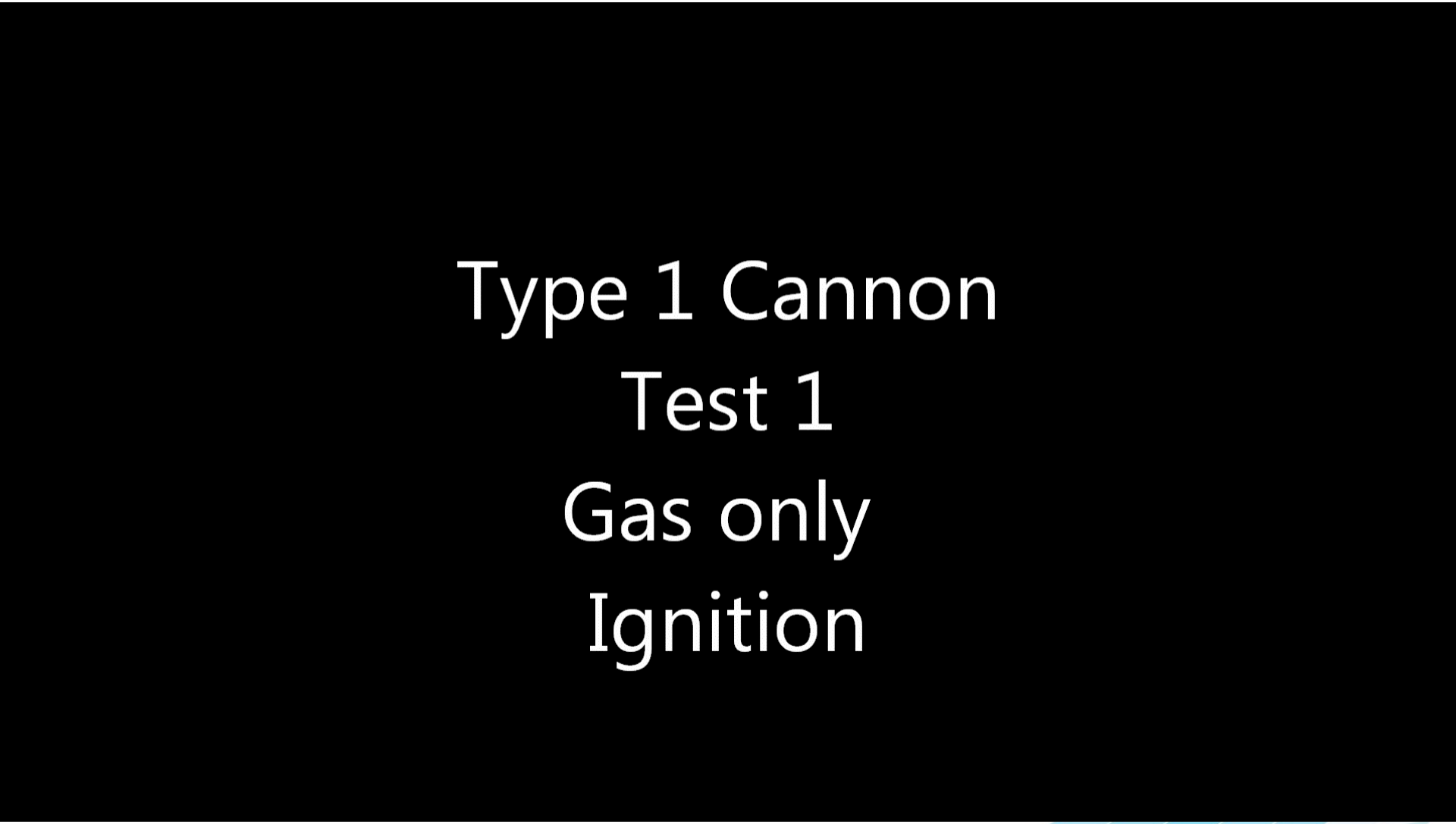
Test and approval of explosives for use in coal mines and other mines in which flammable gas may be a hazard

Testing Memorandum TM 2

(Revised April 1995)

Group P1	Single, simultaneous or delay firing in shafts and drifts.
Group P3	Single or simultaneous firing in undercut coal, rippings, dintings and scouring.
Group P4	Primarily for delay firing in undercut coal and rippings.
Group P5	Primarily for delay firing in solid coal.
Group P4/5	Delay firing in undercut coal and rippings and delay firing off-the-solid.

