



## **Briefing on Small Modular Reactors**

**March 29, 2011**

ADAMS Package ML110620468

March 3, 2011



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Periodic Briefing of the Commission on  
New Reactor Issues – Design Certifications

CONTENTS

<b>Agenda (TAB has been deleted)</b>	.	.	.	.	.	.	.	<b>1</b>
<hr/>								
<b>Advanced Reactor Program</b>	.	.	.	.	.	.	.	<b>2</b>
<hr/>								
<b>Licensing Activities</b>	.	.	.	.	.	.	.	<b>3</b>
<hr/>								
<b>Potential Applicant Schedules</b>	.	.	.	.	.	.	.	<b>4</b>
<hr/>								
<b>Regulatory Framework Development</b>	.	.	.	.	.	.	.	<b>5</b>
<hr/>								
<b>Congressional Interest in SMRs</b>	.	.	.	.	.	.	.	<b>6</b>
<hr/>								
<b>Biographical Data of Principal Managers</b>	.	.	.	.	.	.	.	<b>7</b>
<hr/>								

**TAB 1**

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background book**

## **ADVANCED REACTOR PROGRAM**

### **Background**

The development of advanced reactor designs in the U.S. and abroad has been supported by various government efforts such as the Generation IV program as well as by private companies seeking to introduce an alternative to large light water reactors (LWRs). The NRC has had experience in the area of advanced reactors in the past but the programs usually subsided because of changes in government policies or private sector initiatives. The current NRO new reactor licensing program has benefited from previous advanced reactor programs that led to the certification of the AP-600 passive design and also performed pre-application reviews of gas-cooled and sodium-cooled reactors. The current increased interest in advanced reactors has resulted from:

- the inclusion of a requirement in the Energy Policy Act of 2005 (EPAct) for the NRC to license a high temperature gas-cooled reactor (HTGR) as part of the DOE next generation nuclear plant (NGNP) program;
- the introduction of small modular reactors for domestic and foreign markets; and
- the possible use of fast reactors as part of a solution to close the nuclear fuel cycle.

Therefore, the Advanced Reactor Program (ARP) was created within NRO in January 2009 to address this growing interest and prepare for the review of any future licensing applications for advanced reactor designs (SECY-08-0019).

Currently, the near term focus within the Advanced Reactor Program is on preparation activities to support licensing reviews for advanced reactor designs. Activities include:

- building a knowledgeable and capable organization ready to conduct reviews of advanced reactor designs;
- developing the regulatory and timely licensing reviews of advanced reactor designs; and
- engaging DOE designers and potential licensees in meaningful pre-application interactions and coordinating activities with internal and external stakeholders.

## LICENSING ACTIVITIES

The staff is primarily focused on pre-application activities related to the Next Generation Nuclear Plant (NGNP) Program and integral pressurized water reactors (iPWRs). The staff is maintaining awareness of other reactor technologies but at a low level of effort.

### Next Generation Nuclear Plant (NGNP)

#### **Background**

The NGNP Demonstration Project was established by the Energy Policy Act of 2005 (EPAct 2005) to demonstrate the generation of electricity and/or hydrogen. The Project is executed in collaboration with industry, DOE national laboratories, and U.S. universities. The U.S. Nuclear Regulatory Commission (NRC) is responsible for licensing and regulatory oversight of the demonstration nuclear reactor. DOE and NRC provided Congress with a joint licensing strategy for the NGNP demonstration plant in August 2008.

The NGNP Demonstration Project includes design, licensing, construction, and research and development conducted in two phases. Phase 1 is pre-conceptual and conceptual design leading to the selection of a single technology for NGNP. Phase 2 is preliminary and final design necessary for licensing and construction of a demonstration plant. Research and development, as well as licensing activities, are included in both Phase 1 and Phase 2. Licensing scope supports the development of a licensing framework for high-temperature gas reactors and includes the preparation and submission of a Combined Operating License Application (COLA) for the NGNP. R&D activities are organized into four major technical areas: (1) Fuel Development and Qualification, (2) Graphite Qualification, (3) High-Temperature Materials Qualification, and (4) Design and Safety Methods Validation.

#### **Status**

NRC and DOE staff are coordinating research and pre-application activities related to Phase 1 of the NGNP Program. The staff communicates often with DOE and the lead laboratory, Idaho National Laboratory (INL), regarding research and development activities, as well as the efforts to support the future licensing of the NGNP prototype and subsequent commercial units.

The staff is currently reviewing white papers submitted by INL that address topics including the risk-informed, performance-based regulatory framework (e.g., defense in depth, licensing basis event selection, and safety classification and treatment of structures, systems, and components); materials that may be used in the NGNP high temperature gas reactor; fuel qualification; mechanistic source term; modular plant licensing; and emergency planning. These white papers are intended to serve as a basis for initial discussions between DOE and the NRC regarding the overall approach and issues associated with each topic, informing the prospective designer of issues that should be addressed in a future licensing application. The NRC staff is preparing assessment reports for these white papers, and is requesting additional information, as needed, to address the objectives described by INL. Some topics, such as emergency planning and modular plant licensing, are being addressed as part of NRC's resolution of generic SMR issues.

In addition to routine interactions with DOE/INL on major research and development efforts sponsored by DOE (e.g., fuels and materials testing programs), RES has activities underway to support the NGNP licensing program. The most significant of these NRC research activities involves the development of computer codes and models to support independent NRC evaluations of the behavior of high-temperature gas-cooled reactor (HTGR) systems.

