AP41.10 New Nuclear Plant Deployment

Strategic Content: There are numerous reasons why the current fleet of nuclear plants provides over 20% of the nation's electrical power: autonomy and diversity of supply, emission avoidance, low environmental impact and superior operational safety as well as low and stable operating costs based on excellent performance in recent years. Nuclear energy provides nearly 70% of the country's all emission-free power. This growing record of exceptional accomplishment is vital to the continued use of nuclear power, the determination to build new plants and the substantial role of nuclear in the nation's future electricity supply.

The outlook for building new plants is improving. There has been a broad restructuring and consolidation of nuclear plant ownership and a focus on leveraging these assets to improve their operational performance. While no new plants have been built, improved capacity factors and power uprates have effectively increased nuclear's output by 20 new plants the past decade. Furthermore, license renewal will enable utilization of these assets up to an additional twenty years. Beyond the current fleet, about 50 new plants will be needed to maintain or moderately increase nuclear's share of the nation's electricity supply through the early 2020s. This is part of the industry's Vision 2020 and is also consistent with the DOE's objectives in Nuclear Power 2010. Working backwards from the early 2020's it is clear that the industry needs to devote attention and resources to this need.

While the industry has greatly improved the fleet's performance, the supporting infrastructure reflects that lack of any significant link to the future. With no new plant activities, the ability to support human and capital resources for engineering, construction, manufacturing and supply has eroded. The workforce is aging and maintaining the knowledge base is a problem for all elements of the industry, including regulation. The infrastructure has been downsized to a maintenance level and it will take a significant revitalization effort to build enough capacity to at least maintain nuclear's share of the nation's diverse electricity supply. From a national and global perspective, the increasing need for greater electrification of our energy needs in the industrial and transportation sectors, the importance of fuel diversity to better absorb shocks such as fuel supply restrictions, the need to reduce dependence on foreign oil, the need to better address air pollution and global warming concerns are all reasons to provide nuclear generation in the future. So there is a clear and present need for current plant owners and operators to actively participate in programs for new plants, both to support current plants and to provide nuclear generation in the future.

Industry Timeline: The objective is to at least maintain nuclear's share and this will require about 50 new plants in the 2020s. In order to reach this goal, the industry will need competitive designs, a workable and predictable licensing process, business solutions that leverage the economics of operating families of standard plants, and an infrastructure that supports building four to six units a year. A major first step in achieving this capability is to successfully build and operate a new unit.

The first unit will be a financing challenge because it is difficult to justify from a business perspective as a standalone endeavor. The costs for first-of-a-kind design, licensing and construction work will be large and the licensing process and construction program will include inherent risks. To make a business case the first unit needs to be considered as an investment in a family of plants, where the economics of repetition will create solid business returns for the "nth" and succeeding units. Thus the first unit will require sharing of costs and risks among a group of investors interested in participating in a family of units. Even with a broad group of investors, deployment of the first unit may depend on some form of government support. The energy legislation that stalled in the congress in 2004 is now a priority in 2005. A revised energy bill is in process and proposals for financial incentives for building new plants are being discussed. Beyond financing, sustained public support and excellent operational performance of the current fleet is essential to maintain the building momentum for deploying new plants.

Table 1 provides a top-level overview of key activities needed to support maintenance of nuclear's share of electricity by establishing about 50 new operational plants in the 2020s.

Table 1.
Overview of Top-Level Activities To Support New Plants for Planning EPRI R&D Activities

A notional top-level schedule for deploying a first plant followed by a family of plants for the purpose of planning EPRI R&D activities is shown in Figure 1. The deployment of the first of a family will require activities where there is no specific basis for schedule estimates. Key critical path activities for the first plant include developing the business decision to deploy a family of plants, the COL portion of the licensing process, completion of the site-specific plant design and construction. Succeeding plants, however, will utilize most of the design and licensing work performed for the first plant, including site-specific systems and interfaces that are defined by the site envelope that is used as the site-related design basis for the standard design. The site envelope (Plant Parameters Envelope) has been defined to enable the standard design to be sited at most US sites.

