**Appendix H – Guideline to investigating fume events**

**Investigation of Fume Events**

The thorough investigation of a fume event is essential to:

* Prevent further instances of fumes being generated.
* Ensure fume events and potential fume events are managed to ensure exposures do not occur.
* Ensure persons exposed to fumes are treated promptly and effectively.
* Determine and understand the potential causes of fume.

The investigation must be thorough to ensure that the variables for the prevention of fumes are well understood for that blast, that the management of the fume event can be examined for effectiveness and that any exposures from the event are treated appropriately.

The investigation of a fume event may be undertaken by the following:

* Mine Operator (as part of mine SMS or a statutory direction from the regulator)
* Mines Inspectorate (Consider role of District Workers Representative)
* Explosives Inspectorate
* Explosives company whose explosives were used in the blast
* Blasting contractor (may be an Explosives company that was conducting the blast for the mine)
* A combination of the above

**Composition of Investigation Team**

This will be determined by the Manager appointing a lead investigator and team members. Persons appointed to an investigating team should have appropriate experience, knowledge of the operation and training to undertake the investigation. A term of reference should be given to the lead investigator.

**Guides to Investigation**

1. There are many investigation processes that can be used. The Incident Cause Analysis Method (ICAM) is an appropriate method to use for investigations.

Investigation points directly relevant to Fume Events

2. The following points are directly applicable to fume event investigations:

a) Data collection

b) Analysis of data

**Data associated with Fume Event**

* Blast Job Pack
* Drilling Records
* Environmental monitoring records prior to and at the time of the blast (wind speed, direction, humidity, etc)

**Geology of Site**

* Drill log and reports confirm expected geological conditions
* Identify how to use geological data with explosive product selection and design layout

**Blast Job Pack – The information available here is:**

* Blast plan as designed
* Blast plan as fired
* Timing for blast
* Initiation of sequence (Tie Up)
* Type of initiation method – electrical or detonating cord
* Presence of free faces
* Size of blast holes, collapsed holes
* Inter hole distance
* Hole loadings
* Stemming typed and depth
* Use of air bags
* Decking
* Hole Depth
* Variable to be monitored e.g. VOD, NO2, met conditions, recharge rates, H2O, etc.

**Selection of explosives**

* Initiating system
* Detonators
* Boosters and number of boosters per hole
* Main charge including variations e.g. Emulsion, Heavy ANFO.
* Certificates for EP
* Density and other quality checks performed during the loading process
* Reason for decision on type of explosives to be used
* Method/procedure applied to determine appropriate explosives(shows transparency in decision process)

**Concept Design Review**

This is a review of the proposed blast design involving the relevant team members who will do the blast activities.

* Who was involved
* Identified issues
* Proposed mitigations and controls for issues
* Review of previous blast data
* Responsibility and accountability of firing blast activity members
  + Operations
  + Blast Designer
  + Blast Controller / Preparation Leader
  + Shotfirer Supervisor
  + Drill and Blast Supervisor
  + Team Members

**Loading information**

* Shotfirers dip sheet / standing water / wet sides.
* Drill Plan and drill reports.
* Hole loadings kg.

**Procedures for Blasting**

* Mine
* Explosives supplier
* Blasting contractor
* Variations from procedures (good to bad) work around etc.

**Explosives**

* Raw materials
* Quality – fumes or crystallisation
* Age of product

**Equipment MMU**

* Adequate vehicles available for task
* Manufacture explosives vehicles
* Calibration by Truck ID
* Density of explosives checks
* Pump ability
* Is this truck an issue in involvement of fume events?
* Temperature of product
* Verification % of product to confirm ingredients mass balance
* % fuel
* Changes to truck settings

**Dewater trucks**

* Adequate to meet task requirements
* Effective dewater
* Recharge rates
* Actual checks of holes

**Training**

* Were persons competent?
* Were the competencies trained adequate for task?
* Experience and mentoring of new staff
* Understanding of how each member can reduce fume.
* Previous Involvement in other fume events
* How were the persons appointed to the job
* Supervision

**Video of Blast**

* Examine
* Orientation of camera (N, S, E or W)
* Source of fume – consistent/inconsistent above shot % of shot covered by fume
* Time to form cloud, time to disperse to ‘safe’ level
* Direction of cloud
* Relate to blast plan as fired

**Monitoring Equipment**

* Where placed – distance and orientation (base on expected met conditions)
* Readings PPM
* Type of equipment used
* Calibration records of monitoring equipment
* Video
* Smell and visual appearance

**Meteorological Conditions**

* For loading period if rain – hole protectors – product selection
* For firing period
* After fume event
* Wind speed and direction
* Cloud cover
* Time of day
* Terrain
* Rain occurring
* Humidity

**Pre Firing Review**

* Variations from drill and blast plan
* Variations in loading
* Materials used match the plan
* Calibration issues during load
* Raw material problems

**Post Firing Review**

* Video
* Level of fume
* Incident report if required (Did the fume go outside the exclusion zone?)
* Record and submit blast data to [fumesurvey@deedi.qld.gov.au](mailto:fumesurvey@deedi.qld.gov.au)
* Identify what went well or not so well

**Statement / Interview Personnel, witnesses and exposed persons**

* Story of the shot from all persons involved - separately
* Changed circumstances
* Variation from design
* Variation from product use
* Weather
* Unexpected water
* Equipment problems
* Procedural variations

**Terms of Reference**

It is paramount to issue terms of reference to the person who is to lead the investigation. The terms of reference should be issued by the senior management team to all relevant persons within the organisation are made aware that a thorough investigation of the event is underway and that all employees are to fully co-operate with the lead investigator.

