Challenges of Nuclear Waste Governance

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Abstract

The peaceful use of nuclear energy - and thus also the production of radioactive waste - began more than 60 years ago. More than 500 larger reactors were operated, some of them for decades. Since many decades, the waste - and in particular the high-level radioactive waste - is simply stacked in interim storage facilities. In the meantime, around 400,000 tonnes of spent fuel elements have accumulated worldwide. None of the projects pursued by operators and national waste management agencies for the final disposal of this radioactive waste have been successful. The lecture illuminates the decades of dealing with the radioactive legacy and analyses the reasons for the failure of the projects mentioned, which are closely linked to institutional structures, the governance of programmes and problems of safety culture. The possible current transition strategies with this legacy are briefly examined.

1 A quick look back

The peaceful use of nuclear energy - and thus also the production of radioactive waste - began more than 70 years ago. Since there, more than 500 larger reactors were operated, some of them for decades. Radioactive waste was not really of much interest at that time. The electricity suppliers were primarily interested in the launch of the nuclear program, and radioactive waste was only one obstacle that put pressure on economic efficiency. Only the massive pressure built up by civil societies over time led to the problems of radioactive waste disposal being taken seriously or their handling being adapted. The following pictures show three stages of this process and already say a lot about the way the disposal projects were tackled and implemented. In addition, there are pictures of the consequences of this approach.

1. dilution strategies and dumping in pits
2. the first generation of mining solutions: Asse II
3. the second generation of mining solutions: WIPP (NM)
4. interim storage of high-level waste

What emerges from this selective analysis is that nuclear waste management is still not under control. In the more than 70 years of nuclear energy use, not a single underground disposal project has been successfully implemented worldwide. Not a single one. Even the repositories in the Nordic countries cannot be regarded as long-term safe installations.

Such a performance with such a dangerous stuff is not a glorious sight for the nuclear industry. That is why the circles responsible hardly talk about the failure of their systems. The executive floors of the state or para-state companies responsible for the waste, or the relevant authorities, prefer to ignore history. The processing of the past is correspondingly meager, and in the best case it is processed by university programs (e.g. historians like Anselm Tiggemann or Detlev Möller) and only in rare cases by institutions themselves (NRC historians like Samuel J. Walker). In Germany, the site selection procedure launched in 2017 is referred to as a learning procedure. Learning means learning from mistakes in order to avoid them. How this is to be done in concrete terms, however, is not yet clear. In the following, an attempt will now be made to shed light on individual questions relating to governance and the culture of error and safety. This presentation will give you a small overview of how broad and how complex this undertaking is.

2 Problems of Governance and Safety Culture

The reasons for decades of failure in the field of nuclear waste disposal are manifold. The following excerpt shows in how many areas basic problems can exist. A distinction is made here between four groups of problems:

1 Framework-related (overarching) problems

They refer to the context of the programs, i.e. to political situations (e.g. war or foreign policy conflicts such as the Cold War) or to the respective economic interests and social framework conditions.
These include, for example, the influences of the nuclear bomb programmes of the USA and later the Soviet Union, the decades-long arms race of the nuclear nations, which left little or no room for an ecologically justifiable disposal of radioactive waste. This was the time when the large contaminated sites on military sites of all nuclear nations originated, the remediation of which is now worth trillions of US dollars. This category also includes the economic conditions to be considered at the start of the "Atoms-for-peace" program, which presented a nuclear industry in competition with the coal industry with practically insoluble problems in nuclear waste disposal. Waste disposal was therefore not allowed to cost anything. In this case, too, many sins from this period can be traced back to the general economic conditions in the development of the nuclear industry.
The protests of the nuclear resistance movements that arose from the 1970s onwards had a major influence on the waste management programs too.
The context of the legislation also plays an important role, because it reflects the state of knowledge and problem recognition of the time, and thus also its visions, interests, fades and contradictions. For example, the disposal of radioactive waste was not even mentioned in the legal texts of many countries at that time, which opened the door to "wild" disposal (e.g. sea disposal, dilution, landfills).