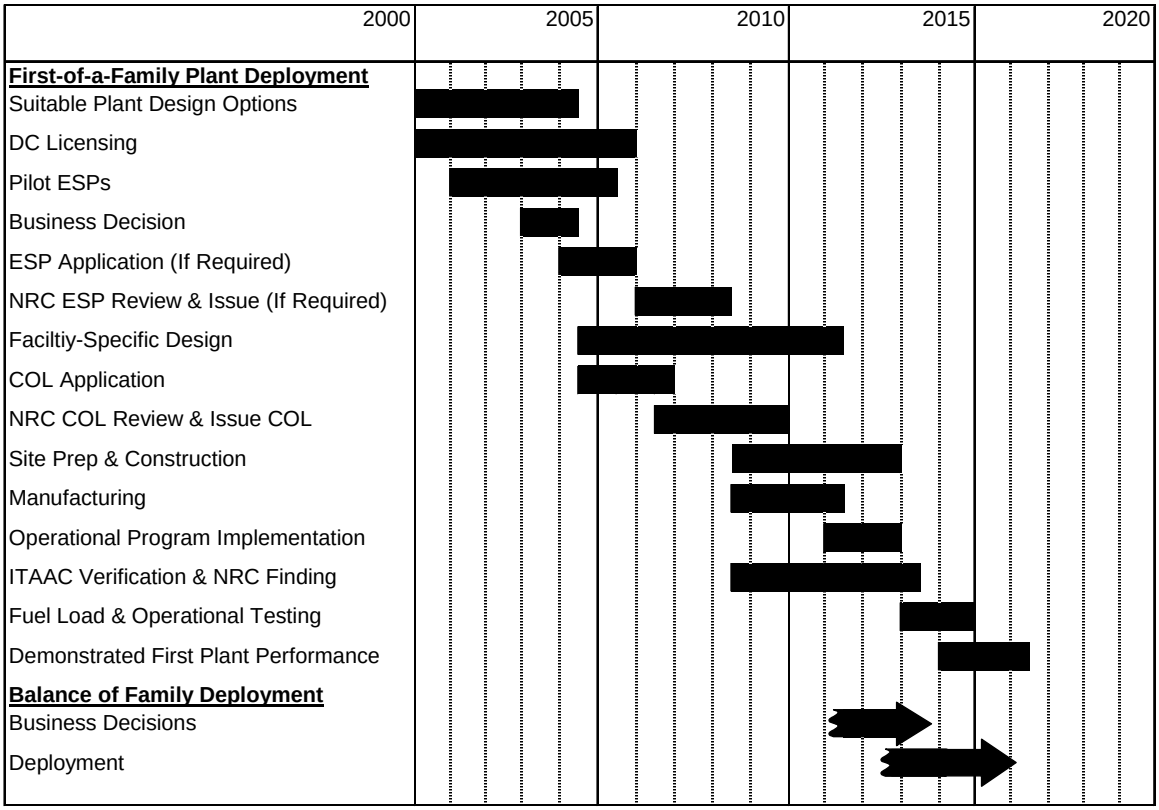

Figure 1.
Notional, Top-Level Timeline for Deploying New Plants for Purposes of Planning EPRI R&D Activities. Note that this timeline is not intended to represent specific and more detailed timelines of other organizations' activities related to new plants.

The DC process has been utilized to demonstrate the cost and time required to obtain a DC and an ESP demonstration is in process. The first demonstration of the COL process will require a large commitment to perform the required design and licensing work and is a key challenge in the business decision to deploy a family of plants. This will likely necessitate a sharing of costs and risks among a group of investor/owners as well as government incentives. Once the first plant is built, an interval of operation, assumed to be one fuel cycle, will be used to demonstrate the plant performs well and feedback lessons learned to the family of plants. The decision to commence licensing and construction of the balance of the family of plants is assumed to occur after the construction and ITAAC verification processes are observed to be proceeding satisfactorily for the first plant. By taking advantage of standardization, the schedule for licensing and construction of succeeding plants should be significantly reduced.

Government Cooperation

Government cost-sharing support from the Department of Energy (DOE) has been vital to the industry's progress in developing plant designs and demonstrating the untested 10 CFR Part 52 regulatory process. Designs that have completed or are in the process of obtaining Design Certification from the NRC received significant support from the DOE in the 1990s. In addition, the DOE is providing cost sharing support under an EPRI/ Industry/DOE cooperative agreement to develop licensing guidance for COL applications. Government support is essential, not only in the form of cost sharing support for first-of-a-family design and licensing activities, but also in the form of incentives to counter-balance schedule and cost risks from licensing-related delays for the first few COL applications.

