DELICENSING AND END STATES ON NUCLEAR AND DEFENCE SITES

These notes were taken by CIRIA at the SAFESPUR meeting held at the Rutherford Appleton Laboratory, Harwell, Oxford, on 8th November 2012 on Delicensing and End States on Nuclear and Defence Sites. They have been circulated as an aide memoire for participants and are not comprehensive. They are not intended as a formal record of the meeting or a definitive account of what the speakers said. The presentation slides have been circulated separately.

- **Part One** of the meeting covered the delicensing experiences at Harwell and the importance of record keeping
- **Part Two** covered the wider aspects of site end states and other perspectives around delicensing and site end states.

The meeting was preceded with a tour of the Harwell nuclear site including a visit inside the DIDO reactor.

PART 1 HARWELL DECOMMISSIONING

Harwell – the legacy and decommissioning approach, Paul Ateyo, RSRL

Harwell is a 113ha nuclear site located on a larger science campus in Oxfordshire. A WW2 airfield Post war, centre for UK nuclear research, at peak employing 6000 scientists.

Operated by UK Atomic Energy Authority until 1990 when decommissioning started, it forms one of the NDA sites and is part of the overall strategy of returning land suitable for next use.

Decommissioning is being led by RSRL Ltd (Parent Body Babcock International) under contract to NDA and regulated by EA and ONR.

Our mission is to clear the current nuclear licensed sites at Harwell and Winfrith so that the **land can be used again safely** , Land is **delicensed** after thorough checking by the regulator and released for its next planned use as a **science campus**

This has involved:

- **processing and repackaging** historic radioactive wastes on the site
- **storing** certain radioactive wastes on the site – awaiting the geological disposal facility to be built elsewhere
- **decommissioning and demolishing** facilities when they are no longer required
- (rarely) **building** new temporary facilities to support our work
- **cleaning or removing** drainage systems and other underground liabilities
- **cleaning-up** the land
- **transporting** radioactive wastes and materials to facilities in the UK that can accept them.

Achievements included:

- 11 hectare contaminated land site cleaned-up and returned for housing use
- significant hazardous waste disposal area remediated
- 100 out of 160 research facilities returned to delicensable land
- 1 million square feet of facility footprint removed
- 20% of site area delicensed

- 11 out of 14 reactors decommissioned
- 16.7km of the 20km of active drains decommissioned to a delicensable standard.

Particular technical challenges and achievements included remediating a 7 ha LLW disposal site, with Beryllium Contamination, other chemicals groundwater pollution and extensive munitions. This involved 10 years of groundwater clean-up followed by remediation 2000-2002. The land was then sold for redeveloped for housing. A liquid effluent treatment plant has still to be decommissioned, as have a solid waste complex and three reactors.

PA recognised that in terms of "next use", Harwell is unlike the other NDA nuclear installations in that a clear agreed end point was agreed with stakeholders with the land being released for development as part of the growing science park. The remediated land was therefore commercially valuable unlike many of the remote sites forming the NDA portfolio.

Each decommissioning site would have its own particular needs but Harwell has provided a means of showing that delicencing is possible and many of the approaches developed would be valuable elsewhere.

Regulator's perspective, Nina Barnes, ONR

In the UK, the Nuclear Installations Act 1965 provides the framework for the regulation of the safety of nuclear installations. Under the NIA65 no site may be used for the purposes prescribed under the Nuclear Installations Regulations 1971 unless an extant nuclear site licence has been granted by the HSE.

Unless a new licence covering the site is issued to another body, the licensee's period of responsibility continues until it has been demonstrated to the satisfaction of the ONR that there has ceased to be any danger from ionising radiations from anything on the site (or part thereof). This is known as the 'no danger' criterion, and applies for any reasonably foreseeable use of the site.

The HSE published the criterion for delicensing (developed following consultation) is that an additional risk of death to an individual of one in a million per year, is 'broadly acceptable' to society. This is taken as representing a dose of the order of 10µSvy-1. However, the principle of ALARP will still apply.

The SLC is required to demonstrate through a Safety Case that appropriate clean-up levels have been reached. The SLC's safety case must include the results of measurements taken during remediation and post-remediation monitoring results. ONR also commissions independent checks through the Health Protection Agency (HPA).

The safety case needs to demonstrate an understanding of the site in terms of buildings, drainage, soakaways, seepage, groundwater, hydrology, geology, contaminant movement etc. It will also need to demonstrate sound practices in terms of measurements, instrument calibrations etc. It will also apply to pipes and other structures such as massive foundations left on site.