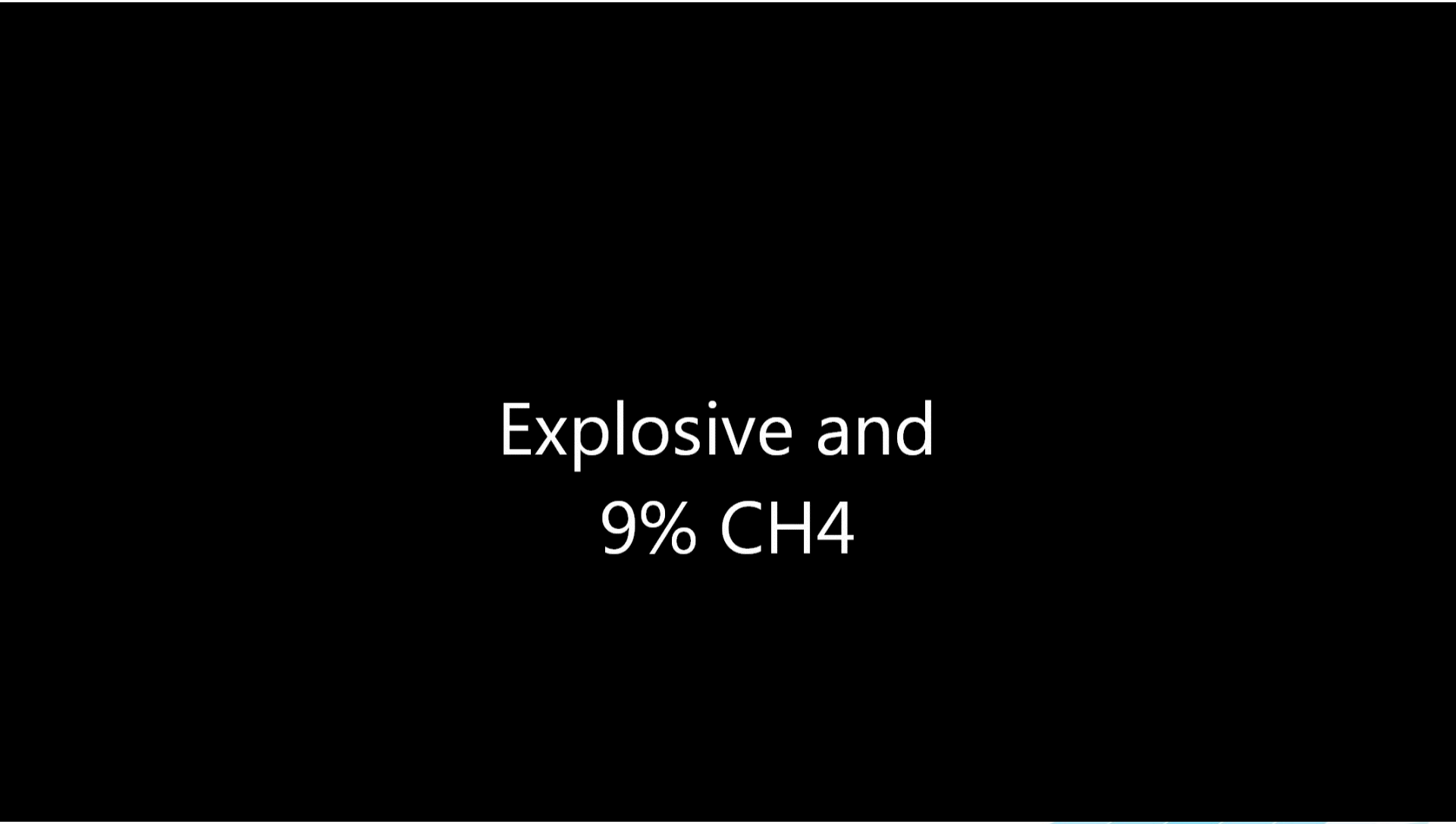
TEST CANNON LONDONDERRY VIDEO



TEST CANNON LONDONDERRY VIDEO

TEST CANNON LONDONDERRY VIDEO

TEST CANNON LONDONDERRY VIDEO



TEST CANNON LONDONDERRY VIDEO

TEST CANNON LONDONDERRY VIDEO

TEST CANNON LONDONDERRY VIDEO

TEST CANNON LONDONDERRY VIDEO

TEST CANNON LONDONDERRY VIDEO

TEST CANNON LONDONDERRY VIDEO

TEST CANNON LONDONDERRY VIDEO

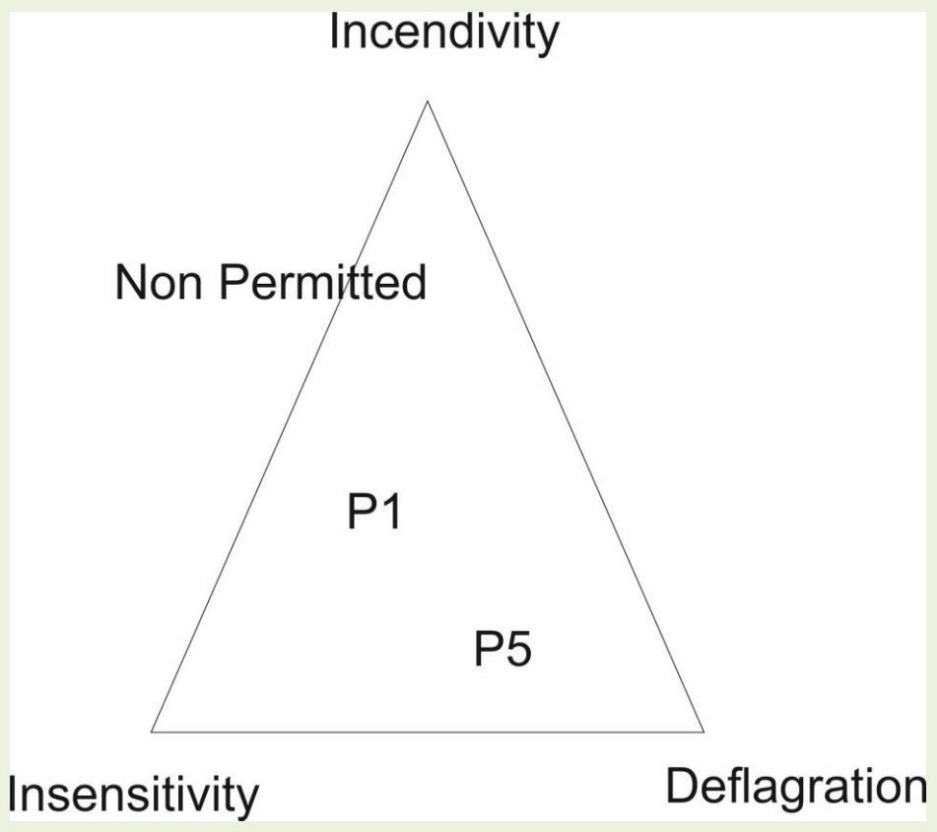
TEST CANNON LONDONDERRY VIDEO

TEST CANNON LONDONDERRY

Courtesy of Duncan Chalmers, UNSW

INCENDIVITY, INSENSISVITY, DEFLRAGRATION

- Test aims:
  - Incendivity – ability to ignite
  - Deflagration – ability to burn rapidly
  - Insensitivity – ability to detonate (FISH)



Duncan Chalmers – ACARP project 20033
http://outburst.miningst.com/wp-content/uploads/2016/11/Chalmers%20-Blasting.pdf

CURRENT PROBLEM WITH PERMITTED

- Currently no P5 available in Australia
- TM2 test suitable for emulsion based explosives?
- Test cannon availability (commissioning)
- Research by UNSW delayed
- Qld CIE Coal Mines letter restricting use of P1 in P5
- NSW Gazette 2008 – P1 in P5 with risk assessment
- 15+ years of not prioritising critical issue…

OTHERS MEANS TO REMOVE COAL?