The DOE has also provided cost sharing for three Early Site Permit Applications (ESPs) under 10 CFR Part 52. In September and October 2003, ESP applications for the Clinton, Grand Gulf and North Anna ESP sites were submitted to the NRC. These three ESP applications have been reviewed by the NRC and the two applicants have received their final SERs and the third applicant anticipated their final SER in early 2006. Commission decisions are targeted for 9 to 10 months following the SERs.

On November 21, 2003, the DOE requested formal applications from nuclear generating companies to partner with the department on licensing activities that would enable a new nuclear plant to be ordered and licensed for deployment early in the decade under their Nuclear Power 2010 program. Three responses were submitted from the Dominion-led, NuStart-led and TVA-led consortia. On May 25, 2004, the DOE announced it would help fund a study for the TVA-led consortium on the costs of building a two-unit ABWR on the Bellefonte site in Alabama. This work has been completed, however further efforts have not continued. On November 4, 2004, the DOE announced awards to the Dominion-led and NuStart-led consortia. Cooperative agreements for each of these two projects are in place. NuStart selected two sites, the Grand Gulf Nuclear Station for the ESBWR and the Bellefonte Site for the AP1000.

In August 2005, the President signed the Energy Bill (Energy Policy Act of 2005), which incorporates a wide range of measures that support today's operating nuclear plants and provides important incentives for building new nuclear plants. The Energy Bill includes several incentives to encourage construction of new nuclear plants, including production tax credits, loan guarantees and risk protection for companies pursuing the first new reactors. The bill also includes an extension of the Price-Anderson Act, an insurance framework for protecting the public in the case of a nuclear incident. The legislation authorizes funding for nuclear energy research and development, as well as funding to build an advanced hydrogen cogeneration reactor in Idaho.

Recent Developments

The pace of new announcements concerning new plants accelerated in 2005. In January, Dominion changed their technology of choice from the ACR-700 to the ESBWR. The President voiced support for the building of new safe and clean nuclear plants in his State of the Union address on February 2, Framatome ANP, a joint venture of French state-run nuclear engineering company AREVA and Siemens AG (SI), has set up a new team aimed at designing and siting new commercial nuclear reactors in the U.S. In a press release, AREVA said the Framatome team will push to get the European Pressurized Reactor (EPR) licensed and built in the U.S. and plans to apply for Design Certification (DC) as soon as possible. In addition in February, Southern Nuclear and Constellation Energy announced their intention to prepare ESP applications and Duke Power announced their intention to prepare a COL application for deploying a plant in the Duke Power service area in the 2015 time frame. Duke also announced that

they have chosen the AP1000 for the COL. In addition Progress Energy has indicated to the NRC that they intend to file two COL applications, one for a new plant in the Carolinas and Florida. Constellation Energy and AREVA, Inc. announced a joint venture, UniStar Nuclear, to provide U.S. EPR designs. Bechtel Power Corporation is the architect-engineer and constructor for UniStar Nuclear. Ameren Corporation announced that it is considering a new plant for its Callaway site. Entergy announced that they will prepare a COL for an ESBWR at their River Bend Station.

On the environmental front, the Northeast Regional Greenhouse Gas Initiative (RGGI), a cooperative effort by 9 Northeastern and Mid-Atlantic states to reduce carbon dioxide (CO_2) emissions was established in late 2003. RGGI participants began discussing the design of a regional cap-and-trade program, initially covering CO_2 emissions from power plants in the region, and possibly expanding in the future to include other greenhouse gases and other sources of emissions. RGGI recently released a draft program that would maintain current CO_2 emissions from the electric sector through 2015 and reduce emissions by 10% between 2015 and 2020. Allowances would be appointed to states based on current emissions and states would decide how to allocate allowances to electric power producers. Officials representing the participating states are currently negotiating the terms of a Memorandum of Understanding that, when signed, would require them to implement the program at the state level (through regulation or legislation).

EPRI's Role

While the activities above involve all aspects of the nuclear power business, it is important that EPRI focus its support on those activities that are unique to its purpose and goals and consistent with its technical capabilities and skills. This section discusses EPRI's past role regarding new plants and EPRI's future objectives from the activities in the timeline above.