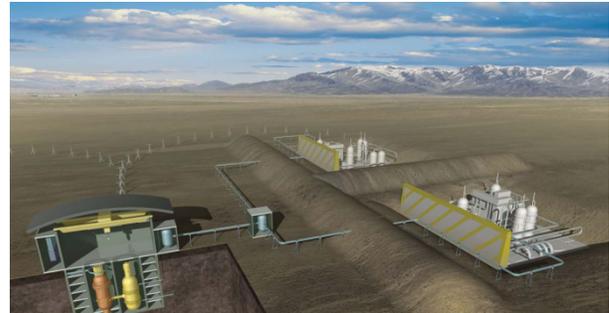
**Design Information Summary:** see next page

**Attachments:**

- Applicable Portion of Energy Policy Act of 2005
- NGNP Licensing Strategy
- Press Releases

## ***NGNP (Next Generation Nuclear Plant)***

<b>Sponsor:</b>	Department of Energy (DOE)
<b>Designer:</b>	To be determined (TBD)
<b>Reactor Power:</b>	TBD (~ 250 MWt)
<b>Electrical Output:</b>	TBD
<b>Outlet conditions:</b>	~750°C
<b>Coolant:</b>	Gas-cooled
<b>Fuel Design:</b>	Prismatic or Pebble Bed
<b>Refueling:</b>	TBD
<b>Letter of Intent:</b>	See NGNP Licensing Strategy Report to Congress (August 2008)
<b>Licensing Plan:</b>	Combined License (Prototype)
<b>Expected Submittal:</b>	FY 2014
<b>Website:</b>	<a href="http://www.ne.doe.gov/neri/neneriresearch.html">http://www.ne.doe.gov/neri/neneriresearch.html</a>



## **Integral Pressurized Water Reactors**

### **Babcock and Wilcox mPower**

#### **Background**

Babcock & Wilcox (B&W), along with FirstEnergy, Oglethorpe Power Corporation and the Tennessee Valley Authority signed a memorandum of understanding on February 17, 2010, to form a consortium for development of a small modular reactor (SMR) demonstration plant featuring a B&W mPower™ nuclear reactor. B&W has indicated that they are continuing discussions with other interested parties, as well.

#### ***Babcock and Wilcox mPower™***

The mPower reactor is a 400-MWt (125-MWe) light-water reactor that consists of a self-contained module with the reactor core, reactor coolant pumps, and steam generator located in a common reactor vessel installed in an underground containment. B&W is considering designing the standard plant for two modules.

The staff has been engaged in pre-application activities with B&W since mid-2009. In October 2010, B&W sent a letter to the NRC that detailed its plans to submit a total of 29 reports during pre-application before submittal of its DC application, expected in late FY 2012. The NRC has received technical reports on the following topics: QA plan for DC, plant design overview, critical heat flux test and correlation development plan, core nuclear design codes and methods qualification, integrated system test (facility description and test plan), instrument setpoint methodology, control rod drive mechanism design and development, and the security design assessment and program plan.

#### **Status**

The staff is establishing review schedules and is providing feedback to B&W through meetings and other appropriate methods. During this quarter, the staff held detailed technical meetings with B&W on core nuclear design codes, critical heat flux test plan, security design, and control rod drive mechanism design. The next meeting with B&W is scheduled for April 21, 2011, to discuss the mPower comprehensive design overview.

**Design Information Summary:** see next page

## ***mPower***

**Designer:** Babcock & Wilcox (B&W)

**Reactor Power:** 400 MWt

**Electrical Output:** 125 MWe

**Outlet conditions:** 609°F

**Coolant:** Light water

**Fuel Design:** “Standard PWR fuel”

**Refueling:** 4-5 years

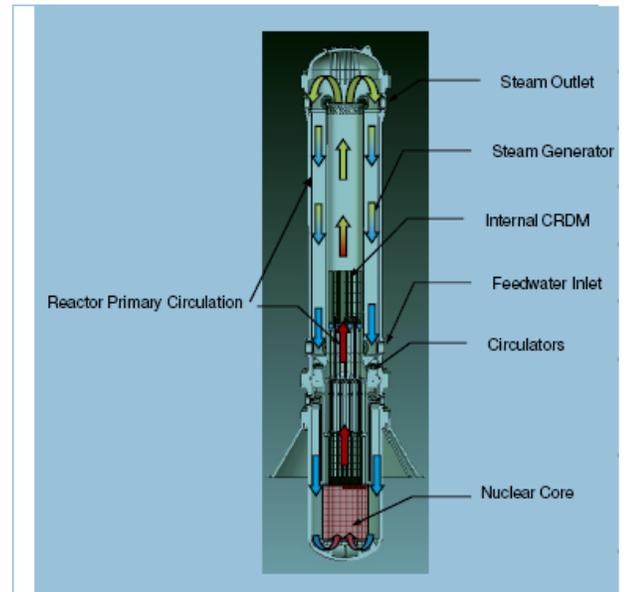
**Letter of Intent:** April 1, 2010

**Licensing Plan:** Design Certification

**Expected Submittal:** Q4 CY 2012 (*subject to change due to TVA plans*)

**Design Information:** LWR with the reactor and steam generator located in a single reactor vessel located in an underground containment.