Given the independent role of the HPA, communication and collaboration between the SLC, ONR and HPA is important, with:

- early interaction between the licensee, the EA and ONR, eg on the overall sampling strategy and technical approach
- regularly discussion of progress on documentation and programme, including discussion of documents at draft stage and of the emerging results of work in progress
- early assessment of supporting documents, which facilitates the assessment of the final safety case.

As with any legal or other relationship between parties, a "no surprises" approach will help all parties concerned.

- "*HSE Criterion for Delicensing Nuclear Sites* http://www.hse.gov.uk/nuclear/delicensing.pdf *Delicensing guidance – guidance to inspectors on the interpretation and implementation of the HSE policy criterion of no danger for the delicensing of nuclear sites* http://www.hse.gov.uk/nuclear/delicenceguide.pdf
- *Clearance & exemption principles, processes and practices for use by the nuclear industry, a nuclear industry code of practice* http://www.unece.org/fileadmin/DAM/trans/radiation/docs/UK_exemption.pdf
- IAEA Safety standards series. Application of the Concepts of exclusion, exemption and clearance, No. RS-G-1.7.

SLC perspective, Susan Holdroyd, RSRL

Key points included:

- the end state for Harwell is a fully delicensed site
- the drivers are to end NDA liability for the site and release it for redevelopment and major science projects
- for most areas of the site, delicensing logically follows on after decommissioning of the facilities
- a phased approach to delicensing has enabled all parties to gain experience and develop competence and systems.

The delicensing process is essentially a matter of "telling the story and providing the evidence". This involves:

- historical survey of records and maps/drawings
- defining characterisation strategy
- radiological and chemical surveys of the land
- building/drains surveys
- investigation/remediation of anomalies
- prepare delicensing case
- formal submission to ONR
- ONR verification surveys, clarifications/ discussions
- ONR approval
- marking the new boundary
- issue of licence variation

Characterisation and on-going sampling is important with inspections and measurements taken before, during and following decommissioning. This includes pre-demolition health physics surveys of all buildings, samples collected under building footprints and Gamma survey of excavated surface where possible. Visual and geophysical inspections are also important as are trial pits, particularly in the case of drains.

Since site activities go back 70 years, records can be incomplete. For instance, a large buried kiln structure was found that records to hand at the time did not indicate. Decommissioning work done in earlier times was checked as part of delicensing, eg drains previously removed and this did identify some things were not as assumed.

Some structures remained on site after delicensing, eg low levels of activity in activated concrete remained following demolition in deep underground structures. A site risk assessment demonstrated that the area met the delicensing risk criteria and was ALARP.

Some key lessons learned from the SLC perspective were:

- demonstrating a thorough process is key
- demonstrating drains meet delicensing criteria is not straightforward
- build delicensing requirements and monitoring/record keeping into decommissioning works, don't just rely on monitoring/sampling afterwards
- keep good decommissioning records
- liaise regularly with the regulators
- it takes time to delicense!

Record keeping – challenges, approach and lessons learned, Angela Bartlett, RSRL

Angela explained the importance of compiling, storing, retrieving and processing data and other information for general operations and in support of the creation of the safety case. The scale of the records was enormous, including data from 11,000 survey points, 737 main building records (1900 individual sub records), plus over 7,000+ documents and 7500+ photographs. These records went back 70 years including wartime operations. Originally, information was held by a variety of organisations, eg contractors. Information included:

- historical building schedules
- infrastructure schedules, archive drawings, AutoCAD/GIS
- post decommissioning reports, safety cases etc
- maps/photos: current and historical infrastructure/buildings
- borehole logs, sampling and monitoring records
- legacy features, rationale for 'grid size' for systematic sampling
- standardised data formats for data capture and storage to allow analysis in GIS/statistical software tools.

Given the scale and value of the overall decommissioning programme (£60m/year), and the value of the information itself in terms of supporting the safety case, the information was brought together within a database system called "IMAGES". This is also being used on other NDA sites.

Key lessons to date include:

- historical and modern data – all is important
- limitations of documents (paper, PDF, word) v data →consider end use of information
- benefits of using database including accessibility, referring to different sources, automated data QA checks and processing etc
- taking the 'opportunity of sampling' to record relevant information to prevent costly reinvestigation but not 'data for data's sake'
- specifying information in the format needed, eg from analytical laboratories
- importance of data verification and validation
- importance of keeping track of site works by area as work progresses.

PART 2 SITE END POINTS AND DELICENSING

Delivering NDA's mission and strategy, Anna Clark, NDA

The NDA mission as defined in the Energy Act 2004 includes "making sites or installations suitable to be used for other purposes". Commensurate with this definition, NDA strategy expresses a preference for restoring sites to a condition suitable for their "next planned use".