Throughout the 1980's and 1990's, EPRI was an industry leader in advancing the option for new nuclear generation worldwide. EPRI worked with utility leaders to produce the Advanced Light Water Reactor (ALWR) Utility Requirements Document, the utilities' technical basis for the next generation of LWRs. EPRI worked with NUMARC and then NEI to investigate the NRC's Early Site Permitting process, and to develop various regulatory positions for new plants. EPRI cost-shared with DOE and NSSS design teams the design certification engineering activities for two ALWR passive plants, and, in cooperation with DOE and the Advanced Reactor Corporation, conducted the First-of-a-Kind Engineering activity for one ALWR evolutionary plant and one ALWR passive plant. Completion of these and other building blocks of the Nuclear Energy Industry's Strategic Plan for Building New Nuclear Power Plants resulted in three NRC certified ALWR designs. These designs and the entire certification process positioned the industry for building new generation when the financial and political environment permits.

Building new nuclear plants is an explicit part of the vision for EPRI's nuclear sector. It is also part of the strategic plans of government and other industry organizations including DOE and NEI. These organizations share the responsibility to develop various proposals and specific licensing requests and will work together with individual utilities, groups of utilities, and the NRC to establish a stable regulatory process to build new plants. Specific areas where EPRI expertise and experience may be helpful to utilities considering the deployment of new plants include:

- Technical support for licensing and regulatory issues
- Design requirement and current fleet experience and ongoing R&D input
- Independent design reviews and assessments
- Technical planning for construction and deployment
- Staffing and standardization effectiveness
- Assessment and application of environmental benefits
- Programmatic and administrative support for government cooperatives and consortia

EPRI has been a leader in supporting improvements in the current LWR plants the past three decades and this experience base and lessons learned from the current fleet are being used to develop improved new LWR designs. Beyond LWR designs, it is essential to continue gas reactor technology development, for direct-cycle gas reactor concepts offer greater efficiency and potential for greater safety. In addition, their higher operating temperatures

establishes gas reactors as candidates for industrial heat applications and may also support hydrogen production and provide a practicable source for a hydrogen economy.

EPRI has also played an important role in identifying the benefits of nuclear power to government agencies and the public through research, including the benefits of no pollutant emissions and no greenhouse gas emissions, direct and indirect reductions in petroleum imports, and the nuclear role in a sustainable and robust generation mix. Recently, EPRI supported an examination of the role nuclear power plays in meeting the RGGI CO_2 cap. The RGGI studies have assumed that all nuclear power plants in the region apply for and receive license renewal. EPRI used the RGGI model to examine the impacts in the region if this doesn't happen. The results showed increased emissions of CO_2 and increased reliance on natural gas (and coal in scenarios where coal is an option) for electricity generation when it is assumed that some (not all) of the nuclear plants in the region do not renew their licenses. In one scenario that was considered, the price of CO_2 allowances was nearly doubled when the amount of nuclear power available after 2020 was reduced by about one third. These study results and associated data which clearly demonstrate the benefits of nuclear power have been released publicly with agreement from the RGGI staff working group. EPRI has completed similar studies on a larger scale, looking at the sustainability of the electric sector (electricity available at a reasonable price and with reasonable levels of air emissions) in the United States with and without new nuclear power plants.

This Action Plan directly addresses the following EPRI Nuclear Power Sector Strategic Objectives:

- Evaluate evolutionary and new designs including gas-cooled reactor technology
- Achieve cost/risk-focused decision-making in regulation, operation, and design
- Employ advances in information technology to design and operations
- Adopt advances in manufacturing and construction technology
- Provide basis for simplified licensing process for new plants (Part 52 process aspect)
- Allay concerns of public safety
- Establish nuclear power as a solution to environmental concerns and other relevant societal issues

The Plan indirectly supports the following EPRI Nuclear Power Sector Strategic Objectives; that is, although there is no significant activity directly addressing the objectives there is technology, expertise or secondary benefit:

- Improve plant capacity, reliability, and availability
- Add cost-effective innovation to existing plants
- Develop high-utilization nuclear fuel cycles to extend resources
- Optimize technology transfer and collaboration
- Provide tools to maintain a skilled, productive work force

Finally, this Plan has links with the following Electricity Technology Roadmap limiting challenges:

- Advances in Enabling Technologies
- Strengthened Portfolio of Generation Options
- Ecological asset management

Barriers to Strategic Success: Past activities have led to three new LWR designs certified under 10 CFR Part 52. Using this experience as groundwork, the strategic focus has been to ensure that competitive nuclear plant design and deployment options are available to meet anticipated needs in both the near-term and the longer term. The near-term goal is to enable new commercial plants to be ordered within the 2005-2009 timeframe. Since 1999, the focus towards meeting this near-term goal has been on improving the competitiveness of passive LWR designs, resulting in the AP1000 and ESBWR Design Certification projects where the capital cost per kilowatt has been significantly reduced.

