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**AWE Fire Investigation**  
**Key Findings and Company Responses**  
**document**  
**For AWE Local Liaison Committee**

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External view of the building after the fire



External view of the building after the fire



Internal view of the building after the fire

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## **Introduction**

On the evening of Tuesday 3 August 2010, a solvent fire broke out in an explosives production building on the Explosives Licensed Site at AWE Aldermaston.

No nuclear materials were involved in the fire and there was no risk of a radiological incident. By design all explosives facilities are located well away from the site's nuclear processing area and segregated from each other. The fire was confirmed to be out within five hours.

A comprehensive, independently chaired investigation was commissioned to determine the circumstances which led to the fire and to make recommendations for improvement. It concluded that an electrostatic discharge was the most likely cause of the fire.

We are sorry that this incident occurred. We have accepted all of the investigation's recommendations and have already taken decisive action to ensure that such an incident does not happen again. We know that AWE has to maintain the highest safety standards. On this occasion we fell short of this.

This document details the investigation findings and recommendations, together with AWE's responses.

## **Overview of the event**

At approximately 9pm on Tuesday 3 August 2010, a solvent fire occurred in an explosives production building at AWE.

Four members of staff were carrying out a mixing process required for the preparation of explosives powder which involved the addition of dry nitrocellulose (NC) to containers of the solvent methyl ethyl ketone (MEK). This lacquer preparation has been conducted approximately 2,000 times at AWE during the last 30 years without incident.

On this occasion, the contents of the container holding MEK ignited. The staff present evacuated the area and the site's emergency response procedures were immediately initiated. One member of staff suffered a burn injury requiring on-site first aid treatment.

AWE technical and specialist staff responded quickly, establishing a safety cordon around the building as a precautionary measure due to the presence of the explosives.

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AWE's on-site emergency services responded rapidly and their initial concern was for the safety of potential casualties. Following normal procedure, they assessed the situation and then called for support from The Royal Berkshire Fire and Rescue Service (RBFRS). On arrival, RBFRS assumed command and control of the incident. A decision was taken to extend the safety cordon beyond the site boundary and this required the closure of some external roads and the evacuation of 14 local residents.

AWE continued to provide the relevant expertise to the Local Authority emergency services throughout the course of the incident.

Following assessment, the fire was allowed to burn out during the night. This minimised any risk to emergency response crews and is normal practice in such circumstances. Damage was limited to equipment and materials inside the building with only minor impact on the building fabric. The fire did not spread to any adjacent areas and was confirmed to be out by 2am.

The interior of the building contained some asbestos. Consequently inspections were conducted, during and after the fire, to establish whether any asbestos contamination had escaped from the building. No asbestos contamination was found.

## **Independent Investigation**

The AWE commissioned investigation to determine the circumstances which led to the fire has been completed. It makes recommendations to prevent any reoccurrence in the future.

The investigation team carried out comprehensive practical analysis as well as theoretical work over a number of months. During what proved to be an extremely complex investigation, they took advice from experts from within and external to AWE, including the Health & Safety Executive. The investigation used a structured methodology to identify all possible fault scenarios. Each was systematically evaluated to reveal the most likely cause of the fire.

The investigation concluded that the fire started in the MEK container, therefore the following possible sources of ignition were considered:

- Electromagnetic (EM) radiation: This was ruled out because there was no source of EM in the building and the building structure provides screening from external sources.
- Chemical reaction caused by impurities: This was ruled out as extensive chemical analysis showed NC and MEK were to specification.
- Degradation of materials by heating or aging: Tests of nitrocellulose taken from storage showed no traces of nitric acid which would have

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been expected in large amounts to create the temperature increase required for ignition. Calculations showed this to be unlikely.

- Friction: This was ruled out because the nitrocellulose would have ignited when being handled by the operator and it was clear that the ignition took place in the MEK bin.
- Shock or impact: This was ruled out as no significant height or masses were involved.
- Electrical current from mains supply: This was ruled out because the bin was in the middle of the room with no power supply present.
- Naked flame: This was ruled out because there was no gas supply present and in line with local rules other ignition sources (e.g. matches or cigarettes) were not present.

## **Cause of the fire**

Having eliminated other possible sources of ignition, the investigation team concluded that the most likely cause of the fire was a build up of electrostatic charge in the dry NC. This then discharged as the NC settled through a flammable layer of MEK vapour in the lacquer preparation container.

Electrostatic build up and discharge in NC is complex to predict and characterise. For it to occur on the night of the fire, a number of circumstances needed to come together that were not apparent in AWE's previous assessments of the hazards and risks.

Despite extensive investigation and analysis, a definitive mechanism cannot be conclusively identified, as it was not possible to replicate the precise conditions at the time of the fire. However, electrostatic discharge is the most likely cause.

The recommendations from the investigation address the causes of the fire and are fully accepted by the Company. A project team has been established and resourced to implement the actions required to ensure that no similar incident occurs in future.

## **Other shortcomings**

The investigation highlighted a number of other shortcomings which, although they did not directly cause the event, did not meet our high standards. AWE has established a project team which has already addressed many of these issues.

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On the evening of the fire, the work area contained some explosives that were not required for the operation being conducted. They were not involved in the fire and, despite their presence, AWE was compliant with the explosives licence. Nevertheless, we recognise that this was not best practice and they should not have been in the building.

The investigation highlighted that lacquer production operation was not carried out in accordance with appropriate process instructions. While the operation had been authorised for the following day, it had not been authorised for the day of the incident. There was a perceived feeling of pressure among the work team even though there was no need to complete the task at that time.