Where the next planned use or probable future use(s) has been identified, this enables optimisation of restoration objectives (balancing the benefits and detriments of site restoration). For example, knowing the next use of a site will indicate how clean the site must be in order to protect people and the environment (clean-up criteria), and will specify any structures or infrastructure that can usefully be retained.

In 2006/07, NDA conducted a review of Site End States (the condition to which designated land, structures and infrastructure will be restored). This started by understanding stakeholder preferences for the next use of each site. Preferences ranged from recreational use and nature conservation to new nuclear power. Harwell is fairly unique in the NDA estate because its next use is clear – it is destined to be an extension of the existing science park.

In practice, to reuse a Nuclear Licensed Site for anything other than another nuclear use or a high-security use, it is preferable for the new user if the site is first delicensed and the period of responsibility under the Nuclear Installations Act 1964 is ended. This requires proof that radioactive contamination is reduced to a level suitable for *any foreseeable future use*. Therefore, for the majority of NDA sites, Site End States involve making the site suitable for any foreseeable future use, even though NDA's strategic preference is to make sites suitable for their next planned use.

Anna concluded her presentation by illustrating a number of challenges where NDA would be looking to its supply chain for ideas and support. These included:

- how do you translate a risk target into clean-up criteria, particularly for land being restored today for release in the future after decades of radioactive decay?
- what is an appropriate end state for subsurface structures?
- what does "foreseeable use" mean in practice?
- what degree of characterisation and validation is appropriate?
- how do you determine the "value" of different land uses to society (eg commercial, recreational, nature conservation)?

Initial reactions and suggestions from the supply chain included:

- techniques for on-site characterisation (avoiding the time delays of sending samples to labs)
- increasingly a lot more work will need to be done "at the face"

- should the above questions be trialled on specific packages of land that are not on the critical path of the overall site?

A defence perspective, Sean Amos, AWE

Sean Amos explained that AWE has two major sites, both based in Berkshire: AWE Aldermaston and AWE Burghfield. Both sites are operational with long term mission of maintaining a credible nuclear deterrent as per the direction of the UK Government.

Aldermaston, covers approximately 285 ha (90% licenced). Formerly a wartime airfield, the site is now a sophisticated centre providing advanced research, design and manufacturing facilities. AWE

Burghfield, a former munitions factory, occupies an 89 ha site (13% licenced) and is responsible for the complex final assembly and maintenance of the warheads while in service, as well as their decommissioning. AWE operates an ISO14001 environmental management system,

Being an operational site, the position at AWE sites is different to that on NDA sites, although there are many commonalities including the "no danger" criterion in terms of delicencing. Although the timeframes are longer and uncertain - and recognising that the delicensing criteria were fixed - there are nevertheless a number of possible approaches for different parts of the site and factors to consider, including:

- rely on institutional controls rather than restoration to manage risks to people and the environment
- restore site (or part of a site) to a condition suitable for next planned use
- restore site (or part of a site) to a condition suitable for any foreseeable future use
- restore site (or part of a site) to its pre-industrial state (background)
- site end state reflects local requirements only
- site end state reflects national requirements only
- site end state balances both national and local requirements.

In the meantime, activities will include: monitoring, dialogue on the criteria, including liaison with the NDA and Regulators, R&D to provide evidence to support the above.

Restoring complex sites, Doug Graham, formerly Dounreay Site Restoration Ltd

Drawing on experience at Dounreay in particular, Doug Graham compared complex sites with those more easily delicensed, looked at some of the challenges in developing clean-up projects on such sites, and considered optimisation in implementing site restoration.

There are three possible reasons for cleaning a contaminated site

- to gain control – to remedy an on-going pollution problem
- to meet a business driver, eg release of land with end state suitable for potentially exposed groups such as housing
- to clean-up a complex site where there is limited demand and/or value of the resulting land

Although not without their own challenges, land delicenced to date has usually involved making delicencing cases for successive parcels of land. In contrast, complex sites can be characterised as follows:

- significant ground rad/non-rad contamination
- maybe continuing pollution, or the potential for pollution
- still operational, with long-term nuclear use
- no commercial driver to release land early, or perhaps ever!
- extent of contamination not fully known

In such cases, initial restoration will be towards and interim end stage. Restoration to meet end state may take place later. Restoration thus becomes a "long journey" Each zone one small step on the journey. Developing a strategy for complex sites will involve considering questions such as:

- can sites be made safe without retrieving all contamination?
- is "squeaky clean" with all structures and contamination removed affordable
- can a case be made for site release dose >10 uSv/yr?
- are engineered controls and institutional control acceptable as part of the case?
- what are the consequences of unrestricted use after institutional control lost, or plan for restricted use?
- what is a reasonable interpretation of foreseeable uses of a restored site?

