Washington
Physicians for Social Responsibility

Small Modular Reactors: Climate Savior or More of the Same?

Testimony of Charles K. Johnson
to Washington State Legislative Task Force on Nuclear Power
Pasco, WA, September 25, 2014

Origins of the Nuclear Renaissance

- Problems with previous commercialization of nuclear power were identified by comprehensive 2003 MIT study:

  1) costs;

  2) safety;

  3) waste; and,

  4) proliferation.

New Designs, Old Designs Revisited

- A plethora of new design concepts, many of them based upon older research that had been abandoned, were proposed by engineers and enthusiasts. These include:
- High Temperature Gas Cooled Reactors;
- Sodium Cooled “Waste Burning” Reactors; and,
- Improved Design Light-Water Reactors

Improved Light-Water Reactors Find Favor

- Greater familiarity for designers and regulators means quicker to market
- Large reactors (Westinghouse AP 1000, Areva Gen III EPR), similar in size to those built during nuclear power's most rapid expansion in 70s and 80s are now being built.
- Four AP1000s under construction in the USA in Georgia and South Carolina.
- These AP1000s and EPRs in Finland and France are experiencing delays and large cost overruns.
- Does this sound familiar?

Small Modular Reactors – theoretical advantages

- Passive design to require fewer moving parts that can fail
- Smaller size means cooling extremely hot core can be more easily controlled
- A unit can be purchased for less money than a larger reactor, so requires less financing costs
- Mass production can bring down individual costs of each unit

Case Study – NuScale v. Columbia Generating Station

- NuScale would suspend 45 megawatt reactors (up to twelve) in large underground tank with passive cooling systems self contained in each reactor
- Columbia reactor has an active cooling system and back up spray ponds above ground that are vulnerable to a loss of coolant accident – similar in design to those that melted down in Japan

- Advantage NuScale

NuScale v. Columbia Generating Station (cont.)

- NuScale would store extremely hot spent nuclear fuel submerged in water below ground
- Columbia reactor stores its extremely hot spent nuclear fuel in a pool six stories above ground – vulnerable to a massive release of radioactive material if the pool was breached and the water drained away

- Advantage NuScale

NuScale v. Columbia Generating Station (cont.)

- NuScale claims that the standard model will be rated for up to .5 g ground motion in an earthquake
- Columbia reactor, was licensed in 1984 with design basis to withstand up to .25 g ground motion – US Geological Survey scientists have revised estimates for Hanford up to .6 g ground motion

- Advantage NuScale

So, where do we sign up for NuScale?

- Before jumping on the bandwagon remember, the design remains unproven
- Despite $217 million in federal matching funds, NuScale announced last spring that it is delaying submitting its design to the Nuclear Regulatory Commission for a year, until summer of 2016
- NuScale says earliest operating prototype won’t be completed until 2023 in Idaho

NuScale is the only SMR project left – Nine others applications “TBD”

- NuScale Power DC
- APPLICATION NOT RECEIVED
- RULEMAKING
- APPLICATION NOT RECEIVED
- TVA Clinch River CP
- APPLICATION SUBMITTAL DATE TBD BY APPLICANT
- Westinghouse DC
- APPLICATION SUBMITTAL DATE TBD BY APPLICANT
- Ameren COL
- APPLICATION SUBMITTAL DATE TBD BY APPLICANT
- RULEMAKING
- APPLICATION SUBMITTAL DATE TBD BY APPLICANT
- B&W mPower DC
- APPLICATION SUBMITTAL DATE TBD BY APPLICANT
- RULEMAKING
- APPLICATION SUBMITTAL DATE TBD BY APPLICANT
- Holtec DC
- APPLICATION SUBMITTAL DATE TBD BY APPLICANT
- Holtec COL
- APPLICATION SUBMITTAL DATE TBD BY APPLICANT
- X-Energy DC
- APPLICATION NOT RECEIVED

From Nuclear Regulatory Commission, New Reactor Licensing Chart, 8/15/2014

Even with federal matching funds, B&W and Bechtel cut SMR program

- Babcock & Wilcox and Bechtel received funding in federal funding in 2012 – had cooperation of TVA for site at Clinch River, TN
- Could not find private funding to match federal money and cut its research this spring from $80 million to $15 million
- After losing the second round of federal funding to NuScale, Westinghouse announced this year it would close shop – unable to find customers.

