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Volume 41

Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2019

Fifty-Second Annual Report

Office of Nuclear Regulatory Research

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PREVIOUS REPORTS IN THIS SERIES

WASH-1311	A Compilation of Occupational Radiation Exposure from Light Water Cooled Nuclear Power Plants, 1969–1973, U.S. Atomic Energy Commission, May 1974.
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NUREG-0323	Occupational Radiation Exposure at Light Water Cooled Power Reactors, 1969–1976, U.S. Nuclear Regulatory Commission, March 1978.
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NUREG-0713	Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities, 2018, Vol. 40, U.S. Nuclear Regulatory Commission, April 2020.

Previous reports in the NUREG-0714 series, which are now combined with NUREG-0713, are as follows:

WASH-1350-R1/ WASH-1350 R6	First through Sixth Annual Reports of the Operation of the U.S. AEC's Centralized Ionizing Radiation Exposure Records and Reporting System, U.S. Atomic Energy Commission.
NUREG-75/108	Seventh Annual Occupational Radiation Exposure Report for Certain NRC Licensees, 1974, U.S. Nuclear Regulatory Commission, October 1975.
NUREG-0119	Eighth Annual Occupational Radiation Exposure Report for 1975, U.S. Nuclear Regulatory Commission, October 1976.
NUREG-0322	Ninth Annual Occupational Radiation Exposure Report for 1976, U.S. Nuclear Regulatory Commission, October 1977.
NUREG-0463	Tenth Annual Occupational Radiation Exposure Report for 1977, U.S. Nuclear Regulatory Commission, October 1978.
NUREG-0593	Eleventh Annual Occupational Radiation Exposure Report for 1978, U.S. Nuclear Regulatory Commission, January 1981.
NUREG-0714	Twelfth Annual Occupational Radiation Exposure Report for 1979, Vol. 1, U.S. Nuclear Regulatory Commission, August 1982.
NUREG-0714	Occupational Radiation Exposure, Thirteenth and Fourteenth Annual Reports, 1980 and 1981, Vols. 2 and 3, U.S. Nuclear Regulatory Commission, October 1983.
NUREG-0714	Occupational Radiation Exposure, Fifteenth and Sixteenth Annual Reports, 1982 and 1983, Vols. 4 and 5, U.S. Nuclear Regulatory Commission, October 1985.

ABSTRACT

This report summarizes the occupational exposure data that are maintained in the U.S. Nuclear Regulatory Commission (NRC) Radiation Exposure Information and Reporting System (REIRS) database. The bulk of the information contained in this report was compiled from the 2019 annual reports submitted by five of the seven categories[1] of NRC licensees subject to the reporting requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) 20.2206, "Reports of Individual Monitoring." Because there are no geologic repositories for high-level waste currently licensed and no NRC-licensed low-level waste disposal facilities currently in operation, only five categories are considered in this report. The annual reports submitted by these licensees consist of radiation exposure records for each monitored individual. These records are analyzed for trends and presented in this report in terms of collective dose and the distribution of dose among the monitored individuals.

In the Fiscal Year 2022 Annual Evaluation Plan [Ref. 11] the NRC developed its Annual Evaluation Plan which included an evaluation of the "Radiation Protection Program." The purpose of the Outcome Evaluation of the "Radiation Protection Program" is to measure the effectiveness NRC's Radiation Protection Program as it pertains to as low as is reasonably achievable (ALARA) regulations of 10 CFR 20.1101(b) for each of the NRC-licensee categories. The evaluation included trend analysis of radiation exposure to transient individuals (i.e., those who have been to two or more sites during the year) as well as radiation exposure histories to individuals who were exposed to radiation at NRC-licensed facilities. The evaluation conducted for the Radiation Protection Program analyzed the radiological risk associated with certain categories of NRC-licensed activities and performed comparative analyses of radiation protection performance. Based upon the trend analysis of the occupational exposure data, for all NRC-licensee categories, the overall NRC/licensee radiation protection program is effective with respect to ALARA.

Annual reports for 2019 were received from a total of **181** NRC licensees from the five categories included in this report. The summation of reports submitted by the **181** licensees indicated that **144,243** individuals were monitored, **60,289** of whom received a measurable dose (dose that is reported as a positive value, see Table 3.1). When adjusted for transient individuals, there were actually **102,182** unique individuals that were monitored, **44,848** of whom received a measurable dose (see Section 5).

The collective dose incurred by these individuals was **7,150** person-rem (71,500 person-millisieverts [mSv]), which represents a **12 percent decrease** from the 2018 value (see Table 3.1). The 2019 collective dose is **14 percent lower** than the 5-year average of 8,348 person-rem (2014 – 2018), which is a statistically significant change.[2] The decrease in collective dose in 2019 was due to decreases in two categories offsetting increases in the remaining three reporting categories. Two reporting categories reported decreases, namely, industrial radiography licensees (**15 percent decrease**) and commercial nuclear power reactor licensees (**13 percent decrease)**. Three reporting categories reported increases; spent fuel storage licensees (**11 percent increase**), fuel cycle licenses (**9 percent increase**) and manufacturing and distribution (M&D) licensees (**8 percent increase)**. When compared to the 5-year average of collective dose for

[1] Commercial nuclear power reactors and test reactor facilities; industrial radiographers; fuel processors (including uranium enrichment facilities), fabricators, and reprocessors; manufacturing and distribution of byproduct material; independent spent fuel storage installations; facilities for land disposal of low-level waste; and geologic repositories for high-level waste. There are currently no NRC licensees involved in low-level waste disposal or geologic repositories for high-level waste.

[2] This report presents additional Statistical Comparisons in Section 2.2.

each category, commercial nuclear power reactor licensees had a statistically significant decrease. The increases or decreases for the remaining three categories were not statistically significant.

The number of individuals receiving a measurable dose decreased by **11 percent** from 2018, and was **15 percent below** the 5-year average and statistically significant. When adjusted for transient individuals, the average measurable dose of **0.20 rem** (2.0 mSv) was slightly higher in 2019, compared to **0.17 rem** (1.7 mSv) in 2018, and is statistically significant when compared to the 5-year average. The average measurable dose is defined as the total effective dose equivalent (TEDE) divided by the number of individuals receiving a measurable dose.

In calendar year 2019, the average annual collective dose per reactor for light-water reactor (LWR) licensees was **53** person-rem (530 person-mSv). This is a **10 percent decrease** from the value reported for 2018 (Table 4.3) and is statistically significant when compared to the 5-year average. The total outage hours at commercial nuclear power plants decreased **12 percent** from 2018 to 2019 [Ref. 1]. The collective dose for the LWR licensee category decreased **748** person-rem (7,480 person-mSv) from **5,829** person-rem (58,290 person-mSv) in 2018 to **5,081** person-rem (50,810 person-mSv). The average annual collective dose per reactor was **105** person-rem (1,050 person-mSv) for the 32 boiling-water reactors (BWRs) and **27** person-rem (270 person-mSv) for 64 pressurized-water reactors (PWRs). The BWR 2019 value is **6 percent** lower than the 5-year average annual collective dose per BWR reactor, but is not statistically significant. The 2019 value for PWR licensees is **32 percent** below the 5-year average annual collective dose per PWR reactor and is statistically significant when compared to the 5-year average. The primary driver for the decrease in collective dose was the closure of Three Mile Island 1 (PWR) and Pilgrim 1 (BWR).

There were **23,196** individuals that were monitored at two or more licensees during the monitoring year. The assessment of the average measurable dose per individual is adjusted each year to account for the reporting of a measurable dose for transient individuals by multiple licensees. The adjustment to account for transient individuals has been specifically noted in footnotes in the figures and tables for commercial nuclear power reactors.

FOREWORD

Through this annual report, the U.S. Nuclear Regulatory Commission (NRC) supports openness in its regulatory process by providing the public with accurate and timely information about the radiation protection program of NRC licensees. Toward that end, NUREG-0713, Volume 41, summarizes the 2019 occupational radiation exposure data maintained in the NRC Radiation Exposure Information and Reporting System (REIRS) database.

Seven categories of NRC licensees are required to report annually on individual exposure in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR 20.2206, "Reports of Individual Monitoring"). Specifically, these categories include commercial nuclear power reactors and test reactor facilities; industrial radiographers; fuel processors (including uranium enrichment facilities), fabricators, and reprocessors; manufacturing and distribution of byproduct material; independent spent fuel storage installations; facilities for land disposal of low-level waste; and geologic repositories for high-level waste. Because the NRC has not licensed any geologic repositories for high-level waste and all low-level waste disposal facilities are regulated by Agreement States, this report considers only the first five categories of NRC licensees. As such, this report reflects the occupational radiation exposure data that the NRC received from 181 licensees.

The data submitted by licensees consist of radiation exposure records for each monitored individual. Adjusted for transient individuals who worked at two or more facilities during the year, 102,182 were monitored and 44,848 received a measurable dose in 2019. This report analyzes and presents these records in terms of collective dose and the distribution of dose among the monitored individuals.

PREFACE

A number of U.S. Nuclear Regulatory Commission (NRC) licensees have inquired as to how the occupational radiation exposure data that are compiled from the individual exposure reports required by Title 10 of the *Code of Federal Regulations* (10 CFR) 20.2206, "Reports of Individual Monitoring," are used by the NRC staff. In combination with other sources of information, the principal uses of the data are to provide facts regarding routine occupational exposures to radiation and radioactive material that occur in connection with certain NRC-licensed activities for use in making decisions that impact public health and safety. The NRC staff uses this data for the following purposes:

1. The data is used to perform a trend analysis that may produce either favorable or unfavorable results. The trend analysis, in part, provides insights into the evaluation findings for the effectiveness of the NRC and licensee radiation protection and as low as is reasonably achievable (ALARA) efforts.