**Website:** [http://www.babcock.com/products/modular\\_nuclear/](http://www.babcock.com/products/modular_nuclear/)



## **Tennessee Valley Authority**

### **Background**

By letters dated October 8 (ML102871000), and December 30, 2010 (ML110050389) TVA provided voluntary responses to Regulatory Issue Summary (RIS) 2010-01, "Process for Scheduling Acceptance Reviews of New Reactor Licensing Applications for Determining Budget Needs for Fiscal Year 2012." TVA stated that it was evaluating small modular reactor (SMR) activities under 10 CFR Part 50 instead of Part 52. TVA plans to develop a detailed Regulatory Framework for up to six SMR modules. Related activities are anticipated to occur during FY2011 and continue through FY2012 with initial license application submittal anticipated in the fourth quarter of FY2012.

In a letter dated November 5, 2010, Tennessee Valley Authority (TVA) described the key licensing assumptions to support 10 CFR Part 50 licensing and construction of mPower™ SMR modules at the Clinch River site in Roane County, Tennessee (ML103120558). The letter details six key assumptions including use of the 10 CFR Part 50 licensing process, TVA would submit a Preliminary Safety Analysis Report (PSAR), the utilization of a "One Design – One Review" NRC license review process, 10 CFR Part 30, 40, 50, and 70 license applications would be combined, the NRC would inspect Generation mPower as a vendor (major portions of the plant to be fabricated in controlled manufacturing environments), and the scope of the inspection and enforcement program along with the initial test program will inform and demonstrate successful execution of future ITAAC that may be specified in the DC or COL applications.

A letter from the NRC staff dated December 1, 2010, (ML103340034) enumerated a series of questions on TVA's assumptions and requested that additional information be provided at a meeting on December 14, 2010 (ML103480878). Following the meeting, TVA provided an addendum to their assumptions by letter dated December 22, 2010 (ML103630573).

On January 31, 2011, (ML110120676) the staff responded to TVA's assumptions letters concluding that there are no legal or licensing issues that would prohibit TVA from applying for a construction permit or operating license under 10 CFR Part 50 for the licensing of a new nuclear facility.

The staff plans to begin a series of public meetings with TVA to discuss the detail associated with the Regulatory Framework for the Clinch River Construction Permit Application in the near future.

### **Status**

The staff envisions that review guidance will be discussed for level of detail, breadth of topics, and other issues that need to be resolved prior to receipt of the CP application.

## **NuScale Power, Inc.**

### **Background**

NuScale Power Inc. is a small start-up company, founded in June 2007. In November 2007, NuScale Power Inc. signed a technology transfer agreement with Oregon State University and secured initial financing in January 2008. In April 2008, NuScale Power Inc. signed a MOU with Peter Kiewit Company (power plant construction firm with past nuclear experience).

The NuScale modular reactor is a 160-megawatt-thermal (MWt) (45-megawatt-electric (MWe)), natural circulation pressurized-water reactor design that consists of an integrated reactor vessel assembly that includes the reactor core, pressurizer, control rods, and two helical steam generators, all located within the reactor vessel, which is submersed in a pool of water. NuScale is proposing that each plant be designed to accommodate up to 12 totally independent modules (reactor vessel and containment), for a total plant electrical capacity of up to 540 MWe. The NuScale reactor is based on the Multi-Application Small Light-Water Reactor (MASLWR) design project, which was conducted under the auspices of the Nuclear Energy Research Initiative (NERI) of the U.S. Department of Energy (DOE) and completed in 2003. Testing to support the conceptual design was conducted at Oregon State University (OSU), which is supporting an assessment of the feasibility of developing the design.

### **Status**

The staff has been engaged in preapplication activities with NuScale since early 2008. NuScale informed the staff that it intends to file its formal request for DC during the second quarter of FY2012. In advance of its DC application, NuScale informed the NRC of its intent to submit 15 topical/technical reports. To date the NRC has received reports on the LOCA Phenomena Identification and Ranking Table (PIRT) and Human Factors Engineering (HFE) Program Management Plan, Cyber Security Plan, QA Topical Report, the Dynamical System Scaling Methodology, and the HFE Implementation Plan. The staff has reviewed the HFE, Cyber Security and QA reports. The staff has issued Requests for Additional Information to NuScale in conjunction with the QA Topical Report and will prepare a SER for the QA Topical Report by the end of 2011.

In January 2011 the Securities & Exchange Commission initiated a civil action against affiliates of the Michael Kenwood Group, NuScale Power, Inc.'s (NuScale) principal investor. This action has prevented the firm from meeting funding obligations to NuScale and has forced NuScale to reduce its spending. Due to the uncertainty surrounding the outcome of these proceedings, NuScale has stopped work on contract activities, placed 30% of its staff on furlough, reduced hours and/or salary of the remaining staff, and taken other precautionary actions pending decisions by the Court hearing the complaint. The SEC has not made any allegations of improper activities by NuScale, and NuScale is not a party in the SEC action. NuScale is pursuing alternative financing strategies and expects the company can resume operations soon.

Consequently, NuScale submitted a letter to the NRC in February 2011 requesting that the NRC scale back on pre-application activities but continue to work on the QA Topical Report review and SER preparation, conduct the Level 1 PRA Audit as scheduled, and begin the review and issue a SER for the Dynamical System Scaling Methodology Topical Report, which are in progress.

During this quarter, the NRC staff met with NuScale personnel at their offices in Corvallis, OR, March 1 – 3, 2011, to conduct an Audit/Review of the NuScale plant Level 1 PRA.

