The Development of fit for purpose Safety Cases for Decommissioning Activities

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1. Introduction

The United Kingdom's civil nuclear industry is accelerating its plans for clean up and decommissioning of its historic nuclear plants. Principal amongst these are the plants at the Sellafield site of British Nuclear Fuels Ltd. As the pace and scope of decommissioning increases, new challenges are being encountered both intellectually in the creation of strategies for the work and its safety justification, organisationally as plants move from the operational phase into decommissioning and in engineering terms as plants that were never designed for decommissioning are modified, cleaned up and dismantled.

A paradox is emerging where the skills and knowledge needed to create new plants is becoming the historical skill of the organisation, and the skills and knowledge to deal with the legacy from years long gone is tomorrow's new skill.

2. The past – building new plants

Typically, designing a new nuclear plant will involve designing it from first principles and constructing it in a "greenfield" site where there is no existing facility or infrastructure. The nuclear industry now has 60 years of experience of doing this. Designers will be supported by well developed procedures and design codes, safety cases will be prepared on the basis of complete knowledge of the plant designs, the feed materials being processed, the processes involved and the radioactive inventory in the plant.

Modern plants will start operation with procedures that ensure operation within a well defined envelope of safe operation, and with procedures that ensure control of and full understanding of any modifications made to the plant or processes.

3. The future – remediation of historic plants

For some historic nuclear plants there does exist detailed and reliable information about the plant as it is configured now and its inventory. There are by comparison some historic legacy plants that have been in existence for up to sixty years: they have been extensively modified though not all modifications are know now, and their inventories of radioactive materials are not fully characterised. In addition, if there has been a prolonged period of passive care and maintenance, the operational history will be lost.

In addition to this lack of full knowledge of the situation is the problem that the structure and systems of historic plants were not designed to modern standards. Even where knowledge is adequate, it is sometimes not possible to produce safety justifications for remediation activities to modern standards. Where knowledge is not adequate, the effort or time needed to gain more knowledge is sometimes not practical. An example would be a historic waste store where early records of wastes received were not kept. Sampling can only deliver a limited amount of understanding of the contents. Indeed, a true understanding of the contents will only come when they have been retrieved. This presents a problem to those trying to devise designs processes and safety cases to allow this retrieval to start.

4. The challenge

"Doing nothing" is not an option and ways must be found to approach remediation work and remediation safety cases so that a start can be made, or existing work accelerated.

The primary requirement in UK law is that at all times risks must be as low as reasonably practical (ALARP). There are other legal limits, for example limits on worker and public exposure to radiation. In addition BNFL has as an objective that it maintains its current standards for safety, both in terms of design objective and also in terms of operational safety on existing plants. Remediation is not an exercise in achieving difficult objectives by cutting standards. There is a need to find alternative ways of arriving at safety substantiation and design of remediation projects.

In addition new ways need to be found for the management of large complex safety cases.

5. The solutions

In part the solutions come from adopting new principles for safety assessment and designs, but in part they come from encouraging a “can-do” mentality.

Safety case substantiation can be made using:

- Experience and historic knowledge where available.
- Use of the judgement of professional engineers when numerical assessment may not be achievable.
- Reliance on supervisory control when engineered precautions are not practical or ALARP to install.
- A recognition that removing inventory reduces risk.
- A recognition that historic plants are not designed and built to modern standards and it is therefore not reasonable to expect modifications for retrievals to comply with modern standards. Good practice should be the basic requirement.
- Many remediation operations are short term and thus the assessment of risk through probabilistic safety assessment may be of limited value.
- There needs to be a balance between the operations to handle and process wastes on one hand, and the risks from storage of the product on the other hand. Many remediation situations require action to be taken earlier rather than later, but this should not be at the expense of creating problems at a later time.

Remediation and decommissioning can involve many frequent changes to plant safety cases. Where these safety cases are large unitary documents, managing these changes can become extremely complex, especially when the safety case (as is the practice in the UK) contains the plant operating instructions, designation of safety significant rules and instrumentation and maintenance procedures.

BNFL has adopted the practice of breaking its remediation safety cases into modules.

- Core activity of keeping safe a redundant facility and its radioactive inventory.
- Remediation projects, significant enough to require formal submission to regulators.
- Remediation projects and minor plant changes, of lesser significance, not requiring formal submission to regulators.
- Contingency arrangements.

These details will be comprehensive.

Sitting above them will be two summary documents:

- Summary live safety case. This is kept as short as possible.
- Strategy overview of future remediation activities and programme of project activities and submissions to regulators.

6. What progress is being made

At some BNFL establishments there is already good experience of success. The complexity of some of the hazards at the Sellafield site has been such that special effort was put into encouraging a culture of acceleration.

Numerous workshop sessions have been held, some only for BNFL, some jointly with regulators (both Nuclear Installations Inspectorate and Environment Agency) to explore how these new pragmatic methods can be used. A number of remediation projects have been selected for development as worked examples for safety cases, and progress has been shared with regulators as these examples develop.

There has been a positive response from regulators and the encouragement received from the NII has been a key factor in making progress. Although the worked examples are not yet completed as projects, the impact of this new way of working is such that the assumption is being made that all future remediation safety cases will be produced this way. The methodology is being formalised into a brief code of practice which will become part of the Sellafield site procedures.

As for management of safety cases, the major historic plants at Sellafield have already established their safety case structure along the lines described above.