Controlled Explosives Application Port Kembla Copper 200m Stack Demolition

'Expert' review of blasting proposal, procedures and risk assessment

I am a mining engineer who has specialised in explosives technology and commercial blasting applications for my 40+ year career. As outlined in my CV (Appendix) I work in most areas of civil and mining blasting including opencut and construction blasting. A major portion of my work in the past 25 years has been in managing Risk Assessments, blasting project evaluation, auditing blasting performances and training engineers and shotfirers in safe & efficient blasting.

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Principal Blasting Consultant
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Consulting Explosives Engineers

27 September 2013

Procedures & checklist for demolition blasting

Contents

1. Scope

This report summarises safe working procedures, design, environmental and other blasting matters relating to a proposal to utilise small controlled blasting charges to fragment and dislodge components of the reinforced concrete chimney. The requirements of Australian Standard 2187 Part 2: 2006, Explosives Regulations and Workcover have been considered.

Whilst I have looked over and discussed the matter of the safety clearance perimeter and the means of achieving this, I understand that these matters have been thoroughly dealt with by New South Wales authorities and stakeholders who are well familiar with the locality. For this reason I will make only a passing comment on the safety perimeter.

2. Executive summary

- All matters identified in the Risk Assessment can be adequately managed and reduced to acceptable levels.
- The blast designs and choice of explosives and initiation types are suitable for purpose.
- Blasting side-effects, flyrock (concrete), vibration / concussion, can be managed by using conventional blast controls including charging designs, initiation sequencing, blasthole drill patterns, and earth-fill, steel mesh, and fabric protection.

3. Methodology

If our approach to this study has involved the following steps:

a. Take an overview of the various engineering reports including original design specifications and dynamic behavioural characteristics
b. Read & consider the Port Kembla Copper Blast Day Management Plan Revision1.
c. Read and consider the Stack Demolition Process & Techniques Plan 18 Sept 2013

d. Review Precision Demolition work method statements
e. Conduct a site inspection with S Miller of Precision Demolition
f. Generate techNick's own set of matters that we would consider for such a project to ensure safety and environmental compliance, and use these as a basis to check the completeness of the Precision Demolition proposal

4. Typical planning for blasting operations

The following matters must be considered and addressed before any blasting is to take place, to ensure safety and environmental compliance. In the next section, under the heading of "Discussion" I will address each one of these in turn and in relation to the Precision Demolition proposal:

1. *Examine job - decide whether blasting may be effective in achieving the result*
2. *Conduct Risk Assessment process*
3. *Obtain permission to blast on site - from Regulatory Authority*
4. *Hold a current Blasting Permit - Issued by Statutory Authority*
5. *Establish a blast preparation program and determine site factors*
6. *Produce a set of suitably conservative blast designs with charging plans*
7. *Calculate quantities of Explosives, Dets, Det cord, Fuse*
8. *Consideration of vibration / concussion / dust / fumes / airblast controls for shots*
9. *Note neighbours and all nearby structures that may be affected*
10. *Communications and notification of persons who may be affected by blasting*
11. *Notify all personnel in the area*
12. *A suitably licensed shotfirer must be available with necessary equipment*
13. *Training of all onsite personnel to identify explosives materials in use and hazards*
14. *Expert supervision of all preparations, charging and blast event*
15. *Specify handling, storage and explosives charging methods for explosives*
16. *Specify installation of sandbags, steel mesh and other protection methods*
17. *Plan for the setting up of vibration / airblast and other monitoring stations if required*
18. *Clearly specify guarding and sentry requirements; Blasting signs, barricades and blast guards, Blasting siren or suitable audible device*
19. *Overnight security if charging must extend beyond one day*
20. *Ensure a suitable plan for surplus explosives at the end of the job*
21. *Consider and address all emergency and contingency plans*

5. Discussion

1) Examine job - decide whether blasting may be effective in achieving the result

Response:

I have looked at the geometry of the structure and the layout of the locality. It is my opinion that the use of explosives to undermine and topple the chimney will be the best and safest means of facilitating its deconstruction.

