



Reg 12(5)(a)  
National  
Security EIR

Health and Safety  
Executive

## Investigation Report with Recommendations

Name(s) of Dutyholder(s)	Atomic Weapons Establishment PLC
Address(es) of Dutyholder(s)	Aldermaston Reading Berkshire RG7 4PR
Role of Dutyholder	Employer
Address/location of incident	Aldermaston Reading Berkshire RG7 4PR
Date(s) of investigation	4-6 August 2010 9-13 August 2010 6-10 September 2010 14-17 September 2010 27-30 September 2010 1 October 2010 11-15 October 2010 9-12 November 2010 15-19 November 2010 6-10 December 2010 19-21 January 2011 1-2 February 2011 9 February 2011 24 February 2011 17-20 May 2011

### Contents

- Part A Investigation details
- Part B Factual report
- Part C Analysis of compliance
- Part D Approval Officer's considerations and decision

### Appendices *(Please tick (✓) when documents included in report)*

- |    |                                   |                                     |
|----|-----------------------------------|-------------------------------------|
| 1. | EMM1                              | <input checked="" type="checkbox"/> |
| 2. | Draft information(s)              | <input type="checkbox"/>            |
| 3. | Summon(es)                        | <input type="checkbox"/>            |
| 4. | Witnesses and others interviewed  | <input checked="" type="checkbox"/> |
| 5. | Exhibits                          | <input checked="" type="checkbox"/> |
| 6. | PACE records                      | <input checked="" type="checkbox"/> |
| 7. | FOCUS/COIN etc inspection records | <input checked="" type="checkbox"/> |

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|-----|-----------------|-------------------------------------|
| 8.  | Evidence matrix | <input checked="" type="checkbox"/> |
| 9.  | CPIA schedules  | <input type="checkbox"/>            |
| 10. | Costs schedule  | <input type="checkbox"/>            |
| 11. | Company search  | <input checked="" type="checkbox"/> |

**Part A – Investigation Details**

**COIN case number** (Give the master or trigger case number from COIN)

4226037

**Matter under investigation** (Give a brief summary of the subject of this report)

On the 3rd of August 2010 at approximately 21:05 hours  
Establishment, Aldermaston, was breaking dry Nitrocellulose (NC) into a plastic bucket that  
contained Methyl Ethyl Ketone (MEK), part of the process to produce NC lacquer. During the process  
walked away from the lacquer and removed his respirator and as he returned to the bucket, the NC  
lacquer ignited producing a fireball that resulted in receiving burn injuries to his face and left arm.

Reg 12(5)(a)  
National Security EIR

**Date of incident** (where applicable)

3 August 2010

**Name of duty holder(s)** (Give full name of legal entity)

Atomic Weapons Establishment PLC

**Role of duty holder(s)** (Employer, principal contractor, etc)

Employer

**Address(es) of duty holder(s)** (Include registered office address, Companies House registration number and company search (Annex 11) if a company, or NI number of individual when prosecution under consideration) (Insert COIN site ID number)

Registered Number 02763902  
DUNS Number 23-117-1414  
COIN site ID 1039498  
Aldermaston  
Reading  
Berkshire  
RG7 4PR

**Location details** (Location of incident or other matter under investigation)

Aldermaston  
Reading  
Berkshire  
RG7 4PR

**Name(s) and address(es) of IP(s), DP(s)** (Where applicable)

All under Reg 13 Personal Information  
unless indicated.

Name and full office address of lead HSE investigator (The lead HSE investigator is equivalent to the 'investigator' for the purposes of CPIA)

[Redacted]

Names of other HSE investigators (Include the names of key HSE colleagues involved in the investigation)

[Redacted]

Name(s) and contact details for non-HSE investigators (Other investigating authorities and key personnel involved)

NONE

Date investigation commenced

4 August 2010

Criminal Procedure and Investigations Act 1996

Investigator		Officer in charge of Inv (SIO)	
Disclosure Officer		Prosecutor	

**Brief Executive Summary**

(This information should be copied from the mandatory investigation details note on COIN. Provide short summary of facts and any enforcement actions taken to date)

Reg 12(5)(a) National Security EIR

On the 3rd of August 2010 at approximately 21:05 hours at the Atomic Weapons Establishment, Aldermaston, was breaking dry Nitrocellulose (NC) into a plastic bucket that contained Methyl Ethyl Ketone (MEK), part of the process to produce NC lacquer. During the process walked away from the lacquer and removed his respirator and as he returned to the bucket, the NC lacquer ignited producing a fireball that resulted in receiving burn injuries to his face and left arm.

AWE PLC were served Prohibition Notice P/ DLN/AWE/060810/1 that prohibits further mixing of Nitrocellulose and Methyl Ethyl Ketone, except for investigation purposes that have been authorised by the Health and Safety Executive.

Company attended a PACE at the HSE Basingstoke Offices to make representations with regard to potential breaches of Health and Safety legislation identified by HSE.

The investigation found that:

- It was not possible to identify with any confidence the immediate cause of the fire. Two potential causes for the ignition have been identified, static and exothermic chemical reaction;
- Operatives had not received appropriate refresher training before commencing the mixing operation and training records of operators were not being maintained;
- The PPE worn by explosives operatives was inappropriate for the hazards present at the time;
- Hazards had not been fully assessed namely the explosive properties of dry NC and the toxic affects of
- The building and equipment did not comply with the standards required for handling explosives that are

Reg 12 (5)(a) National Security EIR

All redacted under Reg 13 Personal Information unless indicated.

sensitive to static or for handling extremely flammable liquids;

- The company Explosives Safety Orders define AWE's safe system of work for explosives operations. Operations in the building at the time of the incident did not comply with the safe system of work in that:
  - a) The quantity of explosive in the building exceeded that specified in the Order (but not that allowed by the licence);
  - b) The batch of NC lacquer was being prepared at the same time as:
    - i) the mixing of a batch of \_\_\_\_\_ was taking place in an enclave to the room ;
    - and
    - ii) the storage of surplus explosives in the process area.

Reg 12(5)(a) National Security EIR.

This is considered extremely poor explosive practice in minimising the quantity of explosives operators are exposed to and the time they are exposed in all.

- The system for ensuring that the on-site emergency response teams were aware of the presence of explosives present in the building failed. As a consequence fire fighters and first aiders were put at greater risk;
- Failures in the management of maintenance activity resulted in low pressure in the emergency water supply because the valves had not been returned to the fully opened position;
- The emergency exits installed in the security fence surrounding the facility
- Supervision failed to identify that these conditions existed. Indications are that this was not a one-off occurrence.

The overall risks associated with explosives appeared to be given a lower priority by management to those presented by nuclear hazards.

Analysis of the evidence and following the enforcement policy statement and the enforcement management model the recommendation of this report is that AWE PLC are prosecuted for alleged breaches of the following:

1. Health and Safety at Work etc Act 1974 section 2(1) for failing to implement a safe system of work
2. Manufacture and Storage of Explosives Regulations 2005 regulation 4(1) for failing to implement control measures to prevent an ignition of explosive substances
3. Personnel Protection Equipment at Work 2002 regulation 4(1) for failing to provide the minimum standard of PPE and provide adequate control in storage.





### Summary of Events Pre-Incident

As part of its demonstration to

1 May 2010 there was a requirement to produce a batch of explosives 1 the appropriate standard for proofing; on this occasion a full batch was not required and a reduced quantity was specified. A programme plan was produced by the team leader identifying the key issues relating to the manufacturing process and those that were outstanding and needed attention before production could start. The full production of 1 was last undertaken in 1

On 16 July 2010 the team leader, 2 identified that the COSHH and risk assessments had not been produced. These were completed at the end of July by an assessor who by his own admission had only undergone in-house training and did not feel truly competent to conduct a process assessment. The resulting assessment only considered the hazards associated with individual chemicals rather than the risks from exposure in the process as a whole.

1 kept a record of actions and activities on an electronic calendar and his record shows that the first stage of the production of 1 began on the 1 and consisted of drying of the Nitrocellulose. The NC was stored in the incident building over the weekend so as to be available for 1 that was due to start the following week.

