

October 1, 2015

MEMORANDUM TO: Michael E. Mayfield, Director
Division of Advanced Reactors & Rulemaking
Office of New Reactors

FROM: Jan Mazza, Project Manager */RA/*
Division of Advanced Reactors & Rulemaking
Advanced Reactor and Policy Branch
Office of New Reactors

SUBJECT: SUMMARY OF SEPTEMBER 1-2, 2015, NUCLEAR
REGULATORY COMMISSION AND DEPARTMENT OF ENERGY
CO-HOSTED WORKSHOP ON ADVANCED NON-LIGHT
WATER REACTORS

The Nuclear Regulatory Commission (NRC) and the Department of Energy (DOE) hosted a two day workshop on advanced non-light water reactors (LWR's) on September 1-2, 2015 at the Marriott Bethesda North Hotel and Conference Center. The workshop included senior officials from NRC and DOE along with speakers, panelists, and participants from industry, the national laboratories, and other non-government organizations. The speakers provided information on past advanced non-light water reactor experience, roles and responsibilities, existing policies, and current regulatory initiatives. Panelists and participants identified and proposed potential near and long term improvements for advanced reactor research gaps and regulatory challenges.

I. Opening Remarks and Objectives of Workshop

The workshop kicked off with opening remarks and objectives of the workshop. Glenn Tracy, Director, Office of New Reactors, NRC welcomed the participants, acknowledged the diversity of organizations present at the workshop, and encouraged active participation during the workshop to establish the most efficient and appropriate regulatory process for non-light water concepts.

John Kelly, Deputy Assistant Secretary, Nuclear Reactor Technologies, DOE also extended a welcome on behalf of DOE and described the DOE's objectives to meet the Administration's climate change goals through the continued support of innovative reactor technologies.

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Dr. Kelly mentioned ongoing DOE initiatives towards advanced reactor development including the Technical Review Panel process, advanced test/demonstration reactor planning study, recent funding opportunity announcement, and university programs. Dr. Kelly also stated the need for fruitful dialogue and feedback from workshop participants to support future research direction.

II. Remarks on Development and Deployment of Advanced Non-LWR Technologies

Stephen Burns, Chairman, NRC; and John Kotek, Acting Assistant Secretary, DOE provided remarks on the development and deployment of advanced non-LWR technologies. Chairman Burns stated that even though the current regulatory processes are LWR based, the NRC has the flexibility and experience to license new technologies under the current framework. Chairman Burns stressed the necessity of building upon past advanced reactor regulatory experience and maintaining active and open communications among DOE, NRC, industrial stakeholders, and professional societies to address non-LWR licensing challenges. Chairman Burns stated that NRC is ready and willing to work with DOE and industry to license innovative new reactors.

Acting Assistant Secretary John Kotek commented on the renewed interest in advanced reactors reflected by the high workshop attendance and recent initiatives. Mr. Kotek described the long term role of advanced reactors in meeting the Administration's carbon reduction goals and the need for participants to identify ways to make DOE's advanced reactor research more impactful.

III. Clarification of Roles and Responsibilities

The first group of presentations provided clarification of NRC and DOE roles and responsibilities. Trip Rothschild (NRC) began the session with a brief history on the establishment of the NRC and DOE. Based on the Energy Reorganization Act of 1974, the NRC serves solely in a regulatory capacity and does not conduct research to develop new nuclear technologies. Instead, it conducts limited confirmatory research to aid in regulatory decision making. Mr. Rothschild stated that research benefiting the promotion and advancement of innovative nuclear technologies falls under the purview of DOE. The NRC does not regulate DOE facilities absent explicit statutory authority (e.g., certain classes of DOE facilities built after 1974, fast breeder reactors, power generating or demonstration reactors). All commercial reactors, even those potentially built on a DOE site, must be licensed by the NRC. Mr. Rothschild stated that advanced reactors may be licensed under the current regulatory framework, but depending on the type of technology to be employed, some rule changes or exemptions from regulations may be needed. The NRC would need to be provided substantial NRC resources to review an application using an advanced non-LWR design. Finally, Mr. Rothschild noted that the NRC's 90% recovery fee requirement leaves little flexibility in assessing applicants the costs of NRC regulatory reviews.

