Market based regulation of nuclear power

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The Enemy is Us

Nuclear power has everything going for it: dispatchable, incredible energy density, tiny amount of waste, tiny amount of land, nil pollution, and near zero CO2. It is not only the only solution to the twin problems of energy poverty and global warming; it is a highly desirable solution. Yet nuclear power has been a tragic flop of epic proportions. What went wrong? It wasn't the sinister machinations of Big Oil. It wasn't the bumbling EPC contractors. It wasn't the misanthropic anti-nukes. The problem lies within.

Nuclear power never escaped from its government sponsored and controlled birth. We set up a omnipotent regulatory apparat from which there is no appeal; a bureaucracy which ignores the benefits of nuclear power while focusing only on the potential hazards and its own survival; a tribunal whose only rule is we set the rules and we can change them whenever we feel like it. Such a system quickly priced nuclear out of the market.

At that point, the incumbents opted to feed at the public trough, falling into the trap of spending tens of billions of taxpayer dollars annually to solve problems that either do not exist or have simple, cheap solutions. This required that they embrace a model which massively and fraudulently exaggerates the risks of low dose radiation, and the harm associated with a release of radioactive material. This in turn forced them to claim that the probability of a large release of radiation is so small, we don't have to worry about it. This lie was quickly revealed and an angry public turned against nuclear power. ***The nuclear power establishment is the reason why nuclear power has been a flop.***

Underwriter Certification

The good news is manmade problems can be manunmade. In order to realize the promethean promise of nuclear power, all we need is a regulatory system that reasonably balances benefit and harm. Underwriter Certification would assign the following roles to four major actors.

National Government

Impose an incrementally increasing CO2 tax. A properly designed carbon tax is essential to a smooth, efficient transition to a low carbon society; but it is not the subject of this little piece. See reference [2] for a proper exposition.

Dump all subsidies and mandates. Technology specific subsidies and mandates are the opposite of a pollution tax. They introduce market imperfections and inefficiencies. In their

most pernicious form, the tax credit, they are a blatant, in-your-face transfer of wealth from the poor to the rich. They are the worst of all possible approaches to the problem.

Promulgate and enforce a firm, fixed table of compensation payments. The unique hazard associated with nuclear power is the potential for a large release of radioactive material. Anyone who suffers true harm from such a release must be compensated. This is not just a matter of equity. Such compensation internalizes this harm, ensuring that the potential harm is part of the developers' design and operating calculus.

The compensation must be based on the Lost Life Expectancy from the dose profile each individual incurred, according to a reasonably realistic dose-response model, and nothing else. Once the dose profile is established, the payment would be both automatic and not subject to dispute. The tort system must be eschewed.

If negligence is subsequently proven, the proceeds from any fines or penalties go to the local and state government, not individuals and their ambulance chasers.

Set liability cap. The body politic must decide on a reasonable, worst case, third party casualty cost. This must be done transparently by elected officials, not bureaucrats, using the table of compensation payments. The cap can have a well-defined inflator, but once set the cap cannot be changed for existing plants.

Require iron clad liability insurance for the cap amount. If a plant's insurer cancels the insurance and the plant is unable to come up with a replacement, government shuts the plant down. If necessary, it can commandeer the plant and take over the operation.

If the compensation cap is exceeded in a casualty, then the compensation payments above the cap shall be paid out of public funds, spreading the harm across all taxpayers.

Prosecute alleged negligence In the event of a conviction, levy fines and prison terms on the individuals involved. Insurance against such fines would be illegal.

Set food and land contamination limits. Set the legal contamination limits above which produce must be taken off the market. Set the contamination limits above which the land cannot be farmed or grazed until the contamination falls below the limit. These limits should be set by elected officials, not unelected bureaucrats. Once set they cannot be changed for existing plants, unless the plant is compensated for any additional cost.

Require any property insurance to have large deductibles. Goal is to make sure shareholders suffer if plant screws up. Utility goes bankrupt and the shareholders are wiped out, before rate payers are asked to bear any of the costs of a casualty.

Require portion of top management compensation to be deferred. These will the first funds used in the event of a release. Goal is to make sure top management suffers if plant has a problem.

Facilitate prototype testing For untested technologies, the insurers will almost certainly require intensive, full scale, stress testing of prototypes. The federal government should encourage this by providing a testing facility on tenant pays basis. The feds set bond that must be posted to be allowed to test.

Do not stifle competition; enforce it. Foster multiple underwriters. Foster multiple Certification Societies. Foster multiple vendors. For the system to work, there must be competition at every level. Aggressive application of anti-trust and price fixing legislation.

Set plant boundary dose rate limits. These limits are triggers whose violation indicates something is not working right, and corrective action, penalties,and/or other intervention is required. These trigger levels need not, and usually are not, harmful dose rates. In most cases, they are and should be set far below the dose rates at which any radiation health effects have been reliably observed. The government must make this distinction clear.