1 received from a supplier was found to have more than the specified quantity of 1. This meant the team leader needed more containers of 1 than usual in order to achieve the quantity of 1 required to produce the 1. This led to explosives being stored in the building that was in excess of the explosive safety order and contrary to the terms of the licence whilst mixing was in process.

The production of 1 started on 1, the operatives assigned to be involved in the production were;

2

On the 1 2 was not available for work and the team leader arranged for 2 to assist. 2 had not conducted the process since 1 and was not aware of the new explosive safety orders or procedures. During the lacquer preparation on the morning of 1 it was noted by 2 that the lacquer was an unusual colour which she reported to 2 and he informed 2 does not recall it being mentioned to him and in the absence of any contrary advice, this lacquer was used in the preparation of 1 without incident.

On the 3 August 2010 the operatives present were:

2

Operators are required to undertake various tasks in parallel and the team leader is not present 100% of the time during 1. 2 reports that there was no telephone system in the room and the tannoy did not work and had not done so for a year, so he brought a radio to the mixing room so that the workforce could communicate with the control centre. As part of AWE's safe system of work and in accordance with the work instruction, direct communication with the work control centre should be available throughout the process.

1 takes longer than a normal working shift, so operatives need to be present until about 1. The team leader knew that there would be insufficient people to conduct the 1 after the normal shift, he therefore seconded 2 to assist in 1 and 2 to assist in the 1. 2 had not been involved in the 1 so spent the early part of the evening reading the process instructions.

No unusual events were noted during the day shift by the operatives or the Supervisor, 2

At the time of the incident the following were present; all had worked their normal shift which normally finished at 16:30 hours (very few breaks were taken and all present were into their fifth hour of overtime):

2

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2

During the evening shift 2 realised that he would be short staffed the following day and it was decided to prepare the next batch of NC lacquer that evening instead of the following day, while the 1 was still in progress. According to witnesses, this activity had been conducted in parallel with the 1 in the past but is now not permitted by the new explosives safety order. 2 was tasked by 2 with preparing the new batch of lacquer in 1 while 1 was still be 1 in the enclave 1

The only issue of note during the evening shift was that it was difficult to get a reading off the thermocouple without it being held in the right position. The thermocouple was used to measure the temperature of the 1 to ensure excessive temperature was not introduced to the 1. This was primarily a quality assurance feature rather than an essential safety measure.

At around 21:00 2 was breaking up the dry NC into a plastic bucket containing MEK positioned 1 and dry NC left over from the 1 in progress. He reports noticing what he thought was a colour change in the NC/MEK mixture; he also had an impression that the NC was taking a long time to disperse and reported seeing bubbles appearing around the wall of the bucket. Moving away to remove his respirator he then approached the bucket to take a closer look, when the NC/MEK mixture ignited and a fireball ensued; 2 was caught in the initial fireball and received burns to his face and left forearm

### Summary of Events Post-Incident

The work control centre was informed by 2 using the radio and the operatives left the building to get to the evacuation building, which is designed as a refuge in cases of emergency. From here, 2 used the telephone to contact the fire service control room to make sure the information about the fire and the presence of explosives had been received. The work control centre had also been informed that somebody had been injured as a result of the incident. A ballistic first aider whose day to day role was to undertake 1 and who had little awareness of the risks relating to explosives was despatched to tend to the IP 2 made 2 way to the evacuation building and in so doing drove directly past the incident building. 2 as not informed that the incident involved explosives or of an appropriate route to take to mitigate potential associated risks. On arrival the IP was under stress and wanted to leave and the decision was taken to distance themselves from 1

The group left and made their way to 1. Neither of the two vehicles they used to get to the 1 contained a burns pack to treat the IP, who had to wait for paramedics to arrive and the key to be found before receiving professional treatment.

According to 2 the work control centre was informed that the building was on fire and it contained explosives. This information does not appear on the fire services log of events.

The fire services also went straight to the incident building without obtaining information from the work control centre. Initial fire service observations state that a small pool fire was present inside the building and a decision was made to fight the fire. At this time the fire service were ignorant of the explosives inventory in the building. The company's system uses e-mail to notify the emergency teams of the presence of explosives on-site in silent hours. A message had been sent regarding the explosives in 1 but this had not been read by the 1

During the course of fighting the fire it was noted by the 1 that the water pressure was low and the hoses were pulsing rather than providing a steady stream; post incident investigation identified that the hydrant valves had not been returned to the fully open position following maintenance.

The 1 followed the AWE fire Services into the explosives area to assist in isolating the building. He also was unaware of the quantity of explosives in the building. The building was not isolated and 2 left the explosives area once he knew that everybody had been located, that they were in a safe position and when he found out about the explosives stored in the building.

### Health and Safety Assessments

AWE undertake compliance checks primarily through inspection. There are numerous inspection records relating to conditions of buildings and plant and indicate the 1 was last inspected on 1. However there are no equivalent records of checks being undertaken on compliance with the 1

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manufacture procedure.

Assessments undertaken on the \_\_\_\_\_ 1 \_\_\_\_\_ process had been conducted and comprised:

- A HAZOP; this had been produced by the company and signed by two participants in the assessment. Normally all participants are recorded and AWE claim that a full assessment team was involved. AWE can offer no evidence of who they were or when employees were involved, nor what constitutes a full Hazop team.
- A COSHH assessment was completed by an in-house trained assessor but considers the individual chemicals in isolation and does not look at the hazards as the chemicals are mixed through the process.
- The risk assessment was reviewed by the same person who conducted the COSHH assessment and he had only received in-house training. This employee was no longer involved in the manufacturing process as he had been assigned elsewhere. There is evidence that part of the risk assessment was cut and pasted from another assessment.
- Assessments failed to identify all the hazards present, in particular the explosive properties of dry NC and the toxic properties \_\_\_\_\_. As a result the secondary static precautions required when handling dry NC and the mandatory medical surveillance of people exposed \_\_\_\_\_ were not identified.

AWE have staff within the company who are employed to ensure that safe systems of work are in place and that they are effective. One employee whose role it is to assess the Health and Safety system within the explosives area did raise numerous concerns regarding instructions and PPE not being of an acceptable standard in November 2009; on the date of the incident these concerns had not been answered

#### Relevant Explosives Manufacturing Training

2

Involved in \_\_\_\_\_ 1 (shadowing an experienced operative)

Team-Leader \_\_\_\_\_ 1

not attended the in house FUSE (Fundamental Understanding of Safety for Explosives) course

Signed off as supervisor for this process.

2

Involved in \_\_\_\_\_ 1 (shadowing an experienced operative) \_\_\_\_\_ 2

Read the \_\_\_\_\_ 1 work instructions

Completed the in-house FUSE course

Aware of new explosives safety orders

Did not read the COSHH or Risk Assessments

Does not have a front line operative log book

Not signed off on the training records.

2

Completed the in-house FUSE course

Attended the COTEC explosive awareness course

No experience with regard to \_\_\_\_\_ 1

Front line operative Log Book not completed by supervisors.

Brand new to the process that morning with no training in \_\_\_\_\_ 1

2

Involved in \_\_\_\_\_ 1 (shadowing an experienced operative) \_\_\_\_\_ 2

Not signed off as competent for any \_\_\_\_\_ 1 unless supervised

Attended the COTEC explosive awareness course

Completed the in-house FUSE course

Aware of new explosives safety orders

Read the COSHH and risk assessments

Awareness training only, not signed off for working with \_\_\_\_\_ 1

unsupervised.

2

Involved in \_\_\_\_\_ 1 (shadowing an experienced operative)

Attended the COTEC explosive awareness course

Completed the in-house FUSE course

Read the work instructions on the night of the incident but otherwise no refresher training.

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2 = Reg 13 Personal Information

In the past an operative would be put through a series of regimes before they were deemed competent to undergo manufacturing process tasks without supervision such as sitting with the supervisor whilst going through the risk assessments and working instructions; conducting an \_\_\_\_\_ discussing process issues; shadowing an operative and then being assessed by the supervisor.

