

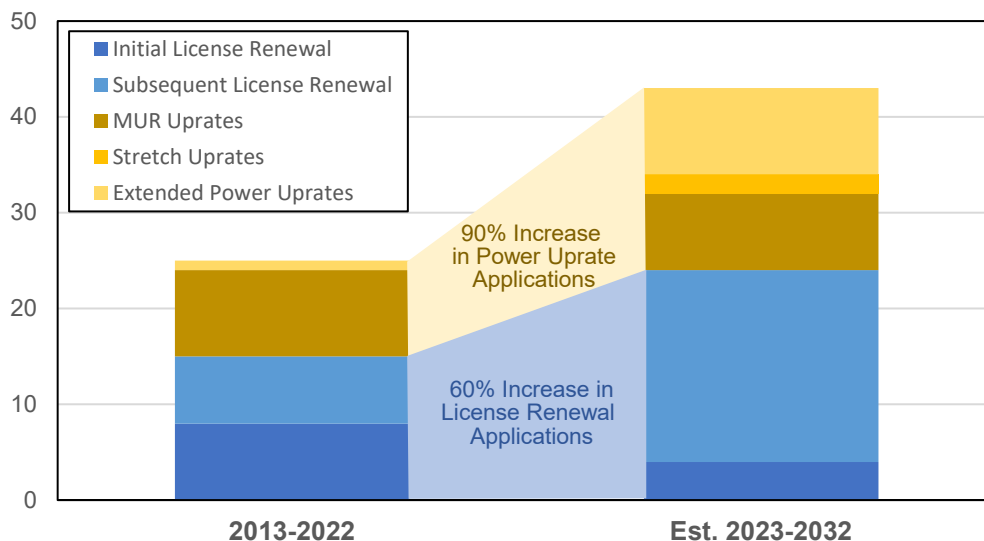
## Examination of NRC Review Performance

### Introduction

Nuclear carbon-free energy is essential to a clean, reliable and affordable energy system. Nuclear generation, both existing and new, is critical to the U.S. energy security and decarbonizing not only the electric sector but the entire economy. Through Federal policy and State action, demand for and advancements in nuclear technology in the U.S. has grown exponentially in the last five years. The passage of the Infrastructure Investment and Jobs Act in 2021 and the Inflation Reduction Act in 2022 has put in place policies that create an inflection point for the future of nuclear power in the U.S.

NEI recently conducted a [survey of member companies](#) to obtain a better sense of the impact these federal actions are having on industry activities underway or in planning, including extending the life of the current fleet of reactors and growing the U.S. fleet. This survey showed that greater than 50% of sites surveyed have plans to increase the power of their reactors, and the cumulative total of these uprates could provide over 2GWe of additional carbon-free nuclear energy in the coming decade. Compared to the past 10 years, these license amendment requests would result in a 90% increase in power uprate applications over the next 10 years compared. In addition, greater than 90% of survey respondents anticipate applying for approval to extend their operating licenses.

**Anticipated License Applications to NRC**



The survey also showed nearly two-thirds of respondent utilities are interested in deploying new nuclear plants, equating to approximately 100 GWe of additional carbon-free nuclear power.

With this anticipated rapid expansion of licensing activities, it is critical that the NRC licensing processes be efficient. Too often, however, the NRC diverts its time and attention into activities that have a negligible effect on safety. As a result, NRC’s review processes are ponderous, prolonged and

unnecessarily resource intensive. To show this tendency, NEI examined public records covering NRC review duration and cost for power uprates, license renewals, design certifications and early site permits. Costs were converted to 2022 dollars for comparison and review hours were estimated using the NRC billing rate for the relevant review period. The primary source for data was an [April 7, 2015, letter](#) from the NRC to the Senate Committee on Environment and Public Works that includes Questions for the Record (QFRs). The [responses to the QFRs](#) provide information on power uprates, license renewals, design certification reviews and early site permits from approximately 2000 to 2015.

The examination of these data shows that review durations, review hours and costs increased significantly over time. Review durations generally doubled. Review hours were estimated to increase by 2 to 3 times over the period of examination. Review costs (in 2022 dollars) increased from 2 times up to 7 times over the period of examination.