If a government decides to change any of the trigger levels, any existing or under construction plants must either be grandfathered or compensated for any additional costs imposed on the plant by the change.

Provide protection from military attack. Providing protection against national or subnational group attacks is the function of the nation's military. This should be true of all high value facilities, many of which such as the transmission grid are far more vulnerable than nuclear power plants. Deploying a small army at each plant is an extremely inefficient way to attempt to protect the plants, and does nothing to prevent the real threat: missile and aircraft strikes. This can only be done by the country's military.

Nuclear plants should be required to provide only normal industrial security, similar to large chemical facilities such as Bhopal or large dams such as Banqiao; both of which are more vulnerable and have at least as much potential for widespread harm as a nuclear plant.

One function the federal government does ***not*** do is approve or disapprove an individual plant. That is the role of the local government where the plant is located. There should be no federal incursions into state and local sovereignty, such as Environmental Impact Statements.

Underwriters

The insurers play a key role in this system. They want to write business, but only profitable business. They require that a Certification Society acceptable to the insurer confirm that a plant meets all the Certification Society requirements. Based on the Certification Society reports the insurer decides whether to insure the plant and at what premium. If the Certification Society reports that a plant is no longer in compliance with its requirements, the insurer cancels the insurance. The insurer can also adjust premiums according to performance.

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If prototype testing is required, the insurers provide the testing bond.

Certification Societies

Certification Societies set the rules with which a plant must comply, witness the tests, perform the inspections, and, if all goes well, certify that the plant is in compliance with the Certification Society's rules. This is an ongoing process. The Certification Society will monitor operating plants, periodically inspect the plant and, if it is not satisfied, report to the insurer that the plant is no longer in compliance with its requirements.

Certification Societies are hired by a plant in order to obtain the certification required to buy insurance.

Local Government

No power plant, nuclear or otherwise, or any large industrial facility should be located in a community that does not want it. Each such community should balance the benefits and costs of such a development and make its own decision. The local community will see only a tiny proportion of the benefit to society as a whole of the cheap, reliable, zero pollution, and near zero CO2 electricity that the plant will provide. But it will bear the brunt of any problem at the plant. It should require compensation for taking on this risk.

This compensation can take many forms including:

1. Hundreds of good, steady jobs.
2. Property and other tax revenues.
3. Parks and other public facilities in the plant's buffer zone, which the local government should set.
4. District heating in cold locales.
5. Here's my favorite. Shares in the plant's ownership and therefore a portion of the plant's profits. This would give the community access to everything a shareholder sees and some say in the choice of directors, and indirectly in the choice of management.

What we need is auctions. Local communities interested in hosting a plant would prepare a package, delineating what they would require in order to agree to host a plant. They could ask for anything they want. The only requirement is the agreement is irrevocable for the life of the plant. The community that offered the most attractive combination of site and compensation package would be the winning bidder.

Once the plant is operating, the local government would operate the radiation monitors and enforce the plant boundary dose rate triggers, including collecting any fines. This must be on a strict pass/fail basis. There can be no judgement calls.

This Proposal is Unoriginal

The core problem in the regulation of hazardous, beneficial activities is finding the right balance between safety and economy. If the regulation is too lax, the result will be disproportionate harm. In the worst case, the technology will be rejected and the benefits foregone. If on the other hand regulation makes an activity overly costly, resources will be expended which could be better allocated elsewhere; and in the worst case, the technology will be priced out of existence.

International Trade and the Classification Societies This issue probably emerged first in ocean transportation. The activity was both highly beneficial, and at the time highly hazardous. The solution was the Classification Society system. Shipowners needed insurance. The insurers needed to understand the risk they were insuring. So they set up ship inspection services called Classification Societies. The Classification Societies not only inspect ships, they set the rules by which ships are built, and certify that a ship complies with those rules. There are roughly a half-dozen major Classification Societies. They are paid by the shipowners. The Classification Societies must compete for shipowners. This set up a balancing mechanism. If a Classification Society is too strict, it loses business. If a Classification Society is too lax, its certification becomes meaningless and won't be accepted by the insurers.

Overall the Classification Society system has done an excellent job of delivering the benefits of international trade. The real cost of transporting goods across oceans has decreased by multiple orders of magnitude. And seaman safety has improved markedly, albeit from abysmal levels.[1]

High Pressure Steam and the Boiler Inspection Services With the advent of high pressure steam in the 19th century, all sorts of formerly unimaginable things became possible. Trains, ocean liners, electricity. At the same time, a whole new danger was unleashed on the public. In the mid-19th century, fatal boiler explosions were running at better than 100 per year.[4] Between 1837 and 1878, there were at least 10 steamboat explosions that killed 20 or more people. The worst of these occurred on the Mississippi near Memphis on April 27, 1865. The steamboat Sultana was badly overloaded with Union soldiers on their way home at the end of the Civil War. At least 1547 were killed when 3 of her 4 boilers exploded.[3].

