Process Safety Forum

Review of the Incident Report for

Fukushima

from

Japanese earthquake and tsunami: Implications for the UK nuclear industry
Final Report

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1. About the Process Safety Forum

The Process Safety Forum was formed in 2009 to provide a platform whereby initiatives, best practice, lessons from incidents and process safety strategy can be distilled and shared across industry sectors; to influence other stakeholders (including the Regulator); and to drive the process safety management performance agenda.

The current membership of the Forum consists of the following trade associations and industry bodies:

Chemical Business Association (CBA)

Chemical Industries Association (CIA)

Energy Networks Association (ENA)

Engineering Construction Industry Association (ECIA)

Nuclear Industry Association (NIA)

Oil and Gas UK (OGUK)

Rail Safety and Standards Board (RSSB)

Tank Storage Association (TSA)

UK Petroleum Industry Association (UKPIA)

The forum meets approximately once every three months and is chaired by Paul Thomas, CB.

2. About the incident

The following extract is taken from the Office of Nuclear Regulation (ONR) final report on the '*Japanese earthquake and tsunami: implications for the UK nuclear industry*', published in September 2011.

> At the time of the earthquake three reactors (Reactor Units 1 to 3) were operating, with Reactor Unit 4 on refuelling outage and Reactor Units 5 and 6 shut down for maintenance. When the earthquake struck all three operating reactors at the Fukushima 1 site shut down automatically and shutdown cooling commenced. When the tsunami hit the site all alternating current (AC) electrical power to the cooling systems for the reactor and reactor fuel ponds was lost, including that from backup diesel generators (although one remained able to operate for Reactor Unit 6 and then Reactor Unit 5). Over the next few days, the fuel heated up and its cladding reacted with steam releasing hydrogen, which ignited, causing several large explosions. In addition, fuel element integrity was lost and containment was breached, which led to a significant release of radioactivity into the environment.
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> The hydrogen explosions caused considerable damage to Reactor Units 1, 3 and 4. Reactor Unit 2 had an internal explosion that appeared to have breached the secondary containment. For over a week the site struggled to put cooling water into the reactors and the reactor fuel ponds, by using untried and unplanned means. Electrical supplies were gradually reconnected to the reactor buildings and a degree of control returned. Heavily contaminated water, used to cool the reactors and spent fuel ponds, collected in uncontained areas of the site and leaked out to sea. It was clear that this was a serious nuclear accident. A provisional International Nuclear and Radiological Event Scale (INES) Level 5 was declared in the early stages, but after further analysis of the amount of radioactivity released from the site, the INES rating was increased to Level 7.
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> Early on in the chain of events the Japanese authorities instigated a 3km evacuation zone, and later a 20km zone with a 30km sheltering zone along with other countermeasures. Governments across the world watched with concern as they considered how best to protect their citizens in Japan from any major radioactive release that might occur. In the UK, the situation was kept under review at the highest level in Government with clear attention to the basic duty of a government – to protect the citizens of the UK. To assist the UK Government many agencies, Government departments and individuals were involved in providing their best technical advice. This was coordinated and led by the Government's Chief Scientific Advisor. We (the Health and Safety Executive's Nuclear Directorate, which became the Office for Nuclear Regulation (ONR) – an agency of the HSE – on 1 April 2011) provided authoritative advice on nuclear safety throughout the crisis.

The purpose of this review by the Process Safety Forum is to determine if any lessons contained in the final report on the incident from the ONR have relevance to other industry sectors represented by the Forum.

2.1 UK and European response

Following the Fukushima Incident, the UK government asked the ONR to produce interim and final reports on the lessons to be learnt from these events, these reports can be found here:

Interim Report: http://www.hse.gov.uk/nuclear/fukushima/interim-report.pdf

Final Report: http://www.hse.gov.uk/nuclear/fukushima/final-report.pdf

Subsequently, the European Council (EC) requested a review of safety at European nuclear power plants. The European Nuclear Safety Regulators Group (ENSREG) produced a plan and criteria for this review, commonly known as a 'stress test'.

The ONR published the findings from the stress tests performed by the UK nuclear power generating industry in the national final report '*European Council "Stress Tests" for UK nuclear power plants*', published in December 2011. A copy of this report can be found here:

http://www.hse.gov.uk/nuclear/fukushima/stress-tests-301211.pdf

3. Review of the Incident

3.1 UK nuclear power generating companies

Following the Fukushima incident on the 11th March 2011, the Office for Nuclear Regulation (ONR) instigated a range of activities to validate the UK nuclear industry's resilience to such events. This work culminated in the issue of the ONR report 'Japanese earthquake and tsunami: Implications for the UK nuclear industry, Final Report', see section 2.1 above (HM Chief Inspector of Nuclear Installations, September 2011). In addition to this the European Nuclear Safety Regulators Group (ENSREG) issued a requirement to European Nuclear Operators to carry out a series of 'Stress Tests' (ENSREG EU 'Stress Test' 13 May 2011). These are a specification for a targeted re-assessment of safety margins using a comprehensive suite of risk and safety assessments to be undertaken by all Nuclear Power Plants (NPP). These assessments were to commence no later than the 1st June 2011. These tests cover extraordinary triggering events, such as earthquakes and flooding, and the consequences of any other initiating events potentially leading to multiple losses of safety functions requiring severe accident management. The ONR made a commitment to apply the Stress Test requirements to both NPP and Non-NPP.