Review Type	Review Duration	Review Hours	Review Cost
Power Uprates:			
MUR	>2x	>2x	5x
SPU	Generally stable	~3X	~3X
EPU	~2X	~3X	~7X
License Renewal	>2X	Highly variable	~2X
Early Site Permit	-	-	~3X
Design Certification	-	-	>4X

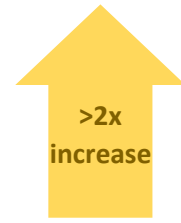
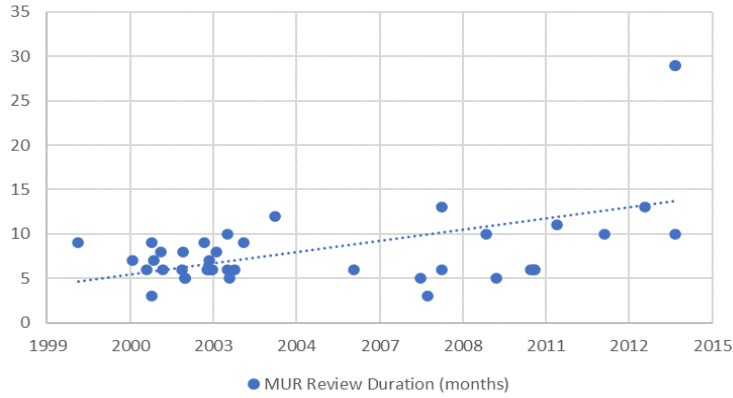
## Power Uprates

Licensees of nuclear power plants have requested and have been granted approval from the NRC to increase the power rating of plants. This process involves a thorough analysis of any changes to the design or operation of the plant to accommodate this increase in power, including the re-analyses of the plant’s response to normal and off-normal conditions to ensure all safety limits are satisfied. These uprates are split into three types according to the increasing magnitude of the power increase, measurement uncertainty recapture, stretch power and extended power uprates, respectively. Although the NRC has performed numerous reviews of all types of power uprates, its review and approval have become less timely and required more resources – the exact opposite of what one would expect.

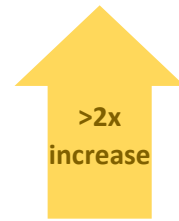
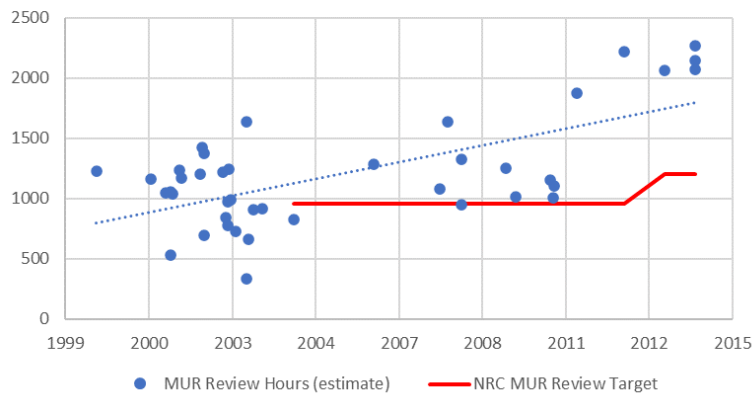
Measurement Uncertainty Recapture Uprates (MURs) involve increasing the power of a nuclear power plant by less than two percent primarily through improving the accuracy of the plant’s prediction of power. The data for MUR uprates, a relatively simple and straightforward modification, show an alarming increase in both the duration and cost of MUR reviews.

The three most recent MUR approvals (Watts Bar 2 in 2020, Oconee in 2021 and Millstone 3 in 2021) have shown a reduction in review hours from the levels reported in NRC’s QFR response, but the review durations remain at 12 months.