**Design Information Summary:** see next page

## NuScale

**Designer:** NuScale Power Inc.

**Reactor Power:** 160 MWt

**Electrical Output:** 45 MWe

**Outlet conditions:** 1850 psia, 575°F

**Coolant:** Light Water

**Fuel Design:** 17 x 17 fuel bundles, 6',  
4.95% enrichment

**Refueling:** 24 months

**Letter of Intent:** February 2010

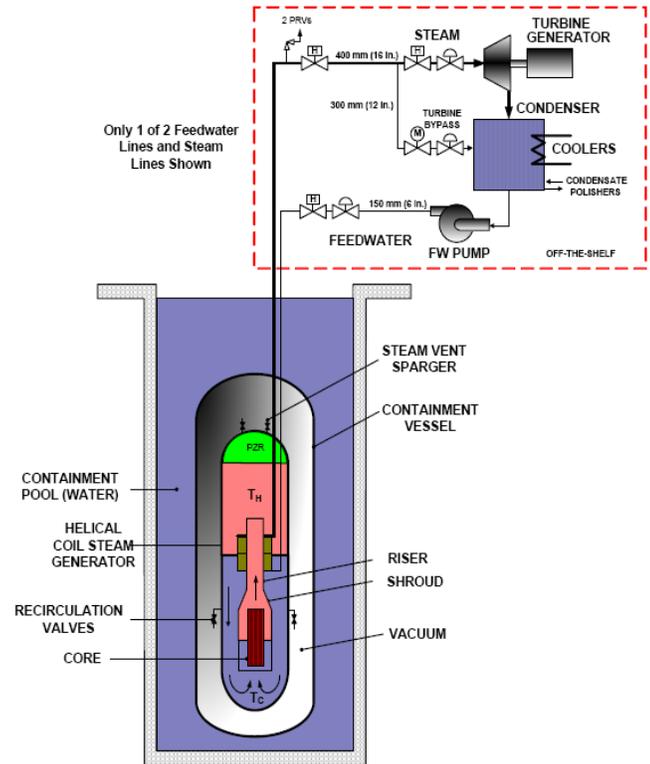
**Licensing Plan:** Design Certification

**Expected Submittal:** 2<sup>nd</sup> Quarter FY2012

**Design Information:** Natural circulation light water reactor with the reactor core and helical coil steam generators located in a common reactor vessel. The containment vessel is submerged in a pool of water.

**Status/Other Info:** Based on MASLWR (Multi-Application Small Light Water Reactor) developed at Oregon State University in the early 2000's

**Website:** <http://www.nuscalepower.com/>



### **Other iPWR Designs**

The staff has been contacted by two other vendors that are proposing to submit iPWR designs for NRC review. Westinghouse is developing their SMR design and is planning to submit an application for design certification. Holtec is developing the Holtec Inherently Safe Modular Underground Reactor (HI-SMUR) design and is also planning to submit an application for design certification. The staff intends to meet with Westinghouse and Holtec, as resources allow, to develop a basic understanding of their designs. Both companies have announced through official press releases (included below) their interests in pursuing the new technologies.



## **Holtec Enters Small Modular Reactor Business with New Company and HI-SMUR Reactor** Design - Edited By Chris Reed -

[http://nuclearstreet.com/nuclear\\_power\\_industry\\_news/b/nuclear\\_power\\_news/archive/2011/02/04/holtec-enters-small-modular-reactor-business-with-new-company-and-hi\\_2d00\\_smur-reactor-design-020404.aspx](http://nuclearstreet.com/nuclear_power_industry_news/b/nuclear_power_news/archive/2011/02/04/holtec-enters-small-modular-reactor-business-with-new-company-and-hi_2d00_smur-reactor-design-020404.aspx)

Holtec International has announced that the proof-of-principle studies on Holtec's 140 MWe (Min.) modular reactor that began a year ago have been successfully completed. The new reactor is named HI-SMUR 140, derived from Holtec Inherently Safe Modular Underground Reactor. As the above words in HI-SMUR's name indicate, its core is located completely underground, it is operated by gravity induced flow (no reactor coolant pump), it does not rely on off-site power for shutdown (*Inherently Safe*), and it can be installed as a single unit or a cluster at a site (*Modular*). Passive in every aspect of its operation, HI-SMUR's principal technical mission is "safety and security first." HI-SMUR's principal safety credentials derive from locating the core underground in a reactor vessel that has no penetrations to provide a drain-down path for the reactor coolant. Eliminating the reactor coolant pump and the need for emergency or off-site power to cool the reactor core in the event of a forced shutdown, are among the distinguishing design features of HI-SMUR that define its mission of utmost safety and security. Other major features of HI-SMUR are its small footprint, minuscule site boundary dose, large inventory of coolant in the reactor vessel and its modularity, i.e., the freedom to build the number of units at a site to best suit the owner's projected power needs. The expected duration of the construction life cycle is 24 months.

The annex 140 in HI-SMUR's name indicates the electric output at full power under adverse heat sink conditions. The waste heat from HI-SMUR's power generation can be rejected through a water cooled or air cooled condenser or a combination thereof. Thus, HI-SMUR is not only a clean source of energy; it is also eco-friendly.

Practically all capital equipment for HI-SMUR will be shop manufactured. The site construction will principally consist of reinforced concrete structures, electrical, I&C, and component

assembly work. We expect HI-SMUR to create a number of new white and green collar jobs across the U.S. through the Company's supplier chain and in the Holtec shops located in Pittsburgh, Pennsylvania; Orrville, Ohio; and Lakeland, Florida. A similar boost in local employment will occur in the countries that invite the HI-SMUR technology into their power generation mix.

