Spent Fuel and Reprocessing Myths and Realities: United States and France

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Overview

- The failure of the federal spent fuel management program and the enormous waste of ratepayer money over three decades has been due to hasty, short-term-oriented, and largely political decisions.
- A hasty development of a consolidated storage site would repeat the pattern and undermine the process of creating a sound science-based geologic isolation program for spent fuel while encouraging reprocessing. A consolidated storage under DOE's purview at or near a DOE site would be specially harmful to long-term management.
- Contrary to common impression in the United States, reprocessing in France has created greater costs, pollution, and complications and other problems without obviating the need for a repository. France uses less than one percent of the uranium resource, despite reprocessing, not 90 to 95 percent as has sometimes been asserted by reprocessing proponents.
- The Blue Ribbon Commission's recommendation for a "consent-based" process must be an informed consent process. At a minimum, (i) radiation protection, safety, and performance standards for storage and disposal must be set in advance so that the public knows to what it is consenting, and (ii) the independent agency recommended by the Blue Ribbon Commission for federal spent fuel management must be set up before any significant actions are taken.

Recap of past failure

- The abandonment of the eastern repository was due to political pressures.
- The 1987 designation of Yucca Mountain was primarily a political decision, but was sold as a scientifically sound one. Result: a poor repository location, and a failed process that cost over $10 billion.
- When an EPA panel concluded that Yucca Mountain may not meet the carbon-14 emissions limit, Congress asked for new standards, instead of a new location. A kind of double-standard standard.
- The NRC changed its rules too to accommodate the reality that the host rock at Yucca Mountain would likely contribute little to isolation of waste.
- It became the antithesis of a science-based, consent-based process that we need for proper implementation of the federal role in long-term waste management.

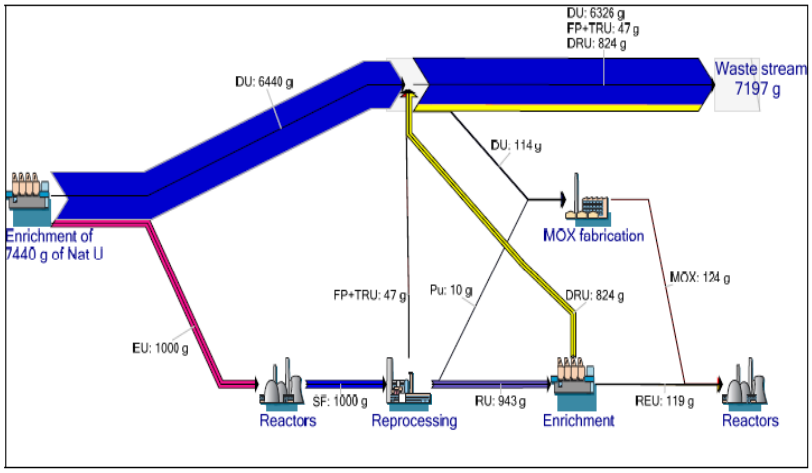
Hasty consolidated storage would be harmful to long-term success

- A hasty development of a consolidated storage site would repeat the pattern and undermine the process of creating a sound science-based geologic isolation program for spent fuel.
- A consolidated storage under DOE's purview at or near a DOE site would undercut the new agency to recommended for spent fuel management by the Blue Ribbon Commission even before it is formed. It would set the stage for conflicts over resources between DOE and the new agency, once it is set up.
- Perceived short-term economic gain should not drive the process.
- Needless packaging and transportation will increase risks and costs without concomitant benefit.
- Perhaps worst of all, consolidated storage at SRS would entrench the lobby for reprocessing, which will further increase costs, pollution, and waste problems. *France is NOT the model to follow in this respect.*

French reprocessing policy recap

- France began its intense push to nuclear with the 1973 oil crisis. The plan was to develop sodium-cooled breeder reactors and reprocessing to make nuclear energy almost independent of new uranium, once established.
- Like other breeder reactor programs, the French program had mixed technical results and poor economical results. The demonstration reactor, Superphénix, operated at only 7% capacity factor. Monju in Japan fared even worse, suffering an accident soon after commissioning.
- Worldwide, roughly $100 billion (2008 dollars) has been spent in the effort to commercialize the sodium cooled breeder. It has failed.
- Towards the end of the 1980s, it was clear that breeders would not be the anchor of French nuclear electricity. Reprocessing would not establish fuel sufficiency. It would be costly to use MOX fuel in light water reactors. But the French did not want to throw any part of nuclear into question. They changed course and started to use MOX in light water reactors.
- Contrary to the impression in some quarters, France uses less than one percent of the mined uranium resource, not 90 or 95%. More than one percent resource use is essentially impossible with light water reactor reprocessing and MOX fuel use.

LWR uranium resource use – necessarily less than ~1 percent even with repeated reprocessing. MOX spent fuel is very unsuitable for reprocessing



Reprocessing in France: La Hague

- Most recovered Pu used as fuel; yet ~over 50 metric tons equivalent surplus French Pu, plus other countries' Pu stored in France
- Cost: ~two cents per kWh more for electricity generated from MOX. Total ~$1 billion per year (2008$).
- Liquid high-level waste storage creates significant unnecessary risks
- ~100 million liters of liquid radioactive waste into English Channel per year, polluting ocean all the way to the Arctic.
- 11 of 15 OSPAR parties voted to voted to urge Britain and France stop reprocessing
- Public opposition to waste disposal has been intense even in France.
- Reprocessing is continuing due to policy inertia and largely government-owned companies, not for economics.

