Accelerating Near-Term Deployment of Advanced Light Water Reactors

Program Overview

Program Description

New nuclear power plants incorporating advanced light water reactor (ALWR) technology must overcome a number of regulatory, economic, technical, and social challenges prior to licensing, construction, and successful startup. Many of these challenges can be addressed through application of focused Electric Power Research Institute (EPRI) technical products and targeted deployment tools that minimize deployment risks.

The EPRI Advanced Nuclear Technology (ANT) program complements – and helps accelerate – industry activities aimed at enabling and building confidence in new nuclear plant deployment through coordinated work on cross-cutting issues. By building upon past industry operating experience and previous research and development (R&D) results, new nuclear plants can realize multiple benefits. These benefits include improved designs for long-term operation, implementation of optimized fabrication and construction practices, and more effective overall deployment of an inherently high-risk project.

Research Value

Research results from the ANT Program increase confidence and reduce risks associated with developing next-generation nuclear plant designs by incorporating current plant operating experience and results from focused research and development. The research addresses regulatory, economic, technical, and social issues that could impact the ability to license, construct, start up, and efficiently operate advanced light water reactors worldwide. Advanced Nuclear Technology participants gain access to the following:

- Materials Management Matrices for advanced nuclear plant designs that can serve as living documents for managing life-cycle material issues.
- New Plant Deployment Program Model, which enables users to systematically analyze various licensing, technical, and plant deployment issues, thereby improving the decisionmaking process.
- Equipment reliability knowledge and tools that can be incorporated into new plant designs to increase the potential for meeting business goals related to such issues as plant availability and capacity factors.
- Refined methodologies for applying risk-informed pre-service and in-service inspection techniques to advanced nuclear plant designs.
- Research supporting design and demonstration of next-generation nuclear plants, including high-temperature gas reactors for process heat, hydrogen production, and cogeneration applications.

Approach

The Advanced Nuclear Technology Program heavily engages the utility and vendor communities to collaboratively identify and overcome the technical challenges confronting new plant deployment. The Program leverages EPRI expertise in various disciplines to resolve common issues. The ANT Program focuses on four core elements:

Facilitating standardization across the new fleet. Nuclear plant developers around the world are working to ensure standardization is factored into all aspects of new project development. However, while the designs may be standardized, many of the supporting systems will not be, including startup testing, balance-of-plant components, equipment reliability programs, operational procedures, and configuration management procedures. EPRI's ANT Program is developing standardized guidance in those areas that provide greatest value to the industry.

Transferring technology to new plant designs. Lessons learned from existing plants and from EPRI's 30+ years of research and development results are being incorporated into new plant designs to drive overall improved performance. Technology advances and lessons learned in materials, chemistry, equipment reliability, nondestructive evaluation (NDE), and fuel performance are being implemented into new plant

designs. EPRI will continue reviewing available information with subject matter experts, designers, and utility representatives to define and prioritize requirements, guidelines, and assessments.

Ensuring top plant performance from start of operations. Nuclear plant performance is a balancing act of equipment selection, material selection, design, operation, maintenance, management, and many other factors. Current financial models for evaluating new nuclear power plants are based on availability factors reflecting the fleet of existing nuclear plants. EPRI's ANT Program provides guidance allowing utilities to maintain high availability factors from startup.

Reducing the overall deployment risk and uncertainty. Constructing, starting-up, and working through initial operations of new nuclear power plants present many large, first-of-a-kind challenges. These challenges establish a deployment risk and uncertainty that affects the ability of utilities to get plants sited, approved, financed, and licensed. The ANT Program will provide research to decrease deployment risk.

Accomplishments

EPRI's ANT Program helps accelerate industry activities aimed at enabling and building confidence in new nuclear plant deployment. Recent accomplishments include the following:

- Secured membership from 21 U.S. and international utilities and nuclear steam supply system vendors.
- Initiated risk management projects focused in critical areas such as proactive materials degradation management, a change to the American Society of Mechanical Engineers (ASME) code to assist in materials performance, and industry leadership on the seismic source characterization database for nuclear facilities.
- Completed Revision 10 to the *Utility Requirements Document*, which provides guidance to ensure new plant designs reflect the latest industry operating experience and research progress for safe and economical operation.
- Continued evaluation of advanced plant designs and nuclear fuel cycles that address high-level waste concerns and nuclear sustainability.

