

The cost of NRC regulation.

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Figure 1: No. The welfare of humanity is our overriding priority

Sticks and carrots

People are always pestering me for concrete examples of the cost of NRC style regulation. I turn them off by telling them it doesn't work that way. It's about incentives and motivation. What are the sticks and what are the carrots? Suppose you tell a football player, your overriding priority is not getting hurt. If you get hurt or do anything that might get you hurt, you are out of football for life. Now go out there and win this game.

When you go from a competitive environment where its build better/cheaper or die to an environment which is ruled by an autocratic regulator's goal to prevent a release, everything goes to hell. Paperwork and process trumps substance erecting massive barriers to entry. Cheap becomes "unsafe".

Everybody's motivation gets wrong headed, not just the regulators. Incumbents work harder on protecting and deepening their artificial moat than they do on their product. Workers forced to follow ridiculous, wasteful procedures and sit around waiting for a series of sign offs on an obvious fix rationally decide if the bosses don't care about doing the job right neither should they. Fixed price contracts become infeasible. The vendors' goal becomes milk each project for as much money as possible for as long as possible. And the next thing you know, plants take three or four times as long to build as they should and cost five or more times what they should.

My inquisitor walks away shaking his head and saying to himself, where are the facts, he doesn't have a real argument.

The Thought Experiment

Sometimes I try the thought experiment. Every year about 30 people are killed in Korean shipbuilding. In my four years in Korean yards, I never saw anybody doing something that I would regard as unsafe, or wouldn't do myself, and I'm scared of heights. The yards have a complete set of safety rules. Our inspectors got in trouble on several occasions for breaking them. But working at height, around all sorts of moving machinery — the yard is a cacophony of horns and beeps and bells — with cables and sparks everywhere, and continually lifting heavy loads is an inherently dangerous enterprise. Bad things happen.

Suppose the Korean government decides this is intolerable. One death is one too many. They would set up a all powerful bureaucracy, the Office of Shipbuilding Deaths (OSD), whose overriding goal is preventing yard deaths and injuries. The OSD would produce a set of rules and requirements with which the yards must comply in order to get a license to build ships. The OSD would require each yard to apply for a license by documenting in detail how they will comply with all its rules and regulations. The yards would switch their best talent to writing these license applications and the scores of supporting documents. Their very best designers and engineers would move to other industries. They would be replaced by lawyer types, skilled in weasle wording and the manipulation of bogus probabilities.

If the government is really serious about eliminating shipyard deaths, they would even allow the OSD to change the rules on the fly. Fixed price contracts and guaranteed delivery would become a thing of the past.

The OSD would deploy inspectors to each yard with the power to stop work if the inspector saw anything he thought violated the license, which includes such amorphous requirements as As Safe As Reasonably Achievable (ASARA), which he has autocratic authority to interpret. Job after job would come to a halt while the yard came up with new procedures, and then got them approved after lengthy negotiations.

The OSD would quickly figure out that the main cause of yard deaths and injury is all the lifting that is going on. They would designate transporters as the Best Available Technology (BAT) for moving stuff around, Heavy lifts whose hoist height exceeded 30 cm would be outlawed. The yards would be required to build shallow ramps to move the blocks down into the building dock.

I know what you are thinking. This time you've gone too far. You've ruined your argument by getting silly. Maybe, but this was precisely what happened in the UK with the ABWR. Boiling water reactors have elevated spent fuel pools. To remove the cooled elements, they must be lowered down to ground level. But the Office of Nuclear Regulation has a lift limit of 30 cm for the transport casks, which was based on PWR requirements. One of the solutions that was proposed was a 230 m long ramp. I'm not making this up.^[1][p 58] After a long squabble a compromise was reached.

Even without the ramps, the finely tuned machine that is a Korean shipyard would be destroyed. The costs of the ships would skyrocket and the quality deteriorate. But when I try this approach, my doubting Thomas walks away saying "The Koreans would never be that stupid". I don't even have a chance to say "Yeah, but we ...".

A Concrete Example

It seems we must have a concrete example. Let's go with the cost of dry cask storage. Under NRC regulation, each dry cask costs about a million dollars. Each cask requires about 30 tons of steel and 30 tons of concrete. Remember the spent fuel has already aged 4 years. Most of the the volatile stuff is gone. We are going to put the casks in the ground or in a vault. If there is a cask failure, nothing much happens,

Using standard construction cost factors, we are talking at most \$50,000. Since we can produce these on a repetitive, automated, assembly line basis, we should be able to beat that. But we do need some neutron absorber (plastic) and some inert gas, so maybe we end up at a bit more than \$50,000. Indeed Jim Hopf's company was profitably making dry casks to NRC requirements for about \$90,000 in the late 1990's, before they were black flagged by the NRC for using competent vendors that, unlike the incompetent Shaw Industries, did not have an N-stamp. So let's very generously estimate a dry cask's should-cost at \$100,000. You can have a fancy car for that price.