- Grunching (traditional D&B)
- Mechanical mining methods
- Leave the coal in affected areas

- Delay in continuous mining = $$$

POSSIBLE SOLUTIONS

- ALARA approach for using P1 in P5 applications
- Research to develop “new” Australian TM2 test for emulsion based permitted explosives
- Accept overseas testing, e.g. USA, India, China, other?
- Jurisdictions collaborate on critical safety issue
- Others (please share)

NSW Government Gazette No.10 25/01/2008

Permitted explosive shall only be used in the hazard scenario or circumstances simulated in the relevant TM2 test, such as Group P1 (single, simultaneous or delay firing in shafts and drifts) and P5 (primarily for delay firing in solid coal), except as follows.

Alternate uses are acceptable provided:

(i) A risk assessment in accordance with MDG 1010, or equivalent, demonstrates at least an equivalent level of safety, and

(ii) The risk assessment and additional control measures, if any, are reviewed by an independent party experienced in underground coal blasting who attests to their adequacy, and

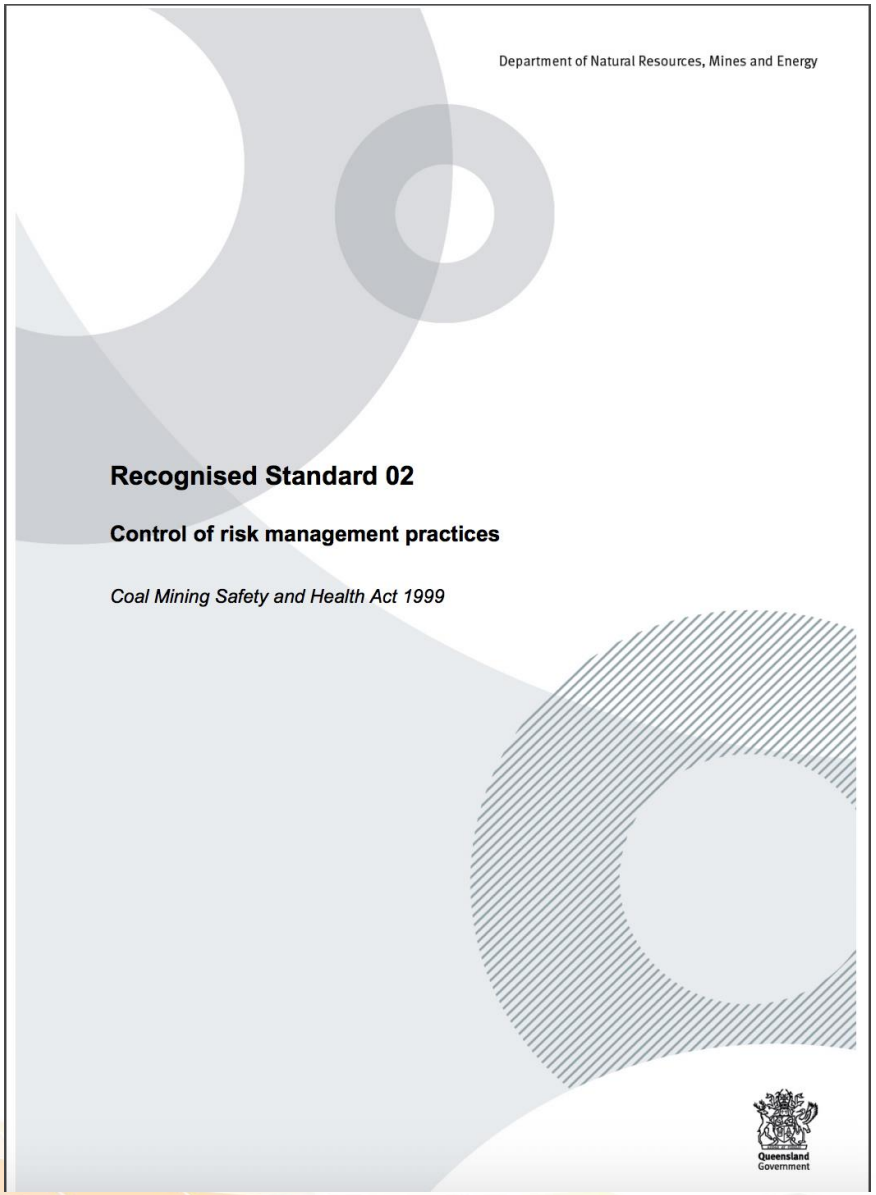
(iii) At least two weeks notice is provided to the Chief Inspector or his delegate, and

(iv) A safety file is to be made up containing risk assessment and review documents, description of proposed shotfiring activities, and location/ district ventilation plan. The safety file is to be maintained at the mine and provided to an inspector on request.