2. The data is analyzed to make evidence-based decisions regarding the radiological risks associated with certain categories of NRC-licensed activities. A comparative analysis using the radiological risks is then performed to determine radiation protection performance (e.g., U.S./foreign, boiling-water reactors/pressurized-water reactors [BWRs/PWRs], civilian/military, facility/facility, nuclear industry/other industries).

3. The data are used within the NRC Reactor Oversight Process for inspection planning and in the Significance Determination Process.

4. The data is analyzed to make evidence-based decisions regarding the radiation exposure to transient individuals.

5. The data are used to establish priorities for the use of NRC health physics resources: research, standards development, regulatory program development, and inspections conducted at NRC-licensed facilities.

6. The data are interpreted to provide insights that are evidence-based and will assist in answering Congressional and administrative inquiries as well as responding to questions raised by the public.

7. The data are used to determine radiation exposure histories to individuals who were exposed to radiation at NRC-licensed facilities.

8. The data can be used to conduct epidemiologic studies.

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ABBREVIATIONS AND ACRONYMS

AEC	U.S. Atomic Energy Commission
ALARA	as low as is reasonably achievable
BWR	boiling-water reactor
CDE	committed dose equivalent
CEDE	committed effective dose equivalent
CFR	Code of Federal Regulations
D&D	decontamination and decommissioning
DDE	deep dose equivalent
DOE	U.S. Department of Energy
ERDA	Energy Research and Development Administration
EVESR	ESADA Vallecitos Experimental Superheat Reactor
FBR	fast breeder reactor
FSSR	final status survey report
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
ISFSI	independent spent fuel storage installation
ISOE	Information System on Occupational Exposure
ISOEDAT	Information System on Occupational Exposure Database
LDE	lens dose equivalent
LTP	license termination plan
LWR	light-water reactor
M&D	manufacturing and distribution
mSv	millisievert
MW	megawatts
MWe	megawatts electric
MWt	megawatts thermal
MW-hr	megawatt-hour
MW-yr	megawatt-year
NEA	Nuclear Energy Agency
NMSS	Office of Nuclear Material Safety and Safeguards
NRC	U.S. Nuclear Regulatory Commission
NS	Nuclear Ship
OECD	Organisation for Economic Co-operation and Development
PSDAR	post-shutdown decommissioning activities report
PWR	pressurized-water reactor
REIRS	Radiation Exposure Information and Reporting System

SDE-ME	shallow dose equivalent maximally exposed extremity
SDE-WB	shallow dose equivalent whole body
SI	international system of units
SG	steam generator
Sv	sieverts
TBD	to be determined
TEDE	total effective dose equivalent
TMI	Three Mile Island
TODE	total organ dose equivalent
UF_6	uranium hexafluoride
VBWR	Vallecitos Boiling-Water Reactor

1 INTRODUCTION

1.1 Background

One of the basic purposes of the Atomic Energy Act and the implementing regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, "Standards for Protection Against Radiation," is to protect the health and safety of the public, including the employees of the licensees conducting operations under those regulations.

On November 4, 1968, the U.S. Atomic Energy Commission (AEC) published an amendment to 10 CFR Part 20 requiring the reporting of a statistical summary of occupational radiation exposure information (but not individual exposure records) to a central repository at AEC Headquarters. At that time, there were only four categories[1] of AEC licensees required to report. These facilities were considered to have the greatest potential for significant occupational doses. Licensees were required to report the total number of individuals who were monitored per dose range (§20.407) and provide cumulative radiation exposure reports for individuals no longer employed (§20.408). Occupational exposure data were extracted from these reports and entered into the AEC Radiation Exposure Information and Reporting System (REIRS), a computer system that was maintained at the Oak Ridge National Laboratory Computer Technology Center in Oak Ridge, TN, until May 1990.

At that time, the data were transferred to a database management system and are now maintained at the Oak Ridge Institute for Science and Education, which is managed by Oak Ridge Associated Universities. The computerization of these data facilitates their collection and analysis. The data maintained in REIRS have been summarized and published in a report every year since 1969. Annual reports for each of the years 1969 through 1973 presented the data reported by both AEC licensees and contractors and were published in six documents designated as WASH-1350-R1 through WASH-1350-R6.

In January 1975, with the separation of AEC into the Energy Research and Development Administration (ERDA) and the U.S. Nuclear Regulatory Commission (NRC), each agency assumed responsibility for collecting and maintaining occupational radiation exposure information reported by the facilities under its jurisdiction. The annual reports published by the NRC on occupational exposure for calendar year 1974 and subsequent years do not contain information pertaining to ERDA facilities or contractors. Comparable information for facilities and contractors under ERDA, now the U.S. Department of Energy (DOE) is collected and published by the DOE Office of ES&H Reporting and Analysis within the Office of Environment, Health, Safety and Security in Germantown, MD.

In 1982 and 1983, 10 CFR 20.408(a) was amended to require three additional categories of NRC licensees to submit annual statistical exposure reports and individual termination exposure reports. The three additional NRC licensee categories were: (1) geologic repositories for high-level radioactive waste, (2) independent spent fuel storage installations (ISFSIs), and (3) facilities for the land disposal of low-level radioactive waste. This document presents the exposure information that was reported by NRC licensees representing one of these additional categories

[1] Commercial nuclear power reactors; industrial radiographers; fuel processors (including uranium enrichment facilities as of 1997), fabricators, and reprocessors; and manufacturing and distribution of specified quantities of byproduct material.

(i.e., ISFSIs), since there are no geologic repositories for high-level waste currently licensed and there are no low-level waste land disposal facilities currently in operation that report to the NRC.

In May 1991, 10 CFR Part 20 was revised to redefine the radiation monitoring and reporting requirements of NRC licensees. Instead of submitting annual reports summarizing the total number of individuals who were monitored (§20.407) and termination reports (§20.408), licensees were required to submit an annual report of the dose received by each monitored individual (§20.2206). Licensees were required to implement the new requirements no later than January 1994. The regulations in 10 CFR 20.1502 specify conditions that require individual monitoring of external and internal occupational dose. Each licensee is also required, under 10 CFR 20.2106, to maintain records of the results of such monitoring until the Commission terminates the license.

This report summarizes information reported for the current year and previous 10 years. More licensee-specific data for the previous 10 years, such as the annual reports submitted by each commercial nuclear power reactor pursuant to 10 CFR 20.407 and 20.2206 (after 1993) and their technical specifications (before Volume 20 of this report), may be found in the documents listed on the inside of the front cover of this report for the specific year desired. Additional operating data and statistics for each commercial nuclear power reactor for the years 1973 through 1982 may be found in a series of reports, “Nuclear Power Plant Operating Experience” [Refs. 2–10]. These documents are available for viewing at all NRC public document rooms, as well as on the NRC public Web site (https://www.nrc.gov), or they may be purchased from the National Technical Information Service, as shown in the References section.

1.2 Radiation Exposure Information on the Internet

In May 1995, the NRC began disseminating radiation exposure information at a Web site on the Internet. This site allows interested parties to access the data electronically rather than through the published NUREG-0713 document. A Web site was created for radiation exposure and linked to the main NRC Web page. The Web site contains up-to-date information on radiation exposure, as well as information and guidance on reporting radiation exposure information to the NRC. Interested parties may read the documents on line or download information for further analysis. REIRView, a software package designed to validate a licensee’s annual data submittal, is available for downloading on the Web site. There are also links to other Web sites dealing with the topics of radiation and health physics. Individuals may submit requests for their dose records contained in REIRS on this Web site. In addition, organizations that have provided documentation to the NRC may submit requests for dose records contained in REIRS on this Web site.

The NRC intends to continue disseminating radiation exposure information on the Web and will focus more resources on the electronic distribution of information rather than on the publication of hard-copy reports.

The main Web address for the NRC is

https://www.nrc.gov

The NRC radiation exposure information Web URL is

https://www.reirs.com

Comments on this report or on the NRC's radiation exposure Web page should be directed to

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1.3 Evidence and Evaluation

1.3.1 Annual Evaluation Plan

In the Fiscal Year 2022 Annual Evaluation Plan [Ref. 11] the NRC developed its Annual Evaluation Plan which included an evaluation of the "Radiation Protection Program." Evaluations included in the annual evaluation plan, such as this evaluation of the Radiation Protection Program, are considered to be of significance to the agency. The purpose of the Outcome Evaluation of the Radiation Protection Program is to measure the effectiveness NRC's Radiation Protection Program as it pertains to NRC's as low as is reasonably achievable (ALARA) regulations of 10 CFR 20.1101(b) along 1 with the licensee's implementation of this regulation for each of the NRC-licensee categories.

By analyzing the data pertaining to number of licensees reporting exposure, the number of individuals monitored, the collective dose, and exposure trends (i.e., average individual and measurable doses) across the five categories of licensees,[2] relative strengths or areas for improvement may be identified. The analyses and assessments will be used for this evaluation to identify potential improvements to NRC's regulatory programs (i.e., licensing, inspection and rule-making).

The NRC conducted evidence-building and evaluation activities to fulfill this project's objective by answering questions such as the following:

- How can the agency use radiation exposure data from NRC-licensed facilities to assess whether the NRC's radiation protection regulatory programs are achieving their intended outcomes?

[2] The five categories include: commercial nuclear power reactors and test reactor facilities; industrial radiographers; fuel processors (including uranium enrichment facilities), fabricators, and reprocessors; manufacturing and distribution of byproduct material; independent spent fuel storage installations; facilities for land disposal of low-level waste; and geologic repositories for high-level waste. There are currently no NRC licensees involved in low-level waste disposal or geologic repositories for high-level waste.

- What do the trends in radiation exposure data at NRC licensed facilities suggest about the radiation protection programs' effectiveness over time?
- Does the data suggest differences in the effectiveness across the agency's radiation protection programs?
- Will increased data use provide insights into potential performance measures or process improvements relating to risk-informed regulation?