George Flanagan (Oak Ridge National Laboratory (ORNL)) provided a brief history on non-light water reactor authorization and licensing in the United States. Early licensing and review activities were customized by the Atomic Energy Commission (AEC) on a case by case basis for reactors like Experimental Breeder Reactor-I (EBR-I). In the 1960's, the AEC developed more structured guidance, using LWR guidance where applicable. The Cooperative Power Reactor Demonstration Program utilized the congressionally authorized AEC 104.b requirement to license several non-LWRs such as Peach Bottom I (high temperature gas reactor), Fermi-I (sodium fast reactor), and Piqua Generating Station (organically cooled reactor).

Following the formation of the DOE and NRC, the NRC performed technical reviews of DOE facilities such as the Fast Flux Test Facility while DOE still remained as the authorizing entity. The Clinch River Breeder Reactor Project saw substantial commercial licensing work by NRC before being terminated in 1983. Ralph Landry (NRC) provided more recent examples of non-LWR licensing experiences for reactors such as the GE- Hitachi Power Reactor Innovative Small Module (PRISM) concept (sodium fast reactor) and the General Atomics Modular High Temperature Gas Reactor concept. Mr. Landry noted that the NRC work on identifying and addressing major policy issues during this period has positioned the NRC to move forward on advanced reactor licensing. Jim Kinsey (Idaho National Laboratory (INL)) provided information on what types of reactors can be regulated by DOE. The DOE does not license but self-regulates its nuclear facilities. Mr. Kinsey also noted that if a reactor is used to demonstrate the suitability for commercial application or for electrical generation connected to the grid it must be licensed and regulated by the NRC.

Mr. Kinsey's second presentation discussed the lessons learned from the Next Generation Nuclear Plant (NGNP) project. This NRC-DOE licensing strategy produced a report to Congress in 2008 describing four policy topics required to be addressed and resolved at the Commission level for the NGNP demonstration project. From 2008-2013, the NGNP program worked to address and resolve the policy topics. In 2014, the NRC staff released an assessment report that found the NGNP technical approach on fuel qualification reasonable and stated the need for Commission consideration on the policy issues. Mr. Kinsey noted the NRC staff has not taken the next step in resolving the policy issues at the Commission level. It was also noted that DOE has not requested that the NRC finish its work in resolving these policy issues, nor have industry stakeholders pushed for resolution in a coordinated or integrated way. The NGNP licensing initiative showed potential that the existing regulatory framework can be adapted for non-LWR applications.

After the presentations, a question and answer period followed. Questions included whether the NRC has the authority and funding to license advanced non-LWR's on DOE-owned facilities. The NRC responded that it does have the authority but funding may be needed. A question was asked about what has changed between the non-LWR activities in the 1960's and now. The DOE noted the emergence of industry interest which had been dormant for the last 20 some years.

IV. Common Terminology and Usage of Terms and Existing NRC Regulations, Policies, and Guidance for Licensing

The next two presentations included the NRC's common terminology for research and test reactors, and existing NRC regulations, policies and guidance for licensing. John Adams (NRC) defined several terms related to licensing options under Section 103 and 104 of the Atomic Energy Act. The NRC defines research and development (R&D) as theoretical analysis, exploration, or experimentation that extends findings of science technical in nature. Research reactors are 10 MWt or less and are not a testing facility. A testing facility is either greater than 10 MWt or greater than 1 MWt with a circulating loop for testing, a liquid fuel loading, or an experimental facility with the core in excess of 16 square inches in cross-section. A prototype is used to test design features for a first of a kind plant and may include additional safety features to protect the public during the testing period. The definition for commercial demonstration reactors is not explicitly defined by statute or regulations.