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Mixed oxide fuel

- Despite huge expenditures, less than ten percent of France's nuclear electricity is generated from mixed plutonium-uranium dioxide fuel. The rest is from imported uranium, including from Niger, where there are considerable security issues.
- MOX spent fuel is hotter and has higher plutonium and other long-lived actinide content.
- The French people have been very unhappy about the prospect of a repository nearby and there has been strong resistance. One site is being investigated, near the village of Bure in north-eastern France.
- The most difficult waste to dispose of at this site by far will be MOX spent fuel. Indeed, France may need a second repository because of it.

US reprocessing prospects

- The prospects that the federal government will provide on the order to $20 billion (give or take a few billion) for a reprocessing plant are essentially nil. The Blue Ribbon Commission recommended against reprocessing spent fuel, though it did recommend research. The Dickstein-Shapiro report of March 13, 2013 that assumes the money could come from the Nuclear Waste Fund is without basis in any finding or recommendation of the Commission.
- There is no customer as yet for the weapons-derived MOX fuel to be made at the facility under construction at SRS, despite over fifteen years of government persuasion. Spent fuel reprocessing would only add to the already substantial weapons surplus inventory. Japan should be a cautionary tale. Reprocessing and plutonium in plenty, but essentially no MOX fuel electricity generation after tens of billions of dollars of expenses.
- If SRS invites consolidated storage, South Carolina will likely become the long-term (permanent?) storage spot for much, most, or all U.S. Spent fuel. If there is reprocessing, the most likely result: increase in the amount of waste, surplus plutonium, cost, and pollution.

LWR System Radwaste volumes (m^3) with and without reprocessing

System	Spent fuel or High-level waste	GTCC waste	Total repository waste	Low-level waste	Annual radiological transports (rail plus truck)	Comments
LWR once-through	70,990	2,500	73,490	150,000 to 585,000	165,000	
LWR with reprocessing	52,000	407,000	459,000	1,740,000 to 2,175,000	1,224,000	~100 million liters of liquid radioactive waste reprocessing discharges per year (Note 2)
Ratio with/without reprocessing	0.73	163	6.2	3.7 to 11.6 (max to max and min to min)	7.4	

Source: DOE/EIS-0396 GNEP Draft Table 4.8-6 (p. 4-139)

Criteria for successful spent fuel management

- The Blue Ribbon Commission's (BRC) recommendation for a "consent-based" process must be an informed consent process. If there is not informed consent, then it is an invitation to compromised science and to environmental injustice, increasing the chances for failure.

At a minimum, informed consent should include:

- radiation protection, safety, and performance standards for storage and disposal ***set in advance*** so that the public knows to what it is consenting, and
- the independent agency recommended by the Blue Ribbon Commission set up before any storage or repository siting or large financial commitments are made. For a clean start, ***the siting process should be decided by the new agency.***

If not science-based, then not informed consent.

A science-based siting process is needed. Without sound science done in advance, informed consent is impossible. The considerable mythology about reprocessing in France provides one example of what is wrong with the US debate on spent fuel.

- A sound, science-based repository siting process would involve detailed generic (not site specific study) of how geologic environments would function together with containers and backfill and sealing systems to form an overall isolation system. Site selection should start only after such studies are completed on a variety of combinations. SRS scientific resources could play a role in such investigations, given the experience with vitrification and other related areas.
- Interim storage and geologic disposal decisions need to be made together, as a whole, to minimize expenditure for a given risk level, which should be determined before hand by generic standards.
- It is important to note that there was across the board agreement in testimony before the BRC that a new federal agency is needed for the spent fuel management role. This is an essential first step that Congress needs to take.

Conclusions

- Inviting consolidated storage to South Carolina would hamper the initiation of sound federal policy and undermine the new federal agency before it is even created.
- Funds for reprocessing are highly unlikely. So if consolidated storage is located in South Carolina, it would likely become the country's storage site for spent fuel.
- Reprocessing would multiply rather than solve plutonium-related security issues, costs, surplus plutonium, and waste management problems.

Resources

- **Reprocessing**: Arjun Makhijani, *The Mythology and Messy Reality of Nuclear Fuel Reprocessing*, IEER, 2010. http://www.ieer.org/reports/reprocessing2010.pdf
- **Reprocessing proliferation risk**: R.Bari et. al, *Proliferation Risk Reduction Study of Alternative Spent Fuel Processing*, Brookhaven National Laboratory, July 2009, http://www.bnl.gov/isd/documents/70289.pdf
- **Breeders**: Breeders: T. Cochran et al., *Fast Breeder Reactor Programs: History and Status,* IPFM, 2010, http://www.fissilematerials.org/blog/rr08.pdf **Transmutation**: H. Zerriffi and Annie Makhijani, *The Nuclear Alchemy Gamble*, IEER, 2000, http://www.ieer.org/reports/transm/report.pdf
- **Interim storage**: Principles for Safeguarding Waste at Nuclear Reactors, signed by well over 100 groups.
- **French Repository Program**: Disposal of Highly Radioactive Wastes in France: An IEER Evaluation, http://www.ieer.org/sdafiles/13-4.pdf
- **Renewable energy system**: Arjun Makhijani, *Carbon-free and Nuclear-Free: Roadmap for U.S. Energy Policy*, IEER, 2008. Free download at http://www.ieer.org/carbonfree/CarbonFreeNuclearFree.pdf