The company confirmed that the last \_\_\_\_\_ was conducted \_\_\_\_\_ and did not include all the employees involved in the manufacturing process on the night of 3 August 2010. None of the operators present on the day reported any refresher training on the procedures prior to start up of manufacture.

**Preventative measures taken by the duty holder(s) BEFORE the incident** (Describe the health and safety risk control arrangements before the incident)

In addition to the various systems identified above, procedures and instructions have been written for each \_\_\_\_\_ that is conducted on site, but there appeared to be a lack of supervision to ensure that the procedures are followed correctly. Effective 'policing' of the process was concentrated on the building and its condition and not on the actual process.

Extensive arrangements to secure compliance and relevant systems are in place for buildings, plant, processes and activities that are conducted elsewhere on the site that do not involve explosives. The same level of attention does not appear to be given to the explosives areas or processes.

Despite the effort expended in seeking legal compliance, the company still lacked a true understanding of the hazards involved when handling dry NC and other hazards and therefore mandatory health surveillance precautions and controls were not in place. (e.g. flame retardant PPE and secondary precautionary measures to prevent electro-static discharge as required by MSER ACOP). Appropriate controls and procedures had been established but been allowed to deteriorate without review or further assessment.

Overall the preventative measures for the NC lacquer process were well below the standards you would have expected in the explosive industry in general. This is indicative of a failure in AWE's assessment procedures to ensure they were suitable and sufficient and remain effective.

The overall impression given by AWE senior management (through the company PACE statement) is that explosives activities were under control and low risk and therefore do not require the same level of attention as the other activities on site. They seem to have lost sight of the importance of ensuring that the appropriate controls are in place so as to ensure the risks remain low.

**Health and safety management** (Where appropriate and to the extent not covered above, describe the health and safety management system before the incident, including any arrangements between duty holders that are relevant to the investigation)

The site is a lower tier COMAH site and a nuclear licensed site. The company have concentrated on the nuclear parts of the business and the explosives business part appears to have played a secondary role. Policies procedures and monitoring is in place but the effective demonstration of it being implemented is not apparent.

**Preventative measures taken by the duty holder(s) AFTER the incident** (Describe the measures taken post event to secure compliance. State where measures taken resulted from HSE intervention (including enforcement action))

All explosives operations across AWE were suspended and a red alert was issued by AWE on 10 August 2010. warning operatives of the potential fire risks when mixing NC with MEK This was in place before the HSE served a prohibition notice suspending the manufacture of NC lacquer which in theory stops the \_\_\_\_\_

All explosives operatives are now required to wear NOMEX coveralls .

Standards for house keeping have been introduced.

Improved competency into explosives hazard identification is being developed.

A review of all high hazard substances and the requirement for health surveillance has been conducted. An alternative methodology for the production of NC lacquer is under research and development.

All on page Reg 12(5)(a) National Security EIR .

**Health and safety management changes AFTER the incident** *(Describe any changes not covered above, stating where they resulted from HSE intervention (including enforcement action))*

An Independently chaired investigation was conducted to determine immediate and underlying causes. AWE concluded that the immediate cause was a build up of static within the NC resulted in an electro-static discharge into the MEK with sufficient energy to cause an ignition.

Based on its investigation and HSE feedback on the issues identified during the investigation, the company have produced a 13 point action plan of improvements. Each action point includes a review of all aspects of a specific topic, e.g. competence, the basis of safety and safety culture across all explosives activity. Aspects of the plan delivered to date include the review and revision of explosives safety orders and working instructions, the development of a basis of safety for each explosives process, the introduction of a behavioural standard for operatives and established a more robust method for the notification of hazard activity in silent hours

## Part C – Analysis of Compliance

(A separate analysis should be completed for each duty holder where appropriate)

**Inspector's conclusions as to causation** (Describe immediate and underlying causes. Give details of any wider learning issues for HSE)

### TECHNICAL POSSIBILITIES FOR CAUSATION

As potential means of ignition, heat, flame, impact, friction, environmental and sabotage were eliminated early on in the investigation as being improbable immediate causes. Detailed consideration was focussed on two mechanisms for initiation:

#### Static Discharge

The manufacturing process for the NC lacquer includes the drying of the \_\_\_\_\_ NC product, weighing of the product and packaging in normal resistive polyethylene bags, all of which can generate electrostatic charge on the NC product. The process of adding the dry NC to the MEK solvent from the polyethylene bag is the last in the process chain that can generate charge and the most likely to be causal to an ESD event. The dry NC will acquire significant electrostatic charge on contact and rubbing against the polyethylene bag, the tearing of the product from the bundle, and by any partial micronising of the product.

MEK is categorised as a highly conductive, highly flammable, liquid solvent and although the polyethylene mixing bin was sitting on a fully conductive floor, the MEK would be an isolated conductive object as a consequence of the insulating properties of the polyethylene bin. As the NC has been electrostatically charged and when such an electrically charged object is in close proximity to a conductive object, isolated from earth, an electrostatic field is created that causes electrical charges on the surface of the object, in our case the surface of the MEK, to redistribute. Albeit that the net charge on the surface of the MEK would not have changed, it will have specific domains of excess positive and negative charges.

NC is a highly resistive product and has a volumetric resistivity of  $10^{14} \Omega/\text{cm}$  that is similar to Nylon and due to its fibrous structure will consist of non-uniform high resistive dielectric zones. Although unknown, NC's position in the triboelectric series is likely to be similar to that of Nylon and Cellulose Acetate which are strongly positive in the series and therefore become strongly positively charged.

The non-uniform electric fields within the NC structure will cause charge separation on the surface of the 'highly conductive' and electrically isolated MEK. Initially the NC will sit on the surface of the MEK liquid within the flammable vapour layer and this will permeate and displace the atmospheric air trapped between the fibres and the non-uniform dielectric zones. As a consequence of these charge separations high electrical potentials would be created with electrical discharges occurring in the vapour filled channels between the fibres and dielectric zones. Because these air channels will have a conductive vapour/air mixture the electrical breakdown strength will be greatly reduced when compared to that of just atmospheric air. The time for the flammable vapour to permeate and displace the air is a reasonable explanation for the observed delay.

Electrostatic discharges from materials with a high volumetric resistivity are referred to as 'Insulator' sparks and such sparks have a range of energies up to a maximum of just over 1mJ, more than enough to ignite MEK vapour in the channels which has minimum ignition energy (MIE) of 0.53mJ.

To ignite the MEK vapour the fuel/air mixture would need to be such that it is within the flammable limits, (1.8 to 11.5 MEK vapour (%) in air). It would therefore be possible for a maximum energy discharge (1mJ) to ignite a relatively weak fuel/air mixture, such an ignition would most likely result initially in an incoherent flame. Heating from such a non-coherent flame would then increase the vapour evolution rate with a transition to a coherent flame and together with the rapid burning of the NC development into a fire ball. Such a process would also be consistent with the observed ignition delay.

#### Exothermic Reaction

The Nitrocellulose was approximately \_\_\_\_\_ and dried at \_\_\_\_\_ before being added to MEK solvent. The age of the product and heating for an extended period of time are cause for concern given that NC has limited shelf life and can decompose via an autocatalytic mechanism. Checks on the wet NC's thermal stability are undertaken annually whilst in storage but are not repeated once dry.

NC is a nitrate ester of the polymer cellulose. Like all nitrate esters it is thermally unstable and will evolve

All on page Reg 12 (5) (a) National Security EIR



nitrogen oxides and nitric acid as decomposition products during heating. This is an autocatalytic process where the evolved nitrogen oxides and nitric acid catalyse further decomposition and lower thermal stability. NC invariably contains a certain amount of water that will react with nitrogen oxides to form nitric acid and unstable nitrous acid. It is feasible for this process, if unchecked, to proceed to spontaneous ignition.

It is well known that substances like MEK are incompatible, and can undergo ignition when mixed, with nitric acid of sufficiently high concentration. Given this, a possible mechanism for the cause of the incident is the mixing of MEK with NC contaminated with nitric acid, caused by decomposition during the The fibrous polymeric structure of NC means that nitric acid could be expected to be incorporated deep into its polymeric structure (supported by the difficulty in purifying manufactured NC from the last traces of mixed acids), This would account for a delay period before ignition i.e. time for the MEK to permeate through the polymeric structure. Also when clumps of NC are added to MEK the outside of the NC will gel followed by a slow permeation of the MEK through the encapsulated NC. This mechanism could actually mean that only small amounts of nitric acid in localised areas of NC need to be present for a thermal reaction to occur and ultimately lead to ignition.