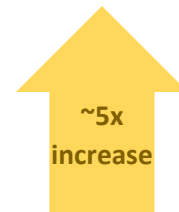
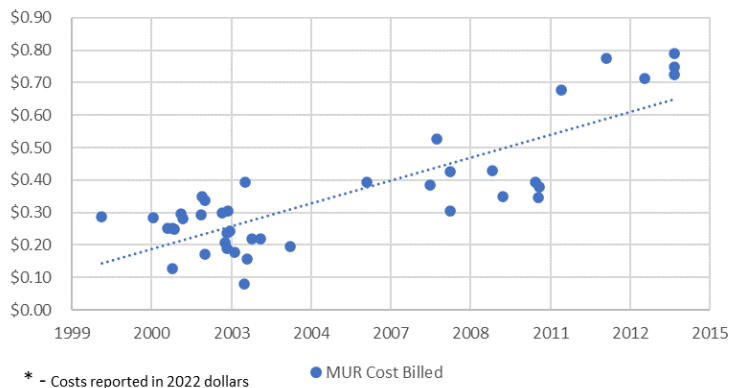
MUR Review Duration (months)



MUR Review Hours (estimated from cost)

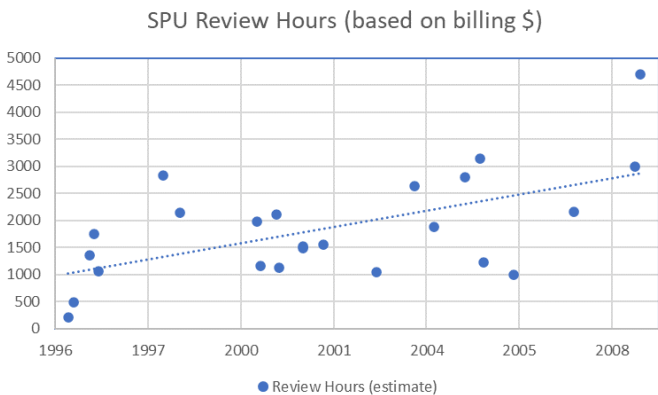
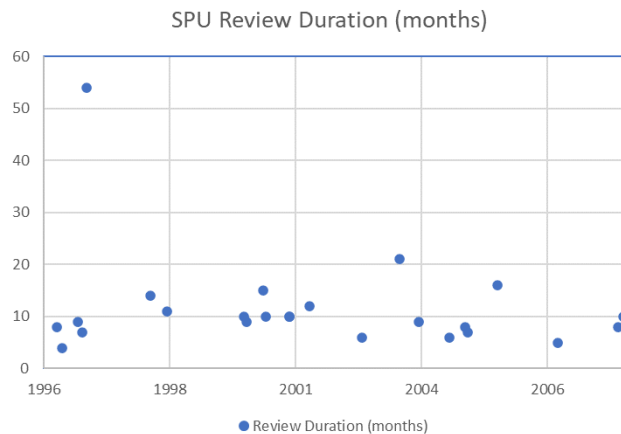


MUR Cost Billed (\$M)



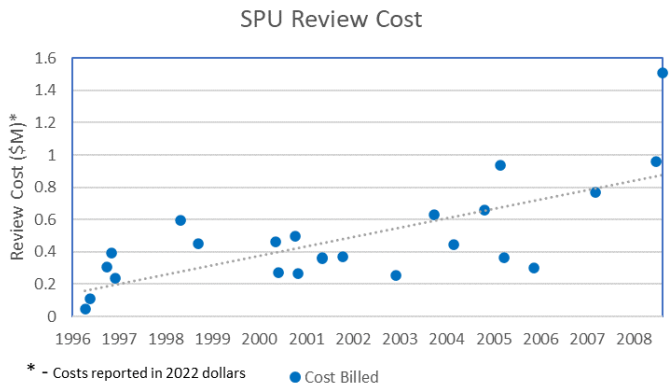
Stretch Power Uprates (SPUs) typically result in an increase in power between 2 and 7 percent and usually involve changes to instrumentation settings. SPUs do not require major plant modifications. The data for SPU applications show a relatively steady review duration but significant increase in both review hours and review costs.