Dated this 23rd day of January 2008.

ROBERT REGAN,
Chief Inspector

RISK MANAGEMENT



- NSW and Qld regulation based on risk management
  - Qld Recognized Standard 02 Risk Management
  - NSW MDG 1010 Risk Management

RISK MANAGEMENT PRINCIPLES

- Reduce methane and coal dust explosion hazard:
  - Only use permitted explosives (P1/P3/P5)
  - Less that 1.25% methane (ventilation; LEL 9% - CH_4)
  - Stone dusting and stone bags (coal dust)
  - Power switch off before wiring blast (ignition)
  - Pattern design to minimize blown out shot (outburst)
  - Exclusion zone (evacuate mine)
  - Safe re-entry procedures

Explosion risk of using P1 in P5:

- Outburst from coal not draining methane
- Gas drainage hole blocked

ACARP FUNDING FOR PERMITTED

ACARP 2017 - Current Development of a Safer Underground Explosive C20033
Andres Castro, Duncan Chalmers (UNSW)

- Confusion arises as to how P1 explosives can be safely used in P5 applications
- Mines conduct risk assessments to manage the incendive hazard created by a cut off shot and the deflagration hazard
- Developing an alternate test regime that assesses the deflagration risk of an explosive
- Provide additional data to change the testing regime for permitted explosives

COMPARISON OF OVERSEAS TESTING

3.5.2 India

ICI Explosives and IDL Explosives both manufacture permitted explosives in India. **Explosives are tested as a requirement from the Indian government in a similar fashion to the Buxton Tests. The permitted explosives used in India are believed to pass the Buxton Tests for P1 and P5 explosives. However, testing done outside of India has found that these Indian explosives do not pass the deflagration test in the Buxton Tests.** P1, P3 and P5 explosives are the only permitted explosives used in India.

C13025 ACARP Report (2005)
Explosives in the 21st Century: Stage 1
An Investigation into the Rationale of Explosive Used in Underground Coal Mines
Duncan Chalmers, Karen Freak & Alison Freeman

C14039 ACARP Report (2008)
Explosives in the 21st Century: Stage 2
An Investigation into the Rationale of Explosive Used in Underground Coal Mines
Duncan Chalmers & Alison Freeman

