


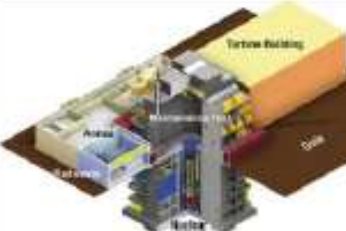




# Small Modular Reactor Hanford Site Analysis

# Small Modular Reactor Designs

SMR		Description
<b>NuScale Power, LLC Module</b>		<p>The NuScale Power, LLC (NuScale) Module is a new kind of nuclear power plant, a smaller, scalable version of pressurized water reactor (PWR) technology with natural safety features which enable it to safely shut down and self-cool. Each NuScale power module has a power capacity of 45 MWe and has a fully integrated, factory-built containment and reactor pressure vessel. The NuScale SMR will be mass-produced in a factory and shipped by truck, rail, or barge for power stations generating between 45-540 MWe.</p>
<b>Babcock &amp; Wilcox Co. (B&amp;W) Generation mPower™ Reactor</b>		<p>The B&amp;W mPower reactor design is a 180-MWe advanced LWR design that gravity, convection, and conduction to cool the reactor in an emergency with a belowground containment.</p>
<b>Holtec International SMR-160</b>		<p>The Holtec SMR-160 is a 160-MW reactor with an underground core. Holtec states that there is no need for a reactor coolant pump or offsite power ability to cool the reactor core.</p>
<b>Westinghouse SMR</b>		<p>The Westinghouse SMR is a 200-MW integral pressurized water reactor with all primary components located inside the reactor vessel. It is based on the established Westinghouse AP1000 reactor design, which is being built in new nuclear plants around the world.</p>

# Small Modular Reactor Hanford Site Analysis

- In March 2014, the state of Washington awarded TRIDEC a \$500K grant to study the benefits of locating an SMR on the Hanford Site
- URS was selected to lead the study
- The Study looked at:
  - current state of nuclear power in the U.S. and the SMR industry,
  - Power needs of DOE and the region, and,
  - the feasibility and cost savings that could be realized by siting an SMR on the Hanford Site
    - More specifically at Energy Northwest's WNP-1 site (the site of a full-scale reactor that was terminated in the 1980's before it was completed)



# Small Modular Reactor Hanford Site Analysis

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***“Small modular reactors represent a new generation of safe, reliable, low-carbon nuclear energy technology and provide a strong opportunity for America to lead this emerging global industry”***

*Energy Secretary Ernest Moniz*

# Small Modular Reactor Hanford Site Analysis

## National Deployment of SMRs would meet -

- **Major objective of the U.S. Department of Energy (DOE)**
  - Inherent safe design
  - Carbon free base load power
  - Siting flexibility
  - Smaller capital investment than larger nuclear plants
- **Cost to design, test, and achieve Nuclear Regulatory Commission design certification of first SMRs could be ~\$1 billion per each SMR vendor**
- **Potential to incur additional \$1 billion or more in first-of-a-kind costs for each SMR vendor**
- **First unit costs difficult for vendors and utilities alone to overcome. Need federal support.**



### **Base Cost of SMR Construction and Operation**

- ✓ Current US SMR designs are projected to cost about \$2.5B for 500-600 MWe multiple module plants.
- ✓ Costs will be higher for the first plants built due to design, licensing, supply chain, and construction development.



# Small Modular Reactor Hanford Site Analysis

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## National Deployment of SMRs (cont'd)

- **Current DOE funding \$452 million for SMR Design and Licensing -- and this support only addresses part of the licensing process and is insufficient**
  - Funds do not substantially offset reactor design certification for multiple vendors
  - Does not assist utilities with costs for developing and licensing designs of initial SMR generating stations
- **Assistance of up to 50% for first-of-a-kind costs may be necessary to enable deployment of SMRs**

***Energy Secretary Moniz recently called “...acceleration of the timelines for commercialization of small modular reactors through cost sharing arrangements with industry partners...” one of his key goals***

# Major Conclusions of the study

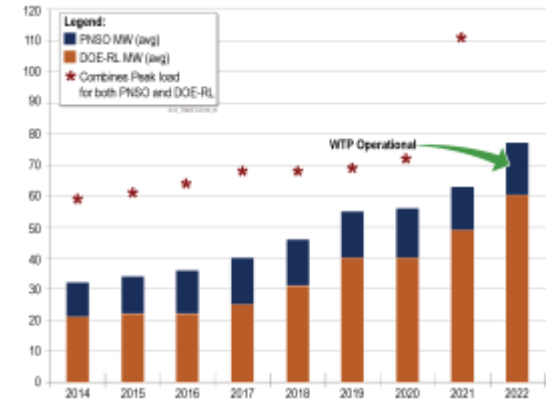
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- **Siting an SMR at Hanford would:**
  - Meet future Hanford and Northwest electricity needs with assured base load, carbon free power
    - Hanford needs additional power (~100 Mwe)
  - Save between \$300 and \$465 million and reduce construction schedule by 1 year
    - ~\$300 million in WNP-1 'site-specific' savings
    - ~\$165 million in FEMP funding (*recognize other uses for at least some of these FEMP fund savings will likely have a higher priority on the Hanford Site*)