During decomposition of NC caused by heating the structure can be degraded to leave groups which are highly sensitive to oxidation such as aldehyde functionality. It may be possible that MEK can slowly permeate through the NC structure causing occluded nitric acid to meet and react with areas of aldehyde functionality and lead to thermal runaway followed by ignition. Such mechanisms only become possible because of the heterogeneous structure of NC, and hence possible localised areas of decomposition.

The plastic buckets used for the preparation of NC lacquer have not been type approved by AWE for this operation and there is no evidence that they have been tested for compatibility with the NC, MEK The buckets in the building were affected by heat and retrospective testing of the plastic would not therefore provide meaningful results. There therefore remains the possibility that a chemical within the plastic bucket had either begun leaching out or underwent chemical reaction following prolonged exposure to the lacquer or its constituent chemicals, which in turn initiated decomposition.

The buckets involved in the incident and used in the were damaged from the heat of the fire hence any testing to determine if they were the ignition source would not be viable. According to the company the remaining buckets left in the building were not used in any other process and remained within the building confines, this had been the case for the Under HSE direction the company have undertaken a number of tests to try and determine what might have caused bubbles to emerge from the NC lacquer and what might have changed the colour of the NC lacquer; To date no results have shown a positive result.

The original manufacturer of the bucket could not be identified due to their age therefore the original chemical composition could not be determined.

## FINDINGS

Analysis of samples, from the same batches of the raw materials used in the preparation of the lacquer found them to be within specification and there was no evidence of incompatible materials being present. Tests on samples of the NC recovered from the building found its thermal stability to be within specification and there was no evidence of high acid content or partial decomposition. As NC is derived from a natural product, variations in its properties batch to batch are to be expected. The possibility therefore remains that within the batch of NC used in this particular mix, conditions were such that it spontaneously decomposed on mixing or contained high acid concentrations.

The equipment used for the preparation of the lacquer is known not to have taken into account appropriate static precautions and is the most obvious mechanism for initiating a fire involving dry NC. However, static discharge would not in itself account for the observed delay between the addition of the NC and the flammable material igniting. Small scale experiments with lacquer have not been able to replicate an ignition or exotherm in order to determine an answer one way or another.

The factors which contributed to this incident are concluded to be:

1. The mixing of dry nitrocotton with MEK; the use of nitrocotton in other industries is normally undertaken with NC wetted with either water or alcohol. No compulsive reasons why AWE could not adopt this practice have been provided;
2. The use of nitrocotton that was The concentration of nitrogen oxides will increase with age and drying increasing the likelihood of further decomposition and increasing its sensitivity;

All on page Reg 12 (5)(a) National Security EIR



3. The lack of secondary static precautions on the lacquer mixing vessel;
4. The absence of authorised equipment for the mixing of the lacquer and the compatibility with the materials being processed.

#### UNDERLYING CAUSES

AWE had established standards for this operation in 1995 but since that date it is evident that changes have been made without the appropriate level of safe guarding, approval and control. It is concluded that many relevant lines of protection have been diminished, examples being:

1. HAZOP's and data sheets show that there is an explosive hazard with dry NC and that it becomes sensitive to static the drier it becomes yet the building and process design did very little to remove or control the hazards. Generally there was a lack of understanding by employees with regard to the hazards presented by dry NC. Similarly the highly flammable nature and sensitivity to ESD of MEK is clearly identified on the MHDS and this was not accounted for in AWE's processes, plant or procedures.
2. Original PPE was sufficient to protect against chemical splash and fire, the replacement of chemical splash suits and flame retardant overalls around with Tyvek coveralls has greatly reduced the protection factor offered to the explosives operator as they present minimal protection against heat and flame.
3. Established practices for training staff, such as team talks to familiarise operators with the process and safeguards and signing-off staff as competent to conduct a task unsupervised, were not being applied. On the night of the incident only the team leader had the recorded competencies to do the job as competent, all other operatives were inexperienced and needed supervision. The team leader claims he was under pressure (could be self imposed) to complete the task and had little time to assess competence or manage safety. It is evident that the management of competence failed significantly in this incident.
4. Essential assessments of practices and procedures have been in the past conducted by a team before were conducted. The relevant documents relating to this incident i.e. COSHH and risk assessments, were conducted by a single person that had only received in-house training; evidence is that this process was last minute and mainly cut and paste rather than a considered assessment. This incident highlights weaknesses in AWE's system for conducting, validating and approving its assessments and for ensuring the controls identified are implemented before activity takes place.
5. The company conduct numerous emergency response exercises, On the night those responding to the alarm call were put at risk because they attended the building without knowing that explosives were present in the building. The explosives could have potentially detonated at any time.
6. Much of the above had been identified by an employee involved in the compliance team who brought it to management attention, but there is little evidence of management acting on the issues brought to their attention.

#### Legal provisions *(List the relevant legal provisions)*

1. To conduct their undertaking in such a way as to ensure, so far as is reasonably practicable, that persons in their employment are not exposed to risks to health and safety as required by Section 2 (1) of the Health and Safety at Work etc. Act 1974.

The company have procedures and policies in place however many were not implemented on the night of the incident. Supervisors did not recognise that some activities were being conducted that were not in accordance with the company's own safe system of work. Information with regard to risks involved with work activity was not transferred to the appropriate employees.

2. To provide, so far as is reasonably practicable, a safe system of work including any necessary training and instruction under Section 2 of The Health and Safety at Work etc Act 1974.

The company do have a training programme and accredit explosives employees. However the level and depth of training varies from process to process and there is little documented evidence that accreditation was conducted for the operators involved in the process on the 3<sup>rd</sup> of August. This potential breach is better defined 'as not implementing a safe of work', therefore this potential breach will be included as evidence for failing to comply with HASAWA 2(1)

All under Reg 12(5)(a) National Security EIR

3. To ensure that an adequate assessment of personnel protective equipment is made to determine whether the personnel protective equipment is suitable, maintained and stored adequately as required by the Personnel Protective Equipment at Work Regulations 2002

MSER ACOP para 253, 254 257 and 258 and the electrical guidance<sup>1</sup> state that PPE must be suitable for explosives use, and it is recommended that overalls of fire resistant cotton are used. Tyvek coveralls as used by explosive operators at AWE fall below this standard. Storage of PPE at the AWE site is in the same room as the process without adequately protecting against contamination which is below the standard of reg 8 of the PPE regs. The potential breach of PPE reg 4 should be pursued in its own right.

4. To ensure that appropriate measures are in place to prevent and mitigate fire and explosion as required by the Manufacturing and Storage of Explosives Regulations 2005.

The company failed to recognise the threats from static discharge and thermal decomposition even though the information was widely available. The company failed to manufacture explosives to mitigate the effects of a potential explosion by keeping surplus explosives in the building whilst processing was in progress and failing to reduce hazardous material to minimum as required in the MSER ACOP. This potential breach of MSER reg 4 should be pursued in its own right.

5. To ensure that the emergency plan shall be adequate for securing the objectives mentioned in Schedule 5 Part 1 of the Control of Major Accident Hazards Regulations 1999.

The company have conducted emergency response training exercises on numerous occasions and do have detailed plans and procedures with competent personnel in place. On the night of the incident the communication between the emergency services and those involved in the incident was poor; also the emergency services did not follow the normal AWE procedure. The potential breaches are better defined 'as not implementing a safe of work', therefore this potential breach will be included as evidence for failing to comply with HASAWA 2(1).

The provision of appropriate emergency arrangements is a specific requirement of the licence issued under the Nuclear Installations Act (as amended) and as such it was agreed that the potential failings in these arrangements would be subject to investigation by the Nuclear Directorate (now the Office of the Nuclear Regulator). ONR have concluded this part of the investigation and their report concludes that there was not a breach of LC11 therefore this issue will not be pursued further by this investigation.

