Waste R&D and Policy Design – Historical Observations

Supporting Materials for Blue Ribbon Commission on America's Nuclear Future
Subcommittee on Reactor and Fuel Cycle Technology
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As far back as the first attempts at R&D for nuclear waste disposal, questions about alternative fuel cycles and waste characteristics have been on the agenda. I have been invited to reflect on these developments before the Reactor and Fuel Cycle Technology subcommittee as a historian of science who studies the development of nuclear waste R&D. The trajectory of this research offers important insights as we think about designing nuclear programs for the future. These lessons are pointedly relevant to the larger questions facing the Blue Ribbon Commission as it deliberates on reorienting America's policy for the back end of the fuel cycle.

In the 1950s, when waste management research began to be institutionalized within the Atomic Energy Commission, alternative fuel cycles were no less part of the picture than they are today. Scientists and engineers at Oak Ridge, Hanford, and other national laboratories were facing some of the same questions that have been recently reopened. The 1950s looked toward a future with massive use of nuclear power. A wide range of reactor options were being explored with government support. This was before BWRs and PWRs had become locked in as the default technologies. On the reprocessing side, the PUREX process had replaced the Manhattan Project's bismuth phosphate technology, but it was still only a few years old. Different fuel cycle options were open for exploration—and the consequences for waste management still unclear.

The nation's famous report of 1957 on geological disposal, authorized by the National Research Council and the National Academy of Sciences, shows signs of wrestling with this problem. The challenge was to define the parameters within which waste management research should move. With little to no experience with waste beyond the urgent operational requirements of the weapons program, scientists and engineers faced a set of questions that were hard even to state in detail. What would be the waste characteristics from these fuel cycle options? How would they affect storage, transportation, and permanent disposal? Above all—for the Atomic Energy Commission in the 1950s, struggling with what seemed like unyielding budgetary constraints—how much would it cost? The scientists in the labs and on the NRC-NAS panel tried to bring order to this domain.

With the tools at their disposal, they did what they could. For the most part, they found it simpler to leave questions of details aside. Devising how to handle and dispose of the waste immediately on hand was a large enough challenge. Against this backdrop, the NRC-NAS report of 1957 on geologic disposal represented a first step down a long road. Although the science of that day led the scientists to some problematic conclusions—the feasibility, for instance, of pumping liquid high-level waste directly into salt cavities—the overall conclusion was that questions about alternative fuel cycles should reasonably be left for the future. The tools wielded by the AEC of the 1950s and its scientific advisors made some questions tractable, largely those technical challenges that appeared to be decoupled from political decisions or market outcomes, beyond sheer order-of-magnitude estimates of the scale of the problem.

The AEC of the 1950s and its Academy advisors could implement this kind of planning. Nuclear waste, and with it other aspects of the nuclear fuel cycle, were technical challenges to be solved by scientists and engineers. The AEC faced relatively little public scrutiny or political opposition on this matter or others. Indeed, the deference the AEC garnered meant it had to deal little with society and politics until the late 1960s and early 1970s. When change did come, as it did in those years, it was due to certain developments internal to the AEC, such as its ways of dealing with leaking waste tanks at Hanford, and to emerging controversies between the AEC and the states being considered for waste disposal operations. On a greater scale, the change went back, no less, to larger social conflicts arising around nuclear power and to a society-wide displacement away from implicit trust in government, industry, and science.

So much has changed, indeed, since the 1950s. Any program for fuel cycle and waste R&D needs to take these changes into account. Beyond much-improved methodologies for working out the technical parameters of innovative technologies, a new set of social dynamics is in place. The last decades have made one thing clear: there is no clean separation between scientific-technical and social-political aspects of nuclear technologies. This may be frustrating for analytical clarity and bounded solutions. But it is empirical social reality.

This is not, in fact, a new insight, just one that has been hard to accommodate within the inherited strategy. In 1978, as the new Department of Energy began to work out its position, its chief historian, Richard G. Hewlett, offered an insider's commentary on America's nuclear waste problem. Describing the history up to his day, he wrote,

> There never has been any shortage of feasible technical solutions .... In fact, the extraordinary accomplishments of federal laboratories and contractors in this area have tended to dazzle the policymakers and to lead them to believe that brilliant technology was sufficient.... Lip service was given to the importance of such nontechnical factors as public understanding and acceptance, economic incentives or disincentives, and federal-state relationships, but almost nothing was invested in the analysis or evaluation of these factors. (DOE/MA-0153-Draft)

We have had many lessons to learn from experience in the years since Hewlett wrote.

One of the huge steps this Blue Ribbon Commission has already taken has been to authorize open discussion of the failures that have happened when technical solutions came first and society and politics were brought in after the fact. Yucca Mountain starts to look like a turning point. At this juncture, one of our major design challenges is to do a better job building societal concerns into our policy from the start. We do have positive examples, as well as negative ones. And we do not want to come back to alternative fuel cycles (or, for that matter, to the waste problem) fifty years hence, appointing a commission to examine what went wrong and concluding we again failed on sociopolitical grounds.

A historian is not the right person to ask where the Commission should look for guidance. Some things, still, seem clear. Proliferation and security are already on your agenda. You have thought about economics and about timing and sequencing (when new technologies will be ready

to implement at scale). You are sensitized to issues of public acceptance, though it is not clear how this has taken concrete form in deliberations around the fuel cycle. You have perhaps given thought to siting issues and governance. You have called in political scientists, sociologists, specialists on risk perception, organizational design theorists, and experts on trust and accountability to publics.

That is admirable. In fact, it is potentially game-changing. It is not, however, a one-time thing. There is a missing infrastructure of social science research on nuclear questions. An older cadre of experts may feel they have been crying in the wilderness for decades, and few new experts have been trained. If the United States is to support social science research in the nuclear field, it will not be for quick answers. But the processes of innovation and implementation in which we are involved have a time constant of decades. Programs in other fields, such as the National Nanotechnology Initiative or the Human Genome Project, show how far nuclear is from the new mainstream regarding the incorporation of social and political issues—and what it can do to get back in. Indeed, much of the social science scholarship on nanotech revolves around questions just as relevant to nuclear policy. Other countries, too, just as they have developed more politically successful practices of repository design and siting, have created more substantive models of social scientific engagement.

Let me close with a historical reflection: This moment we are in is like nothing I have seen. By acknowledging what has failed in our strategies for waste and the fuel cycle, we have created an unprecedented opening. We do not have to stick with our old ways of doing things. I hope the Commission will seize this chance to do something new.