OVERSEAS PERMITTED EXAMPLES

ORICA

YAHUA

EXPLOSIA®
Safety • Quality • Tradition • Innovation

OSTRAVIT® C

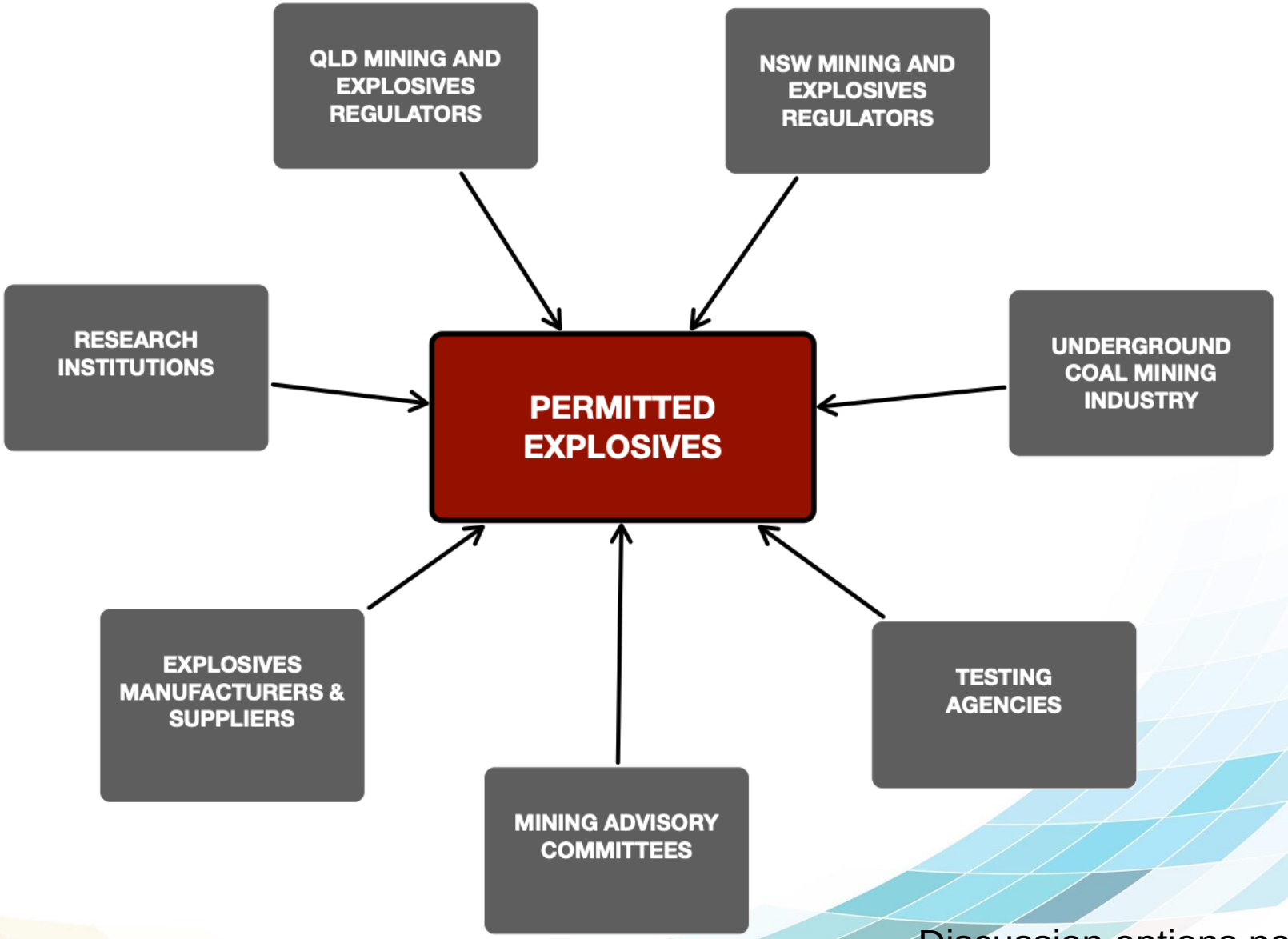
SOLAR INDIA PERMITTED EXPLOSIVES

- Currently Solar manufacture 5000 tonnes of P1, P3 and P5 explosives for India:
  - P1 – Super Coal 1
  - P3 – Super Coal 3
  - P5 – Super Coal 5

  - Solar CED (Copper Instanteneous Electric Detonator)
  - Solar CSDD (Copper Short Delay Detonator)

- Are overseas permitted explosives approved to non-TM2 test methods safe to use in Australian U/G Coal Mines?

SOLUTION THROUGH COLLABORATION



Discussion options paper

ACKNOWLEDGEMENTS

- Solar SMS Australia team
- Solar India team
- Duncan Chalmers, UNSW (collaboration)
- AEISG

QUESTIONS?

Contacts

ryanbrogden@solar-sms.com.au

Mobile: +61 (0) 409 764 476

LinkedIn: Ryan Brogden

www.solar-sms.com.au

Safety Executive (UK) Testing Memorandum No. 2 (TM2)

Permitted explosives are tested against the criteria in Appendix 1 of the Health and Safety Executive (UK) Testing Memorandum No 2 (TM2). The tests for P1 permitted explosives include (but is not limited to) the following;

- **Series (i) test**: Twenty-six shots each of 142 g inversely initiated and loaded as specified are fired without stemming into the specified gas mixture.
- **Series (ii) test**: Five shots, (for emulsion explosives substitute a temporary figure of 10 shots) each of 800 g directly initiated and loaded and stemmed as specified are fired into the specified gas mixture.
- **Series (iii) test**: Five shots, each of 800 g directly initiated and loaded and stemmed as specified are fired into coal dust of the nature and fineness specified.