On January 3, 2011, the HI-SMUR development program was transferred from Holtec International to a newly established Holtec company, **SMR, LLC**. The development of HI-SMUR does not rely on external funding from any private, public, or government source. The program is sufficiently funded to carry out detailed design, analyses, licensing, and other activities to bring the program to the pre-construction phase, ensuring that **SMR, LLC** will not be hobbled by lack of capital. A number of prominent suppliers of nuclear technologies and systems from around the globe have been selected to support the HI-SMUR program. An array of patents based on a provisional filing in February 2010 are now being submitted for intellectual property protection under U.S. and international patent and trademark laws. License application is scheduled to be filed by the close of 2012.

Holtec International is a diversified energy technology company with its world headquarters in Jupiter, Florida and corporate technology center in Marlton, New Jersey. Holtec is widely recognized as a global leader in the technologies to store and transport nuclear fuel and as a provider of capital equipment and services to commercial power plants.

# Westinghouse Announces its Small Modular Reactor (SMR) Design; Marks a New Era in Delivering Clean, Nuclear Energy Safely and Simply

**-- Westinghouse committed to the global small modular reactor market;**

**-- Prepares for U.S. Department of Energy SMR program**

PITTSBURGH, Feb. 17, 2011 /PRNewswire/ -- Celebrating its 125th Anniversary and leveraging more than half a century of advanced nuclear reactor experience, Westinghouse Electric Company achieves yet another milestone in energy history today with the introduction of its Small Modular Reactor. The Westinghouse SMR -- a 200 MWe-class, integral pressurized water reactor -- extends the advances realized in the company's industry-leading **AP1000®** reactor design. The Westinghouse SMR design, the newest to the company's reactor portfolio, uses passive safety systems and other proven technology to achieve the highest levels of safety, while reducing the number of plant components required.

Dr. Kate Jackson, Westinghouse senior vice president for Research and Technology and chief technology officer, said that the Westinghouse Small Modular Reactor design offers yet another option for providing a safe, affordable and secure source of clean-air energy to the world's rapidly changing and diverse markets.

"The Westinghouse Small Modular Reactor enables us to bring together all that we know about operating nuclear plants, designing and licensing plants, and passive safety into a small design that will provide additional power options for our customers. Westinghouse, with its heritage of nuclear technology firsts, is at the forefront of SMR development in the nuclear industry, providing design, construction and operation certainty that no other SMR supplier can match." As part of its commitment to the evolving worldwide SMR market, Westinghouse also is actively working to prepare for the upcoming U.S. Department of Energy SMR program and to be the leading industry collaborator with the government on this important energy initiative. In addition to Westinghouse expertise in technology integration, the Westinghouse SMR also leverages Westinghouse experience and lessons learned from actual experience with the Westinghouse **AP1000®** plant design (currently under construction in China).

For more information about the Westinghouse SMR, including a video, visit:  
<http://www.westinghousenuclear.com/smr/index.htm>

Westinghouse Electric Company, a group company of Toshiba Corporation (TKY:6502), is the world's pioneering nuclear energy company and is a leading supplier of nuclear plant products and technologies to utilities throughout the world. Westinghouse supplied the world's first pressurized water reactor in 1957 in Shippingport, Pa. Today, Westinghouse technology is the basis for approximately one-half of the world's operating nuclear plants, including 60 percent of those in the United States.

SOURCE Westinghouse Electric Company

**<http://www.prnewswire.com/news-releases/westinghouse-announces-its-small-modular-reactor-smr-design-marks-a-new-era-in-delivering-clean-nuclear-energy-safely-and-simply-116399009.html>**

### **Other Reactor Technologies**

The staff has occasional interactions with potential applicants using other advanced reactor designs, such as sodium-cooled fast reactors, lead-bismuth-cooled fast reactors, and fluoride salt-cooled high-temperature reactors. Staff activities related to these designs are limited to low-level efforts (e.g., knowledge management) and non-resource intensive interactions with vendors (e.g., occasional meetings). Although receiving occasional inquiries about the regulation of fusion-based energy devices, the staff, as directed in the SRM dated July 16, 2009, related to SECY-09-0064, "Regulation of Fusion-Based Power Generation Devices," dated April 20, 2009, is not pursuing licensing or infrastructure development related to fusion energy until commercial deployment of the technology is more predictable, as established by successful testing.