Current Year Activities

Advanced Nuclear Technology Program R&D for 2010 will continue its focus on proactive, risk mitigation/management projects for new plants, while expanding the program scope to include construction and startup activities. Specific efforts will include the following:

- Develop new plant welding, fabrication, and surface conditioning guidelines.
- Complete Materials Management Matrices for all new plant designs, and address common issues identified from various projects.
- Continue ASME code case development and technical justification to allow for fitness-for-purpose under ASME Section III for Pre-Service Inspection (PSI).
- Develop new seismic hazard models for the Central and Eastern United States (CEUS) to promote a stable licensing basis for new plant licensing.
- Expand international participation to increase collaboration with those utilities and vendors currently constructing new nuclear plants worldwide.

Selected ANT program activities may be conducted in whole or in part in accordance with Title 10, Code of Federal Regulations, Part 50, (10CFR50), Appendix B, and may invoke 10CFR21 at the discretion of ANT member utilities or EPRI, when such action is deemed appropriate.

Estimated 2010 Program Funding

$6.0 million

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Summary of Projects

Project Number	Project Title	Description
8.1a	Advanced Nuclear Technology (ANT) New Plant Deployment	The Electric Power Research Institute's (EPRI's) near-term research in the ANT Program focuses on the technologies and tools to enhance deployment of new nuclear plants, including welding, fabrication and surface conditioning guidelines, risk-informed inspections, equipment reliability lessons learned, materials management, seismic modeling, and modular equipment testing, shipping, and storage.
P41.08.01.01	New Nuclear Plant Materials	Materials management matrices will be produced for the ESBWR (completed), AP1000 (completed), ABWR, EPR, and APWR. They will list various critical information for each of the components in the nuclear steam supply system (NSSS) (American Society of Mechanical Engineers [ASME] Class 1 equivalent) and become living documents for managing life-cycle material issues.
P41.08.01.02	New Nuclear Plant Reliability	The Electric Power Research Institute (EPRI) has a substantial portfolio of equipment reliability (ER) knowledge that has been effectively deployed across much of the current industry. This project is working with nuclear plants to effectively deploy existing ER tools in new plant designs to increase their potential for meeting business goals.
P41.08.01.03	New Nuclear Plant NDE	Based on previous experience with the successful implementation of EPRI's risk-informed in-service inspection (ISI) methodology to a variety of nuclear plant designs, EPRI is testing and refining the methodology for advanced plants. The goal is to develop a single pre-service inspection (PSI)/ISI program for each design (not site specific) or define any issues and provide guidance where they may be site-specific requirements. Second, EPRI is working with ASME Sections III (construction) and XI (inspection) to provide the technical basis for the necessary actions in Section III to allow acceptance of benign welding flaws by structural analysis. This project will establish and operate the ultrasonic (UT) examination qualification programs that will be necessary to assure accurate, reliable construction inspections of primary pressure boundary components and welds.
P41.08.01.04	Security and Seismic	EPRI is updating a seismic hazard model for the Central and Eastern United States (CEUS) that will facilitate new plant siting and respond to regulatory concerns. An updated generic CEUS seismic hazard model will benefit those companies pursuing new nuclear plant development and those nuclear power plant owners that must respond to issues resulting from NRC Generic Issue 199 (GI-199).

Project Number	Project Title	Description
P41.08.01.05	Configuration of 3D Models	The Electric Power Research Institute (EPRI) is developing a Standard Configuration Management (CM) Reference Model and *Implementing Guideline* to provide a common framework to help manage an automated, integrated, and interoperable CM program in a consistent and connected way. The Standard Configuration Management Reference Model will be an XML tool kit consisting of CM relationship taxonomy, supporting schemas, and supporting Design and Licensing Basis Rule Set. The *Implementing Guideline* will be a best practices document providing "how to" details for the use and implementation of the Standard Configuration Management Reference Model.
P41.08.01.06	Next-Generation Nuclear Plant Research	This project supports the development of next generation nuclear plants, including high-temperature gas reactors (HTGRs) and other small- and medium-sized reactors.
P41.08.01.07	Integrated Spent Fuel Management Research	This project supports the evaluation of integrated spent fuel management strategies, including studying the feasibility of mixed oxide (MOX) fuel in advanced light water reactors. The products from this work will inform industry and government decisions with regard to the feasibility of a closed fuel cycle.

Advanced Nuclear Technology (ANT) New Plant Deployment

Key Research Question

New nuclear power plants incorporating advanced light water reactor designs must overcome a number of regulatory, economic, technical, and social challenges to be licensed, constructed, and put into operation. Many of these challenges can be addressed through focused application of Electric Power Research Institute (EPRI) technical products and targeted deployment tools that minimize deployment risks.

