Enabling Advanced Reactors for the Market

George Washington University • March 8-9, 2018

Informed investment for economic development, sustainability and growth

EPRI
ELECTRIC POWER RESEARCH INSTITUTE

GAIN
Gateway for Accelerated Innovation in Nuclear

NEI
NUCLEAR ENERGY INSTITUTE
Objectives

- Identify opportunities and gaps associated with the economic deployment of advanced reactors and associated technologies
- Enable connection between technology developers and customers
  - Provide an energy market context and explore technical deployment opportunities
  - Understand the “voice of the customer”
- Understand the federal government’s role in advanced reactor policy, regulation, and R&D investment
- Capture the necessary steps to enable advanced reactors for the market.

Being prepared for the future means anticipating and adjusting to the ever-changing factors that shape our society. A resilient, affordable, and clean energy infrastructure is at the heart of our quality of life and a crucial factor for broad economic competitiveness and employment. Leading us into this future are companies, consumers, and organizations that supply and use energy in novel and purposeful ways.

Advanced nuclear reactors are being developed to meet these future energy needs, including new markets, uses, and applications. Developers, energy producers, industrial users, the government, and other organizations each stand to gain from the success of advanced reactors with the assurance of sustainable and secure energy. However, there are several gaps and hurdles to overcome before realizing this future.

The Department of Energy’s Gateway for Accelerated Innovation in Nuclear (GAIN) Initiative, the Nuclear Energy Institute (NEI), and the Electric Power Research Institute (EPRI) are organizing this symposium, “Enabling Advanced Reactors for the Market,” to bring together technology developers, energy users, government representatives, and others in a dialogue about the future energy market and the role of advanced nuclear technologies. This event is being hosted by George Washington University to provide a central location to connect the technology developers with energy end users and federal regulatory, policy, and research and development decision makers. The symposium will identify opportunities and challenges associated with deployment of advanced reactor technologies for future energy markets. Information on the regulatory environment and incentives used to support deployment of advanced reactors will also be discussed.
SPEAKERS

Session 1 – Symposium Kickoff
David Dolling  Dean, School of Engineering & Applied Science  George Washington University
Mark Peters  Laboratory Director  Idaho National Laboratory
John Parsons  Senior Lecturer  Massachusetts Institute of Technology
David Petti  Executive Director  Massachusetts Institute of Technology
Rita Baranwal  GAIN Director  Idaho National Laboratory

Session 2 – Developer Perspective
Jon Ball  Executive Vice President  GE Hitachi
Ron Faibish  Sr. Director of Business Development  General Atomics
Richard Meyer  VP Engineering Operations & Product Development  Kairos Power
Marcia Burkey  Chief Financial Officer  TerraPower
Robin Rickman  VP Business Development  Terrestrial Energy, USA
Harlan Bowers  President  X-Energy

Session 3 – Utility and Energy End User Perspective
John Bistline  Senior Technical Leader  Electric Power Research Institute
Marilyn Kray  Vice President  Exelon
Chris Deir  Senior Business Manager  Ontario Power Generation
Laura Olson  Manager  Salt River Project
Brandon Waites  New Projects Manager  Southern Company
Dan Stout  Senior Manager  Tennessee Valley Authority
Frederick Moore  Global Director for Mfg., Technology, & Energy  Retired-Dow Chemical Co.

Session 5 – Industry, DOE and Regulatory Perspectives
Dan Brouillette  Deputy Secretary of Energy  U.S. Department of Energy
Maria Korsnick  President and CEO  Nuclear Energy Institute
Kristine Svinicki  Chairman  U.S. Nuclear Regulatory Commission

Session 6 – Policy Discussion
Adam Rosenberg  Staff Director, Energy Subcommittee  U.S. House Committee
Kristy Hartman  Energy Program Manager  Nat’l Conference of State Legislatures
Matt Crozat  Senior Director of Policy Development  Nuclear Energy Institute
Ben Reinke  Professional Staff Member  U.S. Senate Committee