Joseph Williams (NRC) provided a high level presentation on both the Part 50 and Part 52 licensing processes. Advantages for the Part 50 process typically include an earlier start on construction and preliminary regulatory acceptance. Disadvantages typically include potential delays associated with the final approval process. Advantages of the Part 52 process typically include potentially more regulatory and financial certainty and more efficient nth of a kind reviews. A primary disadvantage typically includes the need for more development upfront. The Commission is currently reviewing ways to better align the Part 50 and Part 52 processes.

After the presentations, Mr. Adams was asked a question regarding whether a research and development facility of “insignificant” commercial use could be licensed under Section 104c of the Atomic Energy Act. The NRC noted that it had never licensed a power reactor under 104c. The NRC noted that there may be some flexibility in the potential use of Section 104c to license a research and development facility with “insignificant” commercial use, but would have to do more research into what “insignificant” means in a legal and technical sense before taking the position that this section can be used to license a prototype or first-of-a-kind power reactor.

V. Existing Programs, Initiatives, and Activities to Support Advanced Reactor Development

The first afternoon session focused on existing programs, initiatives, and activities to support the development of advanced reactor technologies. Thomas O’Connor (DOE) began with an overview of DOE-sponsored advanced reactor research and initiatives. The DOE sponsors advanced reactor R&D for sodium fast reactors, high temperature reactors, technologies applicable to advanced reactor concepts such as high temperature materials, more efficient energy conversion cycles, and regulatory framework. Mr. O’Connor highlighted the progress made in qualifying advanced TRISO fuel and establishing American Society of Mechanical Engineers (ASME) high temperature code cases. The DOE conducts its research through national laboratories, universities under the Nuclear Energy University Program, international partners through multi-lateral and bilateral collaborations, and with industry through cost-shared collaborations. Mr. O’Connor also highlighted the issuance of a cost-shared funding opportunity announcement (FOA) in July 2015 to further the development of two advanced concepts and an ongoing advanced test/demonstration reactor planning study approved by Congress in 2015 that will identify options that could be pursued based on anticipated future nuclear energy missions and needs.

Everett Redmond (Nuclear Energy Institute (NEI)) led the session on industry initiatives and began with a discussion on NEI’s goal to sustain the 20% share nuclear holds in US electricity generation. With the majority of plants meeting their 60 year end-of-life in the 2020’s and uncertainty in licensing extensions, NEI recognizes the need for license renewals and that new large LWR’s, small modular reactors (SMR’s), and advanced reactors will be required to maintain the target 20% nuclear share of electricity production. NEI has created an Advanced Reactors Working Group (ARWG) led by Stephen Kuczynski, Chairman, President and CEO of Southern Nuclear Operating Company, with membership from several major nuclear utilities to promote the path forward for innovative reactor designs.

Dan Stout (Tennessee Valley Authority) described economic challenges facing the current nuclear market including flat demand and continued low natural gas prices. Innovative reactor concepts must be able to reduce capital expenditures and lower regulatory uncertainty in order to become economically appealing to investors. Light water SMR’s may help alleviate capital

costs and have nearer term deployment (2020-2030's timeframe). Non-light water SMR's would require significant work on updating regulatory policy.

Stephen Kuczynski (Southern Nuclear Operating Company) provided a regulated utility perspective on advanced reactor development. Mr. Kuczynski further emphasized the need for strong communication between industry and government to identify advanced reactor needs and technical requirements. Mr. Kuczynski noted that the NEI Advanced Reactor Working Group acknowledges innovative non-LWRs may provide inherent safety, long term sustainability, capital cost reduction, and flexibility. As such, the working group looks to consolidate industry opinions on advanced reactor cost and performance objectives and support the establishment of efficient licensing pathways. Mr. Kuczynski referred to the morning's NNGP discussion regarding unresolved Commission policy issues as an example of where licensing efficiencies could potentially be improved.