Approach

The EPRI Advanced Nuclear Technology (ANT) Program complements—and helps accelerate—industry activities aimed at enabling and building confidence in new nuclear plant deployment. The ANT Program addresses cross-cutting issues focused around four core elements:

- **Facilitating standardization across the new fleet:** Nuclear plant developers around the world are working to ensure standardization is factored into all aspects of new project development. However, while the designs may be standardized, many of the supporting systems will not be, including startup testing, balance-of-plant components, equipment reliability programs, operational procedures, and configuration management procedures. EPRI's ANT program will develop standardized guidance in those areas that provide greatest value to new plant deployment.

- **Transferring technology to new plant designs:** Lessons learned from existing plants and from EPRI's 30+ years of research and development results are being incorporated into new plant designs to drive overall improved safety and performance. Technology advances and lessons learned in key topical areas—including materials, chemistry, equipment reliability, nondestructive evaluation (NDE), and fuel performance— are being implemented into new plant designs through the utility's technology vendors. EPRI is continuing to review available information with subject matter experts, designers, and utility representatives to define and prioritize requirements, guidelines, and assessments and ensure that new plants will be able to sustain top performance and safety goals.

- **Ensuring top plant performance from start of operations:** Nuclear plant performance is a balancing act of equipment selection, material selection, design, operation, maintenance, management, and many other factors. Current financial models for evaluating new nuclear power plants are based on availability factors reflecting the fleet of existing nuclear plants. EPRI's ANT program is providing guidance that will allow utilities to maintain high-availability factors from startup throughout the life of the plant. Specific guidance is being developed in those areas that provide greatest value to the industry. •

- **Reducing the overall deployment risk and uncertainty:** The construction, startup, and initial operation phases of new nuclear power plants present many large, first-of-a-kind challenges. These challenges establish a deployment risk and uncertainty that affects the ability of utilities to get plants sited, approved, financed, and licensed. EPRI's ANT program is providing research to decrease the deployment risk in a wide range of areas.

Impact

EPRI's Advanced Nuclear Technology (ANT) Program complements – and helps accelerate – industry activities aimed at enabling and building confidence in new nuclear plant deployment. Recent accomplishments include the following:

- Secured membership from 21 U.S. and international utilities and nuclear steam supply system (NSSS) vendors.
- Initiated risk management projects focused in critical areas such as proactive materials degradation management, a change to the American Society of Mechanical Engineers (ASME) code to assist in materials performance, and industry leadership on updating the seismic source characterization database for nuclear facilities.
- Completed Revision 10 to the *Utility Requirements Document*, which provides guidance to ensure new plant designs reflect the latest industry operating experience and research progress for safe and economical operation of new nuclear plants.
- Continued evaluation of advanced plant designs and nuclear fuel cycles that address high-level waste concerns and nuclear sustainability.

How to Apply Results

Organizations pursuing or anticipating new nuclear plant deployment will derive the greatest value from participating in the ANT Program New Plant Deployment projects. Vendors, government agencies, research laboratories, universities, and other nuclear-related entities also are encouraged to engage in the activities.

This supplemental program provides leadership to fully incorporate current plant operating and research and development (R&D) experience into the next-generation light water reactor designs. Products are developed to help ensure that the new plants are competitive and that system designs capture the lessons learned from the operating fleet.

Developed products are used directly by ANT members and their NSSS and engineering, procurement, and construction (EPC) companies to establish, modify, and direct programs, activities, and external interfaces directly associated with the new builds.

New Nuclear Plant Materials (066891)

Key Research Question

Material degradation issues in new nuclear power plants must be actively managed to minimize operational impacts. New plant materials management matrices will be developed for the four proposed advanced light water reactors to limit plant deployment risk and incorporate lessons learned and materials research advances from the existing fleet into new designs.

One of the primary factors affecting materials degradation is residual stresses left during the fabrication process. Proper selection and control of welding processes can reduce or eliminate tensile stresses on the inside diameter surface of piping components. These tensile residual stresses can cause stress corrosion cracking and other failure mechanisms in nuclear plant piping. A group of welding and materials engineers, fabricators, and other industry metalworking experts will be consulted to develop recommendations and document best practices for welding plant components and for fabricating new plants.

Approach

A materials management matrix (MMM) will be produced for the advanced light water reactor designs being considered by Advanced Nuclear Technology (ANT) members (AP1000, EPR, ABWR, APWR and ESBWR). The MMMs will list critical information for each of the components in the nuclear steam supply system (ASME Class 1 equivalent). These matrices will be living documents that can be used to manage material issues over the operating lives of the reactors. Other materials-related projects including welding best practices will be conducted as needed.