**Review duration stable at ~12 months**

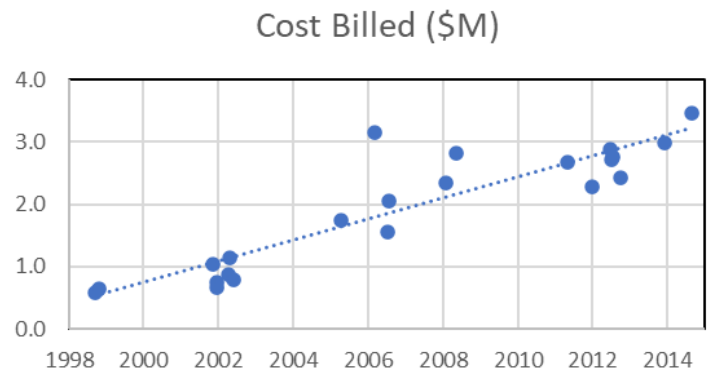
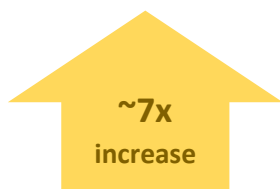
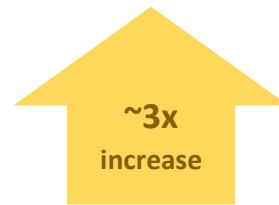
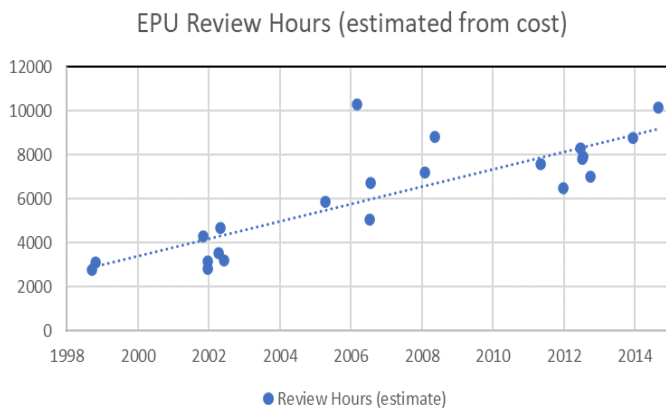
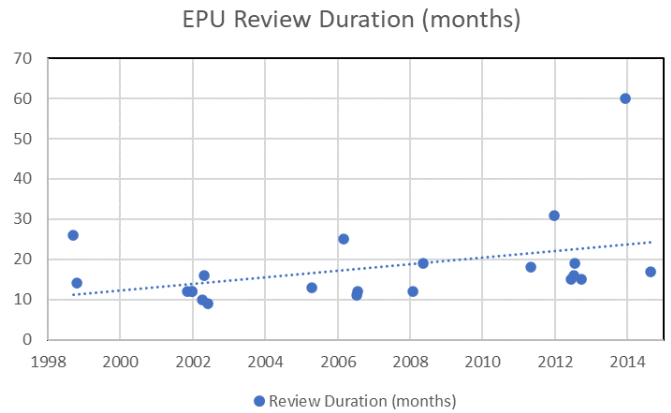
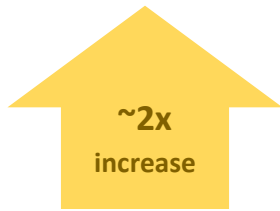


**Review hours have tripled**

**Review costs have tripled**



Extended Power Uprates (EPU) involve increases ranging from 6 percent up to 20 percent. They usually involve modifications to major pieces of non-nuclear equipment, such as high-pressure turbines, condensate pumps and motors, main generators and/or transformers. The data for EPU applications show a doubling of review time. The review costs increased by a factor of 8 and review hours increased by a factor of 3.

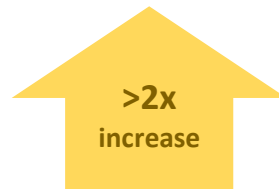
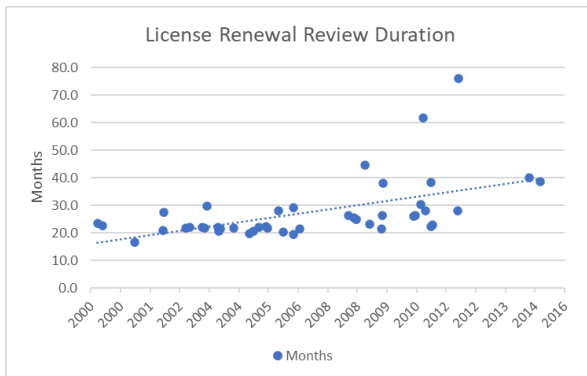


\* - Costs reported in 2022 dollars ● Cost Billed (\$M)

