

Optimised NORM Waste Management Taking Benefit of 60 Years of Nuclear Waste Experience - 15357

Arne Larsson and Chris Hannon, Studsvik

ABSTRACT

Studsvik has more than 60 years of experience of managing radioactive waste from both our own operations as well from international and other domestic waste generators. During last 5 years our services to generators of NORM waste has increased significantly.

Building upon the experience of managing nuclear waste the management of NORM waste can be optimised. An optimized NORM waste management strategy should be based upon a graded approach taking into account the actual conditions (technical as well as regulatory). In line with how work is carried out in the nuclear industry it is recommended that material should be treated for reuse or recycling when appropriate as opposed to conditioning for disposal.

This paper covers the principals and practices that should be adopted when considering NORM waste management from initial characterisation to the safe disposal or clearance of the material for reuse or recycling.

INTRODUCTION

Management of radioactive waste generated during operation of nuclear facilities has been a high priority activity for the facility owners for decades. A regulatory framework for the management of the radioactive waste within the nuclear industry was established in the. Over the years the regulatory framework has been refined to ensure the safe management of the waste from generation to final disposal. During the last decade(s) the Nuclear Industry has faced changes due to the implementation of the waste hierarchy along with the drive within society to establish sustainable waste management systems based on reuse and recycling.

Historically NORM has had less regulatory focus even though the radiological risks with the waste material are, to large extent, the same.

There is a massive amount of waste management experience within the nuclear industry. Studsvik has provided the International nuclear industry with waste treatment services for several decades. The customer base includes more than a dozen countries. To be able to develop and provide these services concept design, construction and commissioning of waste treatment facilities (VLLW, LLW, ILW and HLW) has been undertaken.

Studsvik have been able to draw upon the experience of managing radioactive waste from the international nuclear industry and apply the lessons learnt to the issues facing our NORM clients.

DIFFERENTIATORS NUCLEAR AND NORM WASTE

A reasonable question is what value nuclear experience has when it comes to NORM? The answer is that NORM waste and nuclear LLW have more similarities than differences. The overarching principles and practices that should be adopted are identical. However there are a number of differentiators when considering the waste properties and also the customer behaviors and market drivers.

The main differentiator when it comes to customer behavior and market drivers is that in the nuclear industry management of radioactive waste is core business. Operators have a very good understanding how to manage their radioactive waste. In the NORM sector radioactive waste is a byproduct of another process and not something that the operators have significant experience in dealing with. Therefore the solution is often to outsource radioactive waste management to a third party.

Typical characteristics for NORM and nuclear waste can be listed as follows:

NORM waste characteristics

- Typically no high gamma dose rates.
- Limited number of nuclides (mainly the uranium and thorium decay chains).
- Long decay chains - long decay times.
- Inhalation and ingestion is main concern from a dose perspective.
- Massive natural variation in background levels.
- Some regulatory differences between countries.

Nuclear waste characteristics

- Man made nuclides dominates.
- External dose rates can be a major issue. Large differences between categories.
- A large number of nuclides caused by activation and fission.
- Low public acceptance for recycling of artificial nuclides to society (even if below threshold values).

REGULATORY FRAMEWORK

The nuclear industry has a regulatory framework that is quite international. The reason for this is mainly the influence from international organisations like IAEA, ICRP and others but also the wide international cooperation between regulators as well as licensees.

This is not always the case within the NORM industry for several reasons. Some regulatory differences between countries exist. Another aspect could be that NORM has had less focus than radioactive waste from the nuclear sector. Also, the fact that the natural background differs affects the discussion. Attempts to harmonize and to generate a regulatory framework have been and are being performed by IAEA and others.

RECOMMENDED STEPS OF NORM WASTE MANAGEMENT

The main steps in NORM waste management do not differ significantly from the ones established in the nuclear sector:

Initial Planning/Strategy

The main purpose of the initial planning and strategy phase is to

- Identify the problem, estimate its magnitude
- Analyze potential solutions
- Define what treatment that has to be performed or is the preferred way to manage the waste
- Make a Best Available Techniques (BAT) Assessment
- Develop a waste management strategy
- Initiate the work with a waste management plan
- Secure resources and waste routes – reserve capacity

Waste Characterisation

The main purpose of the waste characterisation is to map the properties of the waste, radiological as well as conventional. The non-radiological properties are for many waste forms as challenging as the radiological.