Impact

- Assist in evaluating materials-related issues, which can significantly affect operating costs in existing reactor designs
- Ensure new plants are economically competitive over their operating life through more effective materials management
- Minimize tensile residual stresses through application of welding best practices
- Simplify management and evaluation of materials degradation and flaws
- Extend initiation time of many degradation mechanisms by eliminating or minimizing the tensile residual stresses in welds

How to Apply Results

The MMMs function as an ongoing roadmap to material issues for the life of the plant. They will be maintained by EPRI and updated periodically with assistance and feedback from vendors and plant owners. Members will use them to assist with purchase decisions and as an ongoing tool for optimizing inspection schedules and mitigation strategies.

New Nuclear Plant Reliability (066888)

Key Research Question

Equipment reliability at nuclear plants starts with design and procurement and continues through construction and startup. When the plant begins operating, the level of success and cost associated with equipment reliability programs are directly related to the foundation established in the early stages of the plant's life.

While equipment vendors can focus on first costs, the owner/operator needs to consider first cost, operating cost, and plant revenue when making decisions. Limited actions have been taken to factor lessons learned from current equipment reliability programs into new plant projects. Also, new plants will apply advanced instrumentation and control (I&C) and communications technologies, including higher-frequency components and wireless, far more extensively than the current nuclear fleet, giving rise to new technical and regulatory concerns.

Approach

This project will develop numerous products to support enhanced plant reliability programs. Products may address component specifications, commodity standards, and new I&C technology. As one example, a practical, clear, common understanding of the concerns, electromagnetic compatibility (EMC) management techniques, and qualification requirements associated with higher-frequency components, will be needed among utilities, regulators, the Nuclear Regulatory Commission (NRC) and equipment suppliers. Therefore, the current guidance needs to be updated and expanded.

Impact

- Establish a foundation for a highly effective operating plant equipment reliability program, leading to high-capacity factors and contained operations and maintenance costs
- Minimize implementation costs for equipment reliability programs through up-front incorporation into new plant designs rather than incorporating at a later date
- Incorporate owner expectations for equipment monitoring into initial project plan

How to Apply Results

Plant staff will apply lessons learned, guidelines, and recommendations from existing plants into plant reliability programs for new plants. With respect to advanced I&C and communications technologies, utilities will be able to make the electromagnetic interference (EMI) information available to their suppliers as needed to ensure that electromagnetic compatibility (EMC) requirements are met. The project will result in new plants that are much less likely to experience EMI problems, with corresponding improvements in plant reliability, safety, and operating costs.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Guidelines for Ensuring Electromagnetic Compatibility for Instrumentation & Control Equipment in New Nuclear Plants : Electric Power Research Institute's (EPRI's) in-house electromagnetic interference (EMI) experts will start with the existing guidance in Regulatory Guide 1.180 Revision 1 and EPRI TR-102323 Revision 3, and develop expanded guidance tailored for new plants, with supporting technical bases and tests. The project will consider present and future emissions and immunity limits while taking changes (for example, growth of digital equipment and extended frequency bands) in the electromagnetic environment into account.	12/22/10	Technical Report

New Nuclear Plant NDE (066885)

Key Research Question

New nuclear power plants must comply with requirements for pre-service inspection (PSI) and in-service inspection (ISI) of pressure boundary components and supports in accordance with regulatory accepted codes and standards (for example, American Society of Mechanical Engineers [ASME] Section XI). These requirements are typically deterministically based, but 90% of existing plants have transitioned to risk-informed methods for meeting PSI and ISI requirements.

In addition, nuclear power plants must comply with ASME Section III requirements for construction, pre-service, and in-service volumetric inspection of the primary pressure boundary. The construction volumetric inspection ensures that the components and welds meet applicable codes. Changes to ASME Section III could eliminate unnecessary repairs by allowing acceptance of fabrication flaws that are not structurally significant. This will require industry and regulatory confidence in the volumetric nondestructive evaluation (NDE) methods that are used to detect and size fabrication flaws.

Approach

The Electric Power Research Institute's (EPRI's) risk-informed in-service inspection methodology will be tested and refined for advanced plant designs. The goal would be to develop a single PSI/ISI program for each design (not site-specific) or define any issues and provide guidance where they may be site-specific requirements.