6. To ensure that employees who are exposed to a substance hazardous to health are under suitable health surveillance as required by regulation 11 of the Control of Substances Hazardous to Health Regulations 2002.

The company assumed that just because the exposure level was low, medical surveillance would not be required, even though mandatory for *Reg 12 (5) (a) National Security EIR*. The assessment recognised that only conducting one assessment was not sufficient and that further assessments should be conducted. Whilst a potential breach in its own right, it is proposed to use this as further evidence that AWE failed to implement a safe system of work and hence failed to comply with HASAWA 2(1)

7. To make a suitable and sufficient assessment of the risks to the health and safety of employees to which they are exposed at work as required by Regulation 3(1) of the Management of Health and Safety at Work Regulations.

The company have conducted numerous assessments and reviews; however because questions asked by the HAZOP were not closed out, it left gaps in the risk assessment. The people who conducted the risk assessment reviews were not technically trained and did not fully understand the hazards and threats that could cause explosives to ignite. This potential breach could be taken in its own right, however it strengthens the evidence for failing to comply with HASAWA 2(1) and will be used to prove the failure

Note 1: HSE/CBI Guidance for electrical installation and equipment within explosives manufacturing and storage facilities, including fireworks. ISBN 978-0-85201-722-7.

**Application of the law** For each of the relevant legal provisions listed above, discuss which have, in your opinion, been breached. Include comment on the following as appropriate:

- Foreseeability of the risk and reasonable practicability of effective preventative measures
- Relevant standards and their source (eg ACoP, BS/EN standard, published HSE or industry guidance)
- Relevant case law
- The effectiveness of control measures and management arrangements prior to the incident/investigation
- The nature and extent of the breaches – how far below the expected standard the duty holder fell and whether the breach was an isolated occurrence.

### **Application of the law**

**It shall be the duty of every employer to ensure so far as is reasonably practicable, the health, safety and welfare at work of all his employees**

**The company contributed to the accident in that they:**

- Failed to conduct an adequate and sufficient risk assessment in that they failed to recognise the hazards present from MEK and dry NC or identify the adequate control measures needed.
- Failed to ensure the health and safety of a person in their employment in that 2 suffered burn injuries to his face and left arm, through lack of information and appropriate PPE.
- Failed to confirm and assess the competence of the staff employed in the manufacturing process in that 2 in his statement believed he was not competent; 2 could only conduct the activity under supervision and 2 had not conducted the process since 1 and needed to read the operating instructions on the night of the incident. The 1 familiarisation exercise was conducted in the previous year with different employees.
- Failed to ensure correct manufacturing procedures were being followed in that the 1 and lacquer preparation were being conducted simultaneously, contrary to the explosives safety order.
- Failed to adequately inform employees involved in the emergency response of the risks, in that 1 employees were present at the scene of the incident without knowing that explosives were involved in the incident
- Allowed surplus explosives to be present while the 1 was in operation, contrary to explosives best practice..
- Failed to conduct health surveillance for employees when they use 1 during the manufacturing process.

### **Foreseeability of the risk and reasonable practicability of effective preventative measures**

Only 2 had the documented training, and according to the training matrix provided by the company all other operatives only had awareness i.e. they had been shown the process but not assessed by line management that they were competent. The 1 was conducted with staff that were not involved in the incident. One operative needed to read the instructions during the process.

It is foreseeable that employees that are shadow trained without the appropriate verifications in place will not follow instructions and could be harmed if not following the correct procedures

It is reasonably practicable to conduct compliance checks and that management understand what activities can and cannot be conducted.

It was reasonable to ensure that employees had conducted the process with 1 before they conducted the process live especially as the process is infrequently conducted.

Employees are known to be at significantly higher risk of injury and ill-health if they are inadequately trained or supervised and there is a long history of incidents where they have been identified as root causes. Systems were in place to ensure staff were competent but these had been allowed to lapse and were not adequately maintained

The fire services and a ballistic first aider had driven past the building and 1 had attended the scene whilst the building was on fire. None were aware of the explosives in the building and it is foreseeable that employees would be put at additional risk when responding to an incident if they are not aware of the hazards present. The system for notifying the on-site emergency response of the presence of explosives out of normal shift pattern was proved to be ineffective.

It was reasonably practicable to conduct a handover that emphasised the risks of late night low management

1 = Reg 12 (5) (a) National Security EIR

2 = Reg 13 Personal Information



attendance and for emergency services to follow procedures to obtain information especially when entering a high hazard area.

It was reasonably practicable for a route to the evacuation building to be assigned without passing the building of the incident

Low water pressure from the hydrants as the fire services tried to tackle the blaze. The Fire Report states that maintenance had left the valves in the incorrect position, there are no controls on who hold the hydrant keys. The company issued an amber alert to collect the keys and state that only authorised persons could be responsible for them.

It would be reasonably practicable for the surplus explosives to be removed from the building before further explosives manufacturing took place or for the preparation of the lacquer to be carried out elsewhere in the building

#### **Relevant standards and their source**

The medical surveillance for [redacted] is mandatory under reg11(5) of COSHH as a prescribed substance and activity in Schedule 6 of the Regulations. The company consider that medical surveillance is not required because the exposure level to [redacted] is low; the company determined the exposure level through the one assessment it conducted [redacted] According to the COSHH regs medical surveillance for [redacted] is mandatory irrespective of exposure or perceived risk.

The Risk and COSHH assessments were reviewed at the last minute by a person no longer involved in or familiar with the process and each substance was assessed in isolation which is not in accordance with para 68 of Regulation 6 of COSHH ACOP

Supervisor came into the room on more than one occasion and didn't recognise that there were surplus explosives in the room. The root cause was that the [redacted] had a lower solids content than that specified hence extra was brought into the room to enable a batch to be made but the surplus should have been removed to a suitable store before progressing (Paragraph 189 -192 MSER ACOP). This is a management failure to ensure that a safe system of work was implemented under the general duties of Section 2(1) of the HASAWA

Information was not passed to employees regarding the risks they were exposed to and the measures in place to mitigate those risks; This is a management failure to ensure that a safe system of work was implemented under the general duties of Section 2(1) of the HASAWA

#### **Relevant case law**

The company could argue that all employees are trained and all measures are in place; they may also argue that they did everything reasonably practicable to do and that the cause was not foreseeable. Hence R v HTM and R v Edwards might be used as an argument.

The fact they failed to identify the original hazards and therefore did not control the risks is a counter argument.

#### **The effectiveness of control measures and management arrangements prior to the incident**

It was normal for surplus explosives material to be stored in the process room without taking into consideration the change to the explosive safety order in [redacted] the reviews of the risk assessment and HAZOPS did not take this fact into account

The Tyvek suits do not offer protection against chemical splashes, the process uses [redacted] a chemical that can cause irreversible damage (liver damage); Company do not conduct health surveillance on the product because they did one assessment on one person and they state the exposure is low

The plant and equipment on site is old and requires a lot of maintenance Statement from the maintenance manager states they can only fire fight as there are so many break downs that all their time is spent doing reactive work and the preventative maintenance only gets done just before commissioning or process restart. If the company had rigorously implemented its RA/COSHH assessment procedures and its compliance management/process control procedures, it would have identified the hazards, risks and controls required.

All on page Reg 12(5)(a) National Security EIR

Employees were put at risk because they went to the burning building whilst it was on fire without the knowledge that it contained explosives yet if the emergency response team had gone to the works control centre as the procedure requires the information would have been known

First aid could not be administered as there was no burns bag in the first aid satchel even though the ballistic trauma first aiders are trained to treat burns

***The nature and extent of the breaches – how far below the expected standard the duty holder fell and whether the breach was an isolated occurrence***

There was no consideration given to preventing fire reaching the other explosives in the building and the in the The potential severity of the incident was therefore much greater than necessary, with the risk of a detonation, blast wave and debris with the potential for fatal injuries to those present and in close proximity.