A question and answer period followed the presentations. Questions for the DOE included how the NRC regulations fit into the plan for a demonstration reactor. The DOE responded that the demonstration reactor would need to be licensed by the NRC in order to demonstrate commercial technological viability. The DOE was also asked if there are plans to restart the fast flux test facility. The DOE indicated that there are no plans to pursue restart of the facility. A question was asked regarding whether additional members (smaller companies that are not current nuclear operators) could join the NEI ARWG. The NEI representative responded that it welcomes additional membership in this group.

VI. Current NRC Activities to Develop Regulatory Framework

The second afternoon session focused on the current NRC activities to develop an advanced non-LWR regulatory framework. Craig Welling (DOE) and Anna Bradford (NRC) began the session with a description of current NRC-DOE initiatives. The DOE Technical Review Panel solicited information from industry stakeholders in 2012 and 2014 on advanced reactor R&D needs. In each case, stakeholders identified the need for a clear licensing framework to reduce regulatory risk and uncertainty. In 2013, the DOE and NRC began a two phase initiative to develop Advanced Reactor Design Criteria (ARDC) for non-LWR's. In phase 1, DOE and national laboratory licensing experts developed a set of draft generic ARDCs along with two draft detailed sets of design criteria for sodium fast reactors and modular high temperature gas reactors. DOE submitted their report to NRC in December 2014. In phase 2, NRC is currently considering the DOE report while developing NRC guidance on the non-LWR ARDC's. The NRC plans to post the NRC's version of the ARDC's for public comment in late 2015. NRC then plans to complete the draft Regulatory Guide in early 2016 and move forward with the normal Regulatory Guide approval process, which includes a formal 60 day public comment period. The goal is for NRC to issue regulatory guidance by the end of 2016.

Anna Bradford provided a second presentation on the recent NRC policy activities that could affect non-LWR technologies and provided a description and status of these activities. Ms. Bradford noted that the resolution of policy issues requires a demonstrated need and some degree of design maturity and performance testing (e.g. fuels, cooling systems, etc.).

During the question and answer period, the NRC was asked whether it made sense to adapt non-LWR technologies to the existing framework rather than developing a performance-based framework with risk insights. The NRC answered that developing a new completely performance-based framework using risk insights would require a large resource expenditure

and data from non-LWR structures, systems, and components that may not currently exist. A question was asked whether increased physical security was needed for designs that utilize higher fuel enrichment. The NRC responded that it would have to review proposed designs and fuel concepts and make an informed decision.

VII. Panel on Potential Challenges To Moving Advanced Reactor Concepts Toward Deployment

The third afternoon session was a panel discussion on potential challenges to moving advanced reactor concepts forward to deployment. Representatives from TerraPower, GE-Hitachi, X-Energy, and Venrock participated in the panel. Kevan Weaver (TerraPower) began the panel session. Dr. Weaver acknowledged the challenges first-of-a-kind reactor developers face during the early stages of the licensing process. The R&D and NRC policy changes needed to achieve advanced system technical readiness require significant time and money. Because of the lack of fast neutron facilities in the U.S., TerraPower currently utilizes the Russian BOR-60 reactor for fuel irradiations. Lack of an established metallic fuel supply chain and NRC policy uncertainties may hinder further investment into TerraPower. To alleviate some of the NRC policy uncertainty, TerraPower has based its licensing approach on LWR criteria as much as practical and sees the NRC-DOE sodium fast reactor design criteria effort as a beneficial first step in adapting the existing framework for advanced reactors.

Eric Loewen (GE-Hitachi) discussed the need for a leveraged, advanced, and concrete approach for advanced reactor deployment. Leverage is gained through interaction and collaboration not just with NRC, DOE, and industry, but also with professional societies such as ANS and ASME. Dr. Loewen used the collaboration of nine companies to develop and explore the PRISM concept through the pre-application phase as an example of coordinated advancement. He stated that industry and the Federal government need to resolve technical and NRC policy issues to draft a clearer regulatory framework that can be executed in a timely manner. In particular, Mr. Loewen pointed to the need to close the unresolved Commission policy issues summarized in the morning session, indicating that leaving them unresolved creates too much uncertainty and inefficiency for advanced reactor developers.