2) Conduct Risk Assessment process

Response:

Identifying risks and deciding responses to these is a shared responsibility of the project team. The following is an extract from the Precision Demolition document "Stack Demolition Process and Techniques Plan 18 Sept 2013.pdf"

The risk assessment is provided in Appendix I. The key potential adverse outcomes identified were:
• Risk of harm to the community and workers from safety hazards
• Risk of harm to people or the environment due to environmental hazards
The following control measures have been developed in order to prevent the adverse outcomes. They are:
• The establishment of a large Exclusion Zone
• The scheduling of the demolition to avoid creation of a spectacle
• Appropriate blast control measures to mitigate vibration, overpressure and dust (refer to the Stack Demolition Management Plan (Golder, 18 September 2013))
• Best practice blast design to ensure a predictable and safe outcome

I am in full agreement with the primary identified risk which is harm to persons. The Precision Demolition documentation outlines a quality approach and adequate responses to this particular risk.

Two other hazards I believe fall into the potential high risk category are:

I. The chimney falls in the wrong direction and crushes houses. Whilst of great consequence, this event would not cause any harm to persons as a result of the 300 metre personnel clearance perimeter. The drill pattern, charge loadings and delay sequence are such that the stack should be undercut and strongly weighted to fall in the desired direction.

II. The chimney fails to collapse after detonation of the explosives and remains in an unstable condition. I have reviewed the blast design with Precision Demolition, and am satisfied that the design is very likely to produce the desired result. In the unlikely event of a failure to fall immediately, this contingency has been appropriately considered.

Both these additional hazard outcomes are covered in the Precision Demolition plans and documentation to a satisfactory degree.

Note that the risk estimations and "weightings" are subjective and based on the experience and interpretation of those persons contributing to the study. Technick was not involved in the original risk assessment so accepts no liability for any injury, loss or damage resulting from the use of or reliance upon the information contained in that risk assessment or for any injury, loss or damage resulting from the omission of any information in this report.

3) Obtain permission to blast on site - from Regulatory Authority

Response:

This item is satisfactorily addressed

4) Hold a current Blasting Permit - Issued by Statutory Authority

Response:

This item is satisfactorily addressed

5) Establish a blast preparation program and determine site factors

Response:

This item is satisfactorily addressed

6) Produce a set of suitably conservative blast designs with charging plans

Response:

I outline here, my approach to designing a controlled demolition:

- ***Typical basic design principles***

1. *Examine nature of the material to be blasted*
2. *Consider any particular requirements for blasting in this area*
3. *Decide exactly what outcome is required from the blasting. This is a crucial step because it influences the decision regarding amount of explosives energy, powder factor, risk of flyrock, airblast, digability, productivity.*
4. *Employ firewall of flyrock protection – Deeply embedded and stemmed charges, sandbags or equivalent if needed to protect the locality and other methods as determined.*
5. *Diagrammatic sections of the structure form the basis for drill and charge designs.*

- ***Key points of the blast design to include:***

- *Calculated and approved safe pre-drilling procedures for different dimensions and masses of concrete and other materials in each segment.*
- *Calculated and specified explosives handling and placement.*
- *Explosives ratios / powder factors determined using established parameters with safety factors built in to maximise safety assurance and integrity of adjacent areas.*

Using the above principles as a template I have checked the Precision Demolition designs, and find them satisfactory. During my site visit with Sean Miller I discussed the details of his charging plans and agree with this approach to fine tuning the process for safety and assurance.

7) Calculate quantities of Explosives, Dets, Det cord, Fuse

Response:

This item is satisfactorily addressed

8) Consideration of vibration / concussion / dust / fumes / airblast controls for shots

Response:

All of these environmental matters have been considered in the documentation.

- I am in agreement that vibration levels will be very small and unlikely to be near any threshold of damage at any point
- As a result of the hollow spaces within a chimney it is difficult to predict the expected levels of airblast or air over pressure. They will definitely be a notable and audible retort at the time of blasting but this will be well below any threshold of damage for any property outside the work boundary. In view of the fact that all the neighbours will have ample pre-warning about the blast, it is unlikely that any persons should have cause for concern for distress.
- Some dust will be generated by the falling and impact of the chimney on the ground. The extent to which this dust drifts and settles will be influenced mostly by the strength and direction of the wind at the time of firing. Attempts to wet down the area or operate water sprays have limited effect in reducing dust. It is clear that the contractor is aware of the importance of minimising dust by covering shotholes with wire and fabric and considering weather effects.