In order to complete the objective of this evaluation plan, the NRC performed an Outcome Evaluation to measure the effectiveness of the Agency's regulatory programs with respect to radiation protection. The Outcome Evaluation helps answer the question of the effectiveness of the Radiation Protection Program for the various NRC-licensee categories.

Section 2 of this report provides a discussion of the radiation exposure data including limitations and statistical comparisons of the data. The inferences and statements used to support the evaluation findings are based upon the data as reported by licensees, which does not include uncertainty values associated with the dosimetric calculations. All statistical inferences are made at the population level, i.e., aggregated doses for a licensee or group of licensees. Sections 3 and 4 of this report provides summaries of the data and trends for each of the licensee five categories. Finally, Section 7 of this report provides a discussion of the radiation protection program evaluation and the effectiveness of the NRC regulatory programs to appropriately limit the occupational dose to nuclear workers.

2 LIMITATIONS OF THE DATA

2.1 Limitations

All of the figures compiled in this report relating to exposures and occupational doses are based on the results and interpretations of the readings of various types of personnel-monitoring devices employed by each licensee. This data, obtained from routine personnel-monitoring programs, assists in characterizing the radiation exposure incident to individuals' work and is used in evaluating the radiation protection program.

Monitoring requirements are specified in 10 CFR 20.1502, which requires licensees to monitor individuals at levels sufficient to demonstrate compliance with occupational dose limits. As a minimum, monitoring must be provided for adults likely to receive, in 1 year from sources external to the body, a dose in excess of 10 percent of the applicable limits in 10 CFR 20.1201(a) and all individuals entering a high or very high radiation area. Separate dose limits have been established for minors, declared pregnant women, and members of the public. Depending on the administrative policy of each licensee, persons such as visitors and administrative individuals may also be provided with monitoring devices, even though the probability of their exposure to measurable levels of radiation is extremely small.

Pursuant to 10 CFR 20.2206(b), certain categories of licensees must submit an annual report of the results of individual monitoring carried out by the licensee for each individual for whom monitoring was required by 10 CFR 20.1502. In addition to this requirement, many licensees elect to report the doses for every individual for whom they provided monitoring. This practice increases the number of individuals that are monitored for radiation exposure. In an effort to account for this increase, the number of individuals reported as having "no measurable dose"[1] is subtracted from the total number of monitored individuals. This resulting number can then be used to calculate the average measurable dose per individual with a measurable dose, as well as the average dose per monitored individual (i.e., with or without a measurable dose).

This report can be obtained from the Web site, www.reirs.com. This report does not include compilations of non-occupational exposures, such as exposures received by medical patients from X-rays, fluoroscopy, or accelerators.

This report contains information reported by NRC licensees. Since NRC licenses all commercial nuclear power reactors, fuel processors and fabricators, and ISFSIs, information shown for these categories reflect all relevant activity in the United States. This is not the case, however, for the remaining categories of industrial radiography, manufacturing and distribution (M&D) of specified quantities of byproduct material, and low-level waste disposal. Many companies that conduct these types of activities are located in Agreement States. More than six times as many facilities are licensed and regulated by Agreement States than are licensed and regulated by the NRC. Agreement States are not required to adopt the reporting requirements in 10 CFR 20.2206. As a result, Agreement State licensees are not required to submit occupational dose reports to the NRC.

Although some Agreement State licensees voluntarily submit occupational dose reports to the NRC, these results are not included in the analyses presented in Sections 3, 5, and 6 of this report. NUREG-2118, *Occupational Radiation Exposure at Agreement State-Licensed Materials*

[1] The number of individuals with measurable dose includes any individual with a total effective dose equivalent (TEDE) greater than zero rem. Individuals reported with zero dose, or no detectable dose, are included in the number of individuals with no measurable exposure.

Facilities, 1997-2010, provides information regarding occupational radiation exposures at Agreement State-licensed facilities [Ref. 12].

The average dose per individual, as well as the dose distributions shown for groups of licensees, also can be affected by the multiple reporting of individuals who were monitored by two or more licensees during the year. Licensees are only required to report the doses received by individuals at their licensed facilities. Section 5 contains an analysis that adjusts the data for transient individuals being counted more than once.

When examining the annual statistical data, it is important to note that all of the personnel included in the report may not have been monitored throughout the entire year. Many licensees, such as radiography firms and commercial nuclear power reactors, may monitor numerous individuals for periods of much less than a year.

Considerable attention should be given when referencing the collective totals presented in this report. The differences between the totals presented for all licensees that reported versus only those licensees that are required to report should be noted. See Section 1.1 for the categories of licensees that are required to report to REIRS. A number of licensees are not required to report to REIRS, but voluntarily report for convenient recordkeeping or because they have reported in the past and have decided to continue this practice. These licensees are listed in Appendix A, Table A2 – "Other Facilities Reporting to the NRC, 2019."

Although uncommon, the data contained in this report are subject to change because licensees may submit corrections or additions to data for previous years.

All dose equivalent values in this report are given in units of rem in accordance with the general provisions for records in 10 CFR 20.2101(a).

1 rem = 0.01 sievert (Sv)
1 rem = 10 millisievert (mSv)
1 Curie (Ci) = 3.7 X 10^{10} Becquerel (Bq)

2.2 Statistical Comparisons

For statistical comparisons of averages, a two-sided one-sample t test with a 0.05 significance level (i.e., 95 percent confidence) is used to determine whether the difference between the two averages is significantly different. For values that are not averages, such as total collective dose, a 5-year average from the previous 5 years (not including the current year under consideration) is calculated with 95 percent confidence interval based on the normal distribution. If the value for the current year falls within the 5-year 95 percent confidence interval, then it is not significantly different; whereas, if the value falls outside (i.e., below the lower limit or above the upper limit), there is an indication of a statistical significant change.

Two-sided one-sample t test formula:

$$t = \frac{\bar{X} - \mu}{\frac{s}{\sqrt{n}}}$$

Where:

t = calculated t statistic

$\bar{X}$ = sample mean

μ = population mean

S = sample standard deviation

n = sample number

Example:

We wish to determine if the average measurable dose for a type of nuclear reactor differs from the previous 5 years. The 5-year mean for the average measurable dose is 0.080. The population mean is the current year's average measurable dose, 0.060. The sample standard deviation is 0.01, and the sample number is 5. Using the formula,

$$t = \frac{0.080 - 0.060}{\frac{0.01}{2.236}} = 4.472$$

The two-tailed probability value (as obtained from a Student's t distribution table) given a t-value of 4.472 is 0.006 which is statistically significant at a 0.05 significance level.

It should be noted that an analysis of the uncertainties associated with dosimetry and dose measurement is not included in this report as the information required for such an analysis is not required to be reported to the NRC. The inferences and statements represented in the report are based upon the data as reported by the licensees, which does not include uncertainty values associated with the dosimetric calculations. All statistical inferences are made at the population level, e.g., aggregated doses for a licensee or group of licensees.

3 ANNUAL PERSONNEL MONITORING REPORTS – 10 CFR 20.2206

3.1 Definition of Terms and Methodologies

3.1.1 Number of Licensees Reporting

The number of licensees in each category is provided in Table 3.1 for each of the seven[1] categories that are required to report pursuant to 10 CFR 20.2206. The first column denotes the NRC license category and the program code. The program code is a five-digit number assigned by NRC to each licensee to designate the major activity or principal use authorized in the license. A full description and definition is referenced in *Consolidated Guidance about Materials Licenses*, NUREG-1556, Volume 20, Appendix G [Ref. 13]. The third column in Table 3.1 shows the number of licensees that have filed such reports during the past 11 years. All commercial nuclear power reactors, fuel processors and fabricators, and ISFSIs are required to report occupational exposures to the NRC, whether or not they are in an Agreement State.

Many companies that conduct industrial radiography and M&D activities are located in and regulated by Agreement States and are, therefore, not required to adopt the reporting requirements of 10 CFR 20.2206. However, industrial radiography and M&D licensees that are licensed and regulated by the NRC are required to report occupational exposure to the NRC. Appendix A, Table A1 lists all nonreactor licensees that reported occupational data to the NRC in 2019.

3.1.2 Number of Monitored Individuals

The number of monitored individuals refers to the total number of individuals that NRC licensees reported as being monitored for exposure to external or internal radiation during the year. This number includes both individuals for whom monitoring is required, as well as individuals for whom monitoring was voluntarily provided and reported (e.g., workers receiving a minimal dose below the monitoring threshold, visitors, service representatives, contract individuals, and administrative individuals).

The total number of individuals was determined from the number of unique personal identification numbers submitted per licensee. Uniqueness is defined by the combination of identification number and identification type [Ref. 14].

3.1.3 Number of Individuals with Measurable Dose

The number of individuals with a measurable dose includes any individual with a total effective dose equivalent (TEDE) that is reported as a positive value.

[1] These categories are commercial nuclear power reactors and test reactor facilities; industrial radiographers; fuel processors (including uranium enrichment facilities), fabricators, and reprocessors; manufacturing and distribution of byproduct material; ISFSIs; facilities for land disposal of low-level waste; and geologic repositories for high-level waste. There are currently no NRC licensees involved in low-level waste disposal or geologic repositories for high-level waste.