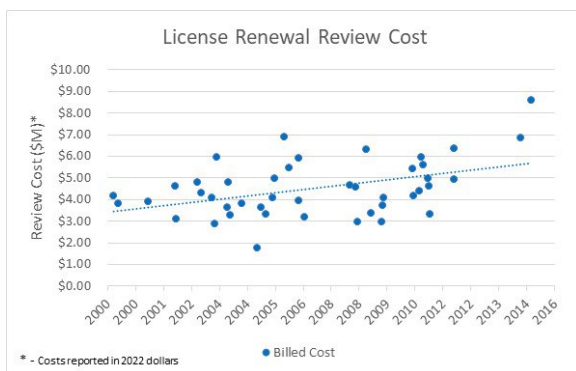
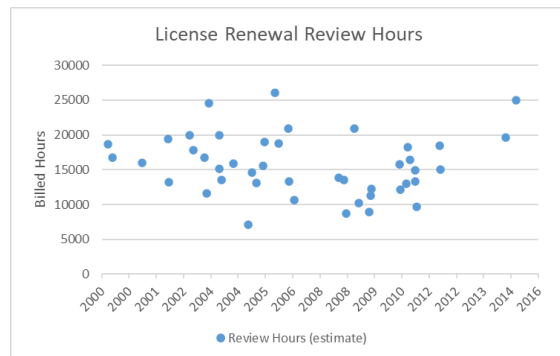
## License Renewal

The NRC regulations limit commercial power reactor licenses to an initial 40 years but also permit such licenses to be renewed if safety is ensured. This original 40-year term for reactor licenses was based on economic and antitrust considerations -- not on any limitation of the power plant. The regulatory review focuses on the applicant's ability to effectively manage any age-related degradation of passive components.

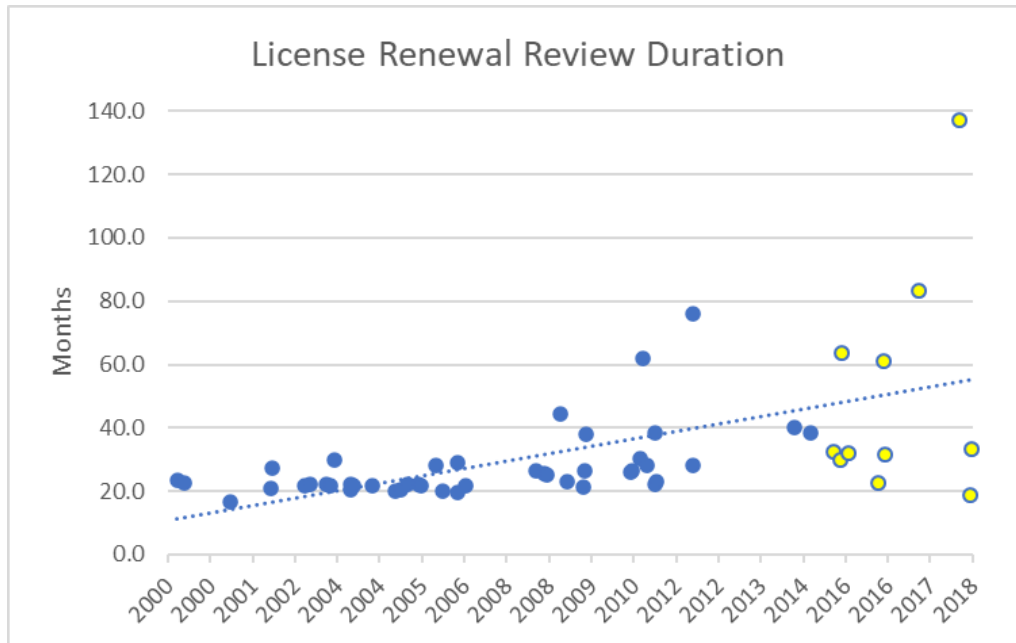
Although the NRC has reviewed and approved license renewal for most of the power reactor fleet, schedules and resource expenditures for initial license renewal reviews are trending in the wrong direction. At its peak performance, the NRC averaged less than 16,000 hours per license renewal review and largely adhered to an 18-month completion target. Review estimates for the most recent license renewal application is 23,000 hours with a review schedule of 22 months.



**Review hours  
highly  
variable**



While billing and review hour information for license renewal reviews performed since the release of the 2015 QFR data is not readily available, an examination of the review duration, post 2015, continues to show an upward trend.



