FACT SHEET
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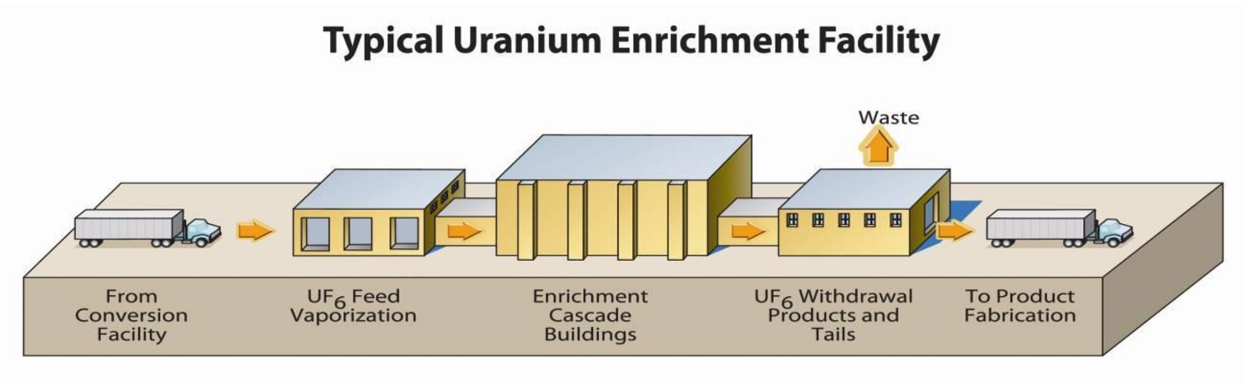
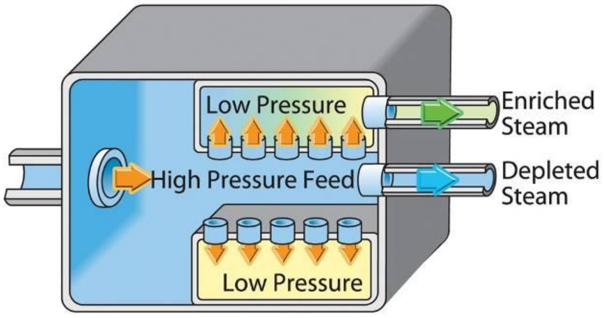
Uranium Enrichment

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 1 percent by weight of the uranium as it is mined or milled. To make fuel for reactors, the natural uranium is enriched to increase the concentration of U^{235} to 3 percent to 5 percent.



The uranium fuel cycle begins by mining and milling uranium ore to produce U_3O_8, also known as "yellow cake," which is then converted into uranium hexafluoride (UF_6). The UF_6 is then enriched before being made into nuclear fuel. Throughout the global nuclear industry, uranium is enriched by one of two methods: gaseous diffusion or gas centrifuge. A third method – laser enrichment – has been proposed for use in the United States.

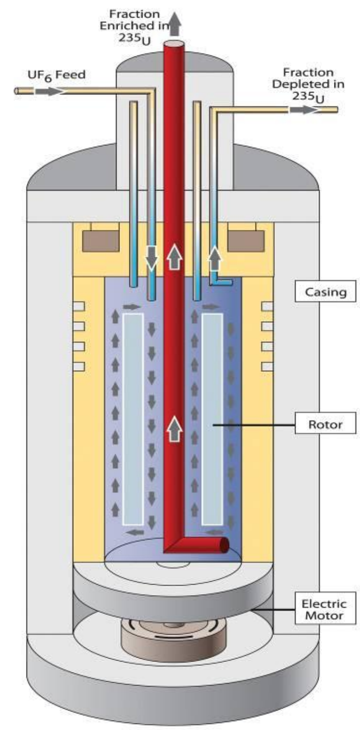
Gaseous Diffusion



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. Because the walls of the vessel are semi-permeable, more of the lighter molecules flow through the wall than the heavier molecules. As such, gas that passes through the walls of the vessel is slightly 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 the Department of Energy's Portsmouth Site near Piketon, Ohio, and DOE's Paducah, Ky, site. 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. The Ohio plant ceased enrichment operations in 2001.

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 UF_6 gas is placed in the cylinder, which is then rotated at a high speed. The rotation creates a strong centrifugal force that draws more of the heavier gas molecules (containing the U^{238}) toward the wall 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 cascade than from a single gaseous diffusion stage.

Two gas centrifuge enrichment plants are currently under construction in the United States. The NRC issued a license in 2004 to USEC to construct a test and demonstration facility known as the Lead Cascade at the Piketon, Ohio, site, and a separate license in 2007 to construct and operate the full-scale American Centrifuge Plant. In June 2006, the NRC issued a license to Louisiana Energy Services (LES) to construct and operate the National Enrichment Facility in Lea County, N.M.

A third gas centrifuge plant is planned. In October 2011, NRC issued a license to AREVA Enrichment Services LLC (AES) to construct and operate the Eagle Rock Enrichment Facility about 18 miles west of the city of Idaho Falls, ID. Construction is expected to start in 2012.

Laser Enrichment

The U^{235} isotope can be separated from uranium through "photoexcitation" by using specially tuned lasers. The lasers are able to ionize a specific isotope, changing its properties and allowing it to be separated from the rest of the uranium. One laser enrichment method, called Atomic Vapor Laser Isotope Separation, or AVLIS, was developed by the U.S. Department of Energy in the 1980s and 1990s but was never used commercially. An Australian technology called SILEX, for Separation of Isotopes by Laser Excitation, is being developed by General Electric in partnership with Hitachi for potential use in the United States.

Laser enrichment has the potential to consume less power, create less waste, and is more efficient than gaseous diffusion and gas centrifuge enrichment.

In January 2009, GE-Hitachi Global Laser Enrichment LLC (GLE) submitted an Environmental Report for a laser-based enrichment plant to be located in Wilmington, N.C. GLE expects to complete a license application for the plant by the end of June 2009.

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 Region II office in Atlanta, which has oversight of fuel cycle facilities. 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, 2013, 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, NRC must license a uranium enrichment plant under 10 CFR Parts 40 (source material) and 70 (special nuclear material). Before an applicant can begin construction of a plant, NRC must issue a license for construction and operation. To issue a license, the NRC must prepare an Environmental Impact Statement (EIS) and a Safety Evaluation Report for the project. NRC must also conduct a formal hearing before issuing a license, and members of the public may request status as intervenors in order to raise important safety or environmental issues about the proposed plant.

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, NRC will prepare a draft 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 typically takes 18 months.

Although the license is for construction and operation, no enrichment plant can begin operating until the NRC verifies through rigorous inspections that the facility has been constructed as required by the license. Throughout construction, NRC inspections will verify that the design, construction, installation and tests of safety significant features, equipment and components comply with the license and NRC regulations. Facility policies, programs and management procedures will also be reviewed.

As construction nears completion, the NRC will conduct pre-operational readiness review inspections of the facility’s most safety-significant features, including but not limited to chemical safety, fire protection, radiological control procedures, emergency preparedness, training and qualification of facility personnel and criticality safety. The NRC will not authorize any licensee to introduce UF_6 into a facility until the NRC has determined, based on these inspection results, that the licensee can do so safely.

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