Table 3.1 Average Annual Exposure Data for Certain Categories of NRC Licensees 2009–2019

NRC License Category* and Program Code	Calendar Year	Number of Licensees Reporting	Number of Monitored Individuals	Number of Individuals with Measurable TEDE	Collective TEDE (person-rem)	Average TEDE (rem)	Average Measurable TEDE per Individual (rem)
Industrial Radiography **03310** **03320**	2009	65	2,662	2,307	1,317.982	0.50	0.57
	2010	57	2,377	2,034	1,297.300	0.55	0.64
	2011	64	2,545	2,210	1,608.821	0.63	0.73
	2012	67	2,670	2,275	1,508.792	0.57	0.66
	2013	60	2,925	2,506	1,547.351	0.53	0.62
	2014	57	3,288	2,862	1,778.171	0.54	0.62
	2015	69	3,426	2,908	1,695.040	0.49	0.58
	2016	64	3,035	2,635	1,270.459	0.42	0.48
	2017	62	3,389	2,912	1,709.858	0.50	0.59
	2018	61	3,876	3,303	1,967.879	0.51	0.60
	2019	60	3,732	3,152	1,668.408	0.45	0.53
Manufacturing and Distribution **02500** **03211** **03212** **03214**	2009	17	1,939	1,388	179.539	0.09	0.13
	2010	18	976	672	146.667	0.15	0.22
	2011	16	903	702	112.023	0.12	0.16
	2012	22	1,057	713	118.709	0.11	0.17
	2013	20	994	627	114.550	0.12	0.18
	2014	19	962	656	138.631	0.14	0.21
	2015	21	949	634	155.688	0.16	0.25
	2016	21	905	606	142.958	0.16	0.24
	2017	21	940	615	139.071	0.15	0.23
	2018	14	1,086	718	136.505	0.13	0.19
	2019	16	1,188	804	147.927	0.12	0.18
Independent Spent Fuel Storage **23100** **23200**	2009	2	72	34	1.465	0.02	0.04
	2010	2	73	39	1.337	0.02	0.03
	2011	2	54	25	1.449	0.03	0.06
	2012	2	42	15	1.099	0.03	0.07
	2013	2	53	18	1.533	0.03	0.09
	2014	2	51	22	3.192	0.06	0.15
	2015	2	57	20	1.102	0.02	0.06
	2016	2	57	22	0.579	0.01	0.03
	2017	2	67	20	0.631	0.01	0.03
	2018	2	70	17	1.740	0.02	0.10
	2019	2	79	28	1.939	0.02	0.07
Fuel Cycle Licenses - Fabrication, Processing, and Uranium Enrichment, and Uranium Hexafluoride (UF_6) Production Plants **11400** **21200** **21210**	2009	11	8,918	3,738	533.721	0.06	0.14
	2010	11	9,362	4,212	541.876	0.06	0.13
	2011	11	9,535	4,361	607.202	0.06	0.14
	2012	9	7,388	3,541	438.729	0.06	0.12
	2013	8	7,476	3,942	357.067	0.05	0.09
	2014	9	6,689	3,685	366.224	0.05	0.10
	2015	7	5,296	3,033	327.112	0.06	0.11
	2016	7	5,413	2,999	277.687	0.05	0.09
	2017	7	5,058	2,930	254.997	0.05	0.09
	2018	7	4,737	2,783	229.530	0.05	0.08
	2019	7	4,347	2,690	250.522	0.06	0.09
Commercial Light-Water Reactors (LWRs) ** **41111**	2009	104	176,381	81,754	10,024.804	0.06	0.12
	2010	104	179,648	75,010	8,631.384	0.05	0.12
	2011	104	191,538	81,321	8,771.326	0.05	0.11
	2012	104	193,977	79,549	8,035.393	0.04	0.10
	2013	100	174,614	67,236	6,759.547	0.04	0.10
	2014	100	174,853	70,847	7,124.519	0.04	0.10
	2015	99	176,886	70,798	7,019.088	0.04	0.10
	2016	99	155,574	59,353	5,365.709	0.03	0.09
	2017	99	157,072	64,761	6,416.548	0.04	0.10
	2018	98	150,219	61,014	5,829.471	0.04	0.10
	2019	96	134,897	53,615	5,080.795	0.04	0.09
Grand Totals and Averages	2009	199	189,972	89,221	12,057.511	0.06	0.14
	2010	192	192,436	81,967	10,618.564	0.06	0.13
	2011	197	204,575	88,619	11,100.821	0.05	0.13
	2012	204	205,134	86,093	10,102.722	0.05	0.12
	2013	190	186,062	74,329	8,780.048	0.05	0.12
	2014	187	185,843	78,072	9,410.737	0.05	0.12
	2015	198	186,614	77,393	9,198.030	0.05	0.12
	2016	193	164,984	65,615	7,057.392	0.04	0.11
	2017	190	159,355	67,341	7,909.670	0.05	0.12
	2018	182	159,988	67,835	8,165.125	0.05	0.12
	2019	181	144,243	60,289	7,149.591	0.05	0.12

NOTE: The data shown in this table for all categories of licensees have not been adjusted to account for transient workers (see Section 5).

* These categories consist only of NRC licensees required to submit an annual report (see Section 2).

** This category includes all LWRs in commercial operation for a full year for each of the years indicated.

3.1.4 Collective Dose

The concept of collective dose is used in this report to denote the summation of the TEDE received by all monitored individuals within a category and is reported in units of person-rem. Since 10 CFR 20.2206 requires that the TEDE be reported, the collective dose is calculated by summing the TEDE for all monitored individuals in each category.

The phrase “collective dose” is used throughout this report to mean the collective TEDE, unless otherwise specified.

Before the implementation of the revised dose-reporting requirements of 10 CFR 20.2206 in 1994, the collective dose, in some cases, was calculated from the dose distributions by multiplying the number of individuals reported in each of the dose ranges by the midpoint of the corresponding dose range and then summing the products. This assumed that the midpoint of the range was equal to the arithmetic mean of the individual doses in the range. Experience has shown that the actual mean dose of individuals reported in each dose range is less than the midpoint of the range. For this reason, the resultant calculated collective doses shown in this report for these licensees may be approximately 10 percent higher than the sum of the actual individual doses. Care should be taken when comparing the actual collective dose calculated for 1994 to 2019 with the collective dose for years before 1994 because of this change in methodology.

In addition, before 1994, doses only included the external whole-body dose with no internal dose contribution. Although the contribution of internal dose to the TEDE is minimal for most licensees, it should be considered when comparing collective doses for 1994 and later with the collective dose for years before 1994. One noted exception is for fuel fabrication licensees, where the committed effective dose equivalent (CEDE), in some cases, contributes the majority of the TEDE (see Section 3.3.5).

3.1.5 Average Individual Dose

The average individual dose is obtained by dividing the collective dose by the total number of monitored individuals. This figure is usually less than the average measurable dose, because it includes the number of those individuals who received zero or less than measurable doses.

3.1.6 Average Measurable Dose

The average measurable dose is obtained by dividing the collective TEDE by the number of individuals with a measurable dose. This is the average most commonly used in this and other reports when examining trends and comparing doses received by individuals in various segments of the nuclear industry.

3.2 Annual TEDE Dose Distributions

Table 3.2 provides a statistical compilation of the occupational dose reports by categories of licensees (see Section 3.3 for a description of each licensee category). The dose distributions are generated by summing the TEDE for each individual and counting the number of individuals in each dose range. In several licensee categories, a large number of individuals received doses that were less than measurable. Eighty-nine percent of the reported individuals with measurable doses (shown in Table 3.2) were monitored by commercial nuclear power reactors in 2019, where they received 71 percent of the total collective dose.

Table 3.2 Distribution of Annual Collective TEDE by License Category 2019

License Category (Number of sites reporting)	Number of Individuals with TEDE in the Ranges (rem) *													Total Number Monitored	Number with Meas. Dose	Total Collective Dose (TEDE) (person-rem)
	No. Meas.	Meas. <0.025	0.025-0.10	0.10-0.25	0.25-0.50	0.50-0.75	0.75-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-6.0	>6.0			
INDUSTRIAL RADIOGRAPHY																
Fixed Locations (2)	4	2	2	-	1	-	-	-	-	-	1	-	-	10	6	4.695
Temporary Job Sites (58)	576	355	462	535	614	396	243	442	77	20	2	-	-	3,722	3,146	1,663.713
Total (60)	**580**	**340**	**463**	**519**	**615**	**396**	**243**	**442**	**77**	**20**	**3**	**0**	**0**	**3,732**	**3,152**	**1,668.408**
MANUFACTURING AND DISTRIBUTION																
Type "A" Broad (2)	124	81	60	39	47	18	16	30	2	-	-	-	-	417	293	102.107
Type "B" Broad and Other (0)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nuclear Pharmacies (14)	260	229	178	70	22	6	1	1	3	1	-	-	-	771	511	45.820
Total (16)	**384**	**261**	**211**	**112**	**69**	**24**	**17**	**31**	**5**	**1**	**0**	**0**	**0**	**1,188**	**804**	**147.927**
INDEPENDENT SPENT FUEL STORAGE																
Total (2)	**51**	**17**	**4**	**5**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**79**	**28**	**1.939**
FUEL CYCLE*																
Total (7)	**1,657**	**1,241**	**654**	**473**	**249**	**67**	**4**	**2**	**0**	**0**	**0**	**0**	**0**	**4,347**	**2,690**	**250.522**
COMMERCIAL POWER REACTORS**																
Boiling Water (32)	26,370	9,271	10,314	5,643	2,666	803	262	140	1	-	-	-	-	55,470	29,100	3,372.909
Pressurized Water (64)	54,912	9,045	10,438	3,869	970	139	38	16	-	-	-	-	-	79,427	24,515	1,707.886
Total (96)	**81,282**	**18,316**	**20,752**	**9,512**	**3,636**	**942**	**300**	**156**	**1**	**0**	**0**	**0**	**0**	**134,897**	**53,615**	**5,080.795**
GRAND TOTALS	**83,954**	**20,175**	**22,084**	**10,621**	**4,571**	**1,429**	**564**	**631**	**83**	**21**	**3**	**0**	**0**	**144,243**	**60,289**	**7,149.591**

NOTE: The data shown in this table for all categories of licensees have not been adjusted to account for transient workers (see Section 5).

* Dose values exactly equal to the values separating ranges are reported in the next higher range.