Eben Mulder (X-Energy) presented an overview of the Xe-100 concept, and regulatory process challenges facing advanced reactor developers. Dr. Mulder stated that a clearer definition of source term is needed, DOE and NRC need to resolve outstanding licensing hurdles, and industry needs to realign priorities and resources to enable advanced reactor licensing. Dr. Mulder also stated that the financial burden for early phase interactions with NRC should be reduced, NRC and the Advisory Committee on Reactor Safeguards should become more familiar with non-LWR technologies, and a licensing paradigm shift may be needed.

Ray Rothrock (Venrock) provided a venture capitalist view on advanced reactors. Mr. Rothrock stated that 38 independent privately funded nuclear endeavors exist in the U.S. Venture capitalists identify opportunities that are risk capital ready and have a “glimmer of greatness.” The Silicon Valley model promotes shared knowledge, talent, and resources with many “shots on goal” to quickly produce a winning strategy or design. Applying such a strategy to advanced reactors would require a major shift in advanced reactor collaborations and NRC licensing processes. Mr. Rothrock then described the Food and Drug Administration (FDA) phased approach as another potential regulatory methodology to provide orderly, predictable, finite, and conclusive decision making to reduce licensing risk for new concepts.

During the question and answer period that followed the remarks, Venrock was asked to clarify what costs it was referring to in the “all or nothing statement.” Venrock acknowledged that the costs included design and development, not just fees paid to the NRC. Venrock was also asked why it would advocate risk-based regulation vs. risk-informed. Venrock clarified that he was referring to financial risk. Other questions included whether the DOE could allocate funds to the NRC for R&D. The NRC answered yes as long as NRC is using the funds for confirmatory analysis and not for technology development. The reactor designers were also asked about the value of a close connection to the national labs development facilities. All three designers acknowledged the benefits of a close connection to both the national labs and universities.

VIII. Panel on Identification of Critical Gaps and Needs

The second day of the workshop began with opening remarks and a summary of day one followed by a panel discussion on identification of gaps and critical needs. Introductory remarks were provided by representatives from General Atomics (GA), Advanced Reactor Concepts LLC (ARC), Gen4Energy, and U.S. Nuclear Infrastructure Council (USNIC). Christina Back, GA, began the session with a description of the EM² gas-cooled fast reactor concept. Dr. Back noted the need for well-defined advanced fuel qualification criteria, ASME high temperature materials codes and standards, clearly defined steps for prototype licensing, and modeling/methods validation.

Irfin Ali (ARC) described the features of the ARC-100 small modular sodium fast reactor concept and suggested the NRC consider policy issues relevant to non-LWRs such as a reduced emergency planning zone, reduced guard force, and fully integrating probabilistic risk assessment in defense-in-depth. ARC also advocated a staged licensing process similar to the vendor design review employed by the Canadian Nuclear Safety Commission (CNSC). ARC suggested that the DOE continue its R&D efforts and assist in a formal compilation of a metal fuel database.

Bob Prince (Gen4Energy) described the Gen4Energy lead fast reactor concept. Mr. Prince identified needs for fast neutron irradiation facilities, clearer guidance on fuel qualification, roles of prototypes, and beyond design basis event requirements for advanced reactors. Mr. Prince noted several challenges facing advanced reactor vendors, including the long lead time required to bring a design to market, which could discourage both customers and investors.

Jeffrey Merrifield (USNIC) stated advanced reactor development will allow the U.S. to maintain global nuclear energy technical leadership. Mr. Merrifield identified gaps and needs for both the DOE and NRC. For DOE needs: higher prioritization of and funding for advanced reactor programs, less-restrictive intellectual property requirements, easier access to DOE facilities, advanced reactor prototype, and interaction with both utilities and vendors. For NRC needs: adjustment of review fees for smaller reactors, closing of unresolved policy issues that create uncertainty for reactor developers, a phased licensing approach with clear milestones, a projected completion timeline, and better interaction with Congress.