This prompted several civic leaders in Hartford, Connecticut to form the Hartford Steam Boiler Inspection and Insurance Company in 1866. The deal was pass our inspection, and we will provide reasonably priced insurance for your boiler. Boiler explosions became increasingly rare, despite a steady increase in steam pressure and temperature.

In Germany, a similar system developed based on inspection services called TUV's. Like the Classification Societies, the TUV's must compete with each other for the inspection business. Like the Classifications Societies, they must find the sweet spot between being overly strict and overly lax.

The system has worked well, delivering the benefits of high pressure steam, allowing technological improvement, with eventually an excellent safety record.

Both the Classification Society and TUV systems have built in balancing mechanisms. They don't always get the balance just right, but they cannot stray too far from the sweet spot. My proposal is merely a variant of the successful Classification Society and TUV regulatory systems.

The German System

I can see the eyes rolling now. This time Devanney's really gone off the deep end. Even if it's a good idea, nothing like what he's proposing is anywhere close to politically possible.

Allow me to present the German system. Germany comprises 16 *lander*, semi-sovereign states. In the German system, the regulation of an individual nuclear plant is the responsibility of the *land* where that plant is located, not the federal government.

However, the federal Kerntechnisher Ausschuss (KTA) sets standards, which must be followed. The KTA was formed in 1972. The KTA is made up of 5 groups, 7 members each.

Vendors 7 representatives of nuclear power plant builders and vendors.

Operators 7 representatives of nuclear plant operators.

Regulators 5 members from the lander governments, 2 from the Federal Ministry for Environment, Nature Conservation, Nuclear Safety, and Consumer Protection (BMUV).

Experts 4 members from the TUV inspection services, 1 from the Society for Plant and Regulatory Safety, 1 from the Reactor Safety Commission, 1 from the Radiation Protection Commission.

Others 1 member from the Federal Ministry of Economics and Technology. 1 from the working group for construction and housing, 1 from the nuclear research institutions and research reactors, 1 from the trade unions, 1 from the insurers, 1 from the German Standards Institute (DIN).

Adopting a safety standard requires 30 positive votes. Any one of the groups can block the adoption of a standard. Standards must be reviewed every 5 years. The KTA standards are enforced by the TUV inspection services. ***It's a TUV that certifies that a plant meets the KTA requirements.*** There are some dozen TUV's, mainly TUV Sud, TUV Nord, and TUV Rhineland. The TUV's are paid by the plants and must compete for the business.

The German system is the same as my proposal with the exception that the KTA sets the standards rather than the Certification Society. However, the make up of the KTA and the requirement for nearly unanimous consent before a standard is adopted introduces some balance and put some pretty strong limits on federal regulatory power. At the same time, no one to my knowledge has claimed that the German system is overly lax.

Underwriter Certification in the USA

Is it possible to implement Underwriter Certification in the US? Almost certainly not. The USA is like an addict that has to hit rock bottom, lots of blackouts with horrific consequences, before it can mend its way. I believe salvation, if it is to come, will start in a developing country, probably a country that has no pre-existing nuclear regulatory apparat.

However, if there is any possibility that the US can avoid the consequences of its own stupidity, it will be through the states. We must have a a state that shows the way, a pathfinder state. The Nuclear Regulatory Commission, Environmental Protection Agency, and a slew of other federal agencies are a violation of the 10th Amendment. They exist only due to tortured interpretations of the Commerce Clause.

But there is no way, the Commerce Clause can be applied to an entirely intra-state grid. The obvious pathfinder state is Alaska. High per capita energy consumption. No sun most of the year. Wind in the wrong places. Very expensive power. Independent minded citizens. If there is a state that can save the US, it is Alaska.

Alaska could implement Underwriter Certification tomorrow, if it so decided. The TUV's and the Classification Societies would scramble over each other for the certification and inspection business. Lot of potential prototype testing sites. Once the state let the investor community know what it was up to, the money would flow in.

The Federal bureaucracies would go bonkers. Suits would fly. This Supreme Court would vote to hear the case on an expedited basis. It would find Alaska was well within its constitutional powers. We would be off and running.

References

[1] J. Devanney. *The Tankship Tromedy.* CTX Press, 2006.

[2] D. Miller and J. Hansen. Why fee and dividend will reduce emissions faster than other carbon pricing policy options. Technical report, November 2019. Testimony to House of Representatives.

[3] S. Spignesi. *The 100 Greatest Disasters of All Time.* Citadel Press, 2002.

[4] R. Thurston. *Steam Boiler Explosions: in Theory and Practice.* J. Wiley and Sons, 1903.