**Design Challenges around Fuel Cycles and Waste – Past, Present, and Future**

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This is not the first time that the United States has asked how alternative fuel cycles, waste characteristics, and disposal options go together. Back at the very beginning of research into disposal—back in the 1950s—it was an active and troublesome issue. At a time when massive expansion was forecast for nuclear power, when the options on the table went far beyond BWRs and PWRs and when PUREX reprocessing technology was just a half-decade old, scientists in the national labs and the NAS/NRC were asking the question. How they tackled back then it is indicative of their era; how we tackle now it should be indicative of ours.

In the 1950s, scientists and engineers had no experience with the waste problem beyond what was sitting in front of them. They faced a future of almost unlimited alternatives, few of them hemmed in as yet by technical or societal constraints. They did their best to survey the parameters: What will be the waste characteristics? What consequences will those have for storage, transportation, and permanent disposal? And central to all of this, how much will the different options cost? The science was at an early stage; the estimates were rough. For the most part, the researchers moved on to other, more tractable questions, largely technical problems that seemed separate from political or market outcomes.

That was the 1950s. What has changed since then? The techniques of fuel cycle analysis and waste disposal have made tremendous advances. But there are other changes, too. In the 1950s, we had only our own (U.S.) expertise to look to. Today we can draw on other countries' experience. The last decades have taught us, too, that every nuclear development is jointly a social-political and a technical issue. We have noticed that the world around us has changed. Strategies from the 1950s no longer work when citizens' trust in government, industry, and scientists has been undermined by things happening inside and outside the nuclear field.

If it does not work any more to first figure out a technical solution—think Yucca Mountain—and take up less tractable societal questions after the fact, then our design challenge is to build societal concerns in from the start. That would let us reap some benefit from our hard lessons since the 1950s. We do not want to come back to this problem in another fifty years, appointing a commission to examine what went wrong with alternative fuel cycles, concluding that we saw it was a social and political problem and just did not deal with it. One thing this implies is social science research accompanying the process of technological innovation. This is nothing new in non-nuclear domains; think of the National Nanotechnology Initiative. We will not get silver-bullet solutions—social and political problems are messy and conflictual—but we will get a more thoughtful and publicly acceptable process accompanying the technical R&D.

What is the challenge to this subcommittee, and to the Commission? This historical moment is practically unique. The system's failures, now that we can acknowledge them, have opened up options we did not have before. We do not need to keep doing what we have done since the 1950s. We have a critical chance to do something new.