In 2004, there is an increased emphasis on reducing the time, effort and uncertainty of the COL portion of the licensing process, not only in licensing guidance and clarification but also in the significant amount of design work on certified plant designs that is needed for COL. The increased emphasis occurred in late 2003 when the DOE announced that they were requesting proposals to develop COL applications.

The longer-term goal is to continue to foster conditions favorable for plant deployment so that new plants can be ordered in the subsequent decade to at least maintain nuclear's share of electricity generation. In addition, the longer-term goal includes the potential for deploying commercial high-temperature gas reactors (HTGRs) for both electricity and hydrogen production and a more efficient use of resources.

The EPRI strategic plan requires cooperation and participation by EPRI, member utilities, NEI, DOE, plant vendors and the NRC. Some projects will be initiated and led by EPRI; some will be done in support of NEI and its New Plant Task Force. The plan requires participation by EPRI personnel and their utility advisors in appropriate NEI and DOE steering groups and task forces.

This Action Plan focuses on overcoming significant barriers to successfully achieving the strategic objectives above. The following seven barriers to success have been identified:

- **Prospective standard plant designs require further design work and licensing review in order to be near-term competitive options for selection as the first built in a family of new plants. (Competitive Plant Designs)** In concert with work supported by utilities intending to prepare a COL application, EPRI will support upgrades of certified LWR designs, certification of new LWR designs and COL-related work on certified LWR designs, with improved economic competitiveness. While the present focus is on licensing of designs such as the AP1000 and ESBWR, there is a continuing need to work on innovative design improvements to enhance the competitiveness of plant designs as well as activities to ensure and enhance the ability of the industry to take full advantage of standardization. EPRI will also monitor and gauge the viability and desirability of other designs such as the U.S. EPR that have applied for DC. EPRI considers these activities as vital to the utilities' role of defining its own future and will continue to seek opportunities to provide oversight and support for activities in these areas.

- **The licensing process has not been shown to be sufficiently workable and predictable to support building a first new plant and has not been successfully demonstrated to support near-term business decisions to build families of plants. (Workable Licensing Process)** EPRI will support NEI and the industry by developing technical content for new plant licensing guidance, generic technical content for licensing submittals and technical bases for revisions to existing licensing requirements. The DOE is providing cost-sharing support for this barrier through the EPRI/Industry/DOE Cooperative Agreement to provide guidance for preparing COL applications. In addition, DOE has issued a request for proposals to provide cost sharing for the development of the first COL applications.

- **The uncertainty of cost, schedule, staffing, workforce, vendor supplies, construction capabilities, and infrastructure for deploying families of new plants are critical factors in the decision to build the first of a family of new plants. (Plant-Related Deployment Uncertainties)** EPRI, in collaboration with the vendors, will explore the development and application of emerging technologies to reduce the cost of nuclear plant deployment options. EPRI continues to develop an integrated construction and schedule modeling approach that will identify staffing, workforce, construction and infrastructure requirements. EPRI will coordinate efforts with NEI on addressing longer-term workforce and infrastructure issues.

- **Financing, risk mitigation, government support as well as continued increased strong public support, are needed to ensure timely progress on decisions to build the first of a family of plants as well as planning for a family of plants. (Industry-Related Deployment Issues)** NEI, member utilities and plant vendor efforts are in the lead for resolution of these issues. EPRI will participate in such efforts and provide technical support.

- **New reactor designs based on non-LWR concepts require technology development. (Non-LWR Technology Gaps)** EPRI will provide solutions to key technical challenges for such designs -- especially HTGRs -- with emphasis on achieving plant reliability, availability, and maintainability goals. Challenges include: high temperature materials, intermediate heat exchanger, power conversion unit and interface with hydrogen production plants.

- **Lack of a viable long-term strategy to ensure the role of nuclear power in the "hydrogen economy." (Hydrogen Role For Nuclear)** EPRI will evaluate the current status and implement technical R&D opportunities to help ensure the nuclear power role.

- **Lack of a viable long-term strategy to optimize the nuclear fuel cycle will eventually limit the deployment of nuclear power in the U.S**. **(Fuel Cycle Optimization)** EPRI will track and participate in research that investigates higher fuel utilization to extend resources and maintain competitive prices while maintaining high safety, reliability and non-proliferation standards.