9) Note neighbours and all nearby structures that may be affected

Response:

This item is satisfactorily addressed

10) Communications and notification of persons who may be affected by blasting

Response:

This item is satisfactorily addressed

11) Notify all personnel in the area

Response:

This item is satisfactorily addressed

12) A suitably licensed shotfirer must be available with necessary equipment

Response:

This item is satisfactorily addressed

13) Training of all onsite personnel to identify explosives materials in use and hazards

Response:

This item is satisfactorily addressed

14) Expert supervision of all preparations, charging and blast event

Response:

This item is satisfactorily addressed

15) Specify handling, storage and explosives charging methods for explosives

Response:

This item is satisfactorily addressed

16) Specify installation of sandbags, steel mesh and other protection methods

Response:

Whilst on-site I discussed in some detail, the types, locations, quantities and extent of shrapnel prevention.

A combination of carefully set, small charges inside the chimney walls with ample stemming cover with steel mesh and geo-fabric will be used to prevent escape of fragments. In the direction towards residential areas there are to be additional substantial sandbag bunds.

Precision demolition is clearly focused on this crucial safety strategy and I believe it is adequately addressed.

17) Plan for the setting up of vibration / airblast and other monitoring stations if required

Response:

This item is satisfactorily addressed

18) Clearly specify guarding and sentry requirements; Blasting signs, barricades and blast guards, Blasting siren or suitable audible device

Response:

This item is satisfactorily addressed

19) Overnight security if charging must extend beyond one day

Response:

This item is satisfactorily addressed

20) Ensure a suitable plan for surplus explosives at the end of the job

Response:

This item is satisfactorily addressed

21) Consider and address all emergency and contingency plans

Response:

This item is satisfactorily addressed

Apart from a failure of the initiation network or a misfire of explosives, the post-blast inspection is a straightforward exercise and can be done by the shotfirer with the Blast Controller shortly after firing.

Actions relating to contingencies are covered in the section “Contingency Planning”

6. CONCLUSIONS

1. It is suitable to safely use small explosives charges to demolish the chimney

2. The structural pre-weakening elements of the design have been checked by a structural engineer.

3. All matters identified in the Risk Assessment can be adequately managed and reduced to acceptable levels.

4. The choice of explosives and initiation types are suitable. Items to be used are standard, off-the-shelf commercial explosives.

5. Blasting side-effects, flyrock (concrete), vibration / concussion, can be managed by using conventional blast controls including charging designs, initiation sequencing, blasthole drill patterns, and earth-fill, steel mesh, and fabric protection.

6. Safety distances for personnel can be adequately managed although this is the responsibility of a team of site-experienced persons and it is not appropriate for this report to attempt to precisely specify these locations.

Yours faithfully

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Blasting Consultant

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7. APPENDIX - Nick Elith - Qualifications and Experience

NAME NICK ELITH
Bachelor of Engineering (Mining)
University of Sydney 1971

POSITION Principal Blasting Consultant
technick Consulting P/L. - Consulting Mining Engineers
DATE OF BIRTH 1948
AFFILIATIONS Member; Australasian Institute of Mining & Metallurgy
Member; International Society of Explosives Engineers

EXPERIENCE Over 40 years involvement with explosives and blasting practices.

1971 - 1976 Explosives Engineer with ICI Australia (Australia's largest explosives supplier) working as a blasting engineer throughout Australia in:

- *Opencut and Quarry Blast Design and improvement*
- *Civil engineering, Construction, Roadworks and Excavations*
- *Initiation Systems design and development*
- *Underground blast design, Tunnelling, Shaft sinking, Stoping*
- *Safety and skills Training*
- *Submarine blasting, Harbour deepening, Offshore Oil-well operations*
- *New explosives development and field testing*

1977 - Present:
Principle Blasting Consultant : technick Consulting Pty. Ltd.
Consulting to the mining, quarrying and construction industries in :

- ✓ Blasting principles and Blasting Physics applications
- ✓ Safety and Cost Efficiency in blasting; Opencut and Underground
- ✓ Blast Design and implementation - Opencut and Underground
- ✓ Conducting On-site drilling & blasting Operational Audits
- ✓ Initiation Systems application and design
- ✓ Field evaluation of new explosives and Initiation Systems technologies
- ✓ Technical writing: Blasting manuals, Operational Procedures
- ✓ Training resources, graphics, Safety / promotional materials
- ✓ Competency-based Shotfirer training
- ✓ Author of Opencut and Underground blasting manuals
- ✓ Demolitions: Structures, Buildings, Machinery (steel, concrete etc.)
- ✓ Submarine / Underwater blasting and demolitions
- ✓ Environmentally sensitive blast design, analysis and supervision
- ✓ Investigation of explosives accidents and Incidents
- ✓ Legal "Expert Witness" representation