## **POTENTIAL APPLICANT SCHEDULES**

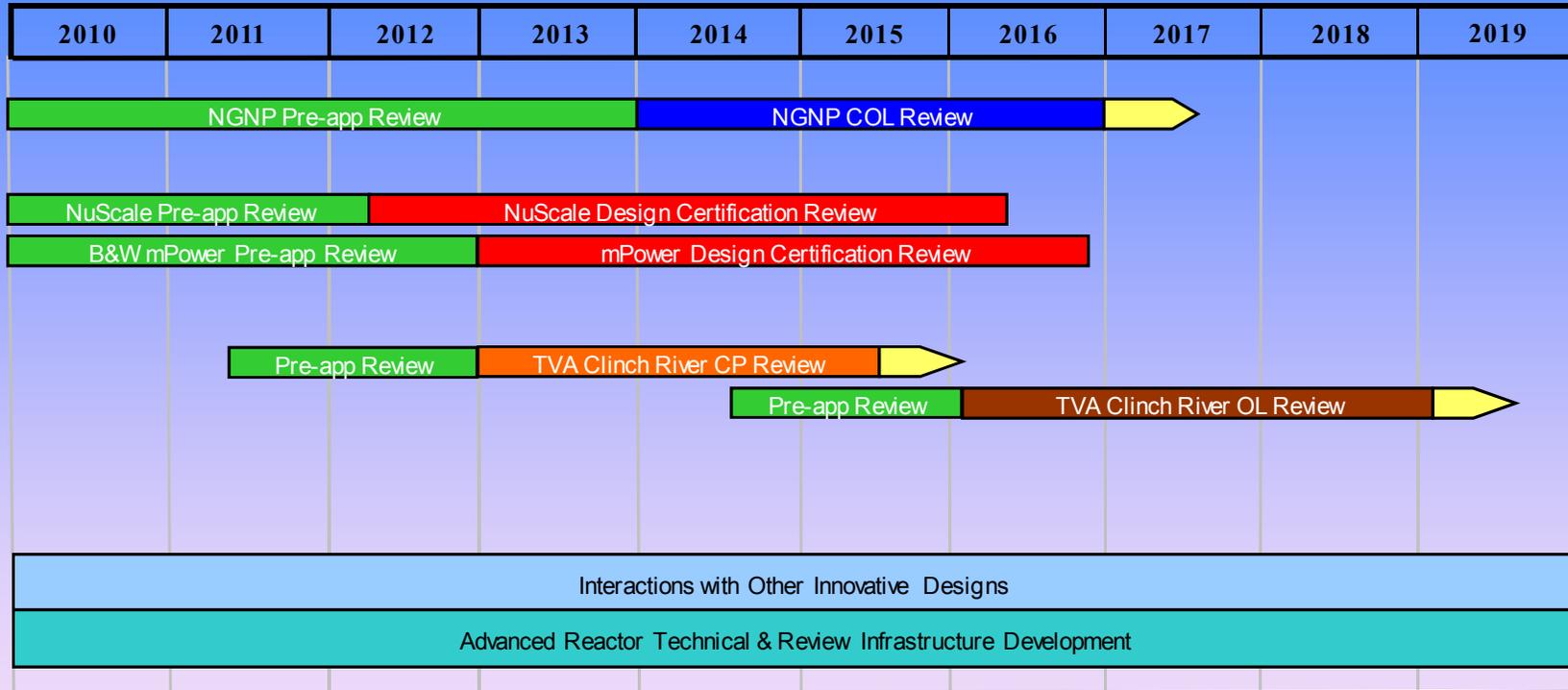
The potential licensing schedule chart attached below depicts potential applicant submittal dates based on both, responses received to Regulatory Information Summary (RIS) 2010-03, dated February 25, 2010, and updates to this information provided through pre-application interactions with potential advanced reactor vendors and potential applicants. More recently, the staff issued RIS 2011-02, dated February 1, 2011 (provided below) requesting updates to plans and schedules from potential advanced reactor vendors and potential applicants. The staff will assess the responses to the RIS, anticipated within 45 days, and makes changes to planned workload as warranted.

### **Attachments:**

- Potential Small Modular Reactor Licensing Applications – Blue Chart
- NRC Regulatory Information Summary (RIS) 2011-02

# Potential Small Modular Reactor Licensing Applications

An estimated schedule by Fiscal Year (October through September)



**Legend:**



**NOTE:** Schedules depicted for future activities represent nominal assumed review durations based on submittal time frames in letters responding to RIS 2010-03 from prospective applicants. Actual schedules will be determined when applications are docketed.



## **REGULATORY FRAMEWORK DEVELOPMENT**

The NRC expects to receive its first small modular reactor application in FY 2012. To support development of a regulatory framework for iPWRs and HTGRs, and ultimately to be ready to conduct licensing reviews during this timeframe, it is essential that major policy, technical, and licensing issues be identified and progress made on their resolution prior to receiving applications. The staff, with support from the national laboratories, is continuing to identify and resolve policy and key technical issues, and prepare revised guidance to support applicants and the NRC staff. Some issues have the potential to influence design decisions and leaving them unaddressed prior to receipt of the applications would greatly complicate the licensing process, reduce the efficiency of the staff, and likely extend the review schedules.

### **Policy and Key Technical Issue Resolutions**

#### **Background**

The staff identified a number of generic issues for the Commission in SECY-10-0034, "Potential Policy, Licensing, and Key Technical Issues for Small Modular Nuclear Reactor Designs," dated March 28, 2010. The staff has developed specific resolution plans for the issues identified in SECY-10-0034 and is also working on many key technical issues associated with iPWRs and the NGNP Program. NRO staff is coordinating the resolution of these issues with other NRC offices and organizations. Within the last year, the industry has also formed groups to discuss and coordinate issues associated with SMRs. NEI and the American Nuclear Society have established various working groups to develop position papers on many of the generic issues identified in SECY-10-0034. To ensure close coordination between the NRC and its stakeholders, as well as timely resolution of the issues, the NRC Advanced Reactor Program and NEI have established routine public meetings to discuss generic approaches to resolving the policy, licensing, and key technical issues for the spectrum of advanced reactor technologies.