Session 7 – Pulling it Together
Mark Menezes  Under Secretary of Energy  U.S. Department of Energy

Symposium Moderators
Justin Coleman  Symposium Integrator  Idaho National Laboratory
Mark Peters  Laboratory Director  Idaho National Laboratory
Dan Lipman  VP Suppliers, New Reactors, and Int’l Programs  Nuclear Energy Institute
John Kotek  VP Policy Development & Public Affairs  Nuclear Energy Institute
Ashley Finan  Policy Director  Nuclear Innovation Alliance
AGENDA - Thursday, March 8, 2018

7:45 a.m.  Registration

8:30 a.m.  Session 1 – Symposium Kickoff

- Welcome from GWU
- Opening Remarks
- Importance of Advanced Reactors to the Market
- GAIN Perspective

Justin Coleman  INL
David Dolling  GWU
Mark Peters  INL
John Parsons  MIT
David Petti  MIT
Rita Baranwal  INL

10:00 a.m.  Break/Networking

10:30 a.m.  Session 2 – Developer Perspective

Current and Future State of Technologies

Ashley Finan  NIA
Jon Ball  GE Hitachi
Ron Faibish  General Atomics
Richard Meyer  Kairos Power
Marcia Burkey  TerraPower
Robin Rickman  Terrestrial Energy
Harlan Bowers  X-Energy

12:30 p.m.  Lunch – Hosted by GWU

1:30 p.m.  Session 3 – Utility and Energy End User Perspective


- Economics of Advanced Reactors

Dan Lipman  NEI
John Bistline  EPRI
Frederick Moore  Dow Chemical Co.
Marilyn Kray  Exelon
Chris Deir  OPG
Laura Olson  Salt River Project
Brandon Waites  Southern Company
Dan Stout  TVA

3:45 p.m.  Break

4:00 p.m.  Session 4 – Breakout Session: Gallery Walk

Darcie Martinson  INL

6:00 p.m.  Reception and Poster Session - Hosted by EPRI and NEI

7:30 p.m.  Adjourn
AGENDA – Friday, March 9, 2018

7:45 a.m.  Registration

8:30 a.m.  Session 5 – Industry, DOE, and Regulatory Perspectives
- DOE Perspective on Advanced Reactors
  Mark Peters  INL
- Industry Perspective
  Dan Brouillette  DOE
- Regulatory Perspective
  Maria Korsnick  NEI
- Moderated Discussion
  Kristine Svinicki  NRC

10:00 a.m.  Break/Networking

10:15 a.m.  Session 6 – Policy Panel Discussion
  Address Government’s Role in Advanced Reactor Policy
- National Conference of State Legislatures
  John Kotek  NEI
- U.S. Senate Committee on Energy and Natural Resources
  Kristy Hartman
- House Committee on Science, Space, and Technology
  Ben Reinke
- Senior Director of Policy Development
  Adam Rosenberg
- Senior Director of Policy Development
  Matt Crozat

11:15 a.m.  Break/Networking

11:30 a.m.  Session 7 – Pulling it Together
- DOE Closing Message
  Mark Menezes  DOE
- Summarize High Level Symposium Takeaways
  Justin Coleman  INL

12:30 p.m.  Lunch – Hosted by GWU / Symposium Wrap-Up
- Participant Feedback
  Participants
- Path Forward
  Rita Baranwal  INL
- Closing Remarks
  Justin Coleman  INL

1:30 p.m.  Adjourn

1:35 p.m.  Information Session
<table>
<thead>
<tr>
<th>Acronym</th>
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<tbody>
<tr>
<td>DOE</td>
<td>Department of Energy</td>
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<td>Electric Power Research Institute</td>
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<td>ERCOT</td>
<td>Electric Reliability Council of Texas</td>
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<td>FERC</td>
<td>Federal Energy Regulatory Commission</td>
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A “gallery walk” breakout session is designed to promote active engagement by all symposium participants and provide the opportunity to share ideas in a smaller group setting, allowing more people to provide input during a large event.