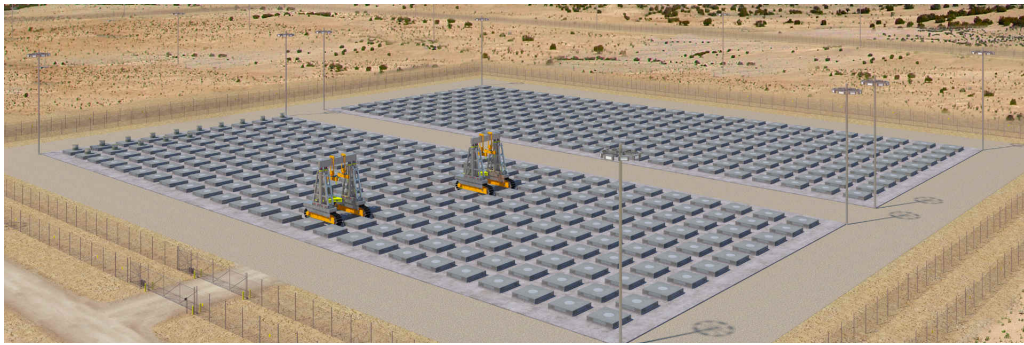


Figure 2: Histore Pad. 580 tons of spent fuel per acre

Table 1 compares the overall cost of dry cost storage for a \$100,000 cask with that for a \$1,000,000 cask. This is based on the Holtec Histore system, Figure 2, and Holtec numbers for the non-cask costs of the system, a real discount rate of 5%, a cask life of 40 years, and storing the spent fuel forever. The \$100,000 cask system cuts storage cost by a factor of 3.

Cask cost	\$100,000	\$1,000,000
\$/MWh	0.103	0.310
¢/kWh	0.010	0.031

Table 1: Perpetual dry cask storage cost, 5% real, 40 year cask life

Thanks to nuclear's insane energy density, dry cask storage is cheap per kWh. Even at NRC's ridiculous cask cost, it's only about 1% of nuclear's should-cost of around 3¢/kWh. Despite this, the NRC which has pushed nuclear's does-cost up to around 15¢/kWh with measures that have had no measurable effect on the probability of a release has chosen to put off this tiny cost for about 20 years by using dense packing.

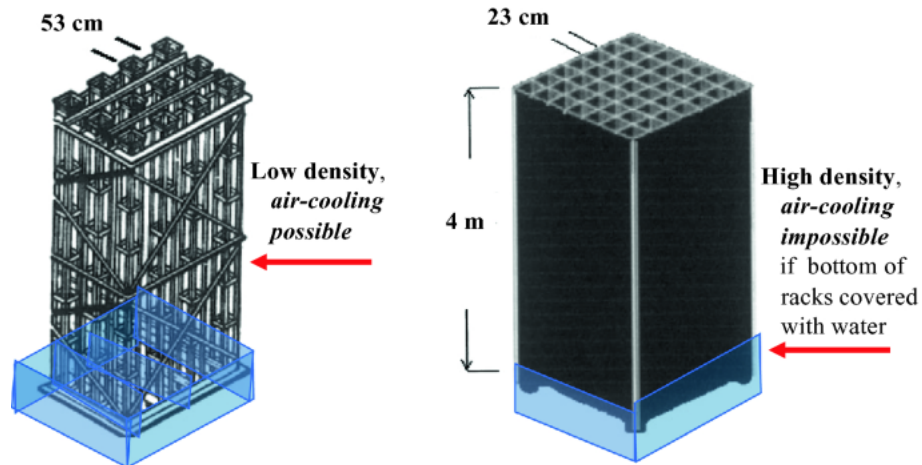


Figure 3: Open-racking left; dense-packing right.

Dense packing means that, if the spent fuel pool is drained, which could happen by simply losing pool cooling, then there is an excellent chance we will have a spent fuel pool fire and a very large release. This almost happened at Fukushima, vonHippel and Schoeppner have computed some of the plumes associated with such a release from the Peach Bottom plant near Baltimore in different weather patterns, Figure 4.[2] Under LNT and EPA rules, millions would be unnecessarily evacuated. The resulting chaos would make Fukushima look like a picnic.