ADVANCED BLASTING ENGINEERING & TECHNIQUES

Summary 1971 - present

- *Opencut and Quarry Blast Design and improvement*
- *Civil engineering, Construction, Roadworks and Excavations*
- *Initiation Systems design and development*
- *Underground blast design, Tunnelling, Shaft sinking, Stoping*
- *Accredited Safety and Blasting skills Training*
- *Submarine blasting, Harbour deepening, Offshore Oil-well operations*
- *Advise, design, execute unusual / sensitive construction / demolition projects:*
- *Control vibrations, air blast, flying fragments, underwater concussion*
- *Buildings, foundations, underwater, mechanical equipment,*
- *Recovery of jammed drill rods, pipes, liners, slag, operating equipment*
- *Calculate, predict environmental effects of blasting in critical areas*
- *Feasibility studies for controlled explosives applications*
- *Legal investigations, reporting and representation*

Demolition and Precision Materials Blasting

Current: Blast structures of; reinforced concrete, cast iron, steel, brickwork

- *Cutting Steel 'Well Heads' below the ocean bed - Bass Strait, NZ, Timor Sea*
- *Train explosives engineers for underwater and offshore steel demolition*
- *Cutting of steel, cast iron, steel alloys, aluminium, brass*
- *Cutting bars, pipes, rail track, "I"- beam, angles, massive blocks*
- *Metal forming, deforming using explosives*
- *Fabrication and firing of basic 'shaped charges'*
- *Demolition of suburban chimneys - to over 50m , built-up areas - Melb / Perth.*
- *Demolition of major industrial site facilities at city chemical complex;- work done inside buildings, control vibrations, air blast, flying fragments*
- *Demolish Furnace & storage kilns ~ 8 structures to 20m high*
- *Demolish Chimneys and towers near operating facilities*

See details over page

Demolition and Precision Materials Blasting

Current: Designs, Risk Assessment & Supervision – various structures

2012 Risk Assess Design, demolition of concrete in-pit crusher - QLD
2011 Risk, Design, demolition of steel / concrete pylon – minesite Qld
2010 Risk, Design, Blast demolition of Post-stressed concrete bridge Canberra ACT
2010 Risk Assess Design, Blast demolition of concrete bridge Pylons Mackay QLD
2010 Review blast design methodology – Port concrete blasting - NWWA
2009 Review / Approve blast design & Risk – Dam refurbishment blasting - NSW
2009 Blasting near ventilation services –Tunnel development Narrabri NSW
2009 Blasting near critical services – UG Coal mine NZ
2009 Design, RA. demolition of reinforced concrete crusher station – PNG
2009 Blasting near critical underground pipes – Tunnel NSW coal mine - NSW
2009 Blast design & Risk – Dam construction near existing facilities ACT
2008 Designs & Risk Assessments – Bridge, River pylons, Adjacent structures - QLD
2007 Risk, Design, Blast demolition of Post-stressed concrete bridge Canberra - ACT
2006 Risk Assess, Design Shaft & Tunnel Adit – Inner city Bne 15m from bldg - QLD
2006 Design, gain approval for collapse of failed steel shiploader conveyor - QLD
2006 Blast Eastlink tunnel electronic dets under houses – Suburban Melb - VIC
2006 Design, Procdrs & calcs to blast sewer shafts – VIC roads, Melb Water - VIC
2005 Risk manage, Design & calcs to blast hot, solid slag in furnace - WA
2005 Risk manage, Design & calcs to collapse elevated conveyor - Indonesia
2005 Design & calcs for blasting jammed 400 mm auger near Melb city hospital - VIC
2005 Design & calcs - blasting massive suspended boulder overhanging roadway - NSW
2004 Demolition of reinforced concrete silos – near Canberra - NSW
2003 Underwater steel pylon Risk Assess & design for demolition harbour - W.A.
2001 Reinforced Concrete Dam intake tower demolition design & Risk Assess VIC
2001 Blast 55 m concrete bunker building – Newcastle steelworks - NSW
2001 Blast mine Portal, Tasmania, 5m from main pipelines, 30m from workshops - TAS
1999 Precision blasting rock outcrop, 4 metres from swimming pool – Cairns - QLD
1999 Demolition of mine headframe structure at Cobar - NSW
1999 Demolition of 2 reinforced concrete chimneys in Brisbane suburban area - QLD
1998 Controlled blasting amongst major LPG tanks - Woodside Petroleum; WA
1996 Investigation / Clearances at Canberra Hospital Implosion - NSW
1996 Demolition of reinforced concrete silos - Mt Isa - QLD
1996 Demolition of NZ dam bulkhead, internal to dam. - NZ
1996 Subsurface demolition of NSW dam floodgates, internal to dam. - NSW
1994, ’95 Blast-furnace demolition within factory complex; BHP Whyalla - SA
1994 Controlled blasting of concrete foundations within factory complex; Brisbane city - QLD
1991 Demolition 900 t steel Bucket wheel excavator - Electricity Commission - VIC
1990 Demolition of two 4-storey buildings - Wiluna Mine, West Australia - WA
1987 Concrete Crusher demolition - within mine office area; Wattle Gully mine. - VIC
1986 Demolition of reo-concrete bridge foundations – Lake Eildon, Victoria - VIC
1973 Research project International demolition blast formulae with ‘Plastic’ explosives - VIC
1972 Blasting concrete, steel, brick foundations inside factory complex; Melbourne - VIC
1970’s Developed deep ocean explosives well-cutting techniques and systems - VIC
1970’s Explosives metal hardening of steel rail tracks other components - VIC

