The Case for Nuclear

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U.S. Department of Energy

October 3-4, 2017
President Trump has ordered a review of U.S. nuclear energy policy

"[W]e will begin to revive and expand our nuclear energy sector... which produces clean, renewable and emissions-free energy. A complete review of U.S. nuclear energy policy will help us find new ways to revitalize this crucial energy resource."

Executive Order Promoting Energy Independence and Economic Growth

Executive Order Reducing Unnecessary and Burdensome Regulations

Revisiting National Waste Policy

"If you really care about this environment that we live in... then you need to be a supporter of this [nuclear energy] amazingly clean, resilient, safe, reliable source of energy."

Secretary Rick Perry at Press conference, May 10th
DOE Nuclear Priorities:

• Stabilize and Expand Existing Nuclear Fleet
• Establish Advanced Reactor Pipeline
• Re-establish National Fuel Cycle Infrastructure
NE Research Programs:

• Stabilize and Expand Existing Nuclear Fleet
  o Light Water Reactor Sustainability Program
  o Accident Tolerant Fuels Development Program

• Establish Advanced Reactor Pipeline
  o Advanced Water-based Reactor Development
  o Advanced Non-Water Reactor Development
  o Gateway for Accelerated Innovation in Nuclear (GAIN)

• Re-establish National Fuel Cycle Infrastructure
  o Fuel Cycle R&D
  o Used Nuclear Fuel Disposition R&D

Cross-Cutting R&D:
- Advanced Modeling & Simulation
- Advanced Sensors, I&C
- Nuclear Science User Facilities
- Advanced Methods for Manufacturing
- Cybersecurity
NE Support for U.S. Nuclear Work Force:

NE executes a well established, highly competitive process for awarding R&D, research infrastructure, and Scholarships and Fellowships to the U.S. university community.

**FY 2017 Awards**
- 66 R&D and Infrastructure awards - $48M
- 58 scholarships and 31 fellowships - $5M

Since 2009, NE has awarded $517M to 119 schools in 40 States and the District of Columbia.
Gateway for Accelerated Innovation in Nuclear

**GAIN = Partnership with U.S. Industry to accelerate deployment of advanced nuclear technology**

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<th>Modeling &amp; Simulation</th>
<th>Crosscutting Design Support</th>
<th>NRC Interface</th>
<th>Base Reactor and Fuel Cycle R&amp;D Programs</th>
<th>Experimentation</th>
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<td>Licensing Framework</td>
<td>Advanced Fuel Cycles</td>
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<td>Validated Software</td>
<td>Nuclear Cyber Security</td>
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<td>Advanced Reactors</td>
<td>Instrumentation</td>
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<tr>
<td>M&amp;S Expertise</td>
<td>Digital I&amp;C Human Factors</td>
<td>Licensing Support Expertise</td>
<td>LW-based Reactors</td>
<td>and Sensors</td>
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**GAIN** — Industry access to DOE national laboratory capabilities and expertise
Advanced Methods for Manufacturing

• **Vision** - To improve the methods by which nuclear equipment, components, and plants are manufactured, fabricated, and assembled.

• **Goals** - To reduce cost and schedule for new nuclear plant construction

- To make fabrication of nuclear power plant (NPP) components faster, cheaper and more reliable

**Current AMM Focus Areas:**
- Factory and Field Fabrication Techniques
- Assembly and Material Innovation to Enhance Modular Building Techniques
- Advances in Manufacturing Processes
- Improved Concrete Inspection, Acceptance and Construction Methods
- Data Configuration Management
Key AMM Areas of Interest

Powder Metallurgy/ Hot Isostatic Processing (PM/HIP)

- 316L Stainless Steel has been approved through the ASME Code Cases for use in components such as valves, pump housings, elbows, and flanges
  - Grade 91 has also been approved

- Project also investigated low alloy steels and nickel based alloy
  - SA508
  - Alloy 600M

- Samples will be neutron irradiated in FY 2017 at the Advanced Test Reactor at the Idaho National Laboratory
SMR Reactor Vessel Manufacture/Fabrication/Demonstration Project

- Overall industry goal is to produce a code acceptable SMR Reactor Pressure Vessel (RPV) within 12 months
  - 18 month schedule reduction
  - 40% cost reduction
- R&D project objective to manufacture the major components for a 2/3 scale (44’ long x 6’ in diameter) of a NuScale RPV utilizing:
  - Powder Metallurgy/ Hot Isostatic Processing (PM/HIP)
  - Diode Laser Cladding
  - Electron Beam Welding
  - Cryogenic Machining
- Partners include EPRI, Carpenter Powder Products, Synertech, TWI, the UK’s Nuclear Advanced Manufacturing Research Center (NAMRC), Sheffield Forgemasters, Sperko Engineering and others

65mm (thick) x 3m length x 1.8m diameter
Welding time: <10 minutes

Photograph provided courtesy: TWI
New Industry-Focused Funding Opportunity Announcement (FOA)

• To be issued in early FY 2018

• Supports innovation and competitiveness of the U.S. nuclear industry by directly sharing costs on cross-cutting applied research and development activities, specifically:
  o All aspects of advanced reactor development
  o Methods to improve the cost and schedule for delivery of nuclear products, services and capabilities, and
  o Resolution of regulatory/certification issues.

• FOA to service nuclear technology developers from early concept to more mature designs. Low to mid-level technology readiness levels and/or first-of-a-kind engineering (FOAKE) development.
NE Support for U.S. Industry Initiatives:

Notional Framework for New Reactor Development FOA

<table>
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<tr>
<th>Tier</th>
<th>Delineation of Tiers</th>
<th>Task Funding Range</th>
<th>Cost Share</th>
<th>Typical No. of Tasks</th>
<th>Length of Tasks</th>
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<tr>
<td>3</td>
<td>License Application with NRC and/or Contractual Arrangement w/ End User(s)</td>
<td>$10M-$100M</td>
<td>50/50</td>
<td>1-2</td>
<td>24-36 months</td>
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<tr>
<td>2</td>
<td>Reactor Technologies and/or Concepts at varying levels of technical and/or regulatory maturity*</td>
<td>$1M-$10M</td>
<td>80/20</td>
<td>4-6</td>
<td>12-30 months</td>
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<tr>
<td>1</td>
<td>Technical and Regulatory Vouchers for work to be performed by DOE labs or licensing discussions w/ NRC</td>
<td>Less than $1M</td>
<td>80/20 (non-WGs) 100/0 (WGs)</td>
<td>20+</td>
<td>6-18 months</td>
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*single company, consortium of companies, or working group (WG) of companies