Incident

Evangelos Florakis Naval Base explosion

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Summary

This case study involves a major explosion of military ordnance that occurred at a naval base in Cyprus in July 2011 resulting in thirteen fatalities. Whilst the circumstances of the incident are unique, there are lessons learned to share across industry.

Many of the details provided in this report are extracted from the official Cypriot "Research Committee" investigation report dated 30 September 2011.

Keywords: Explosives

Introduction

Evangelos Florakis Naval Base is located on the south coast of Cyprus, about 25 km east of Limassol, near the village of Mari, in the Larnaca District of Cyprus (see Figure 1).

It lies immediately to the west of the Vassilikos desalination and power plant that supplies about half of the power for the island country (see Figure 2).

The power station is just above sea level and a hill rises some 15-20 metres to its west, where it enters the property of the navy base.

Background

On 20 January 2009, the Monchegorsk, a Cypriot-flagged ship heading for Syria and originating in Iran, was intercepted in the Red Sea by US warships. A cargo inspection took place and was found to be in violation of United Nations sanctions against Iran. Following various diplomatic discussions between 23 and 28 January, the ship was directed to port at Limassol, Cyprus and on 29 January an inspection found military material, designated "Dangerous Goods". This included various types of gunpowder and Kalashnikov arms[1]. After further political and diplomatic discussions, the cargo was confiscated, offloaded at Limassol Port and transferred to the Evangelos Florakis Naval Base.

In total, 98 shipping containers were removed and stored in the open, towards the north-west corner of the naval base, piled three high. They were located some 300 metres from the main building at the adjacent power plant (see Figures 3 and 4).

Over the following 2½ years, despite multiple political and military discussions, that included concerns about safety of the material, the containers remained *in situ*.

Incident

On the night of 4 July 2011, staff at the naval base noticed that

Google Earth

Figure 1 – Cyprus

Google Earth

Figure 2 – Aerial view of site

Google Earth

Figure 3– Aerial close-up showing containers

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Figure 4 – Close-up showing containers

Figure 6 – Deformed container 5 July 2011

one of the 98 containers, located at the top south-east corner, was deformed. This was reported to the base Commander and the Ministry of Defence who held a meeting on 5 July 2011. On 6 July 2011, a group inspection of the containers took place and photographs were taken (see Figures 5 and 6).

On 7 July 2011, the Chief Expert prepared a safety report, with recommendations including the destruction of the explosives.

On 8 July 2011, the containers were drenched with water from a firefighting vehicle.

On 11 July 2011, at about 03:40, employees of the Vassilikos Power Station noticed some flashes in the sky, on the side of the naval base, and heard explosions. After a few minutes, an officer at the base saw fire in the containers and signalled an alarm. Navy personnel immediately mobilised firefighting equipment to tackle the fire, although they could not contain it.

Local firefighters received a call at 04:27 and attended site with two fire engines and six firefighters.

At 05:55, there was a huge and devastating explosion.

Consequences

Thirteen people died, including the Commander of the Navy, the Commander of the base and six civilian firefighters who had been tacking the blaze prior to the explosion[1]. Sixty-two people were injured and some 150 properties in the nearby village of Mari and Zygi were damaged.

The adjacent Vassilikos Power Plant was severely damaged due to the blast wave and the debris from the containers and the munitions that rained down on the facility. The plant immediately shut down, causing rolling power blackouts across the island for many weeks.

A large crater shows where the containers were located (see Figure 7) and the damage to the power station, oil storage tanks and infrastructure can be seen from the historic Google Earth satellite imagery.

There were concerns about the possible presence of depleted uranium from the ordnance, so a radiological survey had to be conducted before repairs to the power station could commence. Fortunately, no such material was found.