Environmental Blasting and Controls

Current: Regular assessment and prediction of blasting effects & impacts

Environmental calculations & design near houses, optics, cables, pipes, shafts, liquid tanks, bridges, 'green' concrete and sensitive sites

2012 - 2013 Rail widening close-proximity, sensitive blasting – Regional Rail VIC

2012 - 2013 Environmental implications blasting for new mines - NZ

2011 - 2013 Gas plant construction proximity blasting, wall control, Gorgon NWWA

2011 Proximity blast design, Risk definition, underwater near jetties - Qld

2011 Sub-station proximity blasting, environmental specifications – ACT

2011 Pipeline nearby Review, Risk Assess blast design – ACT dam construction - ACT

2011 Gas plant construction proximity blasting, wall damage, specifications – Gorgon NWWA

2011 Underwater proximity blast design, Risk definition, costings - Qld

2010 Pipeline Risk Assessment, Procedures, blast designs – Moomba Gas pipe QLD

2010 Pipeline nearby Review, Risk Assess blast design – QLD

2010 Foundations near Satellite dish Procedures, Reviews, blast designs - ACT

2010 Review / Approve blast design damage Risk – Cotter Dam - ACT

2010 Bridge nearby, Review blast design damage Risk – Mackay QLD

2010 Review / Approve blast design damage Risk – Keepit Dam - NSW

2009 - 10 Review blast damage Risk – Googong Dam refurbishment - NSW

2009 Blasting near ventilation services –Tunnel development Narrabri NSW

2009 Blasting near critical services – UG Coal mine - NZ

2009 Environmental impacts of blasting underwater near marine habitats (SA, WA)

2009 Blasting near critical underground pipes – Tunnel development coal mine - NSW

2009 Blast design & Risk Assessments – Dam construction near infrastructure ACT

2008 Blast design & Risk Assess – construction near infrastructure WA, NSW

2006 - 2010 Risk manage / Design / Audit proximity blast proc - Heritage sites Karratha WA,

2005 Design & environment calcs for blasting near Melb city hospital - VIC

2002 /06 Various mine extension EIS supporting reports: Drilling & Blasting effects

2001 Mine extension environmental effects, blast designs NZ

2000 /06 Guest lecturer – Melbourne University "Environmental Risk" - VIC

2000 /04 Conduct Risk Assessment studies for sensitive blasting near dams, electronic switchgear, sensitive facilities, overhead / underground services - various

2001 Blast mine Portal Tasmania, 5m from pipelines, 30m from workshops - TAS

1998 Close proximity blasting 3 metres from highway; Wollongong NSW

1998 Blasting consultant to Botany underground LPG tanks study - NSW

1998 Controlled blasting amongst major LPG tanks - Woodside Petroleum; WA

1996 Investigation / Clearances at Canberra Hospital Implosion - ACT

1993, 94 Blast design, vibration, air blast monitoring of tunnelling works - homes, school, temples, within tens of metres in - Taiwan

1971 – 2008 Design blasting to optimise productivity and minimise disruption to locality - various