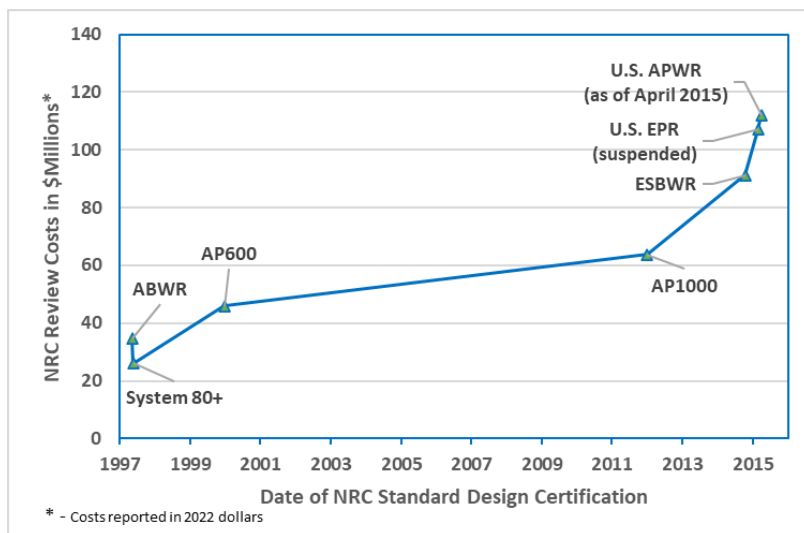
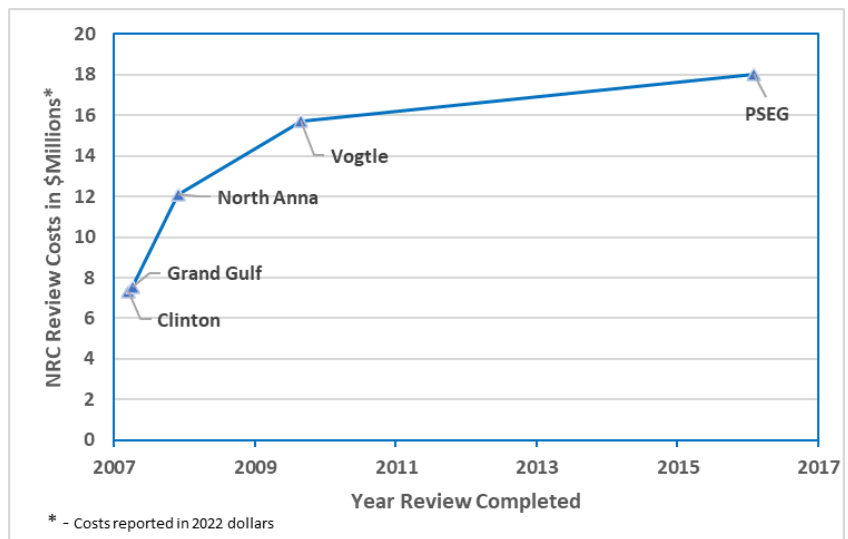
Many plants are now considering a second round of license renewal or subsequent license renewal. To a large degree, a subsequent license renewal review should confirm that any changes needed to the existing aging management programs are adequate and any additional aging mechanisms are included to account for operation to eighty years of operation. However, NRC schedules and resource expenditures for subsequent license renewal reviews are also trending in the wrong direction. Review estimates for the first eight subsequent license renewal applications averaged 23,500 hours and actual expenditures for the three completed reviews were over 25,000 hours (approximately \$7.5 million), with review schedules ranging from 18 to 28 months. The most recent review targets have climbed to 22 months review duration, 23,000 review hours and \$6.4 million. These estimates are expected to continue to rise as more submittals enter the queue.

## New Reactor Reviews

In order for the Nation to achieve its carbon reduction and energy security goals, the NRC will be called upon to review and approve in a timely manner numerous advanced reactor designs, issue construction and operating licenses and siting permits on a scale it has not seen in almost fifty years. Unfortunately, experience with new reactor reviews illustrates that the NRC has continually increased the duration and resources required for new plant reviews, even with advanced technology that is walk-away safe.

- The costs for early site permits (ESPs) issued between 2009 and 2016 have increased by a factor of three.
- The costs of design reviews have increased by more than a factor of four over the last three decades.

~3x  
increase in  
NRC review  
costs



>4x  
increase in  
NRC review  
costs