- **Understanding the environmental benefits of new nuclear power is key when considering options for adding new electric generating capacity.** Nuclear power is the largest non-emitting contributor to the current generation mix. If environmental regulation of carbon dioxide and other greenhouse gases becomes binding, the relative value of existing and new nuclear generation is expected to increase. Geopolitical conditions can raise or lower the price of fossil fuels and ignite or dampen public concern over nuclear proliferation. Uncertainties in the price of electricity, the demand for electricity, and the availability of distribution networks create different scenarios in which fixed-cost, base-load nuclear generation could have more or less advantage compared to other generating technologies. The effect of future electricity market-based regulations on electricity prices in regional power markets and the profitability of different generating technologies will impact utilities differently based on their specific assets and conditions. EPRI will lead studies designed to demonstrate the value of a diverse generation portfolio that includes nuclear generation.

Barriers to Overcome BR41.10.01 - Competitive Plant Designs: In concert with work supported by utilities intending to prepare a combined operating license (COL) application, the Electric Power Research Institute (EPRI) will support upgrades of certified light water reactor (LWR) designs, certification of new LWR designs, and COL-related work on certified LWR designs, with improved economic competitiveness. While the present focus is on licensing of designs such as the AP1000 and economical simplified boiling water reactor (ESBWR), there is a continuing need to work on innovative design improvements to enhance the competitiveness of plant designs as well as activities to ensure and enhance the ability of the industry to take full advantage of standardization. EPRI also will monitor and gauge the viability and desirability of other designs such as the U.S. European pressurized reactor (EPR) that have applied for design certification (DC). EPRI considers these activities vital to members defining their own futures and will continue to seek opportunities to provide oversight and support for activities in these areas.

Deliverables Addressing Barrier to Overcome BR41.10.01

P41.10.01.02.01 Advanced Nuclear Plants

This barrier is a central part of this action plan. The present activities focus on support for the AP1000 and European simplified boiling water reactor (ESBWR) design and licensing projects that have the primary objective of obtaining design certification (DC) from the Nuclear Regulatory Commission (NRC). An additional objective is to maintain continuity with and potential benefits from the Utility Requirements Document (URD) and other agreements achieved in the advanced light water reactor (ALWR) certification processes for similar plants. The AP1000 is an upgrade of the AP600 to over 1000 MWe to substantially increase its economic competitiveness. Final design approval (FDA) for the AP1000 was obtained from NRC in 2004, and DC is anticipated in 2005. The ESBWR design also is a major upgrade of the simplified boiling water reactor (SBWR) to significantly increase its economic competitiveness and the effort on this design has been directed toward obtaining NRC certification in 2007. The Electric Power Research Institute's (EPRI's) objective is similar to the AP1000 effort: to monitor continuity with the Utility Requirements Document and other agreements achieved in the ALWR certification processes for similar plants and support certification. Other designs, for example the SWR1000, which is at the pre-application stage for DC, and the European pressurized reactor (EPR), for which a pre-application DC review is intended, are being marketed in the United States. EPRI's objective is to monitor and assess the status and viability of other designs with respect to NRC certification and domestic deployment.

Current operating plants have made great progress in reducing costs associated with radwaste this past decade. Therefore, a review of advanced plant radwaste processes and systems was performed to ensure new designs are up-to-date with regard to current operating plant practices and experience. This review included a specific review of the radwaste approaches for the AP1000 and the ESBWR. In addition, one of the trends that has helped to improve the performance and efficiency of radwaste processes in current plants is the use of mobile systems. These systems can be interfaced with plants to perform state-of-the-art processing without the need to expend significant capital to replace permanently mounted equipment. Further work in the radwaste area will continue to ensure the radwaste systems for new plants take advantage of the most recent proven technology as designers continue to work towards completing their detailed designs.

The Utility Requirements Document provides requirements that will ensure utility reliability, availability, and maintainability needs are met as well as promote standardization. To provide the latest feedback from operating experience and research and development (R&D) at EPRI and other organizations since the URD was last updated in 1999, a series of new updates are being performed. The information from these updates on topics such as radwaste, general operating experience, the Boiling Water Reactor Vessel Internals Project (BWRVIP), and the Materials Reliability Program (MRP) will be available to members to factor into detailed designs, where applicable. As part of the design processes for new plants, it is important to feedback experience from current plant operations. This was one role of the URD that used the operating experience information provided by the Institute of Nuclear Power Operations (INPO). INPO is presently defining plans to develop updated reports on operating experience for utilities to consider in new designs. EPRI will support INPO's efforts as well as use the results to update the URD.