The project also will establish and operate the ultrasonic (UT) examination qualification programs that will be necessary to ensure accurate, reliable construction inspections of primary pressure boundary components and welds.

Impact

Enable timely and cost-effective compliance with regulatory requirements for construction inspection

- Facilitate regulatory acceptance of fitness-for-service philosophy, eliminating unnecessary repairs
  - Cost savings and elimination of delays during construction
  - Improved resistance to stress corrosion cracking during plant operation
- Reduce construction, inspection, and acceptance costs
- Reduce operating costs
- Shorten construction and turnover schedules by focusing resources on more important systems and components and incurring fewer regulatory actions

How to Apply Results

Members will have access to a regulatory-approved ISI methodology for use in new plant license applications. This also will support future operations and maintenance activities over the life of the plant.

Members will use the UT Qualification products in specifying certification levels and specialized qualifications for UT personnel in construction procurements. As a result of these products, the necessary qualified UT personnel will be available to support new plant construction.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
NDE Project Progress Report: The results of this project will be published first as a code case and then integrated into the code. An owner/vendor would adopt the code case into their fabrication specifications for new construction to establish the basis for acceptance of construction-related benign flaws in piping/component welds.	12/22/10	Technical Update
Revised RI-ISI/PSI Methodology Report with Test Case Results and Regulatory Approval Protocol: Members will have available a regulatory-approved methodology. As with the existing fleet, implementation will be via a relief request or adoption of a newer edition/addenda of the American Society of Mechanical Engineers (ASME) code, once the methodology has been codified by ASME. This also will support future operation and maintenance (O&M) activities as it will be approved for the life of the plants. This approach has been successfully demonstrated on greater than 80 plants to date in the United States.	12/22/10	Technical Report

Security and Seismic (067606)

Key Research Question

The underlying generic seismic source model for the Central and Eastern United States (CEUS) is more than 18 years old and the Nuclear Regulatory Commission is on record as indicating that the model should be updated every 10 years. Also, recent NRC Requests for Information (RAIs) are challenging the source characterization used in the Electric Power Research Institute's (EPRI's) probabilistic seismic hazards analysis (PSHA), continuing the NRC trend away from its use of EPRI's baseline seismic hazard model.

Approach

EPRI is developing a new seismic hazard model for the Central and Eastern United States (CEUS) that will facilitate new plant siting and respond to regulatory concerns. The new generic CEUS seismic hazard model will benefit several industry participants: a) nuclear power plant owners and developers that have submitted an early site permit (ESP) or combined operating license application (COLA) for NRC review in 2007 (or 2008) or will submit a COLA for a second unit in or after 2009; b) nuclear power plant owners and developers that will submit an ESP or COLA for NRC review in or after 2009; and c) operating nuclear power plant owners that must respond to issues resulting from NRC Generic Issue 199 (GI-199).

Impact

- Realize significant time and resources through standardization and partnering
- Achieve stability in the seismic design of new plants
- Inform decisions regarding the current state of knowledge incorporating different proponent interpretations in a non-regulatory environment using the approved Senior Seismic Hazard Analysis Committee (SSHAC) process
- Eliminate potential for multiple, possibly conflicting, interpretations of seismic sources by different consultants
- Avoid challenges to the EPRI-Seismic Owners Group (SOG) (1989) seismic source characterizations by NRC staff, its consultants, or interveners during the hearing process
- Minimize potential for duplication of effort because seismic hazard models for many CEUS sites have significant geographic overlap
- Reduce the opportunity for delays due to more conservative interpretations

How to Apply Results

Members will use project results in developing early site permits, combined operating license applications, and in responding to regulatory concerns. This work replaces a study performed approximately 20 years ago. Since that study was completed, substantial work has been done to improve the understanding of seismic sources and their characterization in the CEUS.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
EPRI CEUS Seismic Source Model : The generic Central and Eastern United States (CEUS) Seismic Source Characterization (SSC) model will be of value to those who are involved in PSHA work, and who wish to use an updated SSC model. This model will be based on a comprehensive and traceable process, in accordance with Senior Seismic Hazard Assessment Committee (SSHAC) guidelines in NUREG/CR-6372, *Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts.* The model will be used to assess the present-day composite distribution for seismic sources along with their characterization in the CEUS and uncertainty. In addition, this model will be in a form suitable for use in PSHA evaluations for regulatory activities, such as Early Site Permit (ESP) and Combined Operating License Applications (COLA).	08/31/10	Technical Report

Configuration of 3D Models (068802)

Key Research Question

New plants will be designed differently than in the past. 3-D computer-aided design (CAD) software will be used extensively. As a result, these plants will be delivered with 3-D models that are comprehensive, detailed, and integrated with plant design, operations and maintenance databases and documents/records. Associated

software suites supporting the 3-D models also may support documentation and characterization of facility system, structure, and component data and attributes. An automated, integrated, and interoperable configuration management (CM) program must be established to maintain consistency between the design requirements, physical configuration, and facility configuration documentation to ensure the ability to document and maintain compliance with the license basis.

