

## Why GAO Did This Study

More demand for electricity and concerns about greenhouse gas emissions have increased interest in nuclear power, which does not rely on fossil fuels. However, concerns remain about the radioactive spent fuel that nuclear reactors generate. The Department of Energy (DOE) issued a research and development (R&D) plan to select nuclear fuel cycles and technologies, some of which reprocess spent fuel and recycle some nuclear material, such as plutonium. These fuel cycles may help reduce the generation of spent fuel and risks of nuclear proliferation and terrorism. GAO was asked to review (1) DOE's approach to selecting nuclear fuel cycles and technologies, (2) DOE's efforts to reduce proliferation and terrorism risks, and (3) selected countries' experiences in reprocessing and recycling spent fuel. GAO reviewed DOE's plan and met with officials from DOE, the nuclear industry, and France and the United Kingdom.

## What GAO Recommends

GAO recommends that DOE revise its plan to include the current readiness levels of fuel cycle technologies and the estimated time and cost to develop them, include a strategy for long-term collaboration with the nuclear industry, and specify how DOE will use international agreements to advance its efforts. GAO also recommends that DOE's Office of Nuclear Energy and its National Nuclear Security Administration (NNSA) complete a memorandum of understanding (MOU) to avoid duplication and overlap of efforts. DOE agreed with the first three recommendations and did not rule out the future use of a MOU. GAO continues to believe that this formal collaboration mechanism is needed. View [GAO-12-70](#) or key components. For more information, contact Gene Aloise at (202) 512-3841 or [aloise@gao.gov](mailto:aloise@gao.gov).

# NUCLEAR FUEL CYCLE OPTIONS

## DOE Needs to Enhance Planning for Technology Assessment and Collaboration with Industry and Other Countries

### What GAO Found

DOE's R&D plan relies on a systematic approach—that is, the use of scientific methods and engineering principles—to select and demonstrate nuclear fuel cycles and associated technologies. However, it does not explain the current readiness levels of the technologies associated with the fuel cycles and the estimated time and cost of further development; it also does not explain how DOE will collaborate with the nuclear industry and other countries experienced in nuclear R&D in achieving its goals. In particular:

- In 2010, DOE screened 863 previously identified nuclear fuel cycles and technologies and grouped them into 266 fuel cycles for further exploration. Independent reviewers found this screening process useful and recommended changes that DOE officials stated they would act on.
- DOE's R&D plan states that it is necessary to assess the readiness levels of technologies associated with nuclear fuel cycles. However, neither the plan nor the screening process describe the current readiness levels of all critical technologies or the time or estimated costs for further development. As GAO has reported, assessing the readiness of technology is a best practice to help control schedule and costs.
- DOE's R&D plan states the importance of collaborating with the nuclear industry—the ultimate user of any fuel cycle and technologies that are developed—and DOE continues to get industry advice. However, the plan does not include a strategy for long-term collaboration with industry, without which DOE cannot be assured that the nuclear industry will accept and use the fuel cycles and technologies that the department may develop.
- DOE has agreements with other countries that provide collaborative opportunities to share research results and leverage DOE's R&D efforts, such as using the countries' research facilities. However, the plan does not explain how DOE will use these agreements to advance its R&D goals.

As stated in DOE's R&D plan, the Office of Nuclear Energy has efforts under way to minimize proliferation and terrorism risks associated with nuclear power, but faces challenges. These challenges include developing reliable and cost-effective fuel cycles while minimizing the attractiveness to potential adversaries of radioactive materials resulting from these cycles. NNSA is also working on these issues, and the two agencies have worked together informally to avoid duplication and overlap but do not have a formal mechanism to collaborate on future efforts, which can help agencies strengthen their commitment to work collaboratively by clarifying who will lead or participate in which activities and how decisions will be made.

GAO reviewed France's and the United Kingdom's decades of experiences in developing and operating reprocessing and recycling infrastructures. These experiences can provide some insights into the decisions DOE may need to make in selecting nuclear fuel cycles and technologies. For example, reprocessing and recycling is likely to reduce the amount of space needed for a nuclear waste repository because some of the radioactive materials are reused, but the amount of this reduction would depend on how much of the radioactive materials that are reused might ultimately require disposal in such a repository.