** This category includes fabrication, processing, and uranium enrichment plants (see Section 3.3.5).

*** This category includes all reactors in commercial operation for a full year during 2019.

3.3 Summary of Occupational Dose Data by Licensee Category

3.3.1 Industrial Radiography Licensees - Fixed Location and Temporary Job Sites

Industrial radiography licenses are issued to allow the use of sealed radioactive materials, usually in exposure devices or cameras that primarily emit gamma rays for nondestructive testing of pipeline weld joints, steel structures, boilers, aircraft and ship parts, and other high-stress alloy parts. Some firms are licensed to conduct such activities in one location, usually in a permanent facility designed and shielded for radiography; others perform radiography at temporary job sites in the field. The radioisotopes most commonly used are cobalt-60 and iridium-192. As shown in Table 3.1, annual reports were received for 60 radiography licensees in 2019. Table 3.3 summarizes the reported data for the two types of industrial radiography licensees for 2017, 2018, and 2019 for comparison purposes.

Table 3.3 Annual Exposure Information for Industrial Radiography Licensees 2017–2019

Year	Type of License	Number of Licensees	Number of Monitored Individuals	Individuals with Measurable Dose	Collective Dose (person-rem)	Average Measurable Dose (rem)
2017	Fixed Location	2	12	7	0.325	0.05
	Temporary Job Sites	60	3,377	2,905	1,709.533	0.59
	Total	**62**	**3,389**	**2,912**	**1,709.858**	**0.59**
2018	Fixed Location	2	11	6	0.944	0.16
	Temporary Job Sites	59	3,865	3,297	1,966.935	0.60
	Total	**61**	**3,876**	**3,303**	**1,967.879**	**0.60**
2019	Fixed Location	2	10	6	4.695	0.78
	Temporary Job Sites	58	3,722	3,146	1,663.713	0.53
	Total	**60**	**3,732**	**3,152**	**1,668.408**	**0.53**

The average measurable dose for individuals performing radiography at fixed locations historically over the last 5 years is about 10 percent of the average at temporary job sites. In 2019, one individual (of the 6 individuals with measurable dose) received a total effective dose of 4.255 rem. The resulting collective dose for fixed location radiography increased to 4.695 person-rem for 2019 with an average measurable dose of 0.78 rem. This is the first time the fixed location average measurable dose was above the value for temporary job site radiographers.

High exposures in radiography can be directly attributable to the type and location of the radiography field work. For example, locations such as oil drilling platforms and aerial tanks offer the radiographer little available shielding. In these situations, there may not be an opportunity to use distance as a means of reducing exposure. A relatively small number of exposed individuals involved in radiographer licensee activities usually receive average measurable doses that are higher than those received by other license categories.

Figure 3.1 shows the number of individuals with a measurable dose, the total collective dose, and the average measurable dose per individual for both types of industrial radiography licensees from 1994 through 2019. From 2018 to 2019, there was a 5 percent decrease in the number of individuals with measurable TEDE and a 15 percent decrease in the collective TEDE. Compared to the 5-year average of 2,924, the number of individuals with measurable TEDE was not statistically higher in 2019. Compared to the 5-year average of 1,684 person-rem (16,840 person-mSv), the collective TEDE was not statistically higher in 2019. The average

measurable TEDE decreased to 0.53 rem (5.3 mSv) for 2019, but was not statistically different than the 5-year average of 0.57 rem (5.7 mSv).

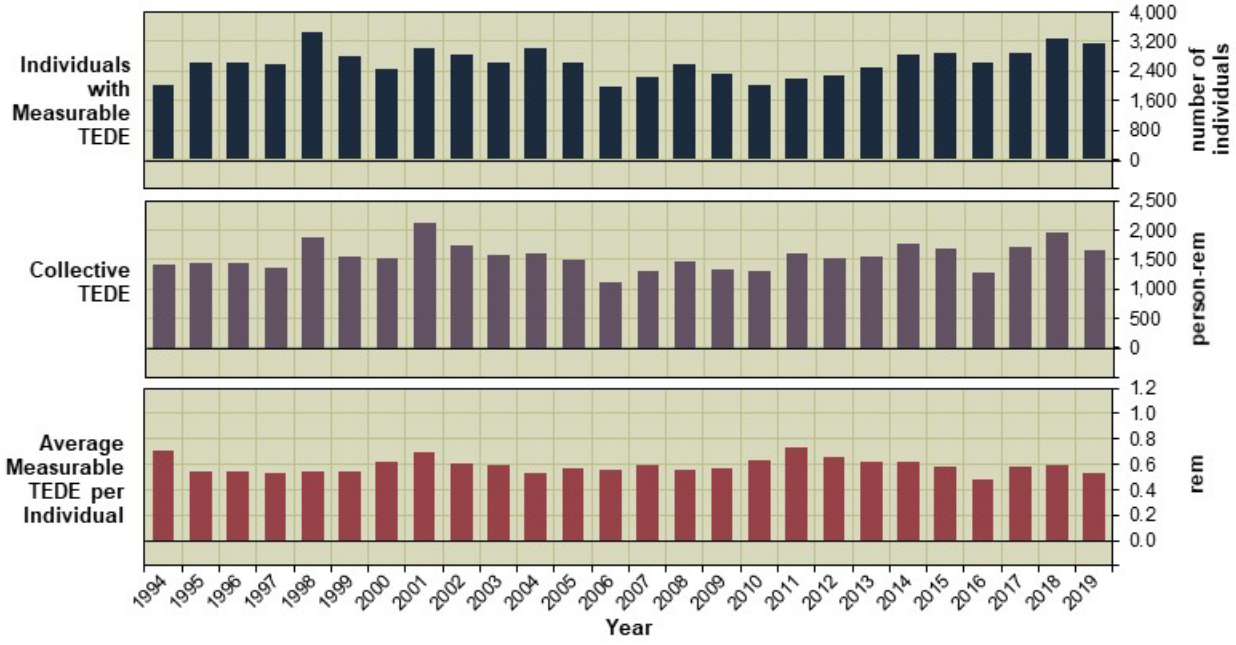


Figure 3.1 Individuals with Measurable TEDE, Collective TEDE, and Average Measurable TEDE for Industrial Radiography Licensees 1994–2019

3.3.2 Manufacturing and Distribution Licensees – Broad-Type A, Broad-Type B, Other, and Nuclear Pharmacies

M&D licenses are issued to allow the manufacture and distribution of radionuclides in various forms for a number of diverse purposes. The products are usually distributed to organizations or companies specifically licensed by the NRC. Broad-Type A licenses are issued to larger organizations that may use many different radionuclides in many different ways and that have a comprehensive radiation protection program. Some Broad-Type A firms are medical suppliers that process, package, or distribute such products as diagnostic test kits, radioactive surgical implants, and tagged radiochemicals for use in medical research, diagnosis, and therapy. Broad-Type B licenses involve the processing, encapsulation, packaging, and distribution of the radionuclides that have been purchased in bulk quantities from production reactors and cyclotrons. Major products include gamma radiography sources, cobalt irradiation sources, well-logging sources, sealed sources for gauges and smoke detectors, and radiochemicals for nonmedical research. Note that no Broad-Type B licensees have reported to NRC since 2010. M&D Other licenses are usually issued to smaller organizations requiring a more restrictive license. These licenses are usually more specific in identifying each radionuclide, the chemical and physical form, and the authorized activities and users. Nuclear pharmacies are involved in the compounding and dispensing of radioactive materials for use in nuclear medicine procedures.

Table 3.4 presents the annual data that were reported by the three types of licensees for 2017, 2018, and 2019. As shown in the table below, the average measurable dose is generally higher for the Broad-Type A licensees, which includes only two licensees in the NRC's active licensee list.

Table 3.4 and Figure 3.2 show the number of individuals with measurable doses, the total collective dose, and the average measurable dose per individual for Broad-Type A, Broad-Type B

and Other, and Nuclear Pharmacy licensees. From 2018 to 2019 the number of individuals with a measurable dose increased by 12 percent and the collective TEDE increased by 8 percent. While the number of individuals with a measurable dose in 2019 was 24 percent more than the 5-year average of 646, the average measurable dose in 2019 (0.18 rem) was statistically lower than the 5-year average of 0.22 rem.

The values for Broad-Type A licensees are attributed to Curium US, LLC and International Isotopes Idaho, Inc., which accounted for 69 percent of the total collective dose in 2019.

Table 3.4 Annual Exposure Information for Manufacturing and Distribution Licensees 2017–2019

Year	Type of License	Number of Licensees	Number of Monitored Individuals	Individuals with Measurable Dose	Collective Dose (person-rem)	Average Measurable Dose (rem)
2017	M & D - Type "A" Broad	2	315	205	99.578	0.49
	M & D - Type "B" Broad and Other	1	1	1	0.010	0.01
	M & D - Nuclear Pharmacies	18	624	409	39.483	0.10
	Total	**21**	**940**	**615**	**139.071**	**0.23**
2018	M & D - Type "A" Broad	2	357	237	88.338	0.37
	M & D - Type "B" Broad and Other	0	0	0	0.000	0.00
	M & D - Nuclear Pharmacies	12	729	481	48.167	0.10
	Total	**14**	**1,086**	**718**	**136.505**	**0.19**
2019	M & D - Type "A" Broad	2	417	293	102.107	0.35
	M & D - Type "B" Broad and Other	0	0	0	0.000	0.00
	M & D - Nuclear Pharmacies	14	771	511	45.820	0.09
	Total	**16**	**1,188**	**804**	**147.927**	**0.18**

