Fact Sheet on Uranium Enrichment

Background

The fuel of a nuclear power plant is uranium, but only a certain type of uranium atom can be easily split to produce energy. This type of uranium atom — called uranium-235 (U^{235}) — comprises less than one percent by weight of the uranium as it is mined or milled. To make fuel for light-water reactors, the natural uranium is enriched to increase the concentration of U^{235} to three to five percent.

The uranium fuel cycle begins by mining and milling uranium ore to produce ""yellow cake,"" which is then converted into uranium hexafluoride (UF6). The UF6 is then enriched before being made into nuclear fuel.

Throughout the global nuclear industry, uranium is enriched by one of two methods: gaseous diffusion and gas centrifuge.

Gaseous Diffusion

Gaseous diffusion is based on the separation effect arising from molecular effusion (i.e., the flow of gas through small holes). In a vessel containing a mixture of two gases, molecules of the gas with lower molecular weight (U^{235} as opposed to the heavier and more plentiful U^{238}) travel faster and strike the walls of the vessel more frequently, relative to their concentration, than do molecules with higher molecular weight. Assuming the walls of the vessel are semi-permeable, more of the lighter molecules flow through the wall than the heavier molecules. The gas that escapes the vessel is enriched in the lighter isotope.

Currently, the United States uses the gaseous diffusion process to enrich uranium. There are two gaseous diffusion plants in the United States, at Piketon, Ohio, and Paducah, Kentucky. Both are operated by the United States Enrichment Corporation (USEC), which was created as a government corporation under the Energy Act of 1992, and privatized by legislation in 1996. Although the Ohio plant no longer enriches uranium commercially, it is where USEC intends to locate its proposed Lead Cascade facility to test the gas centrifuge process for the U.S. market (see below).

Gas Centrifuge

The gas centrifuge process has been widely used in Europe for about 30 years to enrich uranium for the commercial nuclear power market. The process uses a large number of rotating cylinders interconnected to form cascades. The UF6 gas is placed in the cylinder and rotated at a high speed. The rotation creates a strong centrifugal force that draws the heavier gas molecules (containing the U^{238}) toward the outside of the cylinder, while the lighter gas molecules (containing the U^{235}) tend to collect closer to the center. The stream that is slightly enriched in U^{235} is withdrawn and fed into the next higher stage, while the slightly depleted stream is recycled back into the next lower stage. Significantly more U^{235} enrichment can be obtained from a single gas centrifuge stage than from a single gaseous diffusion stage.

Two companies, USEC and Louisiana Energy Services (LES), have notified the Nuclear Regulatory Commission (NRC) that they are considering constructing gas centrifuge facilities. USEC''s program consists of three phases: a demonstration program, a Lead Cascade, and commercial deployment. In February 2003, USEC submitted an application to operate the Lead

Cascade facility, a demonstration and test facility to be located at Piketon, Ohio. USEC plans to submit an application for a commercial facility to be located in Piketon or Paducah, Kentucky, by late 2004, or early 2005. LES has announced its intention to submit a license application and environmental report for a commercial facility to NRC in 2003. The primary site under consideration for this facility is Hobbs, New Mexico.

NRC Responsibilities

The NRC licenses and inspects all commercial nuclear fuel facilities involved in the processing and fabrication of uranium ore into reactor fuel, including facilities that enrich uranium. The agency currently has two full-time resident inspectors at USEC''s enrichment plant in Kentucky, and specialized inspections are conducted using personnel from NRC headquarters in Maryland and the regional offices. The NRC also reports to Congress on the status of USEC''s gaseous diffusion plants, whenever the agency renews the company''s certificate of compliance. The current certificates will expire on December 31, 2003, unless USEC has submitted an acceptable renewal application before that date. The next report to Congress will be issued following the renewal decision at that time.

Under the Atomic Energy Act, as amended, any new uranium enrichment plant must be licensed by the NRC under Title 10 of the Code of Federal Regulations Parts 40 (source material) and 70 (special nuclear material). The NRC performs a safety and security review of the plant and an environmental review of the impact of plant construction, operation, and decommissioning on the local environment.

If the application is for a commercial production facility, the NRC will conduct a ""scoping"" meeting to get public input into the types of issues to be addressed in the environmental review. Following the scoping process, the NRC will prepare a draft Environmental Impact Statement (EIS) to assess the proposed facility''s potential impact on public health and safety and the environment, including land, air and water resources, and offer a formal opportunity for the public to comment on it. The EIS process is expected to take 18 to 22 months. If the application is for a test facility, such as USEC''s Lead Cascade, then an EIS may not be required and the NRC may prepare an Environmental Assessment (EA). An EA is less detailed than an EIS and results in either a finding of no significant impact (FONSI) or a decision to conduct a full EIS. Preparation of an EA does not require a scoping process or a formal opportunity for the public to comment on a draft version. The EA process is expected to take about 12 months.