This is a management failure to ensure a safe system of work was implemented under the general duties of Section 2(1) of the HASAWA

***Any person who manufactures or stores explosives shall take appropriate measures to prevent fire or explosion***

The company took a series of actions that contributed to the accident, namely that they

- Failed to recognise the hazards with the substances that are used during the manufacturing process in that ESD and thermal decomposition were not identified.
- Failed to introduce measures to control thermal decomposition and ESD in that they did not have an anti-static regime in place when handling NC and MEK and that they used dry NC without knowing what hazards that thermal loading had introduced to the NC

***Foreseeability of the risk and reasonable practicability of effective preventative measures***

Dry NC is static sensitive; it is delivered wetted with anti-static bags. AWE remove the wetted NC and dry it in pans at around and then place it in normal plastic bags. Any charge that has built up within the dry NC cannot dissipate as the plastic bags are an insulator. The dry NC is weighed and then put into smaller plastic bags increasing the static build up again before being broken up and placed into the MEK. MEK is highly flammable and should be protected against static discharge. The bucket that the MEK was put in was again plastic therefore any dissipated charge could not go to earth and would remain in the NC until a release source was found.

The HAZOP for the lacquer preparation asked questions with regard to ESD and thermal decomposition but were not closed out. The HAZOP was signed by two people; that would make a very small team and not all the issues were addressed. The issues with the NC static and thermal loading were not identified at this stage therefore controls were not implemented

The Material Hazardous data sheets for both MEK and NC clearly state that ESD must be guarded against and that plastics should not be used during the process. The company used normal polythene bags to store the dry NC, normal nitrile gloves when handling the dry NC and polythene buckets to mix the NC and MEK

The MEK is a highly flammable substance and is sensitive to ESD. The dry NC is an explosive substance and is sensitive to ESD and thermal decomposition.

It is foreseeable that an inadvertent ignition of dry NC/MEK would occur if anti-static precautionary measures were not in place. Practicable anti-static precautions are well known/documented in guidance and standards. the company failed to recognise this position and did not put control measures in place

It is practicable to prepare the NC lacquer without drying the NC first; it was practicable to store the NC in anti-static bags, it was practicable to use conductive buckets to prepare the NC lacquer; it was practicable to earth bond the process.

Basically the company did not have an effective system to prevent a fire from ESD or thermal decomposition.

All on page Reg 12 (5) (a) National Security EIR



### **Relevant standards and their source**

The manufacture and Storage of Explosives Regulations 2005 ACOP paragraphs 107 to 117 recommend the required precautionary measures needed when handling sensitive to static materials.

of dry NC and MEK process requires secondary precautionary measures in accordance with MSER para 111; AWE failed to comply in that no humidity controls were present, no earth straps, gloves are nitrile and they used normal plastic bags and buckets

Both MHDS's state that the substances are sensitive to static and that plastic equipment should be avoided.

The company claim that the coveralls were anti-static and a conductive floor was present and that every time an employee entered the room they must pass the HATM.

According to the PACE statement the company assert that they followed JSP482 as this was the most relevant guidance and that there was never an expectation that safe guards were to be retrospectively fitted. The room was refurbished in ACOP guidance was available in 2005 therefore I do not believe the companies argument stands. Whilst we would accept compliance with JSP 482 as appropriate guidance, the lack of humidity control, the equipment being used, and the procedures being applied demonstrate failure to comply with this guidance.

The DSEAR assessment assumes the lacquer preparation would be conducted in which was appropriately zoned. However, mixing of the lacquer took place in the which was not considered as part of this assessment. equipped for static protection.

presented to the company in that there was potential for thermal decomposition with NC if the fibres contained water.

### **Relevant case law**

No relevant case law can be identified that undermines the potential breach or can offer a defence for the company.

### **The effectiveness of control measures and management arrangements prior to the incident**

The preventative measures in place were not effective and contributed towards the incident because the company had not recognised that ESD or thermal decomposition could be an ignition source and that controls were not present.

The company state that conductive shoes and flooring were present but failed to recognise that all the plastics used in the process were insulators.

Errors in the risk assessment for (i.e. sections were cut and paste from the and patently not relevant) calls in to question the whole risk assessment process and the competency of those doing the assessment.

COSHH assessment takes each chemical in isolation not taking into account what happens as they get mixed during the process or process conditions. One risk assessment is cut and paste from another process and is not relevant. Company safety orders (part of the safe system of work) were not followed. The COSHH assessment is therefore not considered suitable and sufficient contrary to Regulation 6(1) of COSHH nor does it include the required elements of Regulation 6(2).

### **The nature and extent of the breaches – how far below the expected standard the duty holder fell and whether the breach was an isolated occurrence**

NC lacquer is typically produced with wetted NC not dry NC to reduce the risks associated with handling a highly flammable and static sensitive solid; the company failed to identify the increase in risks and to implement necessary controls. The risk gap identified is far greater than what is acceptable and considered to be gross breaches. The potential consequences could therefore have been much higher than those experienced.

Guidance was readily available from within the cellulose industry or HSE; AWE had their own experts capable of providing advice on NC thermal decomposition and protection against ESD but these were not consulted.

All redacted under Reg 12(5)(a) National Security EIR

Unless indicated

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information

The event could have occurred at any time because the company failed to recognise the hazards present. A fundamental requirement of any company is to identify hazards and determine the risks and then mitigate against the risks to an acceptable level. AWE failed to do this, even though the information and the methods to control were easily available and well known.

**Every employer shall ensure that suitable personal protective equipment is provided to his employees who may be exposed to a risk to their health and safety while at work except where and to the extent that such risk has been adequately controlled by other means which are equally or more effective.**

The company contributed to consequences of the accident, in that they

- Failed to ensure that production operatives were wearing adequate PPE in that the tyvek coveralls were not suitable protection against fire
- Failed to ensure that PPE was stored in a correct manner in that PPE was stored in the same room as where there was a possibility of contamination

#### **Foreseeability of the risk and reasonable practicability of effective preventative measures**

operatives used to wear air-hoods cotton coveralls and chemical splash suits to protect against the potential spillages of \_\_\_\_\_ and MEK; this type of PPE was changed in \_\_\_\_\_ under the instruction of a former employee. In \_\_\_\_\_ and on the night of the incident the operatives were wearing Tyvek coveralls, this type of coverall offers no protection against fire. Therefore appropriate PPE had been provided in the past but standards were reduced without any form of assessment or change management.

If the IP had been wearing the correct personal protective equipment at the time of the incident, it would not have stopped the incident but the injuries he sustained would not have been as severe.

#### **Relevant standards and their source.**

The standards of PPE should have been identified as a result of the company's Risk and COSHH assessments. Relevant standards exist for fire protective overalls, solvent protective gloves and RPE but none of this had been considered. The case is not that they provided the wrong standard but that they failed to specify suitable PPE at all.

MSER ACOP and CBI guidance recommends that all explosives workers wear cotton protective clothing.

The coveralls gloves etc are stored in the same room as the process with no protection against cross contamination which contravenes Regulation 8 of the PPE regs.

The company do not use changing rooms to segregate clean personal clothing from contaminated PPE as per the guidance in the PPE ACOP part 2 para 86.

#### **Relevant case law**

No relevant case law can be identified that undermines the potential breach or can offer a defence for the company

#### **The effectiveness of control measures and management arrangements prior to the incident**

AWE employee \_\_\_\_\_ <sup>Reg 13 Personal Information</sup> identified that the PPE worn by AWE employees did not meet normal standards that he had encountered during his working environment with other explosives employers; informed line management \_\_\_\_\_ On the night of the incident none of the issues and been rectified

According to the Company statement, PPE was not required as the process was low risk this is a good indicator that the system of work had not identified all the hazards and taken proportionate measures to protect against them

**Extent of the breaches – how far below the expected standard the duty holder fell and whether the breach was an isolated occurrence**

All on page Reg 12(5) (a) National Security EIR

Unless indicated.

The company failed to identify the increase in fire risks when using dry NC and to implement necessary controls. The resultant gap between controls in place and the expected standards introduced a substantial risk of serious personal injury.

Guidance was readily available from within the cellulose industry or HSE; AWE had their own experts capable of providing advice on personal protective clothing for protection against fire but these were not consulted.

