GAIN
Gateway for Accelerated Innovation in Nuclear

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Idaho National Laboratory · Oak Ridge National Laboratory · Argonne National Laboratory

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Things we'll talk about today

What is GAIN?

Mission-Vision-Goals

Industry R&D Needs

Associated Roadmaps

Summary

GAIN Vision

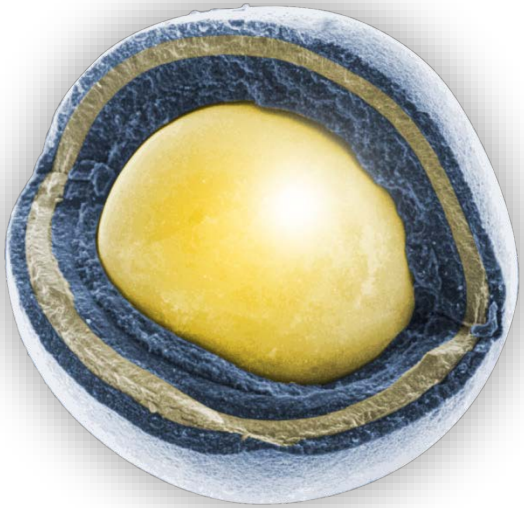
By 2030,
The U.S. nuclear industry is equipped to lead the world in development of innovative nuclear technologies to supply urgently needed abundant clean energy both domestically and globally.

GAIN is,
A public-private partnership framework aims at rapid and cost-effective development of innovative nuclear energy technologies towards market readiness.

GAIN Mission

Mission:
Provide the nuclear energy industry with access to technical, regulatory and financial support necessary to move innovative nuclear energy technologies toward *commercialization* in an accelerated and cost-effective fashion

GAIN is:
The organization principle for relevant, federally-funded nuclear energy RD&D programs.



TRISO Fuel Particle

GAIN Initiative: Simultaneous Achievement of Three Strategic Goals

Technology Working Groups (TWGs)

- Operate under the NEI ARWG
- Focused on technology research and regulatory needs of their systems

Molten Salt Reactor TWG

Duke Energy
Elysium Industries
Exelon Corporation
Flibe Energy, Inc.
Southern Company
TerraPower, LLC
Terrestrial Energy USA Ltd.
ThorCon Power
Transatomic Power Corporation

High Temperature Gas Reactor TWG

AREVA NP, Inc.
BWX Technologies, Inc.
Duke Energy
Kairos Power
StarCore Nuclear
X-energy, LLC

EPRI, NEI, DOE, NTDs, and GAIN also participate in their quarterly meetings.

Fast Reactor TWG

Advanced Reactor Concepts, LLC
Columbia Basin Consult Grp, LLC
Duke Energy
Elysium Industries
Exelon Corporation
General Atomics
General Electric – Hitachi
Hydromine, Inc.
Oklo, Inc.
Southern Company
TerraPower, LLC
Westinghouse Electric Co., LLC

Cross-cutting RD&D Needs: *High-priority recommendations to DOE*

Access to Applied Technology (AT) documents

- Create database of AT-marked documents
- Streamline access to AT documents, removing AT designation where appropriate

Reserve existing high assay LEU (>5%) for initial core loads

M&S Code Development and V&V for Design and Licensing

- Describe DOE-NE's advanced M&S tools
- Develop plans for additional code development to address gaps
- Develop joint strategy with stakeholders for V&V of advanced tools
- Develop join strategy with NRC for V&V and usage of advanced tools for licensing analysis

Advanced Reactors Licensing Framework to accelerate joint work with NRC for advanced reactor licensing

- General design criteria
- Gradual reduction of licensing risk
- Risk-informed and performance-based licensing strategy

Fast Reactor TWG Needs

Add their technologies

Supports DOE efforts to:

- Deploy a fast test reactor that is operational by 2026
- Restart TREAT
- Expand experimental fuel fabrication facilities to prototype fabrication methods and materials
- Expand NSUF to support early stage exploratory fuel design and irradiation testing (start in FY2018)

Specific Needs include

- Legacy Data Mgmt (QA equivalence prog, databases and QA reviews)
- Nuclear Data–refined/evaluated for sensitivity driving nuclides (~U-238)
- Flexible testing facilities with multiple testing capabilities (~**Thermal hydraulic and materials testing loops**, chemical interaction, fuel handling, mechanical testing, Brayton cycle/heat exchanger tests, liquid metal component testing capabilities, SETs, integral tests, etc.).

High Temperature Gas Reactor TWG Needs

Maintain required programs:

1. **DOE Advanced Gas Reactor Program**
   - Provide fuel qualification data
   - Develop/qualify fuel manufacturing processes
2. **DOE Advanced Graphite Creep Program**
   - Obtain irradiation performance data on new nuclear grade graphite
   - Six capsule irradiations in ATR followed by PIE of graphite specimens

In addition:

- **Fuel related R&D - fuel kernel & coating, compacts & pebbles fab, & inspection tech**
- **Testing and qualification of key materials used in VHTR in near-and-long-term designs**
  - HTGR materials (metallic, ceramics, and graphite materials)
  - Power Conversion Systems (PCS)
  - Steam Generators or Intermediate Heat Exchangers
  - Balance of Plant
- **Components and Component Test Facility (PCS, Rankin & Brayton Cycle, compressor blades, etc.)**
- **Metal Corrosion issues with hot cycle gases**
- **Compressor blade performance testing**

Molten Salt Reactor TWG Needs

Separate Effects Tests

- **Base Technology** – Studies (lab experiments and tests) to develop data that informs model V&V, licensing, design decisions, feasibility questions, risk reduction, etc.
- **MSR M&S** – Interaction of non-linear coupling between fuel motion and neutron dynamics to predict reactor behavior under design-basis conditions.
- **Flow Loops and Dynamic Corrosion** – Electrically heated small-scale forced convection flow loops constructed from a variety of materials, using a variety of salts, to provide basis for down-selection of loops and materials.
- **Irradiation Studies** – Coupons, capsules, and in-pile loop testing and PIE to characterize the effects on materials and salts over time and effects of radiation-enhanced corrosion.

Vendor Development

- Engage vendors to shorten the critical path to MSR deployment
- Establish a supporting supply chain to support advanced reactor market deployment

DOE Roadmaps

- Roadmaps will incorporate GAIN industry's R&D needs and path forward.
- Drafts of the technology roadmaps were completed, reviewed by laboratory and industry staff, and sent to DOE for internal review.
  - Liquid Metal Reactor (LMR)
  - Molten Salt Reactor (MSR)
  - High Temperature Gas-cooled Reactor (HTGR)
  - Gas-cooled Fast Reactor (GFR)
- GAIN National Technical Directors assigned for FR, HTGR, and MSR.

Summary

- TWGs meet quarterly and are actively involved with DOE, GAIN, NEI, EPRI, and NRC.
- GAIN workshops will continue in FY-18 to inform industry on domestic research capabilities.
- GAIN integrates industry with appropriate DOE Programs and funding opportunities.
  - Provides needs to the content of the funding call
  - Informs programs of capability needs of industry
  - Informs industry of funding and collaborative opportunities

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