It was also noted that on the night of the fire, some of the staff intended to work a shift of up to 16 hours as was common practice for this infrequent operation.

The investigation acknowledged that reviews of the process had been conducted in the past. While they recognised that there were electrostatic hazards, they did not identify the particular complex behaviour of dry NC.

It was noted that there was a belief among the work teams that the process could not be amended. AWE's safety management system was found to be complex and, in certain areas, difficult to use.

Improvements need to be made in risk assessments associated with the process and in the use of protective clothing.

A comprehensive competency matrix for the explosives team was found to be in place. However, the investigation team could not find sufficient evidence of assessments against this training process and only limited records were found.

While the emergency response to the incident on the night was prompt, AWE's fire and rescue services went directly to the scene of the fire. This was due to their initial concern to ensure the safety of any casualties. They should have gone first to the work control centre where they would have received briefing on the casualty and explosives situation.

## **Investigation Recommendations**

The investigation report has defined a set of specific recommendations, all of which are accepted for action by AWE:

**Recommendation 1:** No further lacquer preparation should take place until a full review of the process has been carried out with the objective of either eliminating the hazards or reducing to as low as reasonably practical (ALARP), the risk of harm and fire through engineered controls.

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**Recommendation 2:** Ensure that all buildings where explosives are managed or stored are operated in accordance with Explosive Safety Orders (XSOs) which are clear, unambiguous and compliant with the Explosive Licence.

**Recommendation 3:** Reassess all non-nuclear high hazard processes confirming that hazards have been correctly identified, and where they cannot be eliminated, suitable control measures have been fully implemented. Those processes infrequently operated should not restart until this assessment has been made.

**Recommendation 4:** Review the set of product design specifications, approved processes and operating instructions to ensure they are up to date, consistent and practical to safely implement.

**Recommendation 5:** Ensure that a suitable training and competency system is in place and fully implemented for all high hazard non-nuclear operations.

**Recommendation 6:** Ensure that the formation of operating teams for high hazard batch processes recognises the importance of resource planning, team cohesion and the need to avoid significantly extended working hours.

**Recommendation 7:** Strengthen the arrangements which enable the Company to effectively draw on defence sector, and other external sources of expertise and experience of energetic materials and processes.

**Recommendation 8:** Establish a process for periodic review of high hazard non-nuclear processes against modern standards ( i.e. industry best practice).

**Recommendation 9:** Ensure that audit and inspection programmes adequately test the process safety aspects of high hazard activities, particularly where these are infrequently performed.

**Recommendation 10:** Provide advice on the required level of awareness and preparedness by AWE for potential emergencies arising during out of hours working, and build into the emergency exercise programme, reinforcing the need to follow designed arrangements.

**Recommendation 11:** Conduct a joint review with the Local Authority to identify necessary changes to plans for responding off site during non-radiological events. This should include communications in general in a non-nuclear incident.

## **AWE's Response**

AWE has accepted all the recommendations of the investigation into the causes of the fire. A project team has been established and resourced to implement the actions required to ensure that no similar incident occurs in future.

The lacquer preparation process was stopped immediately and will not be restarted until engineered controls confirm the safety of the process. Process restart decisions will be made in agreement with the Health and Safety Executive. (Recommendation 1)

An immediate review was conducted of all AWE explosives and flammable operations. It confirmed that this was an isolated occurrence and that similar conditions do not exist elsewhere on our sites. (Recommendation 3)

AWE's nuclear processes are already subject to rigorous periodic review and we have recently completed a major investment to review all our nuclear operations in accordance with our Nuclear Site Licence.

Wider and more detailed reviews are also being carried out to improve the inspection of the higher hazard, non nuclear processes across our sites. Learning points from these reviews are being built into our systems of work. (Recommendation 8)

We are challenging our documentation to ensure that the safe systems of work in place at AWE are simple and easy to follow. (Recommendation 4)  
Our task risk assessment process has already been reviewed and improved. (Recommendation 9)

Greater emphasis is being placed on human factors, the role of external technical experts and demonstration of competence, to further improve safety on our sites. (Recommendations 6 & 7)  
Improvements in training for explosives operations are being accelerated. (Recommendation 5)

All Explosives Safety Orders, which restrict quantities of explosives in every building, have now been simplified and communicated to staff. (Recommendation 2)

Following the fire, AWE has improved its arrangements to make it clear which operations can be safely carried out in any area of our sites at any given time. (Recommendation 10)

A programme of broader and more demanding training and emergency response exercises is being deployed to maximise learning opportunities. (Recommendation 5 & 10). The offsite emergency response plan has been reviewed with the local authority and liaison arrangements have been improved. (Recommendation 11)



## **Conclusions**

Ensuring the safety of our staff, neighbours and local community remains AWE's highest priority.

We are sorry that this incident occurred and have already taken decisive action to ensure that it doesn't happen again. We know that AWE has to maintain the highest safety standards. On this occasion we fell short of this.

The particular operation taking place at the time of the incident will not restart until we, and the Health & Safety Executive, are satisfied that a safe alternative process has been developed.

The reviews we have already carried out give us confidence that this was an isolated event. We know there is no room for complacency.

A full and thorough independent investigation has been completed. This has established the most likely cause of the incident and identified other shortcomings. We have fully embraced all the recommendations made by the investigation team and are sharing them with all of our stakeholders.