A fire an inherent hazard when handling flammable substances. A fundamental requirement of any company is to protect employees from potential fire, with PPE used as a last resort. No AWE employee handling flammable substances wore PPE as a protection measure even though the issue was raised by an employee; this is far below what is acceptable within the industry even though the information and the methods to control were easily available and well known

**Evidential sufficiency** (Comment upon the admissibility of prosecution evidence, its weight, any conflicts of evidence, the reliability of witnesses, the results of any PNC checks completed at this stage, an assessment of any expert evidence obtained and any other matters that could affect the strength of prosecution evidence presented in court. Cross refer to the evidence matrix where appropriate.)

Evidence is primarily company documents, witness accounts in statements and PACE interviews. No suggestion that any of the witnesses are unreliable but comprehensive checks to be undertaken once decision on enforcement action has been made.

**Possible lines of defence** (Include any relevant case law)

Reg 13 Personal Information

From the PACE interview given by \_\_\_\_\_ on behalf of AWE on

Systems are in place; specific assessments for each building have undergone scrutiny. Properties of dry NC were not apparent therefore not foreseeable and are so complex that they are not fully understood today:

With the company's new understanding of the risks involved the company is doing everything reasonably practicable to control the risks.

Whilst a risk assessment and Safe System of Work was in place the team leader decided the lacquer preparation work could be carried out in conjunction with the powder preparation activity.

Company believe that Human Behaviour will always stray away from plans in times of emergency

Company believe medical surveillance is not required because they conducted an assessment \_\_\_\_\_ and the level of exposure was within acceptable limits

Reg 12  
(5)(a)  
National  
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**Material satisfying the disclosure test** (You must draw attention to all material, whether used or unused, which has the potential to undermine the prosecution case or assist the defence)

COSHH and risk assessments collected as evidence within this report were provided by the company as being relevant to the fire, however none are signed and the company could now claim that they are not the relevant assessments undermining the prosecution case.

The incident update briefing notes prepared by the investigation team to HSE line management state that prosecution should be given serious consideration. This type of statement could undermine the case if they are read as pre-judging the case.

Bearing the implications of the Bradford fire and the involvement of the HSE, I held a meeting on \_\_\_\_\_ with AWE to discuss the shortfalls I had found and asked the company to make improvements to their safe systems. This could be assessed as pre-judgement..

**Relevant previous enforcement and advice by HSE** (Provide details including inspection and enforcement history (letters, notices, prosecutions). Indicate where consideration could be given to using evidence of bad character. Refer to FOCUS/COIN etc reports where appropriate)

Reg 12(5) (a)

National Security EIR



AWE PLC has been prosecuted on one previous occasion; however this was when the company were a GOCO and managed by Hunting Bray. Since that date the management structure is completely different and I believe it is a different legal entity therefore cannot be used as previous enforcement.

**Duty holder's attitude** (Comment on the attitude of the duty holder towards health and safety management, the incident and HSE, including whether the duty holder co-operated with the investigation. Where not stated above, give the duty holder's explanation for any contravention(s).

Attitude is positive and safety is high profile issue within the company normally. They have accepted that there are deficiencies in their systems and are actively trying to remove them. Managers find it hard to believe that an operative would not follow a procedure but realise that this is an underlying factor and was not the immediate cause of the incident.

**Views of IP(s) or bereaved relative(s), where applicable** (Include reference to any Victim Personal Statements obtained)

Refer to Victim Impact Statement made by

feels upset that he was not made aware of all the risks when handling explosives during the and believes the company mislead him with their attitude that nothing would happen. He cannot understand why he did not have the same rigorous training and protection as he did for his normal day job.

Even though he his undergoing counselling with regard to the incident he is of the opinion that he will not be able to work with explosives in the near future.

no longer has faith in AWE PLC to look after his well being, it appears to him that the company is only interested in saving money.

Just after the incident was conscious of people staring at him and he felt damaged. This is improving with the counselling however he has still has been left with a scar on his left forearm,

**Any other aggravating, mitigating or other relevant factors** (Indicate any additional aggravating, mitigating or other factors not already identified above. Indicate any further Public Interest factors not identified in the preceding sections. Refer to the Enforcement Policy Statement (paragraph 39), the CPS Code for Crown Prosecutors (England and Wales) and the Howe judgement)

#### Mitigation

The company assisted in every stage of the investigation including conducting tests on behalf of the investigation.

The company have a very positive attitude towards health and safety and strive to be a leader in the explosives sector including having membership of the Explosives Industry Group.

Lessons learnt from the incident are being passed on to other areas of the business where explosives are not part of the business.

#### Aggravation

Failings of AWE were comprehensive and basic, particularly when compared with arrangements in place elsewhere in the company. The company did not pay sufficient attention to non-nuclear high hazard activities on site which it considered low risk. For this process the company did not recognise some of the potential hazards involved in the manufacturing of NC lacquer and classed it as a low risk activity.

The type of PPE needed for explosives processing was highlighted by an employee in November 2009 however the company were very slow to react to the recommendations

There was a different safety approach to the nuclear side of the business in comparison to the explosives side.

### Enforcement Policy Statement and Enforcement Management Model

**Application of HSC's Enforcement Policy Statement and the Enforcement Management Model** (Discuss the application of the EPS and the EMM to the circumstances - completed EMM1s must be attached as Appendix 1)

All on page Reg 13 Personal Information  
unless indicated.

Reg 12  
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Paragraph 40 of the EPS states that a company should be prosecuted or prosecution recommended if the gravity of an alleged offence, taken together with the seriousness of any actual or potential harm warrants it.

The incident itself resulted in one building being damaged and an employee suffering burn injuries to their face and left arm. However the consequences could have been far more severe if the fire had ignited the explosives contained within the room. The potential of this incident could have resulted in many fatalities of the emergency responders who attended the scene whilst the fire was still burning.

On the night of the incident the company failed to implement many of its policies and procedures, but the main root cause was that the company failed to recognise the hazards and therefore mitigation or controls were not in place.

The company's own investigation report states that it was a solvent fire and has played down the potential consequences.

The EMM has shown that the risk gap is substantial mainly because the company did not follow approved code of practice stated within numerous HSE documents; also experts within the company were not involved in designing the safe systems of work.

Overall the company's actions leading up to and including the night of the incident fell far below the standard expected in an explosives manufacturing company. In my opinion prosecution of the company is warranted as this was an incident waiting to happen and the company were fortunate that the consequences did not lead to numerous fatalities.

It could be argued that the company are compliant and that this is a one off incident. However there were so many management failings on the night of the incident and that the conditions and activities did not meet standards that are evident elsewhere on site points to prosecution being the only course of actions that realistically serves the EPS.

**Recommended action** (Describe the action proposed with specific reference to the EMM (relevant duty holder/strategic factors and the Confirmed Enforcement Expectation), the EPS and the CPS Code for Crown Prosecutors (England and Wales). Where prosecution is proposed, comment on the preferred venue (Magistrates/Crown Court) and prepare draft information(s), including as appendix 2.

It is recommended, from the range of potential breaches identified above, that AWE PLC are prosecuted for the following alleged breaches as being the most relevant and focussed:

Health and Safety at Work etc Act 1974 Section 2(1)

*It shall be the duty of every employer to ensure, so far as is reasonably practicable the health, safety and welfare at work of all his employees because the company*

AWE failed to ensure that the health and safety of 2 and others present in that they failed to provide the necessary training and supervision and to ensure a safe system of work in the manufacture of NC lacquer and 1 had been implemented.

AWE failed to provide the necessary information and instruction to 11 personnel (fire fighters, site engineers and first aider), so as to ensure their safety, in that they failed to have a robust system for informing them of the hazards and risks associated with explosives present in 1

Personal Protective Equipment at Work 1992 Reg 4(1)

*Every employer shall ensure that suitable personal protective equipment is provided to his employees who may be exposed to a risk to their health or safety while at work except where and to the extent that such risk has been adequately controlled by other means which are equally or more effective because the*

AWE failed to provide 2 and others with appropriate PPE when dealing with flammable, extremely flammable, explosives and other hazardous material to ensure protection from the effects of fire.