The principles and practices covering radiological characterisation for both NORM and nuclear waste are as follows:

Planning

- Collection and evaluation of historical information (Provenance)
- Initial categorisation of the objects based upon risk for contamination or provenance
- Methodology/ sampling strategy, equipment selection

Implementation

- Information and training of staff
- In situ measurements, sampling and laboratory analyses
- Preliminary assessment of results versus initial categorisation

Data assessment and evaluation

- Review and evaluation of the data obtained
- Comparison of the measurement results with the historical information and initial categorisation
- Re-categorisation (as necessary)
- Define if additional measurements or other activities are needed

The output from the characterisation efforts is a necessary platform for the further activities. Especially important is to segregate the waste into different categories depending on whether it is subject to clearance/exemption as is or whether it requires certain treatment or should be

disposed in the current form.

Treatment

Radioactive waste treatment relates primarily to volume reduction, optimising the potential for clearance and/or to ensuring that remaining waste can be conditioned for safe and cost efficient disposal.

Selection of treatment method(s) should be based on a combination of the following aspects:

- Material properties – define what is possible to do with the actual material
- The waste hierarchy – if potential for reuse or recycling it is in most cases the preferred option.
- End-state perspectives – which waste forms are suitable for the available disposal options. Do not forget the generated secondary waste.
- Cost related aspects – which treatment option gives the lowest total cost at an acceptable risk.

Packaging and Transportation

When it is time to move the waste it has to be packed properly and the transport regulations has to be met. The types of packages and the regulations relating to safe transport are more or less identical for NORM and nuclear waste.

Exclusion, Exemption and Clearance

The terms exclusion, exemption and clearance are essential in NORM waste management as they usually apply in one way or another to the majority of the NORM waste.

Even though international recommendations exist it is up to the respective government or its regulatory body to determine which practices or sources within practices are to be exempted from some or all of the requirements of these Standards.

Licensed operations normally require clearance. Clearance operations are usually divided into two groups, general clearance (i.e. for free use) and conditional clearance. Good understanding, categorisation, traceability and a good structure is crucial for success in clearance.

Good concepts exist within the nuclear industry which after certain modifications can be applied to the NORM industry.

Waste Conditioning and Qualification for Disposal

One key lesson learnt from the nuclear industry is to start the disposal planning early. Without a clear view of the end-state options available, or potentially available, it is hard, if not impossible, to properly determine the correct waste conditioning requirements.

Another recommendation is to implement a multi-barrier defense in depth concept for the disposal starting with the waste form. With lower risk with the waste to be disposed further repository alternatives may be possible. One key issue for a successful waste conditioning is to have Waste Acceptance Criteria (WAC) available as early as possible. With WAC in place a graded approach can be implemented.

Never underestimate the long term safety aspects – most NORM waste has very long decay times.

Never try to dispose of waste which do not meet the relevant WAC. Retrieval of disposed waste is costly and will damage stakeholder confidence.

DISCUSSION

A long list of key success factors can be listed based on lessons learned within NORM operations and within the nuclear sector.

It is initially of importance to spend time on analyzing the problem and not forget toxic elements and conventional safety aspects including the one related to the toxic elements. Define clear objectives and do not over engineer processes as good enough is fine as long as safe, robust and well working.

Schedule issues are always important. A lesson learned is to never postpone the management of waste without a schedule as historic waste without documentation is a nightmare. Another schedule related topic is to focus on the planning phase as a short physical handling phase will equate to cost efficiency. Do not forget the work related to the waste disposition in the planning.

Do not re-invent the wheel and do not allow waste management projects to be research projects. Learn or take support from others. Experts and specialized facilities are available. Do not forget to take benefit of the national and international bodies.

Make sure that all the entire project is completed before the project team is demobilized. A long break in a complex project often lead to more or less a full restart.

CONCLUSION

To summarize, the following focus areas are essential for a success in NORM waste management:

- Experience, competence and understanding
- Structure and logistics, do things in the right order
- Safe, effective and robust processes
- Stakeholder involvement

REFERENCES

[1] International Basic Safety Standards, General Safety Requirements Part 3, IAEA, 2014