During the question and answer period the participants were asked whether their designs were being considered for non-electric generation applications (e.g., ship propulsion, process heat). Most answered not at this time but Gen4Energy did note the results of a study that concluded some uncertainty with respect to the licensing authority in some applications. Marcel de Vos from the CNSC provided some insights.

The CNSC does not certify designs. CNSC utilizes an early engagement model with the vendor followed by a review of a construction license application and finally an operation license application. Both applications are prepared through a collaboration between the vendor and licensee.

IX. Open Forum

After the panel discussion, the audience was asked to comment on opportunities for improving the existing processes and practices. Some key themes that were raised by stakeholders included: 1) encouraging DOE to complete TRISO fuel qualification; 2) NRC's reliance on experimental testing has become cost prohibitive, consider the benefit of high powered computational tools and accepting analysis in lieu of experimental data; 3) the DOE national lab sites have valuable built-in infrastructure (security, emergency plans and organization, workforce, etc.) that should be accessible to advanced reactor companies; 4) the International Atomic Energy Agency's SMR regulators forum could provide some "low hanging fruit" for the resolution of issues common to both SMRs and non-LWRs; 5) suggest NRC update NUREG-1226, "Development and Utilization of the NRC Policy Statement on the Regulation of Advanced Nuclear Power Plants" to better define the process for addressing NRC policy issues; 6) hold additional advanced non-LWR workshops; 7) industry should consider working together to identify common goals similar to the LWR Design Center Working Groups; 8) NRC and DOE should stimulate Congressional interest in advanced non-LWRs; 9) a preference for a more performance-based and/or flexible regulatory framework was noted; 10) utilize the staged licensing process to memorialize expanded pre-application interactions; 11) generic NRC policy issue resolution; 12) sharing information with international counterparts is beneficial; 13) need for irradiation facilities in the U.S. utilizing fast spectrum, for fuel and material qualification; 14) need for transient testing capability; 15) need for enhanced government R&D support for small innovative companies; 16) need for avenues for knowledge transfer from senior to the younger members of the nuclear industry; 17) investors want to see demonstration before full commercialization; and 18) concern for NRC's fee recovery requirements and how they affect new entrants to the nuclear industry.

X. Summary and Path Forward

After the open discussion period, the NRC and DOE provided a summary and path forward. DOE indicated they would: 1) examine potential test capabilities for fuel qualification as part of their advanced test/demonstration reactor study; 2) continue to develop transient testing capability; 3) explore facilitating access to DOE facilities and expertise; and 4) pursue greater engagement with industry including funding approaches. NRC indicated they would: 1) consider whether a "staged" licensing process is possible; 2) clarify some targeted guidance of particular interest to non-LWR designers such as prototype guidance; and 3) continue progress on identified policy issues.

XI. Closing Remarks

John Kelly (DOE) and Glenn Tracy (NRC) reiterated their thanks to the participants and commended all attendees on a successful workshop.

The meeting agenda and meeting attendees are included in Enclosures 1 and 2. The meeting slides are available through Agencywide Documents Access and Management System (ADAMS). The ADAMS accession number for the slide package is ML15245A637. ADAMS is the system that provides text and image files of NRC's public documents.

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Documents are available electronically at the NRC's Electronic Reading Room at <http://www.nrc.gov/reading-rm/adams.html>. If you do not have access to ADAMS or have problems accessing the documents located in ADAMS, contact the NRC Public Document Room (PDR) staff at 1-800-397-4209, 301-415-4737, or pdr@nrc.gov.