Manufacture and Storage of Explosives Regulations Reg 4(1)(a)

*Any person who manufactures or stores explosives shall take appropriate measures to prevent fire or explosion because*

AWE failed to identify the hazards associated with handling dry NC and implement adequate controls to prevent fire when handling NC

1 = Reg 12 (5) (a) National Security EIR

2 = Reg 13 Personal Information



The matters in this report have been considered with regard to the Enforcement Management Model and following any Management Review an EMM1 form has been completed. Consequently, where prosecution has:

- **not been indicated**, the supporting appendices should only be completed as agreed with the investigator's line manager; or
- **been indicated**, the appendices should be completed as appropriate; or
- **been indicated** and charges are not being proposed, the reasons should be outlined above.

Investigator's name

Investigator's signature

Date

Line Manager's signature

Date

Reg 13 Personal Information

## Comments

Isolating which of the two potential causes of the initial ignition, or whether it was a combination of the two, would require considerable additional research time and resource with no guarantee of success. In considering the precautions expected for the handling of dry NC, anti-static precautions and the prevention of exothermic reaction are the two obviously necessary controls that have been omitted by AWE. Focussing on the introduction of relevant controls will reduce the likelihood significantly of a reoccurrence.

What is more disturbing are the catalogue of other failures and erosion of the controls adopted for handling explosives that have been brought to light by this investigation. From the range of breaches identified, the perception is that whilst extensive management processes and procedures may have been introduced, ensuring they are implemented in practice and remain effective has not had appropriate attention.

Three key failings have been identified as a result of this investigation:

- i) AWE failed to identify the potential of electrostatic discharge as a potential ignition source in the mixing of NC Lacquer, despite it being expressly mentioned in the material hazardous data sheets for both NC and MEK. Within the explosives industry it is well known that dry NC is extremely sensitive to static and why, wherever possible, it is handled wetted. As a result appropriate control measures, which are well documented in the ACOP to MSER, were not identified. The location, equipment and processes used were not suitable for the handling of dry NC or flammable liquids. Likewise thermal/chemical decomposition of the dry NC was not appreciated as a risk. The dry NC was tested for quality purposes but the connection with preventing fires and explosion was not made or considered.
- ii) Management arrangements that had been put in place had been allowed to be ignored, defeated or neglected, as demonstrated by operators' failure to adhere to operating procedures, the provision of appropriate tools and equipment, ensuring the competency of staff involved in the process, the disregard of explosives hazards in the emergency response and the emergency provisions in general.
- iii) Changes being made without appropriate assessment or securing appropriate approvals as exemplified by the reduction in the standard of PPE specified for NC lacquer mixing.

The proposed action provides the opportunity to focus management's attention on some key areas:

- A safe system of work does not exist on paper alone, AWE need to see them through into practice and check they are being effective;
- Care has to be taken when assessing hazards and how they can materialise in order to ensure necessary controls are identified (e.g. handling dry NC, extremely flammable MEK or
- Explosives require the same attention as other licensed activity on site.

Significant failings have also been identified in their assessment processes and potential breaches of COSHH and the Management of Health and Safety Regulations have been considered. A further breach of Regulation 9 of MSER is also indicated (in that explosives were being stored in \_\_\_\_\_ while the \_\_\_\_\_ of NC lacquer took place contrary to the licence) and this should also be kept under consideration. The extent of the weaknesses found in AWE's arrangements in the explosives area was such that a string of alternative charges could be laid. I agree that, out of the multitude of possible offences, the three recommended offences are appropriately representative and should be pursued because:

Regulation 4 MSER – Prima facie case as all necessary measures had not been taken to prevent fire. Evident controls needed to reduce the likelihood of fire were not in place. It is important to have an explosives offence on the charge sheet in order to raise the profile of explosives as a major hazard with AWE.

Section 2 HSWA - The disregard of the systems of work was such as to be almost non-existent. Need to reinforce the message that having a system in place on paper is only half the job; implementation and conditions on the ground are what is important. Another factor is the evident contrast with the robust standards required of staff working in other areas on-site and what is reasonably practicable in high hazards operations.

Regulation 4(1) PPE Regulations – Reinforce the management of change procedures and incorporates their failures in assessing risks under MHSWR and COSHH in identifying suitable PPE. A suitable standard has been used in the past and provides irrefutable evidence of what is reasonably practicable.

- Reg 13 Personal Information

Reg 12  
51(a)  
National  
Security  
EIR

## Part D - Approval Officer's Considerations and Decision

(Approval Officer's consideration of the evidence, public interest factors, proposed defendants, proposed charge(s) and decision on prosecution)

Duty holder's name

Atomic Weapons Establishment PLC

**Note:** Separate Parts C and D should be prepared for each defendant.

**Review the application of the Enforcement Policy Statement and Enforcement Management Model to the circumstances presented by the investigating inspector:**

The EMM record clearly shows that prosecution should be undertaken and I agree it meets the following policy principles:

- **proportionality** in applying the law and securing compliance;
- **consistency** of approach;
- **targeting** of enforcement action;
- **transparency** about how the regulator operates and what those regulated may expect;
- **and accountability** for the regulator's actions.

**Review the application of the CPS Code for Crown Prosecutors in relation to each proposed case presented by the investigating inspector, giving reasons:**

**Evidential Stage:**

Evidence consists of statements, documents and records voluntarily given to the HSE also a PACE statement from an AWE representative. All the evidence is admissible and there are no contradictions within the evidence. The evidence that possibly undermines this case are Exi's briefings to senior management, but these briefings are not considered to be detrimental to the case.

**Public Interest Stage:**

There is still political interest in the incident; HSE's reputation could be attacked if enforcement action is not taken. It is in the public interest to ensure that operators of high hazard establishments are held to account when arrangements for preventing catastrophe fall short of the standards required.

**Decision on each of the proposed charges with the reasons for or against approval**

It is agreed, from the range of potential breaches identified above, that AWE PLC are prosecuted for the following alleged breaches as being the most relevant and focussed:

**Health and Safety at Work etc Act 1974 Section 2(1)**

*It shall be the duty of every employer to ensure, so far as is reasonably practicable the health, safety and welfare at work of all his employees because the company*

AWE failed to ensure that the health and safety of <sup>2</sup> others present in that they failed to provide the necessary training and supervision and to implement a safe system of work in the manufacture of NC lacquer and <sup>1</sup> Prime fascia failing

AWE failed to provide the necessary information and instruction to 11 personnel (fire fighters, site engineers and first aider), so as to ensure their safety, in that they failed to have a robust system for informing them of the hazards and risks associated with explosives present in <sup>1</sup> Prime fascia failing

**Personal Protective Equipment at Work 1992 Reg 4(1)**

*Every employer shall ensure that suitable personal protective equipment is provided to his employees who may be exposed to a risk to their health or safety while at work except where and to the extent that such risk has been adequately controlled by other means which are equally or more effective because the*

AWE failed to provide <sup>2</sup> and others with appropriate PPE when dealing with flammable, extremely flammable, explosives and other hazardous material to ensure protection from the effects of fire. Prime fascia failing

1 = Reg 12(5)(a) National Security EIR

2 = Reg 13 Personal Information

Manufacturer and Storage of Explosives Regulations Reg 4(1)(a)  
*Any person who manufactures or stores explosives shall take appropriate measures to prevent fire or explosion because*  
AWE failed to identify the hazards associated with handling dry NC and implement adequate controls to prevent fire when handling NC. Prime fascia failing

**Preferred venue (Magistrates'/Crown Court) and reasons**

The incident resulted in an injury of an employee and damage to one building; however the consequences could have been severe if the whole contents of the building had ignited. The preferred venue is Magistrates because the failings in this case are through lack of understanding and ensuring a safe system of work was implementation and there is no evidence that the company were seeking advantageous profit.

**Post-approval action, including use of solicitor agent, referral for ILO**

There will be political interest in this case therefore the use of ILO is to be sought. Press office advised of proposed action once the company has been informed of our intentions.

**Approval officer name, signature and date of decision**

Name			
Signature		Date	

Reg 13 - Personal Information