Light Water Designs of Small Modular Reactors: Facts and Analysis

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NEWS RELEASE

IEER REPORT: Small Modular Reactors a "Poor Bet" to Revive Failed Nuclear Renaissance in U.S.

$90 Billion in Initial Manufacturing Order Book Needed, Requiring Massive Involvement by the Chinese or Taxpayer-Backed Federal Subsidies;
Major Implications Seen for Companies and SMR Test Sites in FL, MO, NC, OR, PA, SC, and TN.

WASHINGTON, D.C.///August 8, 2013///A shift to "small modular reactors" (SMRs) is unlikely to breathe new life into the increasingly moribund U.S. nuclear power industry, since SMRs will likely require tens of billions of dollars in federal subsidies or government purchase orders, create new reliability vulnerabilities, as well as serious concerns in relation to both safety and proliferation, according a report issued today by the nonprofit Institute for Energy and Environmental Research (IEER) think tank .

The IEER report has implications for SMR companies headquartered or with planned test sites in Florida, Missouri, North Carolina, Oregon, Pennsylvania, South Carolina, and Tennessee.

Titled "Light Water Designs of Small Modular Reactors: Facts and Analysis the IEER report focuses on light water reactor (LWR) SMR designs, the development and certification of which the U.S. Department

of Energy (DOE) is already subsidizing at taxpayer expense. The four leading SMR designs are: mPower Reactor by Charlotte, NC-headquartered Babcock & Wilcox Company, which, in partnership with the Tennessee Valley Authority, could get from the DOE up to $226 million in federal funding, of which $79 million has been secured; Westinghouse Electric, headquartered in Pittsburgh, PA., and now working with Missouri-based utility Ameren to secure DOE funding for design and certification of the Westinghouse SMR; Jupiter, FL-based Holtec, the subject of a DOE agreement for the construction of a Holtec SMR test unit at the Savannah River Site, a nuclear-weapon materials facility near Aiken, S.C. and NuScale Power, a Corvallis, OR. Company, which has signed an agreement with the DOE to build a NuScale Power SMR demonstration unit at the Savannah River Site.

Key conclusions of the IEER report include the following:

- **$90 billion manufacturing order book could be required for mass production of SMRs.** As the report notes: “SMR proponents claim that small size will enable mass manufacturing in a factory and shipment to the site as an assembled unit, which will enable considerable savings in two ways. First, it would reduce onsite construction cost and time; second, mass manufacturing will make up in economies of volume production what is lost in economies of scale. In other words, modular reactors will be economical because they will be more like assembly-line cars than hand-made Lamborghinis … A hundred [mPower] reactors, each costing about $900 million, including construction costs … would amount to an order book of $90 billion, leaving aside the industry’s record of huge cost escalations. This would make the SMR assembly- line launch something like creating a new commercial airliner, say like Dreamliner or the Airbus 350 … SMRs will still present enormous financial risks, but that risk would be shifted from the reactor site to the supply chain and the assembly lines. Shifting from the present behemoths to smaller unit sizes is a financial risk shell game, not a reduction in risk.”
- **Who pays?: China or massive federal subsidies … or both.** As the report notes, the industry’s forecast of relatively inexpensive individual SMRs is predicated on major orders and assembly line production. However, “China, where 28 reactors are under construction, already has a much better supply chain than the United States. So the U.S. government subsidies to B&W, TVA, and Westinghouse and others may pave the way for an assembly line in China! In fact, Westinghouse has already signed a memorandum of understanding with China’s State Nuclear Power Technology Corporation ‘to develop an SMR based on Westinghouse SMR technology.’ .. The alternative to Chinese manufacture would be federal government subsidies to set up manufacturing in the United States.” Westinghouse has claimed that U.S. reactor orders would be sourced in the US – but would require two supply chains. Already, there is discussion of billions of dollars in additional federal subsidies for SMRs to do what the private marketplace will not.
- **SMRs will lose the economies of scale of large reactors.** As the report notes: “Nuclear reactors are strongly sensitive to economies of scale: the cost per unit of capacity goes up as the size goes down. This is because the surface area per kilowatt of capacity, which dominates materials cost and much of the labor cost, goes up as reactor size is decreased. Similarly, the cost per kilowatt of secondary containment, as well as independent systems for control, instrumentation, and emergency management, increases as size decreases … For these reasons, the nuclear industry has historically built larger and larger reactors in an effort to benefit from economies of scale. The four designs would reduce the size of each reactor considerably: by a factor of five (Westinghouse) to a factor of 25 (NuScale) relative to the reactors now being built in Georgia and South Carolina. Such large size reductions imply significant increases in unit cost due to loss of

economies of scale." It is highly questionable whether mass manufacturing cost reduction can make up for the cost escalation caused by loss of economies of scale.

Arjun Makhijani, Ph.D., nuclear engineer and president, Institute for Energy and Environmental Research, and author of the SMR report, said:

> "SMRs are a poor bet to solve nuclear power's problems and we see many troubling ways in which SMRs might actually make the nuclear power industry's current woes even worse. SMRs are being promoted vigorously in the wake of the failure of the much-vaunted nuclear renaissance. But SMRs don't actually reduce financial risk; they increase it, transferring it from the reactor purchaser to the manufacturing supply chain. Given that even the smaller risk of projects consisting of one or two large reactors is considered a 'bet my company' risk it is difficult to see that Wall Street would be interested in betting much larger sums on financing the SMR supply chain without firm orders. But those orders would not be forthcoming without a firm price, which cannot be established without a mass manufacturing supply chain. This indicates that only massive federal intervention with tens of billions of dollars in subsidies and orders could make mass-manufacturing of SMRs a reality in the United States."