2. Structural problems

These represent the framing context. The development of nuclear energy was primarily supported by state and para-state institutions as well as by science. It was therefore logical that the organizational structure reflected this model. At the beginning of nuclear use, the institutions entrusted with the promotion of nuclear energy were responsible for both military and civil programs, and not only that: they developed the strategies, implemented them with the help of science and industry, and also controlled them. Logically, the posts in the administration were occupied mainly by people who were in favour of nuclear programs. Critical voices were already radically sorted out at that time. The unbundling of roles between project promoters and supervisors was implemented only slowly and hesitantly. In addition, support was provided by the international, well-resourced organizations such as IAEA, NEA (OECD) and Euratom, which were all founded in 1957 and were part of the implementation strategy of the powerful nuclear industry with its links to the highest government bodies. This strong attachment to the nuclear industry has prevented the establishment of truly independent regulatory agencies to this day. We can very nicely trace these dependencies, for example in Japan (Fukushima), and even in countries like Switzerland, Finland or Sweden. How do you intend to implement a nuclear disposal policy that contradicts the interests of the nuclear industry? The understanding of roles, especially the distribution of roles between the waste producers and the regulatory authorities, is a fundamental problem of governance.

3. Programmatic problems: Science, technology, planning

From the very beginning, university and private-sector science was involved in the disposal programs, albeit only on a small scale. The main conceptual lines of action for nuclear waste disposal were laid down at that time. The disposal concepts were an expression of the state of the art in science and technology. One promising solution was to dispose of radioactive waste in disused salt mines. But they had no experience with waste that was so difficult to manage (keywords: radioactivity, toxicity, heat release). Science and technology therefore underestimated the difficulties of such disposal programs - one could almost say systematically. The planning processes do not reflect such difficulties in any way. For example, the Lyons high-level waste project at the old Carey Salt Mine failed because for years it had been overlooked that dozens of exploratory wells had been drilled into the salt deposit and that there was a risk that the mine would sink. Another example: the program planning. Worldwide, the complexity of implementing waste management programs was underestimated, which, together with other factors, meant that the timetables regularly got out of hand and the nuclear industry had to build interim storage facilities. There are a large number of well-documented examples that testify to the influence of poor or inadequate planning on program implementation or explain the failure of projects.

4. Problems of quality assurance and feedback

Finally, the underdeveloped to missing feedback is of course one of the main reasons why programs fail. If, as with WIPP, well-established quality assurance programs are thinned out for cost reasons, it is not surprising that barrels are conditioned in violation of regulations and bursts, with dramatic consequences. More than a dozen workers easily (?) contaminated, more than the $2 billion total damage, a big image problem for the WIPP lighthouse project. In addition, retrieving the waste became illusory, which contradicts the legal requirements. However, it was foreseeable that WIPP would become a plutonium-contaminated facility anyway due to the collapse of the ceiling.
More problematic than the bypassed or missing quality assurance or the absence or underdeveloped safety culture are open manipulations of programs. In Switzerland, flagrant interventions from of this kind can be traced - from deliberate and systematic overhearing and negation of negative developments to the manipulation of basic concepts. If the nuclear waste management agency writes the technical concept after it is to be assessed, and the authorities neither make it visible nor intervene, then something is fundamentally wrong. Such influences of course make an orderly execution of a program impossible and of course damage the development of a safety culture.

The purpose of this brief and far from complete interpretative order is to show how necessary and urgent it is to address these structural and governance issues. It shows the importance of a historical review of events as a basis for identifying and analyzing the organization of the institutions involved and the management (or non-execution) of programs and projects. The findings for the safety culture (culture of error) and governance for today's programs depend crucially on how well the experience gained to date is integrated into the further development of the program. My personal experience in participating in and monitoring many waste management programs does not make me particularly optimistic about the learning capacity of the entrusted institutions and the effect on the concrete projects. It is precisely for this reason that urgent attention should be paid to these issues - not least because the nuclear industry and the competent authorities are reluctant to address these problems. This field could be of particular interest for university research. And there are already various universities that have begun to become active in this field. However, the funds available are relatively meager, both in terms of personnel and funding. And that brings me to the outlook.

3 Outlook

One should grant the critical debate the space it needs - because it is the most socially acceptable and ultimately cheapest way to deal with nuclear waste disposal and to avoid what is going on in society and at x locations in the past and today: Loss of confidence and resistance. After decades of failure of nuclear waste management policy, it is not too much to ask for four measures to be introduced comprehensively and implemented in a targeted manner:

1) The creation of transparency through a far-reaching opening of the archives - in certain countries this is already on the way, but by no means in all;
2) A comprehensive and sober historical review of past nuclear waste management projects, analyzing and identifying mistakes and identifying measures to avoid them (e.g. research projects via joint ventures between universities and practice [companies, consulting industry]);
3) The establishment of a safety culture worthy of the name, in which the procedures for identifying and dealing with errors are defined and handled, and the handling of criticism is determined. In this way it should serve to avoid mistakes in the future:
4) The allocation of sufficient financial resources for such tasks, which should also make it possible to carry out the corresponding research programs and to build up the "human resources" - i.e. the necessary competences - and not only in technical disciplines.