Economics are not favorable for nuclear – and SMRs especially

- Low cost of natural gas due to fracking and low cost of operating wind generators is making existing large baseload plants unprofitable
- The cost of solar and wind continue to decline rapidly and can be delivered now
- Storage options are becoming competitive, making variable systems more attractive
- SMRs don’t have economy of scale advantage of building large to recoup expensive construction with increased energy produced

SMRs need orders – and a supply chain

- Factory production and modular design is supposed to reduce the per unit cost
- Westinghouse CEO Danny Roderick says, “unless you’re going to build 30 to 50 of them, you’re not going to make your money back.”
- Foreign markets are possible, but risk nuclear proliferation concerns
- And what will happen to the market if there are factory failures and recalls?

How does NuScale design fare in dealing with MIT's four challenges?

1) Costs

*not currently favorable and long-term prospects are dim

*has advantage of deep-pocketed Fluor Corporation's purchase of the company to continue research for now

2) Safety

*possibly improved, but not yet proven or accepted by regulatory agencies for another decade at least

3) Waste

*produces identical long-lived highly radioactive waste products to those the US and world have failed to dispose of – the 'Achilles heel' of industry from the start

*the cancellation of Yucca Mountain due to environmental and political concerns and the recent failure of the WIPP facility in New Mexico do not bode well for a safe storage of these deadly materials for over 100,000 years

*requires the same destructive and contaminating uranium mining and milling processes

4) Proliferation

*reactors that are quick to build, with lower up front cost per unit, sold around the world could lead to sales to countries and organizations we may come to regret

Admiral Hyman Rickover's Wisdom

Paper Reactors, Real Reactors (written in 1953 and read into the record at the Atomic Energy Commission Congressional Hearings in 1970)

An academic reactor or reactor plant almost always has the following basic characteristics: 1) It is simple. 2) It is small. 3) It is cheap. 4) It is light. 5) It can be built very quickly. 6) It is very flexible in purpose. 7) Very little development will be required. It will use off-the-shelf components. 8) The reactor is in the study phase. It is not being built now.

On the other hand a practical reactor can be distinguished by the following characteristics: 1) It is being built now. 2) It is behind schedule. 3) It requires an immense amount of development on apparently trivial items. 4) It is very expensive. 5) It takes a long time to build because of its engineering development problems. 6) It is large. 7) It is heavy. 8) It is complicated.

Paper Reactors, Real Reactors

…Unfortunately for those who must make far-reaching decisions without the benefit of an intimate knowledge of reactor technology, it is much easier to get the academic side of an issue than the practical side. For a large part those involved with the academic reactors have more inclination and time to present their ideas in reports and orally to those who will listen

…Those involved with practical reactors, humbled by their experiences, speak less and worry more.

References:

- **Light Water Designs of Small Modular Reactors: Facts and Analysis**
- By Dr. Arjun Makhijani, Institute for Energy and Environmental Research
- http://ieer.org/resource/energy-issues/light-water-designs-of-small-modular-reactors-facts-and-analysis/

- August & September 2013

References:

- **Small Isn't Always Beautiful: Safety, Security, and Cost Concerns about Small Modular Reactors**
- By Dr. Edwin Lyman, Union of Concerned Scientists
- http://www.ucsusa.org/news/press_release/small-modular-nuclear-reactor-0404.html#.VCONr1eKWNF

- September 2013

References:

- **The Economic Failure of Nuclear Power and the Development of a Low Carbon Electricity Future: Why Small Modular Reactors are Part of the Problem, Not the Solution**
- Mark Cooper, PhD, Institute for Energy and the Environment, Vermont Law School
- https://www.nirs.org/reactorwatch/newreactors/cooper-smrsaretheproblemnotthesolution.pdf

- May 2014

References:

- **One size doesn't fit all: Social priorities and technical conflicts for small modular reactors**
- Drs. M.V. Ramana, Zia Mian, Princeton University
- Published in "Energy Resereach & Social Science" vol. 2, June 2014, Pages 115-124
- http://www.sciencedirect.com/science/article/pii/S2214629614000486