# Conclusions (cont'd)

## Siting an SMR at Hanford

- **Clear need for additional electric power**
  - Hanford Site and Pacific Northwest National Laboratory
  - Power consumption estimated to increase by 150% by 2022
- **Siting an SMR at the Washington Nuclear Power Plant Unit No. 1 site is technically feasible and financially advantageous**
  - Over \$300 million site-specific savings can be applied to capital costs
  - Significant advantages exist because of current operating commercial nuclear plant and assets, documentation (i.e., NEPA), and cost avoidances



### WNP-1 Site Utilization and Estimated Cost Savings

- ✓ Use of the WNP-1 site for construction of an SMR is feasible and will benefit from existing infrastructure and licensing documentation.
- ✓ WNP-1 site was previously issued a Nuclear Regulatory Commission construction license.
- ✓ Seismic reports and other site characterization data and environmental studies have been performed for the WNP-1 site.
- ✓ Recently updated documentation for the Columbia Generating Station is beneficial to locate an SMR at the WNP-1 site.
- ✓ Conservative estimate of capital cost avoidances by using WNP-1 site: \$140-165M.
- ✓ Licensing documentation cost avoidances: \$30-50M.
- ✓ Schedule improvement cost savings (1 year): \$80-110M.
- ✓ Total cost savings/avoidances: \$300M.



# Conclusions (cont'd)

## Siting an SMR at Hanford (cont'd)

- **Siting an SMR generating station near an operating commercial nuclear power plant offers attractive advantages**
  - Shared services and infrastructure
  - Hanford is only DOE site currently under consideration that has an operating commercial nuclear power plant nearby
- **Hanford and Tri-Cities region offer major resource**
  - Large nuclear-trained workforce
  - Nuclear qualified emergency services
  - Local business base of nuclear engineering and manufacturing services
  - Local nuclear fuel fabrication at AREVA (*can develop new SMR fuels*)



### Other Regional Assets

- ✓ Approximately \$3B in federal money comes into the Tri-Cities every year.
- ✓ Large engineering and construction companies anchor the nuclear construction, treatment, and remediation contracts at the Hanford Site, performing nearly \$2B per year.
- ✓ Robust local base of small engineering, fabrication and testing consulting firms support nuclear work.
- ✓ PNNL provides a national laboratory service that provides a scientific and analytical foundation to the community.
- ✓ Columbia Basin College and Washington State University Tri-Cities provide educational opportunities and growth.
- ✓ Documented political support from the Washington State Governor and Legislature facilitate the development of SMRs at the Hanford Site to advance carbon-free energy.

# Help is needed from DOE and States

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- **DOE should:**

- Provide up to \$1 Billion of cost sharing for first of a kind plants
- Mandate power from initial SMRs to be purchased at DOE sites. (~3-5 sites)
- Use Loan Guarantee programs, PPAs, and/or SMR energy credits to support SMR deployment, and,
- DOE could ask Bonneville Power Administration to “meld” the cost of power from new Northwest SMRs with current average costs of power

- **States should:**

- Include SMR-generated power in mandated clean energy portfolios
  - Comparable to ‘Renewable Energy’ sources like wind or solar
- Offer tax incentives for SMR generated power – carbon free power
  - Meets Governor’s goal for reducing carbon emissions throughout the State

# Path Forward

**TRIDEC should work with the DOE, state of Washington, and electrical utilities to further promote and assist in siting SMRs at the Hanford Site and across the US**

## DOE

- Develop cost sharing strategy with vendors, purchasing utilities, and financiers that would fund up to \$1 billion (from DOE) to support costs and support deployment of most viable of the designs (applicable across US)
- Mandate power from initial SMRs to be purchased by BPA and/or at DOE sites using power purchase agreements and extend cooperative agreements to reactor vendors to utility owners
- Revise DOE guidelines to require agencies to incorporate reduction of greenhouse gasses through all clean energy sources
- Pursue converting the WTP steam plant from diesel to natural gas using resulting FEMP savings to support an SMR
- Enable use of Loan Guarantee program for SMRs

## State of Washington

- Revise existing energy policy to require power portfolios of major utilities to be no less than 15% clean energy (meets intent of a renewable energy source)
- Develop legislation to revise priorities of the Pacific Northwest Electric Power Planning and Conservation Act to include nuclear power as a means of reducing greenhouse emissions
- Propose an exempt privilege or tax preference for use of energy generated from SMRs

## Energy Northwest

- Become operator for SMR plant sited at WNP-1
- Evaluate pursuing a loan guarantee with DOE for cost sharing of required capital
- Work with Pacific Northwest Electric Power Planning and Conservation Act in promoting the use of SMRs as a potential new technology