In 2003, a conformance assessment was performed on the AP1000 design that had received a final design approval (FDA) from the NRC. This assessment was valuable to utilities, EPRI, and the design team since it provided a thorough and systematic review of the design and documented deviations that were due to more recent information, new design constraints, and other causes. Similar conformance assessments are planned for the ESBWR and the EPR.

Human factors engineering (HFE) is a key COL item and important aspect of the detailed design work for new plants. EPRI will support design-related HFE activities for the AP1000. The starting point for this activity is the work done for design certification. The design tasks to be undertaken will provide a basis for developing the detailed human-system interface (HIS).

Deliverables

Deliverable Title	Delivery Year	Deliverable Type	Secondary Barrier(s)
DC support for EPR	2007	AREVA report	
URD updates for BWRVIP	2007	URD chapters update	
URD updates for recent operating experience	2007	URD chapters update	
URD updates for MRP	2007	URD chapters update	
URD updates for ALARA, chemistry, seismic and security	2007	URD chapters update	
Conformance assessment for the EPR	2007	Technical update	
Continued support for I&C, Human Factors and Control Rooms	2007	Technical report	
DC support for EPRI	2008-2009	Technical Update	
URD chapter updates	2008	URD Chapter Updates	
I&C, Human Factors and Control Room Support	2008	Technical Update	

Barriers to Overcome BR41.10.02 - Workable Licensing Process: The Electric Power Research Institute (EPRI) will support the Nuclear Energy Institute (NEI) and the industry by developing technical content for new plant licensing guidance, generic technical content for licensing submittals, and technical bases for revisions to existing licensing requirements. The Department of Energy (DOE) is providing cost-sharing support for this barrier through the EPRI/Industry/DOE Cooperative Agreement to provide guidance for preparing combined operating license (COL) applications. In addition, DOE has issued a request for proposals to provide cost sharing for developing the first COL applications.

Deliverables Addressing Barrier to Overcome BR41.10.02

P41.10.02.01.01 Workable License Process

The Electric Power Research Institute (EPRI) is collaborating with the Nuclear Energy Institute (NEI), the Department of Energy (DOE), and the nuclear industry to support demonstrations of the new Nuclear Regulatory Commission (NRC) licensing process that will apply to siting, construction, and operation of future nuclear power plants in the United States. This support includes providing technical research and development for licensing applications.

Deliverables

Deliverable Title	Delivery Year	Deliverable Type	Secondary Barrier(s)
Continued Technical Support to NEI on COL Requirements	2007	Staff Support	
Support to NEI for Risk-Informed Licensing for New Plants	2007	Staff Support	
Seismic licensing design basis to support multiple new plant orders	2007	Staff Support	
Continued support to NEI on COL requirements	2008-2009	Staff support	

Barriers to Overcome BR41.10.03 - Plant-Related Deployment Uncertainties: The Electric Power Research Institute (EPRI), in collaboration with vendors, will explore development and application of emerging technologies to reduce the cost of nuclear plant deployment options. This effort includes emphasis on security, instrumentation and control (I&C), plant support engineering, and deployment modeling. EPRI will coordinate efforts with the Nuclear Energy Institute (NEI) on addressing longer-term workforce and infrastructure issues.

Deliverables Addressing Barrier to Overcome BR41.10.03

P41.10.03.01.01 Plant-Related Deployment Uncertainty

This project looks at specific opportunities for cost reduction that may be achieved in new plant designs. Reports are being prepared that detail staffing reduction initiatives, radwaste process savings, and a model to help reduce the uncertainty of cost, schedule, and other factors.

Deliverables

Deliverable Title	Delivery Year	Deliverable Type	Secondary Barrier(s)
New plant security concepts	2007	Technical report	
Technical Assessment Support for New Plant Consortia	2007	Staff support	
Updated New Plant Deployment Program Model (NPDPM)	2007	Technical report	
New Plant Deployment Program Model	2008	Model	
New Plant Security	2008	Technical Report	

Barriers to Overcome BR41.10.04 - Industry-Related Deployment Issues: The Nuclear Energy Institute (NEI), member utilities, and plant vendor efforts are in the lead for resolution of these issues. The Electric Power Research Institute (EPRI) will participate in such efforts and provide technical support.