In such cases, initial restoration will usually include interim end stages.

Maintaining stakeholders' trust and confidence in the process, David Collier, White Ox Consulting

David Collier talked about the importance of trust between community, SLC and regulator, emphasising the following points:

- things have moved on a long way - the generally constructive relationships and institutions we have today bear no relation to those 30 years ago
- stakeholder groups have helped us define our end points and still hopefully giving confidence to the community by being close to what's going on. As a side issue, note that many members and the local pressure groups who keep them honest are getting old along with the rest of us
- they will not, however, be sufficient to deal with the very long timescales over which land where waste is being managed in situ (or even monitored post-decommissioning). If conditional release becomes a reality, that brings its own challenges. We know there are uncertainties - models prove false, assumptions maybe mistaken
- we are looking for trust is not just about now, or 5 years, it's what can be relied on about 50, 100 years into the future - when Governments run out of money and site licensees can change quite quickly.

The public perception and response to risk is strongly affected by how a person judges a risk and how a person responds to a risk (discussed in the next section), and the protection of personal interests. But arguably the most important factor – more important than the use of any particular approach - is whether the individuals and groups involved trust the process being used and those making the decisions about a particular risk.

SAFEGROUNDS guidance addresses issues of trust: process, organisation and people. However, while process, people and organisation are often depicted as the three apexes of a triangle, they should not be seen as representing discrete steps within a process.

Trust in process: if involvement then genuine, objective decisions, trusted data process (joint fact finding?)

- stakeholders need to understand the overall approach, the tests and measurements, the uncertainties and how these are going to be dealt with, third party auditing, eg independent verifiers. The scrutiny of the Sellafield site by the Office of Government is an example of this, as is the role of the HPA in site delicencing as described earlier.

Trust in the organisation: acceptable motives, realistic strategies and effective regulation, reliability, openness

- stakeholders recognise that the driver may be a commercial one, but expect openness and transparency. Organisations have to be seen to be regulated and challenged.

Trust in individuals: credibility: competent, credible, symathetic

Trust can be difficult to establish and may take time. However, it is very easy to lose. Reliability is an important factor and sometimes little things like not following up on promises or actions – even as simple as making a promised phone call can knock the process back. "Spin" is no longer acceptable. Stakeholders expect to receive straight answers to straight questions. Harwell's approach of fielding technical people at consultation meeting as opposed to less technical PR people was a good example of this.

The timescales were long and people need to trust that resources will be available and action will be taken if a problem is discovered, even decades into the future. This has to go beyond trust in the regulator, because so many more parties are involved in mobilising a response and none of the original organisations: NDA, SLC etc will probably exist.

Governance is becoming an increasingly important factor in the management of processes, projects and organisations for this reason. Governance arrangements should provide an opportunity to consider things holistically and for the reassurance of independent review.

Collaborative governance is a process and a form of governance in which participants (parties, agencies, stakeholders) representing different interests are collectively empowered to make a policy decision or make recommendations to a final decision-maker who will not substantially change consensus recommendations from the group.

Thus it is a more integrated approach that suits managing longer term issues rather than operational decisions. Not one or two parties reporting to each other, but collaboration in managing.

Is that what we are looking for to deliver long term stewardship?

Supply chain perspective, James Penfold, Quintessa

As the day has demonstrated, the NDA and SLCs are faced with challenging technical problems, cost and time constraints (like any other organisation) and uncertainties. They are reliant on the supply chain to help them and, in turn, supply chain companies are challenged with providing a cost-effective service while:

- Dealing with uncertainties in requirements
- Addressing technical challenges in achieving criteria
- Dealing with non-radioactive as well as radioactive contaminants/hazards
- Making sense of lots of information
- Maintaining knowledge
- Showing optimisation
- Working systematically towards an End State that may be decades hence
- Constructing robust arguments in the face of uncertainty
- Communicating with and involving a range of stakeholders.

This can be summarised as "constructing robust arguments and demonstrating optimisation in the face of uncertainty".

The UK has a health and competitive consultancy market. Working on projects with the NDA and SLCs provide opportunities for technical excellence, introducing innovation (in methods and in analysis), and technology and knowledge transfer from other industries and countries. However, there are challenges.

Clear objectives

- End states are often far in the future, not well defined
- It's easy to "dig and dump", but is it the best option?

Effective relationships

- Long-term involvement is often beneficial, but this can be difficult, contractually.

The right resources

- Contractual routes can mitigate against specialists
- Where do the new people come from?

Questions the supply chain might consider therefore are:

- How can innovation be best nurtured and deployed?
- How can sustainability in skills and resources be achieved?
- How can healthy and effective relationships in the supply chain be fostered?