Project No.: 0814

Enclosure:

1. Agenda
2. List of Attendees

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AGENDA
NRC-DOE WORKSHOP ON ADVANCED NON-LIGHT WATER REACTORS
SEPTEMBER 1-2, 2015
MARRIOTT BETHESDA NORTH HOTEL AND CONFERENCE CENTER

Tuesday, September 1, 2015		
Time	Topic	Speaker
8:30 AM	Welcome and Logistics	NRC (J. Mazza)
8:35 AM	Opening Remarks and Objectives of the Workshop	Glenn Tracy, Director, Office of New Reactors, NRC John Kelly, Deputy Assistant Secretary, Nuclear Reactor Technologies, DOE
8:55 AM	Remarks on the Development and Deployment of Advanced Non-LWR Reactor Technologies	Stephen Burns, Chairman, NRC John Kotek, Acting Assistant Secretary, DOE
9:15 AM	Clarification of Roles and Responsibilities <ul style="list-style-type: none"> • NRC's statutory role • Previous experience licensing/authorizing non-LWR reactors in the US • DOE roles and responsibilities 	NRC (T. Rothschild) NRC/DOE (R. Landry/G. Flanagan) DOE (J. Kinsey)
10:30 AM	Break	All
10:45 AM	Common Terminology and Usage of Terms	NRC (J. Adams)
11:00 AM	Existing NRC Regulations, Policies, and Guidance for Licensing	NRC (J. Williams)
12:00 PM	Lunch	All
1:15 PM	Existing Programs, Initiatives, and Activities to Support Advanced Reactor Development <ul style="list-style-type: none"> • DOE strategy for supporting advanced reactors <ul style="list-style-type: none"> ○ DOE-funded research ○ DOE-funded project development (Test/Demo Reactor Study and Advanced Reactor Development FOA) • Industry initiatives <ul style="list-style-type: none"> ○ US industry's role in pursuing non-LWR technologies ○ Utility interest ○ NEI Advanced Reactor Working Group 	DOE (T. O'Connor) NEI (E. Redmond) TVA (D. Stout) SNOC (S. Kuczynski)

2:30 PM	Break	All
2:45 PM	Current NRC Activities to Develop Regulatory Framework <ul style="list-style-type: none"> • Joint NRC-DOE advanced reactor licensing initiative • Policy activities that may affect non-LWRs 	DOE/NRC (C. Welling/A. Bradford) NRC (A. Bradford)
3:30 PM	Panel on Potential Challenges to Moving Advanced Reactor Concepts Forward Toward Deployment <ul style="list-style-type: none"> • Licensing framework • R&D, technology development • Policy considerations • Financial considerations 	TerraPower (K. Weaver) GEH (E. Loewen) X-Energy (E. Mulder) Venrock (R. Rothrock)
4:45 PM	Open Discussion	All
5:00 PM	Adjourn	All

Wednesday, September 2, 2015		
Time	Topic	Speaker
8:30 AM	Opening Remarks and Summary of Day 1 Activities	DOE (C. Welling)
8:35 AM	Panel on Identification of Gaps and Critical Needs <ul style="list-style-type: none"> • Regarding the licensing process • Regarding technology development or deployment 	GA (C. Back) ARC (I. Ali) Gen4Energy (B. Prince) USNIC (J. Merrifield)
9:45 AM	Break	All
10:00 AM	Opportunities for Improving the Existing Processes and Practices <ul style="list-style-type: none"> • Potential near-term actions/approaches • Potential longer-term solutions 	All
11:00 AM	Open Discussion	All
12:30 PM	Summary and Path Forward	NRC (A. Bradford)
12:45 PM	Closing Remarks	NRC (Glenn Tracy) DOE (John Kelly)
1:00 PM	Adjourn	All