#### **Status**

License Structure for Multi-module Facilities: One of the policy issues being assessed is the license structure for multi-module facilities composed of small and medium nuclear reactor modules. NRO is working to develop an information paper to the Commission describing the different license structure approaches and the staff conclusions. Papers on this topic submitted by the NGNP Program and NEI are being considered in the development of the Commission paper. The configurations of multi-module facilities are also a topic within other issue resolution plans and will need to be addressed within the proposed approaches to resolve those broader issues. Examples include the need to address risk assessments for multi-module facilities, the handling of multi-module facilities in the NRC fee structure, and the requirements for liability and property insurance.

Manufacturing License Requirements for Future Reactors: The staff and various stakeholders have raised questions about using the manufacturing license provisions in 10 CFR Part 52 for SMRs. The NRC has issued only one manufacturing license and it was for Offshore Power Systems floating nuclear plants in 1982. The first issue related to manufacturing licenses for SMRs is how the provisions could apply to a reduced scope, as compared to the total plant licensed in the case of Offshore Power Systems, and whether the industry is actually interested in using such provisions, assuming that clarifications or changes to the requirements are pursued. The staff has discussed this topic at several public meetings with the industry, requested additional information in RIS-2011-02, "Licensing Submittal Information and Design Development Activities for Small Modular Reactor Designs," dated February 2, 2011, and plans to continue discussions with stakeholders during future interactions. Following the gathering of information and insights from stakeholders, the staff will develop possible alternatives for Commission consideration and expects to provide a Commission paper by the fourth quarter of FY 2011.

Risk-Informed Licensing Approaches: The issue resolution plan for risk-informed licensing was revised to address the Commission's direction in SRM-COMGBJ-10-0004/COMGEA-10-0001 (included as an attachment) to develop a framework to apply risk insights in the licensing of SMRs in order to improve the efficiency and safety focus of the staff's reviews. In SECY-11-0024 (included as an attachment), the staff proposed a more risk-informed and more integrated review framework for pre-application and application review activities pertaining to iPWR designs. The proposed iPWR review framework is consistent with current regulatory requirements and Commission policy statements and builds on the staff's current application review process. Design-specific review plans derived from the framework would be prepared for the anticipated near-term iPWR design applications. The issues described in SECY-10-0034 related to defense in depth, licensing basis event selection, and probabilistic risk assessments have been incorporated into the staff's recommendations in SECY-11-0024. As directed in the SRM, the staff developed an approach for creating, over the longer term, a new risk-informed and performance-based regulatory structure for licensing advanced reactor designs (e.g., HTGRs and LMRs). This regulatory structure would build on insights from iPWR reviews and ongoing interactions with the NNGP Program. The staff's activities related to the longer-term initiative will be coordinated with and possibly integrated into or subsumed by the Task Force for Assessment of Options for More Holistic Risk-Informed, Performance-Based Regulatory Approach chartered by the Chairman's tasking memorandum to the Executive Director for Operations (EDO) and the General Counsel (OGC), dated February 11, 2011.

Appropriate Source Term, Dose Calculations, and Siting: The staff source term working group has reviewed white papers submitted by the NNGP Program on the use of a mechanistic source term for HTGRs and Fuel Qualification. The staff has provided requests for additional information on these topics to INL and had drafted an assessment paper on the INL proposal for a mechanistic source term. The staff is aware that in some cases the iPWR vendors are interested in pursuing aspects of a mechanistic source term and is waiting for specific information from iPWR vendors.

Appropriate Requirements for Operator Staffing for Small or Multi-module Facilities: Given the low power output, modular nature, and passive design of advanced reactor designs, the staff is actively engaged in addressing the appropriateness of staffing requirements set forth in 10 CFR 50.54(m). The staff has established a working group and developed an issue resolution plan to resolve the issue for near-term applications and to inform long-term decisions, research,

and potential rulemaking. The working group is currently executing according to its issue resolution plan. In the near term, the staff is focusing on activities aimed at developing the technical basis and guidance to support review of submittals related to HFE and giving reviewers the tools to address exemption requests to 10 CFR 50.54(m) for the first round of anticipated SMR COL applications. NRO established a user need with RES for long-term rulemaking efforts and has additionally contracted with the DOE national laboratories to support development of regulatory guidance documents and training with both near-term and long-term deliverables. The staff is actively seeking stakeholder interaction by discussing this topic at regular SMR generic topic meetings, reviewing position papers from an American Nuclear Society special committee and Nuclear Energy Institute, as well as evaluating topical reports and white papers from potential vendors. The staff is developing input for a SECY paper intended for summer 2011 to clearly define the problem and inform the Commission of best approaches to resolve the issue. The SECY paper will also request the Commission's view on proceeding with guidance and rulemaking that may result in appropriate staffing levels less than what is prescribed in 10 CFR 50.54(m) for some plant designs and configurations. Throughout the execution of the issue resolution plan, updated user needs and priorities are communicated with research for longer-term investigations. Additionally, the staff is conducting an Issue Identification and Resolution Program (IIRP) for operator staffing which is aimed at identifying and ranking issues related to the staffing issues. The output of that effort will help inform the staff of other issues which might need to be tackled in the near term and will inform the priorities for those issues. The IIRP is expected to be complete by the end of March 2011. Since the establishment of the working group, it has become clear that for near-term application exemption requests to 10 CFR 50.54(m), those requests will focus on Task Analysis and Workload Analysis to form the technical basis of the exemption. Task and Workload Analysis are methods following established NRC guidance from which there is strong experience and an existing framework.