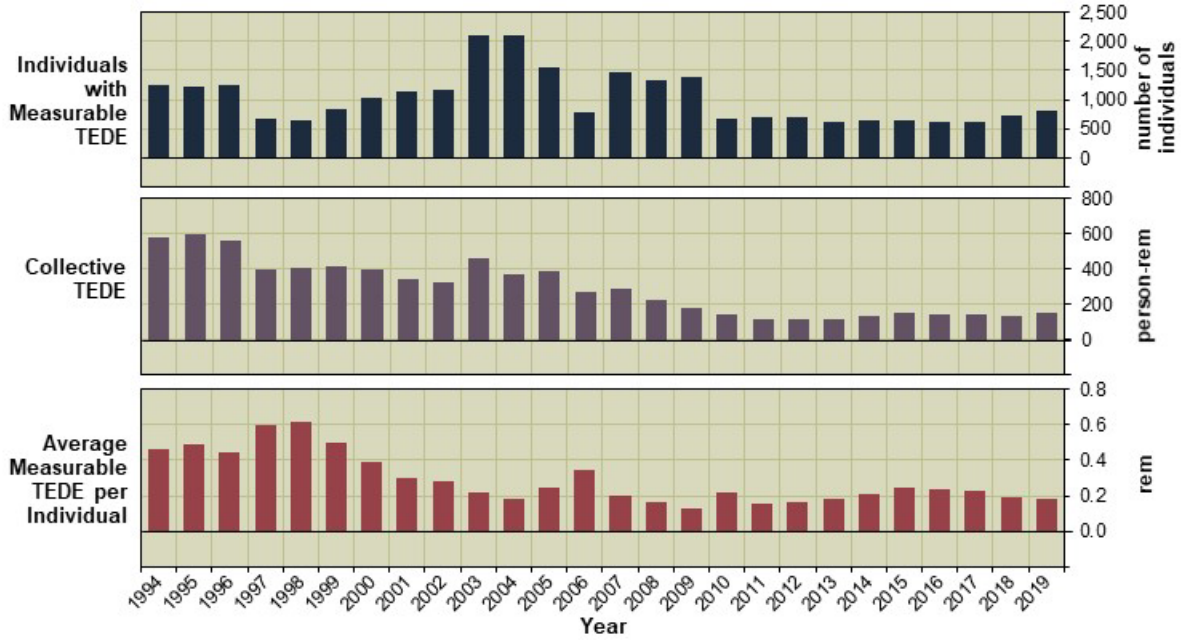


Figure 3.2 Individuals with Measurable TEDE, Collective TEDE, and Average Measurable TEDE for Manufacturing and Distribution Licensees 1994–2019

3.3.3 Low-Level Waste Disposal Licensees

Low-level waste disposal licenses are issued to allow the receipt, possession, and disposal of low-level radioactive wastes at a land disposal facility. The licensee has the appropriate facilities to receive wastes from places such as hospitals and laboratories, store them for a short time, and dispose of them in a properly prepared burial ground. Since 1999, all licensees that have conducted these activities have been located in Agreement States, which have primary regulatory authority over the licensees' activities; therefore, there are no NRC low-level waste licensees who report radiation exposure data to REIRS.

3.3.4 Independent Spent Fuel Storage Installation Licensees

The NRC issues ISFSI licenses to allow the possession of commercial nuclear power reactor spent fuel and other associated radioactive materials for the purpose of storage. According to 10 CFR 72.3, "Definitions" [Ref. 15], spent fuel means "fuel that has been withdrawn from a nuclear reactor following irradiation, has undergone at least 1 year of decay since being used as a source of energy in a power reactor, and has not been chemically separated into its constituent elements by reprocessing. Spent fuel includes the special nuclear material, byproduct material, source material, and other radioactive materials associated with fuel assemblies." The spent fuel that is removed from the reactor is initially stored in a spent fuel pool and usually cooled for at least 5 years in the pool before it is transferred to dry cask storage at an ISFSI. The NRC has authorized transfer as early as 3 years; however, the industry norm is approximately 10 years. An ISFSI provides interim storage of spent fuel and protection and safeguarding, pending its final disposal.

The majority of ISFSI facilities are located on site at commercial nuclear power reactors. The occupational dose information from ISFSI facilities is usually included with the dose information reported by the commercial nuclear power reactors and is not reported separately to the NRC. Since 2005, two ISFSI licensees reported dose information to the NRC. One is the GE Morris facility located in Illinois and the second is the Trojan ISFSI located in Oregon. The GE Morris facility is the only spent fuel pool that is not located at an existing or former reactor site. The GE Morris ISFSI license has been renewed by the NRC until 2022. The Trojan commercial nuclear power reactor is no longer in commercial operation and has been decommissioned. However, the ISFSI facility at Trojan remains in operation and the occupational dose information is reported to the NRC under the ISFSI license. Appendix A, Table A1 summarizes the occupational dose information reported by these licensees.

Figure 3.3 shows the number of individuals with a measurable dose, the total collective dose, and the average measurable dose per individual for ISFSI facilities. Table 3.1 shows that the number of individuals with a measurable dose increased to 28 individuals in 2019 from 17 individuals in 2018. Although the collective TEDE increased by 11 percent from 2018 to 2019, the dose increase was relatively small (1.740 person-rem in 2018 to 1.939 person-rem in 2019) and was statistically insignificant. The effect of a slight increase in the collective TEDE and the increase in number of individuals with a measurable dose resulted in a slight (but not significantly different) decrease in the average measurable TEDE per individual which decreased to 0.07 rem. The average measurable dose was not significantly different from the 5-year average.

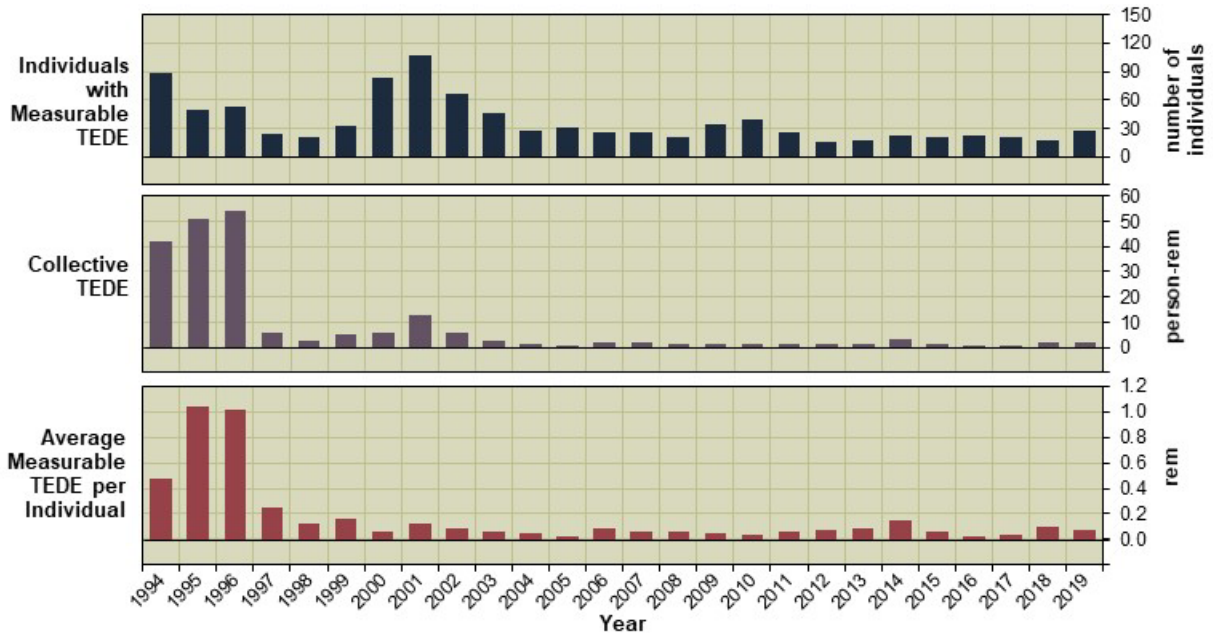


Figure 3.3 Individuals with Measurable TEDE, Collective TEDE, and Average Measurable TEDE for Independent Spent Fuel Storage Installation Licensees 1994–2019

3.3.5 Fuel Cycle Licensees

The fuel cycle category addresses the use and handling of special nuclear material as described in 10 CFR Part 70, “Domestic Licensing of Special Nuclear Material” [Ref. 16]. While the bulk of exposure cited in this report addresses reactor fuel production, there are other uses of special nuclear material in education, research, and homeland security. The fuel cycle facilities are licensed by the NRC to process and handle special nuclear material, source material, or both. These forms of nuclear material are highly regulated to ensure the safe use and enhanced security.

The majority of fuel cycle licenses are issued to allow the processing, enrichment, and fabrication of reactor fuels. Many of the fuel cycle facilities are different from each other—in purpose and technology—as they comprise the different stages of the Nuclear Fuel Cycle. The fuel cycle facilities that are currently operational fall into three different categories: uranium enrichment, uranium conversion, and fuel fabrication. Fuel fabrication facilities convert enriched uranium into fuel for nuclear reactors. Fabrication also can involve mixed oxide fuel, which is a combination of uranium and plutonium. Fuel cycle facilities make nuclear fuel for commercial nuclear reactors and for the U.S. Navy's nuclear fleet.

Figure 3.4 shows the number of individuals with a measurable dose, the total collective dose, and the average measurable dose per individual for fuel cycle licensees. The collective deep dose equivalent (DDE), the DDE average measurable dose, the collective CEDE, and the CEDE average measurable dose are also shown, because they make a significant contribution to the TEDE for fuel fabrication facilities.