M.V. Ramana, Ph.D., Nuclear Futures Laboratory and Program on Science and Global Security, Woodrow Wilson School of Public and International Affairs, Princeton University, said:

> "SMRs would likely increase proliferation risks. My colleagues at Princeton University and I analyzed the proliferation risks of SMRs of various kinds … and concluded that the proliferation risks would increase significantly unless specific design and safeguards steps were taken to mitigate them. Left unaddressed risk increases by about 45 percent compared to current light water reactors for an equivalent power capacity. This risk increase does not include the inspection problems attendant upon a larger geographic dispersal that may accompany small modular reactors. The safeguarding of the reactors and spent fuel would be a more difficult and complex task than with the large reactors of today."

Dr. Makhijani added:

> "Without huge federal subsidies, the SMR supply chain is likely to emerge in other countries, probably China, even if the designs are proven and tested in the United States. Why would China order large numbers of U.S. reactors when it can set up its own supply chain and can manufacture industrial goods more cheaply? It is fanciful and impractical to believe that SMRs can bring large numbers of industrial jobs to the United States in a globalized world economy governed by World Trade Organization rules. Efficiency improvements and wind-generated electricity, are already cheaper than new large reactors. On the other hand, commercialization of SMRs will require mass manufacturing facilities for the entire supply chain, which will take a decade or more, if there are sufficient orders. By that time, a distributed grid based on renewable energy is likely to be a reality, eliminating the need for a new generation of nuclear reactors large or small."

Other key report findings include the following:

- **SMRs could reduce some safety risks but also create new ones, particularly if current reactor rules are relaxed.** Key elements of SMRs would be underground. "These [safety] features [of SMRs] would reduce some risks. But they could create new problems as well. For instance, they could aggravate the problem of flooding … Safety improvements may be reduced because SMR proponents are already arguing for changes in regulations to reduce costs. For instance, the current mPower design would have just three personnel for operating for two reactors – an operator for each reactor and one supervisor overseeing them both. This raises serious safety questions – will three operating staff be able to adequately respond to and manage a serious accident? Reducing security requirements, the plant exclusion zone, and the 10-mile emergency planning zone are other industry regulatory goals for SMRs."
- **It breaks, you bought it: No thought is evident on how to handle SMR recalls.** "Millions of cars, presumably made to high quality control are routinely recalled. The most comparable example in terms of the size of the supply chain and overall order books for SMRs would be passenger aircraft. Boeing Dreamliners were presumably rigorously designed, tested, and certified before they entered into service. But battery failures, including a fire in flight resulted in a worldwide grounding of all the planes. How would a similar situation with SMRs be handled? Would they all be shut down pending resolution of an issue of comparable significance? What about grid stability, if SMRs supply almost 25 percent of the electricity by 2035 (as has been suggested)."

See the full report here.

The nonprofit Institute for Energy and Environmental Research provides interested parties with understandable and accurate scientific and technical information on energy and environmental issues. IEER's aim is to bring scientific excellence to public policy issues in order to promote the democratization of science and a safer, healthier environment.

EDITOR'S NOTE: A streaming audio replay of this news event will be available by 5 p.m. EDT on August 8, 2013.

News Stories and Reports

- Report: Small modular reactors face uphill battles, *Sustainable Business Oregon* (August 8, 2013)
- Critics of small modular reactors forecast financial risk, *The Augusta Chronicle* (August 8, 2013)
- Critics of small modular reactors forecast financial risk, *GA Daily News* (August 8, 2013)
- Small-scaling nuclear reactors: New report says SMRs not quite the fix, *Chattanooga Times Free Press* (August 9, 2013)
- Critics of small modular reactors forecast financial risk, *Democratic Underground* (August 8, 2013)
- Experts cast doubt on viability of small reactors *E&E Greenwire* (August 8, 2013) – **Log-in**

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- NuScale refutes SMR critics, *Corvallis Gazette Times* (August 9, 2013)
- Report: Small modular reactors not practical, *Aiken Standard* (August 10, 2013)
- Report: Small modular reactors not practical, *Energy Central* (August 10, 2013)
- Opinion: Think Too Much: Is this the time to rethink nuclear power?, *Corvallis Gazette Times* (August 11, 2013)
- 'Gaining momentum': B&W says testing facility gives company advantage, *Lynchburg News & Advance* (August 9, 2013)
- Opinion: Think Too Much: The time seems right for a fresh look at nuclear power, *Albany Democrat-Herald* (August 11, 2013)
- Bedford County facility writing new chapter in nuclear energy, *The Roanoke Times* (August 10, 2013)
- Report: Nuclear industry shouldn't rely on SMRs, *Pittsburgh Business Times* (August 9, 2013)
- Report questions value of SMR programs, *South Carolina News* (August 12, 2013)
- Report questions value of SMR programs, *GSA Business* (August 12, 2013)
- B&W's seeks to change nuclear industry with smaller reactors, *Richmond Times-Dispatch* (August 13, 2013)
- Nuclear SMRs a game of risk, *Fierce Energy* (August 13, 2013)
- B&W's Seeks to Change Nuclear Industry with Smaller Reactors, *Investor Intel* (August 13, 2013)
- Report questions value of SMR programs, *Columbia Regional Business Report* (August 12, 2013)
- SMRs Won't Revive Failed 'Nuclear Renaissance', *Nuclear Power Daily* (August 14, 2013)
- Smaller, transportable nuclear reactor, *Democratic Underground* (August 19, 2013)