**ATTENDANCE LIST
NRC-DOE WORKSHOP ON ADVANCED NON-LIGHT WATER REACTORS
SEPTEMBER 1-2, 2015**

NAME	AFFILIATION
Rod Adams	Atomic Insights LLC
John Adams	NRC
Amir Afzali	Southern Nuclear Company
Tony Ahn	KHNP
Irfan Ali	ARC
Benton Arnett	OMB
Kazuhito Asano	Toshiba
Joseph Ashcraft	NRO/DE/ICE
Kati Austgen	NEI
Tina Back	General Atomics
Nick Baker	NRC
Michelle Bales	USNRC
Matt Bandyk	SNL Energy
Maitri Banerjee	USNRC
Rita Baranwal	Westinghouse
Thomas Bergman	NuScale Power, LLC
Timothy Beville	DOE
Alisa Beyninson	U.S. Government Accountability Office
Willis Bixby	Gen4Energy
David Blee	USNIC
Tom Blee	Science Council for Global Initiatives
Mark Block	Block RF & Associates, LLC
Robert Bodner	Terrestrial Energy Inc.
John Bolin	General Atomics
Anna Bradford	NRC
Kathryn Brock	US NRC
Matthew Bucknor	Argonne National Laboratory
Nurul Ashikin Bujang	IPIN GLOBAL
Stephen Burns	NRC
Robert Caldwell	US NRC
Francis Cameron	CameronGray LLC
Andy Campbell	NRC_NRO_DSEA
Scott Campbell	Baker Donelson Bearman Caldwell & Berkowitz
Alice Caponiti	DOE
Donald Carlson	NRC/NRO
Marcia Carpentier	NRC
Wade Carroll	DOE
Michael Case	USNRC
Yoon Chang	Argonne National Laboratory

NAME	AFFILIATION
Harry Chang	KHNP
Wei-Wu Chao	AEC
Doug Chapin	MPR
Travis Chapman	UPower Technologies, Inc.
Michael Cheok	US Nuclear Regulatory Commission
Frederick Childers	GAO
Allen Egon Cholakian	Harvard University
Sean Clark	Black & Veatch
Andrew Clark	Sandia National Laboratories
Caroline Cochran	UPower
Leland Cogliani	Lewis-Burke Associates
Leslie Collins	Westinghouse Electric Company
Keith Consani	NIST
Lindsey Cooke	U.S. NRC
Albert Coons	FEMA
William Corwin	U.S DOE Office of Advanced Reactors
Arlon Costa	USNRC
Anne Cottingham	Nuclear Energy Institute
Jack Cushing	USNRC
Kirsten Cutler	OSTP
Dennis Damon	NRC/NMSS
Diane D'Arrigo	NIRS
Edward Davis	Pegasus Group
Matthew Dennis	Nuclear Regulatory Commission
Nishka Devaser	NRC
Marcel Devos	Canadian Nuclear Safety Commission
Jacob DeWitte	UPower
David Diamond	Brookhaven National Laboratory
Paul Dickman	Argonne National Laboratory
Steven Dolley	Platts
Steven Downey	US Nuclear Regulatory Commission
Ron Faibish	ARPA-E
Madeline Feltus	U.S. Dept. of Energy
Paolo Ferroni	Westinghouse Electric Company
Allen Fetter	NRC/NRO
Ashley Finan	Clean Air Task Force
Phillip Finck	Idaho National Laboratory
Robert Fitzpatrick	US Nuclear Regulatory Commission
George Flanagan	Oak Ridge National Laboratory
Larry Flick	FGA Group
Steven Frantz	Morgan, Lewis & Bockius LLP

NAME	AFFILIATION
Bill Freebairn	Platts Nucleonics Week
Josh Freed	Third Way
Steven Freel	Freelance Performance
Kelly Friend	GE
Edward Fuller	NRC/RES
Ted Garrish	Wolverine Nuclear Services
Mirela Gavrilas	NRC
Joseph Giacinto	U.S. NRC
Vince Gilbert	US Nuclear Infrastructure Council
Sal Golub	DOE Office of Nuclear Energy
Charles Goodnight	Goodnight Consulting, Inc.
Carol Grabner	NRC
Christopher Grandy	Argonne National Laboratoy
Eddie Grant	Excel Services Corporation
Thomas Grice	U.S. NRC
Jack Guttman	NRC
Jeff Halfinger	Elysium
Linda Hansen	Capacity Strategies, LLC
Dan Hanson	NNSA
Salman Haq	US NRC
Charles Harbuck	Office of New Reactors, US NRC
Margaret Harding	4 Factor
Alexander Hashemian	AMS
Peter Hastings	The Hastings Group
Trey Hathaway	U.S. Nuclear Regulatory Commission
Matthew Hayes	Elysium Industries
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