Approach

This project consists of three sub-tasks:

- Develop a Standard Configuration Management Reference Model and *Implementing Guideline* to provide a common framework to help manage an automated, integrated, and interoperable CM program in a consistent and connected way.
- Develop New Nuclear Plant XML Equipment Schemas for a set of critical components to help facilitate information interoperability throughout the full plant life cycle.
- Develop a *New Nuclear Plant Information Handover Guide* providing a full plant life-cycle information strategy establishing the methodology for defining the information requirements and the "how to" for developing and implementing an information handover plan.

Impact

- CM programs implemented using the Standard Configuration Management Reference Model and *Implementing Guideline* will realize the following benefits and avoid past problems:
  - Design basis will be clear.
  - Plant physical configurations will match documents/records and design requirements.
  - Operating procedures will be integrated well with design constraints and limits.
  - Records used to support maintenance (for example, Q-lists and bill of materials) will be complete.
  - Designs will contain instrumentation for monitoring the physical plant to ensure equipment configuration is maintained consistent with design requirements.
  - Long-term plant shutdowns, caused in part by CM problems, will be avoided.

How to Apply Results

The 3-D model will be a significant investment for the new build fleet. These products will assist plant owners in managing and improving the return on that investment. The information developed will be in the form of guidelines and new nuclear plant XML equipment schemas that the plant owner can directly implement. Much of the benefit will be from the industry adoption of data interoperability standards developed in this project.

2010 Products

Product Title & Description	Planned Completion Date	Product Type
Standard Configuration Management Reference Model and Implementing Guideline: The basis for Standard Configuration Management Reference Model and *Implementing Guideline* will be built upon existing configuration management (CM) practices, operating experiences, and knowledge. This knowledge exists in several places, with one of the most important being the nuclear industry with experts who are responsible for CM at their plants.	06/30/10	Technical Report

Next-Generation Nuclear Plant Research (052492)

Key Research Question

New sources of energy are being developed to alleviate two key challenges facing all industrialized and developing countries: increased energy security to improve national and global security and reduced carbon footprint in all economic sectors to address manmade contributions to global climate change. One such energy source is the high-temperature gas reactor, which can extend the use of improved nuclear technologies into energy sectors beyond electricity generation.

Approach

This project covers multiple activities associated with various next-generation nuclear plant designs:

1. Supporting activities around developing a public/private partnership to determine the feasibility and practicality of using advanced high-temperature gas reactor systems for process heat, hydrogen production, and cogeneration.

2. Studying sonoluminescing bubbles and nanomaterials synthesis. Sonoluminescence is the light emission associated with catastrophic bubble collapse of a gas bubble oscillating under an ultrasonic field. Sonoluminescence can be applied to synthesize nanomaterials, which can be used for the direct catalyzed decomposition of methane into hydrogen—a potential process for hydrogen production in high-temperature gas reactors.

Impact

- Accelerate and direct the development, demonstration, and deployment of advanced reactor technology for future energy markets. The commercial deployment of new technologies can help address critical issues of energy security and global climate change.
- Investigate alternate processes to enable hydrogen production at lower costs and with less energy input.

How to Apply Results

Members will review research and development results to guide awareness and development of the next generation of nuclear power plants, including high-temperature gas reactors.

Integrated Spent Fuel Management Research (065399)

Key Research Question

Greater interest in nuclear power and its long-term viability have renewed interest in the potential closing of the nuclear fuel cycle.

Approach

Support the research, development, and evaluation of a proliferation-resistant closed fuel cycle, in which spent fuel is reprocessed. Establishing a closed fuel cycle with the demonstrated ability to handle more nuclear waste will increase confidence in a stable fuel supply and long-term spent fuel management and support expanded use of nuclear power.

Impact

- Identify the technical challenges associated with a partial or fully closed nuclear fuel cycle
- Critically evaluate the ability of advanced light water reactors (Gen III/III+) to utilize mixed oxide fuel

How to Apply Results

Members will use the results of this project to guide their strategic planning related to new planned commercial nuclear reactors.