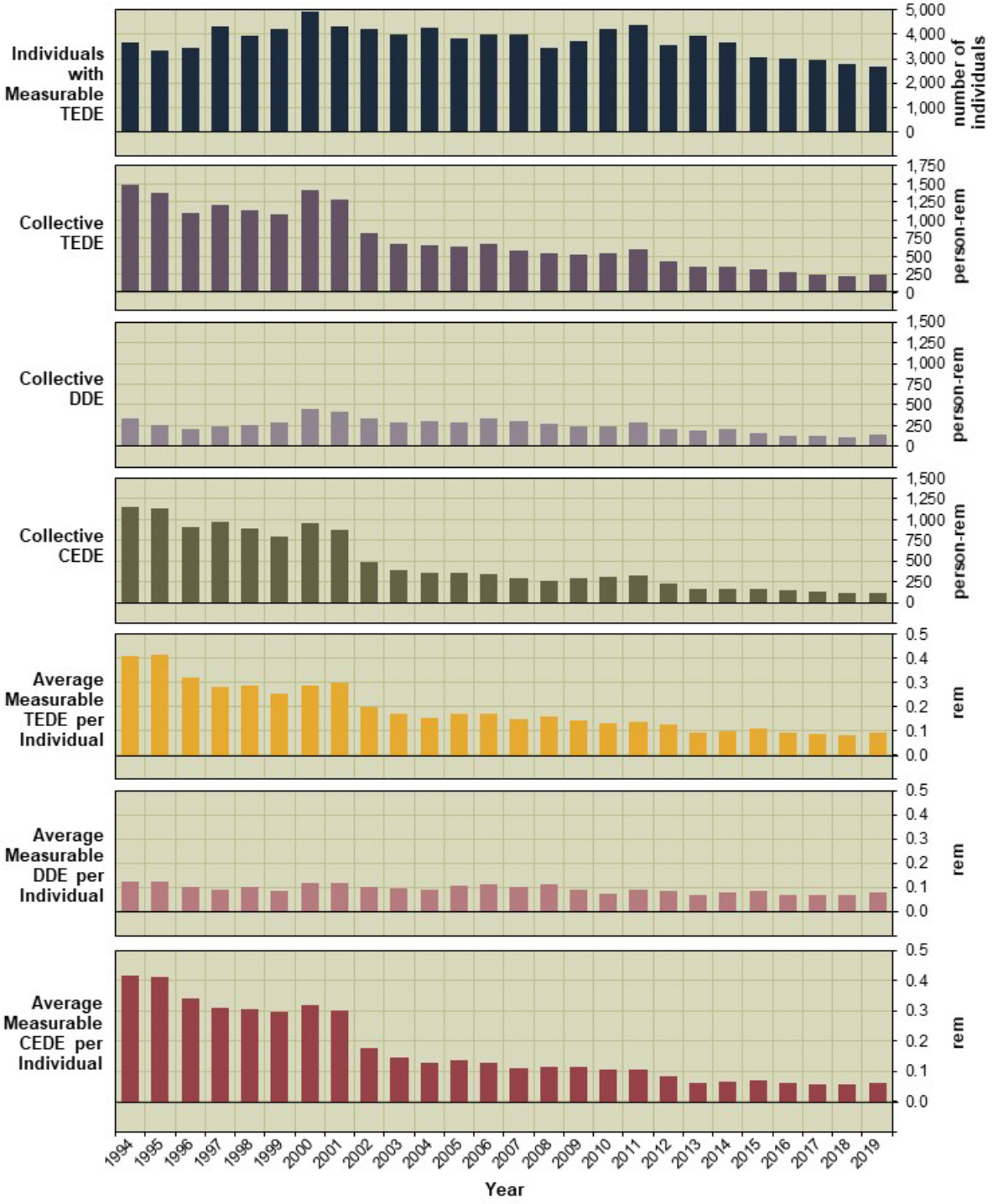


Figure 3.4 Annual Exposure Information for Fuel Cycle Licensees 1994–2019

Table 3.5 shows that there were seven licensed fuel cycle (fabrication processing, uranium enrichment, and UF_6 production) facilities reporting in 2019. The collective TEDE and DDE increased in 2019 by 9 percent and 19 percent, respectively, and the collective CEDE decreased by 2 percent from 2018. When compared to the 5-year average, the increases in collective TEDE

and collective DDE were not statistically significant, whereas the decrease in collective CEDE was statistically significant.

Honeywell International, Inc. reported a decrease (26 percent) in collective TEDE in 2019. Since the 2011 Fukushima Daiichi event, demand for nuclear fuel has dropped while global supply overall has increased, resulting in decreased fuel production by this licensee. In addition, after a routine outage in October of 2017, Honeywell announced in November of that same year that they were suspending operations at the UF_6 production plant which has remained in a "ready-idle" status since that time. The shift from production related activities to maintaining minimal operations is a major factor contributing to the reduction in collective TEDE in 2019.

Table 3.5 Annual Exposure Information for Fuel Cycle Licensees 2017–2019

Year	Type of License	Number of Licensees	Number of Monitored Individuals	Individuals with Meas. TEDE	Collective TEDE (person-rem)	Average Meas. TEDE (rem)	Individuals with Meas. DDE	Collective DDE (person-rem)	Average Meas. DDE (rem)	Individuals with Meas. CEDE	Collective CEDE (person-rem)	Average Meas. CEDE (rem)
2017	Fuel Cycle	7	5,058	2,930	254.997	0.09	1,879	127.017	0.07	2,220	127.980	0.06
2018	Fuel Cycle	7	4,737	2,783	229.530	0.08	1,764	117.856	0.07	1,913	111.674	0.06
2019	Fuel Cycle	7	4,347	2,690	250.522	0.09	1,779	140.757	0.08	1,838	109.765	0.06

3.3.6 Light-Water Reactor Licensees

LWR licenses are issued to utilities to allow them to use special nuclear material in a reactor that produces heat to generate electricity to be sold to consumers. There are two major types of commercial LWRs in the United States, pressurized-water reactors (PWRs) and boiling-water reactors (BWRs), each of which uses water as the primary coolant.

Table 3.1 shows the number of licensees, number of monitored individuals, number of individuals with a measurable dose, total collective dose, average collective dose and average measurable dose per individual for reactor facilities that were in commercial operation for at least 1 full year for each of the years 2009 through 2019. The values do not include reactors that have been permanently shut down, or reactors that have been in commercial operation less than 1 full year. The figures for reactors have not been adjusted for the multiple counting of transient individuals (see Section 5).

Appendix B presents the reported dose distribution of individuals monitored at each plant site for the year 2019 in alphabetical order by plant name. Sections 4 and 5 contain more detailed presentations and analyses of the annual dose information reported by commercial nuclear power reactors.

3.3.7 Other Facilities Reporting to the NRC

Appendix A, Table A2 contains data for additional facilities that provided occupational radiation dose reports to the NRC in 2019. These facilities are not among the seven categories of licensees required to report under 10 CFR 20.2206 and are not included in the analyses presented in this report. However, these facilities may be of interest to researchers and are included in this report for completeness.

3.4 Summary of Intake and Internal Dose Data by Licensee Category

All internal dose estimates are based on the amount of the intake as the basis for the calculation. The intake is the total amount of radioactive material that enters the human body, and internal dose (as defined in 10 CFR 20.1003) means that portion of the dose equivalent received from radioactive material taken into the body. For each intake recorded, licensees are required to list the radionuclide that was taken into the body, pulmonary clearance class, intake mode, and amount of the intake. An NRC Form 5, its equivalent paper document, or an electronic format containing this information is required to be completed and submitted to the NRC under 10 CFR 20.2206.

Tables 3.6 and 3.7 summarize the intake data reported to the NRC during 2019. The data are categorized by licensee type and are listed in order of radionuclide and pulmonary clearance class or pulmonary solubility type. Table 3.6 lists the intakes where the mode of intake into the body was recorded as ingestion or "other," such as absorption through the skin or injection through a puncture or wound.

Table 3.6 Intake by Licensee Category and Radionuclide Mode of Intake—Ingestion and Other 2019

Mode	Licensee Category	Program Code	Radionuclide	Number of Intake Records	Collective Intake in Microcuries (sci. notation)
Ingestion	Nuclear Power Reactor	41111	Am-241	1	3.30E-07
	Nuclear Power Reactor	41111	Ce-144	1	5.19E-04
	Nuclear Power Reactor	41111	Cm-242	1	1.07E-06
	Nuclear Power Reactor	41111	Co-58	2	9.91E-02
	Nuclear Power Reactor	41111	Co-60	**7**	**3.73E-01**
	Nuclear Power Reactor	41111	Cr-51	1	1.56E-01
	Nuclear Power Reactor	41111	Fe-55	1	1.58E-02
	Nuclear Power Reactor	41111	Fe-59	1	3.08E-03
	Nuclear Power Reactor	41111	Mn-54	2	1.13E-02
	Nuclear Power Reactor	41111	Nb-95	2	2.00E-01
	Nuclear Power Reactor	41111	Ni-63	2	6.27E-03
	Nuclear Power Reactor	41111	Sb-124	2	9.41E-04
	Nuclear Power Reactor	41111	Sb-125	1	1.04E-03
	Nuclear Power Reactor	41111	Sn-113	2	7.30E-04
	Nuclear Power Reactor	41111	Zn-65	2	3.29E-03
	Nuclear Power Reactor	41111	Zr-95	1	5.41E-02

Table 3.7 lists the intakes where the mode of intake was inhalation from ambient airborne radioactive material in the workplace. The pulmonary clearance class or pulmonary solubility type is recorded as D, W, Y (days, weeks, years) or F, M, S (fast, medium, slow), respectively, corresponding to the clearance half-time from the pulmonary region of the lung into the blood and gastrointestinal tract. The pulmonary clearance class designation depends on whether the licensee is using the nomenclature in International Commission on Radiological Protection (ICRP) Publication 30 (D, W, Y) [Ref. 17], which is described in 10 CFR Part 20, or ICRP Publication 68 (F, M, S) [Ref. 18]. Licensees that use the methodology described in ICRP Publication 30 use D, W, and Y pulmonary clearance classes to determine the dose. Licensees that use the methodology described in ICRP Publication 68 use F, M, and S pulmonary solubility types to determine the dose.

