



# BACKGROUND

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## Power Uprates for Nuclear Plants

When the NRC licenses a commercial nuclear power plant, it sets limits on the maximum heat output, or power level, for the reactor core. This power level plays an important role in many of the analyses that demonstrate plant safety, so the NRC's permission is required before a plant can change its maximum power level. A "power uprate" only occurs after the NRC approves a commercial nuclear power plant's request to increase its power.

Utilities have used power uprates since the 1970s as a way to generate more electricity from their nuclear plants. As of January 2022, the NRC has approved 171 uprates, resulting in a gain of approximately 24,089 MWt (megawatts thermal) or 8,030 MWe (megawatts electric). These uprates are [listed on the NRC website](#). Collectively, these uprates have added generating capacity equivalent to about eight new reactors.

To increase the power output of a reactor, typically a utility will refuel with either slightly more enriched uranium fuel or a higher percentage of new fuel. This enables the reactor to produce more thermal energy and therefore more steam, which drives a turbine to generate electricity. Components such as pipes, valves, pumps, heat exchangers, electrical transformers and generators must be able to accommodate the higher power level. For example, a higher power level usually involves greater steam and water flow through the systems used to convert heat into electric power. These systems must be able to handle the increased flows.

Some licensees modify or replace components in order to accommodate a higher power level. Depending on the desired power increase and original equipment design, this may involve major plant modifications, such as the replacement of main turbines. All of these factors must be analyzed by the licensee as part of its license amendment request for the uprate. The analyses must demonstrate that the proposed new configuration remains safe and that measures continue to be in place to protect the health and safety of the public. The NRC's technical and legal staffs review these complex technical analyses before approving an uprate request.



Calvert Cliffs in Maryland was the first U.S. nuclear power plant to implement an uprate.

## Types of Power Uprates

U.S. commercial reactors are designed with excess capacity to allow for a potential uprate. There are three types of uprates: 1) measurement uncertainty recapture power uprates, 2) stretch power uprates, and 3) extended power uprates.

Measurement uncertainty recapture power uprates increase the licensed power level by less than 2 percent. They are achieved by implementing improved techniques for calculating reactor power. This involves the use of state-of-the-art devices to more precisely measure the feedwater flow used to calculate reactor power. More precise measurements reduce the degree of uncertainty in the power level, helping analysts predict the ability of the reactor to be safely shut down under possible accident conditions.

Stretch power uprates are typically between 2 percent and 7 percent, with the actual increase depending on a plant design's specific operating margin. Stretch power uprates usually involve changes to instrumentation settings but do not involve major plant modifications.

Extended power uprates are greater than stretch power uprates and have been approved for increases as high as 20 percent. Extended power uprates usually require significant modifications to major pieces of non-nuclear equipment such as high-pressure turbines, condensate pumps and motors, main generators, and transformers.

## Review Process

Since uprates change a reactor's licensed power level, utilities seek NRC permission to amend their operating license in order to implement a power uprate. The process for requesting and approving a change to a plant's power level is governed by [10 CFR 50.90-92](#). The applications and reviews are complex and involve many areas of expertise in the NRC's offices of Nuclear Reactor Regulation and General Counsel. Some reviews may also involve the Office of Nuclear Regulatory Research and the Advisory Committee on Reactor Safeguards. In evaluating a power uprate request, the NRC reviews data and accident analyses submitted by a licensee to confirm the plant can operate safely at the higher power level.

The NRC uses a review standard for extended power uprates ([RS-001, December 2003](#)) that has been endorsed by the ACRS. The standard provides a comprehensive process and technical guidance for reviews by the NRC staff, and provides useful information to licensees applying for an extended uprate.

After a licensee submits an uprate application, the NRC informs the public through a notice in the *Federal Register* that the agency is considering the application. The public has 30 days to comment on the licensee's request and 60 days to request a hearing where the application could be contested. The NRC technical staff thoroughly reviews the application and any public comments, while the Atomic Safety and Licensing Board considers any requests for hearings. When the staff completes its review, it issues a safety evaluation and another *Federal Register* notice to inform the public of its decision.

If the ASLB determines a hearing is required a separate legal process takes place, and the NRC staff provides technical information as needed. The safety evaluation and any hearing rulings form the

basis for the NRC's final decision on the uprate request, although the staff can authorize an uprate while a hearing is underway. The NRC issues a press release for any approved uprate.

## **Uprates—Completed, Under Review, Expected**

The NRC has approved 171 uprates and can have several applications for power uprates under review at any given time. Lists of uprate applications approved, under review, and anticipated can be found on the NRC's [website](#).

## **Public Involvement**

The NRC welcomes public involvement in our activities as part of our strong, fair oversight of the nuclear industry. The public's opportunities to participate in the power uprate arena include:

- Pre-application meetings, where licensees discuss their uprate plans with NRC staff (some portions of these meetings may be closed to the public to discuss proprietary information).
- Comments related to an application and requests for a hearing on the application.
- Briefings to the ACRS on the results of the staff's review of the applications (some portions of these meetings may be closed to the public to discuss proprietary information). ACRS meeting schedules are available on the NRC's [website](#).

For each extended power uprate, the NRC staff typically issues a draft environmental assessment for a 30-day public comment period. The NRC staff considers and addresses all comments before finalizing the environmental assessment.

**January 2022**