The rolling blackouts continued for several weeks until Greece provided portable generating capacity of 70 MW via a package of 129 heavy containers[2]. These were transported by the end of July and a temporary generating farm was installed to supplement the nation's supplies whilst repairs to the power

Figure 5 – Deformed container 5 July 2011

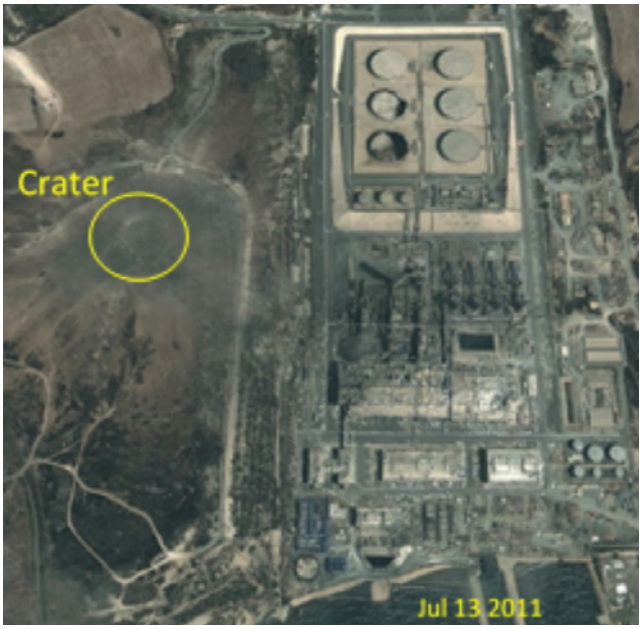

Figure 7 – Aerial photo 2 days after incident

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Figure 8 – Temporary Generators

station were carried out (see Figure 8).

It took some two years before the power station was back to full operation[3].

Due to the political fallout that followed the investigations, the president's defence and foreign ministers resigned[4].

Investigation and analysis

A "One Member Research Committee" investigation was set up by the Cypriot Authorities and led by a lawyer, Polis Polyviou[1]. His 643-page report was issued on 30 September 2011. The remit was extensive and included issues such as:

- Actions, omissions, events, circumstances, or their combination, which led to the explosion.
- The facts and decisions on the basis of which containers were unloaded and kept in the Republic.
- The facts and decisions related to the choice and method of placement of containers on the naval base.
- Events and decisions related to maintenance of containers from their placement in the naval base up to the explosion.
- The correctness and/or the adequacy of the decisions and measures taken, as well as the instructions given by the placement of the containers until their explosion.
- The correctness of the actions following the discovery of deformation of a container on 4 July 2011 up to and including the explosion.
- Suggestions for how to improve the situation to avoid similar incidents in the future.

The terms of reference included many other factors such as correspondence and decisions/actions taken by government officials and whether any liability arises.

Findings

The Research Committee report lists a number of findings including the following comments[1] that have been translated from Greek and edited:

- The immediate cause of the explosion was self-ignition.
- The summer temperatures had been increasing steadily throughout July and reached a peak for the month of 32°C on the day before the explosion[5].
- The method of storing the material was contrary to any rules for storage of ammunition and/or explosives and was wholly inadequate. They were not insulated from the sun and were piled on top of each other.
- The hazards of the cargo were known to all stakeholders from the beginning.
- The officials were concerned with the security of the material, rather than the safety of personnel.
- The decision for the location of the storage did not consider its proximity to the island's main power station.
- Political and diplomatic issues were cited as a major factor in the delays in making a decision to relocate or dispose of the material.
- Although samples were taken in March 2011, to be sent to Greece for analysis, they were never sent due to issues with airline security and import license.

A hazard label from one of the containers inspected (see Figure 9), shows that a particular item was a class 1.3 explosive, which does not have a mass explosion hazard; however, it is understood that the cargo did not undergo a full survey. Furthermore, any deterioration of the explosives, which most probably occurred due to the inadequate storage arrangements, would tend to decrease its stability as was clearly demonstrated by the deformation of one of the containers. Whilst this issue was recognised and samples were eventually taken, analysis was not conducted.

The findings of the official report were highly critical of the politicians, including the prime minister and defence ministry, their decisions to store in the location and the manner in which they were stored and the lack of action to remove / destroy the material.

Discussion

There are several issues arising from this tragic event. Clearly it was a unique situation that would not be considered as part of the normal operation of a government or naval base.

