

2.4.3 NEAR-TERM NUCLEAR POWER PLANT SYSTEMS

Technology Description

Electricity from nuclear power generates no greenhouse gas emissions. To the extent that deployment of near-term nuclear power plants can address prevailing concerns, nuclear power can continue to be an important part of a greenhouse gas emissions-free energy portfolio. In order to enable the deployment of new, advanced nuclear power plants in the United States in the relatively near-term – by the end of the decade – it is essential to demonstrate the untested federal regulatory and licensing processes for the siting, construction, and operation of new nuclear plants. In addition, other major obstacles (including the initial high capital costs of the first few plants and the business risks resulting from this and the regulatory uncertainty) must be addressed. Research and development on near-term advanced reactor concepts that offer enhancements to safety and economics is needed to enable these new technologies to be competitive in the deregulated electricity market, and support energy supply diversity and security.



The *Near-Term Deployment Roadmap* was issued in October 2001 and advises DOE on actions and resource requirements needed to support deployment of new nuclear power plants by 2010. The primary focus of the roadmap is to identify the generic and design-specific gaps to near-term deployment, to identify those designs that best promise to meet the needs of the marketplace, and to propose recommended actions that would close gaps and otherwise support deployment. This includes, but is not limited to, actions to achieve economic competitiveness and timely regulatory approvals.

System Concepts

- Advanced fission reactor designs that are currently available or could be made available with limited additional work to complete design development and deployment in the 2010 timeframe.

Representative Technologies

- Certified Advanced Light Water Reactor designs: ABWR, AP600, System 80+.
- Enhancements to certified designs with some engineering work already completed: AP1000, ESBWR.
- Gas reactor designs with significant engineering work already completed: PBMR, GT-MHR.
- Proposed designs from overseas with significant potential for near-term deployment in the United States: SWR-1000, ACR-700.

Technology Status/Applications

- All near-term deployment designs are well-defined concepts in varying stages of development. Most still need significant detailed engineering development and/or regulatory approval.

Current Research, Development, and Demonstration

RD&D Goals

- Demonstration of the untested regulatory processes for Early Site Permit (ESP) and combined Construction and Operating License (COL) processes.
- Industry decision to order a new nuclear power plant by 2005.
- Deployment of one or more new nuclear power plants in the 2010 timeframe.

RD&D Challenges

- Most R&D challenges remaining for near-term deployment options relate to advanced light water and gas

reactors, including fuel development, characterization, manufacture, testing and regulatory acceptance; power conversion system design and testing, including resolution of uncertainties regarding materials, reliability, and maintainability; and fission reactor internals design and verification.

- Support resolution of the technical, institutional, and regulatory barriers to the deployment of new nuclear power plants in the 2010 timeframe, consistent with recommendations in *Near-Term Deployment Roadmap*.
- In cooperation with the nuclear industry, demonstrate the untested regulatory processes for Early Site Permit and combined Construction and Operating Licenses to reduce licensing uncertainties and attendant financial risk to the licensees.
- Provide for conduct of R&D to enable finalization and NRC certification of those advanced nuclear power plant designs that the U.S. power generation companies are willing to build.
- Provide for development and demonstration of advanced technologies to reduce construction time for new nuclear power plants and to minimize schedule uncertainties and associated costs for construction.

RD&D Activities

- Demonstration of regulatory processes for Early Site Permit and combined Construction and Operating Licenses.
- Development and NRC certification of advanced nuclear plant designs.
- Gas reactor fuel development and qualification.

Recent Progress

- Three near-term deployment designs have been certified by the Nuclear Regulatory Commission.
- The Advanced Boiling Water Reactor has been deployed successfully in Japan; Advanced Boiling Water Reactors are under construction in Taiwan.
- Three U.S. utilities plan to apply for NRC approval of sites for new nuclear plants.
- Reactor vendors are exploring NRC certification of advanced reactor concepts.
- The three cost-shared Early Site Permit (ESP) demonstration projects initiated with industry in FY 2002 continued with the plan for completed ESP applications to be submitted by the power-generating companies to NRC for review and approval.
- A nuclear power plant project cost and construction assessment to independently evaluate the cost, schedule, and construction methods of advanced nuclear plant designs, as well as identify promising improvements to the construction methods and techniques to support new nuclear power plant deployment in the 2010 timeframe was initiated.
- The advanced gas-cooled reactor fuel development and qualification activities initiated in FY 2001 continued.
- Fuel fabrication process development in laboratory-scale equipment as well as manufacture and characterization of the demonstration fuel, which will undergo irradiation testing, was initiated.

Commercialization and Deployment Activities

- At least two designs and perhaps more can be commercialized in the United States in the 2010 timeframe. Achieving this goal will require a major effort by industry and DOE to work together to resolve open issues and to share the one-time costs of closing both generic and design-specific gaps.

Market Context

- The focus of the market is in the United States. Due to the uncertainty regarding the impacts of deregulation, designs in the 100-300 MW_e range and the 1,000 MW_e-plus range are both required.