Industry Response

In response the Nuclear Industry's Safety Directors Forum (SDF) set up a Fukushima sub-group with the aim of providing a forum for good communication and interaction between all UK nuclear licensees, in relation to the Fukushima accident / event, by:

- Seeking to ensure an aligned approach within the UK nuclear industry on matters relating to Fukushima.
- Sharing knowledge and information to achieve appropriate improvements in standards of safety while minimising workload, where possible.
- To demonstrate to the Office of Nuclear Regulation (ONR) that there is a reasonably coordinated and aligned approach within the UK nuclear industry.
- To identify areas where a simple UK Nuclear industry response may be required.

The improvements Licensees are considering include:

- Hardening remote control rooms.

- Providing containerised/mobile emergency response hardware in offsite locations.
- Strengthening resilience of essential power and cooling water supplies.
- Enhanced resilience to severe external events (weather, seismic etc.)
- Modifications to severe accident assessment processes to better inform suitable and sufficient control of rare or combined severe external hazards.
- Enhancements to communications during severe accidents.
- Better understanding and communication of country wide response.

3.2 Review of the recommendations by other industry sectors

A full list of the recommendations can be found in the final report from the ONR (refer to section 2.1)

Many of the recommendations raised in the final report relate either to the regulator, or specifically to the design and operation of nuclear power stations, these may not be directly relevant to other sectors. The following provides a summary of those recommendations deemed by the Forum as having a potential wider relevance to other industry sectors. Where appropriate commentary is provided relating to how this recommendation has been addressed.

<Note the commentary below is relevant for the chemical and downstream oil industry – other sectors may wish to add further comments>

3.2.1 National Emergency Response

Recommendation IR-2: *The government should consider carrying out a review of the Japanese response to the emergency to identify any lessons for UK public contingency planning for widespread emergencies, taking account of any social, cultural and organisational differences*

Recommendation IR-3: *The Nuclear Emergency Planning Liaison Group should instigate a review of the UK's national nuclear emergency arrangements in light of the experience of dealing with the prolonged Japanese event.*

For the downstream oil industry, a review of national emergency response arrangements has been tackled following the fire and explosion at the Buncefield oil storage depot in 2005. The Buncefield Major Incident Investigation Board (MIIB) produced "Recommendations on the emergency preparedness for, response to and recovery from incidents" (EPRR).

The Competent Authority (CA) working with industry, emergency planners and other external organisations through the Chemical and Pipelines Emergency Planning and Liaison Group (CAP EPLG), has produced COMAH-specific guidance to assist in the integration of COMAH and other emergency planning requirements in response to these (note that this guidance is still awaiting publication by the HSE). This Guidance includes:

- Top-tier operators and local authorities duties relating to off-site emergency plans

- Top-tier operators and local authorities duties relating to review and testing of on and off-site emergency plans
- Mutual aid schemes
- Provision of information to the public, Competent Authority and to other establishments

Further guidance relating to the preparation of on and off site emergency plans can be found in the Process Safety Leadership Group final Report '*Safety and environmental standards for fuel storage sites*', which can be found here:

http://www.hse.gov.uk/comah/buncefield/response.htm

3.2.2 Impact of natural hazards

Recommendation IR-10: *The UK nuclear industry should initiate a review of flooding sites, including from tsunamis, in light of the Japanese experience, to confirm the design basis and margins for flooding at UK nuclear sites, and whether there is a need to improve further site-specific flood risk assessments as part of the periodic safety review programme, and for any new reactors. This should include sea-level protection.*

In 2011, the Chemical and Downstream Oil Industry Forum (CDOIF) environmental work-stream commissioned a project to review natural hazards and climate change, and its potential effect on UK business.

The output of the working group was '*Preparing for flooding – a guide for regulated sites*', which will shortly be published by the Environment Agency. This guide provides a source of reference for industry to help:

- Find out if a site is in an area at risk of flooding
- Know when flooding is imminent
- Understand flood warnings
- Obtain more detailed flood modelling information
- Prepare a flood plan
- Improve a sites flood resilience

4. Conclusions

For the nuclear power generation sector, the recommendations from the ONR final report on the Fukushima incident have been dealt with directly through the ONR, and in response to the EC stress testing.

For the chemical and downstream oil industry, it is felt that potential relevant lessons from the incident have already been addressed through other working groups such as CAP EPLG and CDOIF. No further action is proposed by these sectors in response to Fukushima, unless subsequent national or international reports identify other potential learning's from the incident.

<Note: these conclusions relate to the chemical and downstream oil industry, other sectors may wish to add further text as necessary>