Instructions

1. Prior to the breakout session, review the eight (8) regions in your symposium booklet and select five (5) where you have the most interest, knowledge or passion.
2. When instructed, assemble at one of your top five selected regions (posters of each region will be hung near the meeting room). A moderator will be stationed at the region and will provide instructions. If the group is overcrowded, move to a different region.
3. The moderator will begin the discussion by giving a brief (less than 2 minutes) overview of their assigned region.
4. Using the markers provided, review the regional information on the poster and write down your responses to the questions below on the flipcharts. Before leaving the region, place checkmarks by those ideas with which you strongly agree. The moderator will allow 15 minutes for your responses to the questions for this first region.
5. An announcement or signal will be made when it is time to move to the next region. Move to another region of your choice, keeping each station balanced regarding number of people (allow 1 minute to move between stations).
6. The moderator at the next region will provide a brief (less than 2 minutes) overview of previous ideas. Your new group will be allotted 10 minutes to provide additional answers to the questions. Before leaving the region, use checkmarks to signify strong agreement with ideas.
7. An announcement or signal will be made when it is time to move to the next region. Move to another region of your choice, keeping each station balanced regarding number of people.
8. After you have rotated to a total of five (5) regions, each moderator will summarize the input from all participants.
9. Moderators will provide a 3 to 5 minutes report out to the entire group, seeking input and clarification.

Questions

With respect to advanced reactors:
1. What are the opportunities?
2. What are the barriers/challenges/issues (e.g., technical, policy, economic, regulatory, social, political)?
3. What actions should be taken to exploit the opportunities, remove barriers or address the challenges/issues?

Regions

- California
- Midcontinent
- New England and New York
- Northwest
- PJM Interconnection
- Southeast
- Southwest Power Pool
- Texas
Midcontinent

Electricity Market
Independent System Operators / Regional Transmission Organizations

<table>
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<tr>
<th>Midcontinent ISO Prices</th>
<th>$ per kW/hr</th>
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<tr>
<td>Louisiana</td>
<td>7.46</td>
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<tr>
<td>Arkansas</td>
<td>8.13</td>
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<tr>
<td>Michigan</td>
<td>11.05</td>
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<td>Missouri</td>
<td>9.74</td>
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<td>Illinois</td>
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<td>Iowa</td>
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<td>Wisconsin</td>
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<td>Michigan</td>
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<tr>
<td>Minnesota</td>
<td>9.99</td>
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<tr>
<td>North Dakota</td>
<td>8.94</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>9.50</strong></td>
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SOURCE: EIA 2018 Annual Energy Outlook

Capacity

- Coal: 11
- Gas & Oil: 8
- Nuclear: 38
- Hydro & Renewables: 42
- Other: 2

Generation

- Coal: 15
- Petroleum: 7
- Natural Gas: 54
- Nuclear: 23
- Pumped Storage/Other: 23
- Renewables: 54
- Distributed Generation: 23
- Total: 120

SOURCE: EIA 2016 Annual Energy Outlook

EIA projections to 2050, indexed to 2015

- Coal
- Petroleum
- Natural Gas
- Nuclear
- Pumped Storage/Other
- Renewables
- Distributed Generation
- Total

WORLD ENERGY OUTLOOK, 2018

MIDTERM 2015-2016 ENERGY PROJECTIONS
New York

Electricity Market
Independent System Operators / Regional Transmission Organizations

Capacity
- Coal: 46
- Gas: 7
- Nuclear: 4
- Hydro & Renewables: 8
- Gas/Oil Combined Cycle: 14
- Oil: 21

Generation
- Coal: <1
- Petroleum: 35
- Natural Gas: 30
- Nuclear: 6
- Pumped Storage/Other: 26
- Renewables: 26
- Distributed Generation: 30

New York Energy Price
14.47¢ per kWhr

SOURCE: EIA Annual Energy Outlook 2018

EIA projections to 2050, indexed to 2015

SOURCE: EIA Annual Energy Outlook 2018