This could be avoided by going back to open-racking where the fuel elements are spaced so that air cooling is sufficient to keep the fuel elements from bursting and catching fire. That was the AEC/NRC's original plan. It was a good plan.

Why would the NRC abandon open-racking for dense-packing? At least part of the reason was bureaucratic infallibility. Originally dense-packing was just a short term fix to a temporary problem. When it morphed into a universal, standard operating procedure, NRC was faced with

1. admitting they had screwed up and allowed an unnecessarily risky situation to develop, or
2. claiming that it's all part of the plan.

Deskpots are never wrong. It had to be (b).

Another big contributing factor is the Price Anderson suicide pact. Under Price-Anderson, the costs of a really big release are spread over all the US plants. If an individual plant decided

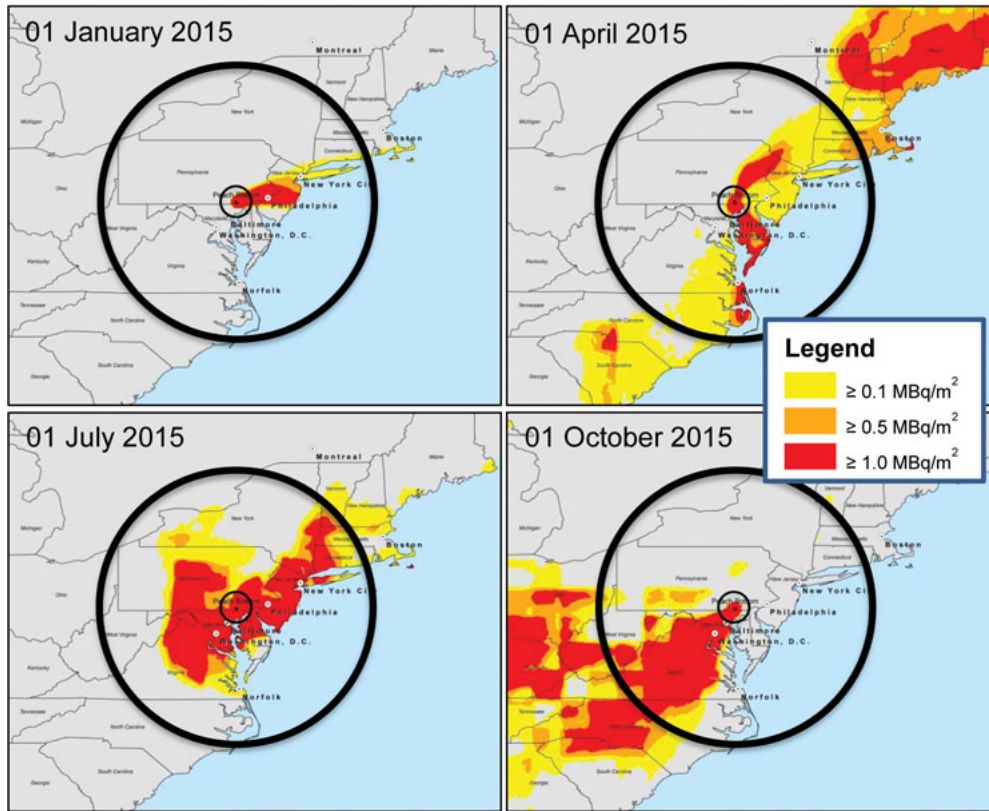


Figure 4: Cesium-137 ground contamination from a postulated dense-packed spent fuel pool fire at the Peach Bottom plant north of Baltimore. The figure shows four different weather patterns.[2] The red area would have to be evacuated under EPA recommendations. ***This would be a tragedy of epic proportions. 1.0 MBq/m² is far below the level at which there will be any detectable harm.***

dense packing is crazy, and paid for open-racking, he would still be on the hook for a big spent fuel pool fire at any of the other 95 plants. He sees only 1/96th of the benefit of his investment.

But an important factor is that getting rid of open racking is at least three times as expensive as it should be because of the paper work required to build a simple steel and concrete can.

In short, NRC style regulation is the reason every nuclear power plant in the US uses dense-packing, which is by far the most likely, non-weapons path to a Chernobyl or larger sized release in the USA. Such a release coupled with the NRC's immoral, indefensible defense of LNT will cause panic, evacuation, and exile that will shake the country to its roots. Is that a big enough cost for you?

References

- [1] J. Fingleton. Nuclear regulatory review. Technical report, Nuclear Regulatory Taskforce, 2025.
- [2] F. vonHippel and M. Schoepfner. Reducing the danger from fires in spent fuel pools. *Science and Global Security*, 24(3):141–173, 2016.