The team to investigate the fume incident should have appropriate knowledge in the operation of blasting and be competent in investigating an incident.

The terms of reference are to ensure that all applicable matters are covered in the investigation. It should also indicate that the investigator is to follow up on any pertinent matters that were not acknowledged in the terms of reference, but are issues that could have contributed to the fume event. Following is an example that may used by a Mine Site or the Regulator to investigate a fume incident.

**Sample**: **Terms of Reference**…..

**Investigation terms of reference for Fume Incident at Longbeach**

**Describe the incident and include the following:**

* Time/date and place at which the incident occurred
* Report of Injury or property damage
* Explosive type by brand name and composition
* Equipment involved

The licence and authority holder who manufactured the explosives involved. They must be described as they appear in the licence holder record.

***Sample:***

*The excessive post blast generation of oxides of nitrogen at ABC mine occurring at Longbeach on the 4 Sept 2010.*

*Slate Resources operate the Chandlers open cut coal mine at Longreach. Slate resources have site appointed shotfirers supported by a downhole service supplied by ABC Explosives. At 4.30pm on Sunday the 4th of January 2010 an overburden shot was fired. The shot generated a fume event that was rated extreme on 5 out of 5 on the ABC explosives fume scale. The fume cloud travelled 3 kilometres to the west of the site and entered the mine workshop area.*

*Nine workers from the workshop presented at the Longbeach base hospital reporting exposure to the fume cloud. Five persons were detained overnight at the hospital for observation.*

*A report provided to inspector of explosives XXX by the Slate resources Blast supervisor indicates that the operator had loaded the shot with a mixture of ANFO and HANFO. The ANFO and HANFO were manufactured on site by ABC Explosives. ABC Explosives have an MMU Licence to manufacture class one ammonium nitrate based explosives. ABC Explosives Pty Ltd had licensed the mobile manufacturing unit within Queensland under authority 100000.*

*The investigation is continuing to compose findings in relation to the incident to reveal conclusions from their findings.*

*Recommendations are to be made that would assist in preventing a recurrence of fume, manage a fume event and ensure appropriate treatment of exposed persons.*

*Without limiting the scope of your investigation, the following particulars should be established.*

***Consider the facts, sought after by the authority holder. Examine activities realistically occurring under legislation, codes, safety management system and operational procedures. See below for example:***

* *The specific facts and timeline surrounding the incident.*
* *Specific facts’ relating to the ABC Explosives as it applies to the activity undertaken.*
* *What systems procedures were applied or absent in relation to this incident as detailed in schedule 3 part 1 of the Explosives Regulations 2003.*
* *What operational procedures were applied or absent in relation to this incident as detailed in schedule 3 part 2 of the Explosives Regulations 2003.*
* *If the authority holder has taken reasonable precautions and used reasonable care to avoid endangering any person’s safety, health or property.*
* *Has the authority holder given effect to their safety management system as it applies to this incident?*
* *Interview of persons involved in shot from concept to clearance*
  + *Story of the shot*
  + *Changes to shot*
  + *Improvement opportunities*
  + *Site SOP’s*
    - *Primarily loading and coping with change*
  + *Decking*
  + *Production pressure*
  + *Weather*
    - *Wind, speed and direction*
  + *Training*
    - *Currency, relevance and competency in the field*
* *Examination and retention of documents and/or records including*
  + *The concept or pre blast review*
  + *Blast design*
  + *The job hazard/risk assessment*
  + *Drill plans*
  + *Drill logs*
  + *Dip Logs*
  + *Timing plans*
  + *Load plan*
  + *Tie in plans*
  + *Documents showing changes to plans*
  + *Other documents in the blast pack*
  + *MMU calibration records*
  + *MMU quality control records*
  + *Video of shot*
  + *Training records for the shotfirer, MMU operator and bench hands*
  + *Magazine records for class 1 explosives*
  + *Records for class 5.1 explosive precursors*
  + *Records for diesel and effect chemicals used in the manufacture of explosives*
* *An examination of the raw product used to manufacture and fire the explosive including* 
  + *For initiating explosives – 1.1B detonators*
    - *The planned number of detonators for the shot, the actual number used, type and batch number, dates of manufacture and expiry.*
  + *For high explosives – 1.1D including boosters and detonating cord*
    - *The planned number of explosive items for the shot, the actual number used, type and batch number, dates of manufacture and expiry.*
  + *For prilled ammonium nitrate of UN1942*
    - *Certificates of compliance, date of manufacture and expiry, density, absorbency and fines*
  + *For ammonium nitrate emulsions and water gels of UN3375*
    - *Manufacturers specifications, appropriateness for task, date of manufacture and expiry, density, temperature, viscosity, PH and QC records*
  + *Fuel oil*
    - *Specifications, storage location, temperature*
* *History on the site from a previous similar shot*
  + *Archived blast packs*
* *The mobile manufacturing unit*
  + *Calibration settings and records*
  + *Density of manufactured product*
  + *Start up records and defects*
  + *Temperatures*
  + *Load record*
  + *Is there sufficient support for the rate of loading*
    - *Dewaterers before the load front*
    - *MMU’s to load the pattern in the time frame*
    - *MMU’s to accommodate servicing requirements*

A preliminary report is required by the ***8th October 2010***

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The following pages include a template to indicate the key headings that can be used for a fume report to ensure it deals adequately with all aspects of an incident investigation. It has been based on the requirements of this QGN and review of actual investigations conducted by the regulator, explosives companies and mining companies. The template can be used and adapted by persons investigating fume events. The detailed data may be attached to the investigation report as appendices.