Figure 9 – Hazard label on one of the items

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It is likely that the naval base had procedures for the safe storage and handling of ordnance, although in this case, the material was not what they would normally handle and it may have been considered that the standard procedures did not apply.

In the process industries, the introduction of a new material onto a site should lead to a series of risk assessments. This may form part of the Management of Change (MoC) process that should start with considering inherent safety (What you don't have can't explode!). The location of the site in relation to on and off-site risks would be considered at an early stage. In this case, politics played a major part and refusing to accept the material was probably not an option.

The next stage would be the equivalent of a HAZID that would address issues such as the nature and hazards of the materials and any regulations that apply. In this case, a detailed programme of inspection and testing was required, which would have identified the hazards of self-ignition, the potential for detonation, the safety measures required (such as the location and design of the storage facility) and a quantification of the risks. Mitigation measures may be required to ensure the risks are as low as reasonably practicable. The hazards of the cargo were understood, to some extent, although based on the storage arrangements, or lack thereof, it would appear that a detailed risk assessment was not conducted.

An emergency plan should have been produced including recommendations to stand-off rather than tackle a fire on the containers. This would have saved numerous lives.

Perhaps the most significant factor with this case study is that it was known that the material was explosive and required careful handling. The issue had been raised several times but was not dealt with for over 2½ years. The "inflated" container that was noted and inspected a week before the incident was a clear precursor to the main event.

Root causes

Incident investigations almost invariably lead to root causes that involve failures of the management system in an organisation. In this case, the "organisation" involved multiple parties, which is not a particularly unusual situation; on a process plant, there are usually many different stakeholders that should be involved in safety management. This may include contractors working on site and possibly neighbours outside the fence-line. It is critical that safety-related issues are managed, discussed and dealt with across these organisational boundaries.

In this case, the apparent failure to conduct an adequate risk assessment was a key management failing. It is most unlikely that there was a procedure at the naval base on how to handle explosives of unknown composition. However, despite concerns being expressed throughout the 2 ½ year period, no effective action was taken to identify or manage the hazards and risks.

The apparent lack of an emergency procedure in the event of a fire on the containers is another management system failure.

After the incident, there was a resignation of politicians, presumably because they were considered responsible for the incident. However, it is likely that the root causes of the incident go beyond these individuals. Government and military organisations often operate on a strict hierarchy and stepping outside this structure can cause difficulties. There was probably little that the staff at the naval base could do to influence any decisions for fear of "rocking the boat". An open culture where safety issues are discussed and efficiently dealt with is far more effective.

Lessons for industry

- The management system must ensure that a risk assessment is carried out when changes are made or new materials are introduced to a site. Depending on the scale of the change and the associated hazard, this might be achieved through a Management of Change procedure, which may require a formal Process Hazard Analysis.
- Special or unusual materials, particularly waste materials or unintended by-products, need to be treated with extreme caution and must be included in the risk assessment processes.
- Once the hazards have been identified, controls, mitigation measures, emergency response plans, training, emergency drills, etc. can be put in place.
- The culture of the organisation should be such that safety matters are discussed openly at all levels and driven by the senior management. Management should be visibly accountable for issues and concerns that are expressed and actions to tackle safety matters should be prioritised and tracked to completion.
- If possible, monitor what is happening on neighbouring sites. You may not have control of what others do, but if you notice significant changes that may impact your site, you need to both influence the owner to deal with them and modify your own contingency plans, if required.
- Beware of temporary arrangements that last for longer. This is especially relevant where there may be seasonal issues. In this case the explosives may have been safe if stored during the winter months, but not in the summer.
- If something doesn't look right, it probably isn't right and should be reported and dealt with quickly and effectively.
- Business continuity needs to be considered as part of a site emergency plan. Whilst one is unlikely to anticipate a scenario whereby explosives detonate at a neighbour's site, emergency plans should be available in case a significant event occurs.

This article aims to raise awareness of some of the issues that need to be considered in the workplace when changes are made. Whilst the case study lies outside the process industry, the lessons from this tragic event apply to many industries and organisations.

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