Offsite Emergency Planning and Preparedness Requirements: The staff discussed this theme at several SMR generic topics public meetings and is reviewing position papers along with other assessments from vendors, the NGNP Program, and other sources to develop possible approaches to establishing emergency planning and preparedness (EP) requirements for SMRs. An NEI working group has been formed and is also addressing EP for SMRs. The staff completed a series of internal meetings, which identified possible policy and key technical issues associated with EP requirements and has identified emergency planning zones (EPZs) as a key issue impacting SMR EP licensing activities and programs. The staff is developing and has drafted an Information SECY paper to the Commission describing possible alternatives for EP approaches for SMRs. One alternative involves establishing a graded approach to EP, which includes options for determining EPZ sizes for SMRs. The information paper will be provided to the Commission in the near future and the staff will continue discussions with internal and external stakeholders, including other federal, state, and local agencies.

Security and Safeguards Requirements: Similar to emergency preparedness, the staff is assessing various documents related to security and possible approaches for increasing the degree to which security concerns are addressed in plant designs. This is another topic that the staff will address during routine meetings with the SMR community and for which the staff will solicit position papers from NEI and more detailed information from vendors. The staff expects a position paper from NEI in the 4th quarter of FY2011. The staff will inform the Commission and, if appropriate, seek Commission direction on the activities and approaches being pursued by the staff, vendors, and likely licensing applicants. The staff is currently conducting an IIRP

(Issue Identification and Ranking Program) to identify any potential issues that were not identified during earlier analyses. The staff is also working with Sandia National Laboratory to put contracts in place for preliminary vital equipment identification and target set analysis and source term evaluation. The staff continues to work with vendors to provide safeguards level information that will assist them during design development in incorporating security elements into their designs.

NRC Annual Fees: The staff has assessed the public comments received in response to an advance notice of proposed rulemaking issued in 2009 that sought views on possible changes to the current NRC annual fee structure to incorporate SMRs. An NEI task force has presented a position paper to the NRC staff for consideration in the development of a possible variable fee structure for SMRs. The staff assessed the industry position paper and considered it while developing a memorandum (included as an attachment) to the Commission dated February 7, 2011, which describes a variable annual reactor fee approach based on licensed thermal power. The staff will be preparing a proposed rule to codify the variable annual fee for reactors and expects to provide the proposed rule to the Commission in FY 2013.

Insurance and Liability Requirements: The staff is conducting internal meetings and has engaged the NEI working group to develop possible approaches to address SMR insurance and liability requirements, especially those requirements related to the Price-Anderson Act. This issue was discussed at the SMR generic topics public meeting held in November 2010. NEI is preparing a position paper on this topic, which is expected to be submitted early in 2011. The staff intends to have alignment meetings with DOE and other stakeholders to evaluate the possible need for legislative and/or regulatory changes. A policy paper to the Commission is planned for the end of FY 2011.

Decommissioning Funding Requirements: The staff's working group assessed an industry position paper submitted by NEI, which addressed requirements for decommissioning funding assurance (DFA) for SMR facilities. The staff concluded that SMRs will not introduce major DFA policy issues and has described the planned approach and the resolution of several other policy issues in a Commission paper. The staff will pursue changes to the regulations and guidance at that point in the future when additional insights are available from DFA cost estimates for SMR designs and when the number of expected SMR facilities is such that the use of the exemption process is no longer appropriate and a rulemaking is warranted.

#### **Attachments:**

- SECY-10-0034: Potential Policy, Licensing, and Key Technical Issues for Small Modular Nuclear Reactor Designs
- Memorandum – Resolution of Issue Regarding Variable Annual Fee Structure for Small- and Medium-Sized Nuclear Reactors
- Staff Requirements – COMGBJ-10-0004/COMGEA-10-0001 – Use Of Risk Insights To Enhance Safety Focus Of Small Modular Reactor Reviews
- SECY-11-0024: Use of Risk Insights to Enhance the Safety Focus of SMR Reviews

## **Issue Identification and Ranking Program**

### **Background**

The Advanced Reactor Program (ARP) within the Office of New Reactors (NRO) has initiated an Issue Identification and Ranking Program (IIRP). The goal of the program is to gather staff members with a breadth and depth of knowledge of certain policy issues and identify any potential licensing issues in an effort to make sure previous efforts have not overlooked any potential problems.

### **Status**

The staff successfully completed an IIRP for emergency preparedness and documented its results in a report dated September 2010 (ADAMS Accession No. ML102980662). The staff currently has IIRPs underway for both staffing, and source term which should be completed in April 2011. The staff is also preparing to start an IIRP for physical security set to get underway this fiscal year.

## **CONGRESSIONAL INTEREST**

A clear indication of the interest in the development and deployment of advanced reactor designs is a host of several draft legislative proposals directing DOE and NRC to coordinate the licensing of an SMR. In light of this congressional interest in SMRs, on December 15, 2009, the Director of NRO provided testimony to the Senate Committee on Energy and Natural Resources on the status of the staff's preparation activities. Included in the attachments are the bills that have been proposed and/or approved.

### **Attachments:**

- Approved Bill H.R.5866, Nuclear Energy Research and Development Act of 2010
- Proposed Bill S.2812, Nuclear Power 2021 Act – Senator Jeff Bingaman
- Proposed Bill S.2052, R&D and Demonstration Program for Nuclear Reactors – Senator Mark Udall
- Proposed Bill H.R.5163, Nuclear Energy Research Initiative Improvement Act of 2010 – Representative Jason Altmire

**TAB 7**

**BIOGRAPHICAL DATA OF EXTERNAL PANEL MEMBERS**