Barriers to Overcome BR41.10.05 - Non-LWR Technology Gaps: The Electric Power Research Institute (EPRI) will provide solutions to key technical challenges for non-light-water-reactor (non-LWR) designs—especially high-temperature gas reactors (HTGRs)—with emphasis on achieving plant reliability, availability, and maintainability goals. Challenges include high-temperature materials, intermediate heat exchangers, power conversion units, and interfaces with hydrogen production plants.

Deliverables Addressing Barrier to Overcome BR41.10.05

P41.10.05.01.01 High-Temperature Gas Reactor

The project's objectives are to resolve technology gaps to the extent possible and develop plant designs that not only provide increased efficiencies, but also have adequate plant reliability and maintainability. Technology issues include auxiliary bearing performance, helium stator seal capabilities, use of dry gas seals, identification and qualification of high-temperature materials, and improvements to power conversion unit designs. Studies to assess high-temperature gas reactor (HTGR) designs as an energy source for hydrogen plants also will be required to determine needed design features and capabilities.

Deliverables

Deliverable Title	Delivery Year	Deliverable Type	Secondary Barrier(s)
Fuel characterization study	2007	Technical update	
Auxiliary bearing design	2008-2009	Technical report	
Dry gas seal design and testing	2008-2009	Technical report	
Address adequacy of codes and standards	2008-2009	Technical report	
Identification and qualification of high temperature materials	2008-2009	Technical report	
Power conversion unit development	2008-2009	Technical report	
Nuclear heat source and IHX design for hydrogen plant	2008-2009	Technical report	

Barriers to Overcome BR41.10.06 - Hydrogen Role For Nuclear: The Electric Power Research Institute (EPRI) will evaluate the current status and implement technical research and development (R&D) opportunities to ensure the nuclear power role.

Deliverables Addressing Barrier to Overcome BR41.10.06

P41.10.06.01.01 Hydrogen Role for Nuclear

This program will identify requirements and technical issues for using a high-temperature gas reactor as the energy source to produce hydrogen. Issues of producing both hydrogen and electricity from the same energy source will be addressed.

Deliverables

Deliverable Title	Delivery Year	Deliverable Type	Secondary Barrier(s)
Hydrogen plant energy source requirements	2007	Technical report	
Nuclear hydrogen and electricity co-location issues resolution	2008	Technical report	

Barriers to Overcome BR41.10.07 - Fuel Cycle Optimization: The Electric Power Research Institute (EPRI) will track and participate in research that investigates higher fuel use to extend resources and maintain competitive prices while maintaining high-safety, reliability, and non-proliferation standards.

Barriers to Overcome BR41.10.08 - Environmental Benefits: Nuclear power is the largest non-emitting contributor to the current generation mix. If environmental regulation of carbon dioxide and other greenhouse gases becomes binding, the relative value of existing and new nuclear generation is expected to increase. Geopolitical conditions can raise or lower the price of fossil fuels and ignite or dampen public concern over nuclear proliferation. Uncertainties in the price of electricity, the demand for electricity, and the availability of distribution networks create different scenarios in which fixed-cost, base-load nuclear generation could have more or less advantage compared to other generating technologies. The effect of future electricity market-based regulations on electricity prices in regional power markets and the profitability of different generating technologies will impact utilities differently based on their specific assets and conditions. The Electric Power Research Institute (EPRI) will lead studies designed to demonstrate the value of a diverse generation portfolio that includes nuclear generation.

Deliverables Addressing Barrier to Overcome BR41.10.08

P41.10.08.01.01 Environmental Benefits of Non-Emitting Generators

The Electric Power Research Institute (EPRI) has studied the potential role of nuclear power and advanced nuclear reactor and fuel system technologies in the context of the global energy system and climate change using an integrated assessment model. Long-term scenarios in which nuclear technology evolves and advances along various pathways, with and without constraints on carbon emissions, were considered. The work to date has focused on how the choice of nuclear fuel cycle, the cost of nuclear technologies, and the presence of climate policy affect deployment of nuclear energy systems and overall market share of nuclear power, both globally and in the U.S. electric sector. Work will continue to customize models to better represent specific conditions in various regions and market forces in the United States and other countries.

Deliverables

Deliverable Title	Delivery Year	Deliverable Type	Secondary Barrier(s)
Support for environmental benefits research	2007-2008	Staff support	
Support for environmental benefits research	2007-2008	Staff support	