The amount of material taken into the body is given in microcuries, a unit of measure of the quantity of radioactive material. For each licensee category, the maximum number of intake records and the maximum intake are highlighted in the table in bold and boxed for ease of reference.

Table 3.7 Intake by Licensee Category and Radionuclide Mode of Intake—Inhalation 2019

Licensee Category	Program Code	Radionuclide	Pulmonary Clearance Class or Solubility Type	Number of Intake Records *	Collective Intake in Microcuries (sci. notation)
Nuclear Pharmacies	02500	I-123	W	8	6.91E-02
	02500	I-131	D	6	5.34E-01
	02500	I-131	W	**89**	**3.08E+00**
Manufacturing and Distribution Type A Broad	03211	Cs-137	D	**7**	**9.26E+00**
	03211	I-131	D	**7**	7.40E-01
Uranium Hexafluoride (UF_6) Production Plants	11400	Ac-227	D	1	1.00E-06
	11400	Ac-227	W	88	1.33E-04
	11400	Pa-231	D	1	1.00E-06
	11400	Pa-231	W	88	1.33E-04
	11400	Pb-210	D	79	1.06E-04
	11400	Po-210	D	1	1.00E-06
	11400	Po-210	W	71	8.80E-05
	11400	Ra-226	D	1	2.00E-06
	11400	Ra-226	W	112	3.17E-04
	11400	Ra-228	D	1	1.00E-06
	11400	Ra-228	W	64	7.80E-05
	11400	Th-228	D	1	1.00E-06
	11400	Th-228	W	64	7.80E-05
	11400	Th-230	D	1	2.20E-05
	11400	Th-230	W	128	3.20E-03
	11400	Th-232	D	1	1.00E-06
	11400	Th-232	W	64	7.80E-05
	11400	U-234	D	1	2.06E-03
	11400	U-234	W	**130**	**2.95E-01**
	11400	U-235	D	1	9.60E-05
	11400	U-235	W	**130**	1.38E-02
	11400	U-238	D	1	1.72E-03
	11400	U-238	W	**130**	2.46E-01
Uranium Fuel Processing Plants	21210	Am-241	M	26	1.03E-04
	21210	Pu-239	M	53	4.22E-04
	21210	Sr-90	S	249	3.81E-01
	21210	Th-232	M	9	1.36E-07
	21210	Th-232	S	14	1.52E-04
	21210	U-232	D	2	8.80E-07
	21210	U-232	W	1	1.00E-08
	21210	U-232	Y	111	1.98E-04
	21210	U-234	D	182	1.51E-01
	21210	U-234	F	720	4.94E-02

NOTE: The data values shown bolded and in boxes represent the highest value in each category.

* An intake event may involve multiple nuclides; individuals may incur multiple intakes during the year. The number of intake records given here indicates the number of separate intake reports that were submitted on NRC Form 5 reports under 10 CFR 20.2206.

Table 3.7 Intake by Licensee Category and Radionuclide Mode of Intake—Inhalation 2019 (continued)

Licensee Category	Program Code	Radionuclide	Pulmonary Clearance Class or Solubility Type	Number of Intake Records *	Collective Intake in Microcuries (sci. notation)
Uranium Fuel Processing Plants	21210	U-234	M	648	6.39E-03
(continued)	21210	U-234	S	**1,702**	**1.96E+00**
	21210	U-234	W	65	5.37E-02
	21210	U-234	Y	624	1.60E+00
	21210	U-235	D	130	2.99E-03
	21210	U-235	S	317	5.63E-02
	21210	U-235	W	65	2.00E-03
	21210	U-235	Y	241	3.34E-02
	21210	U-236	D	130	1.55E-04
	21210	U-236	F	645	9.59E-04
	21210	U-236	S	50	3.85E-04
	21210	U-236	W	65	8.58E-05
	21210	U-236	Y	241	7.53E-03
	21210	U-238	D	182	2.26E-02
	21210	U-238	M	538	3.98E-04
	21210	U-238	S	326	1.98E-01
	21210	U-238	W	65	7.29E-03
	21210	U-238	Y	624	2.36E-01
Nuclear Power Reactor	41111	Am-241	W	1	1.80E-07
	41111	Ce-144	Y	1	2.76E-04
	41111	Cm-242	W	1	5.60E-07
	41111	Co-58	W	1	1.70E-02
	41111	Co-58	Y	8	2.50E-01
	41111	Co-60	W	3	1.05E-01
	41111	Co-60	Y	8	1.80E-01
	41111	Cr-51	Y	3	8.28E-02
	41111	Fe-55	W	1	8.39E-03
	41111	Fe-59	W	1	1.63E-03
	41111	I-131	D	**84**	7.50E+00
	41111	I-132	D	2	2.78E-01
	41111	I-133	D	80	**4.90E+01**
	41111	I-135	D	64	3.00E+01
	41111	Mn-54	W	3	2.83E-03
	41111	Nb-95	Y	5	1.10E-01
	41111	Ni-63	W	1	7.14E-04
	41111	Sb-124	W	1	4.04E-04
	41111	Sb-125	W	1	5.53E-04
	41111	Sn-113	W	1	2.55E-04
	41111	Zn-65	Y	1	1.30E-03
	41111	Zr-95	D	1	1.70E-01
	41111	Zr-95	W	2	7.05E-02
	41111	Zr-95	Y	2	1.10E-08

NOTE: The data values shown bolded and in boxes represent the highest value in each category.

* An intake event may involve multiple nuclides, and individuals may incur multiple intakes during the year. The number of intake records given here indicates the number of separate intake reports that were submitted on NRC Form 5 reports under 10 CFR 20.2206.

Table 3.8 lists the number of individuals with a measurable CEDE, the collective CEDE, and the average measurable CEDE per individual for each licensee category. The number of individuals with a measurable CEDE was significantly lower than the 5-year average. Fuel fabrication facilities combined with the UF_6 production facility had the majority of internal doses (98.7 percent of total collective CEDE) in 2019. The UF_6 production facility had a collective dose of 4.249 person-rem. Although not statistically significant, the average CEDE for fuel fabrication facilities decreased to 0.062 rem in 2019 which was below the 5-year average of 0.066 rem. The fuel fabrication licensee with the highest collective dose reported 41.905 person-rem and an average of 0.133 rem per individual. This is due to the exposure of individuals to uranium during the processing and fabrication of the uranium fuel.

Table 3.8 Collective and Average CEDE by Licensee Category 2019

Licensee Category	Licensee Name	License Number	Number with Meas. CEDE	Collective CEDE (person-rem)	Average Meas. CEDE (rem)
MANUFACTURING AND DISTRIBUTION					
02500	CARDINAL HEALTH	34-29200-01MD	**27**	0.085	0.003
02500	CARDINAL HEALTH	34-31473-02MD	2	0.003	0.002
02500	GE HEALTHCARE - KENTWOOD	21-26707-01MD	3	0.011	0.004
02500	GE HEALTHCARE - ST. LOUIS/OVERLAND	24-32462-01MD	1	0.002	0.002
03211	CURIUM US, LLC	24-04206-01	1	0.213	**0.213**
03211	INTERNATIONAL ISOTOPES IDAHO, INC.	11-27680-01	11	**0.319**	0.029
	Totals and Averages		45	0.633	0.014
UF_6 PRODUCTION					
11400	HONEYWELL PERFORMANCE MATERIALS AND TECHNOLOGY	SUB-0526	**130**	**4.249**	**0.033**
	Totals and Averages		**130**	**4.249**	**0.033**
FUEL FABRICATION					
21210	BWX TECHNOLOGIES, INC.	SNM-0042	224	10.500	0.047
21210	FRAMATOME, INC.	SNM-1227	241	27.594	0.114
21210	GLOBAL NUCLEAR FUEL - AMERICAS, LLC	SNM-1097	383	22.995	0.060
21210	NUCLEAR FUEL SERVICES, INC.	SNM-0124	**544**	2.522	0.005
21210	WESTINGHOUSE ELECTRIC COMPANY, LLC	SNM-1107	316	**41.905**	**0.133**
	Totals and Averages		1,708	105.516	0.062
COMMERCIAL LIGHT-WATER REACTORS					
41111	RIVER BEND	NPF-47	**90**	**0.630**	0.007
41111	SOUTH TEXAS	NPF-76	1	0.003	0.003
41111	SUMMER	NPF-12	8	0.117	**0.015**
41111	SEQUOYAH	DPR-77	2	0.030	**0.015**
41111	POINT BEACH	DPR-24	7	0.009	0.001
	Totals and Averages		**108**	**0.789**	**0.007**
Grand Totals and Averages			**1,991**	**111.187**	**0.056**

NOTE: The data values shown bolded and in boxes represent the highest value in each category.

Table 3.9 shows the distribution of internal doses (CEDE) from 1994 to 2019 for licensees required to report under 10 CFR 20.2206. For the purposes of this table, the definition of a measurable CEDE is any reported value greater than zero. As noted above, the vast majority of the internal doses were received by individuals working at fuel fabrication facilities. In 2019, the collective CEDE decreased by 1 percent from 2018 while the number of individuals with a measurable CEDE decreased by 3 percent. The collective CEDE was significantly lower from the 5-year average of 141.0 person-rem, as was the number of individuals with a measurable CEDE in 2019 (1,991) from the 5-year average of 2,357. The collective CEDE of 112.004 person-rem in all facilities in 2018 decreased to 111.187 person-rem. Although there was a decrease in the number of individuals reported with CEDE dose and a decrease in the collective CEDE, the average measurable CEDE increased by 2 percent to 0.056 rem for 2019. However, the average measurable CEDE in 2019 was not statistically different from the 5-year average.

Table 3.9 Internal dose (CEDE) distribution 1994–2019

Year	Number of Individuals with CEDE in the Ranges (rem) *										Indiv. with Meas. CEDE	Collective CEDE (person-rem)	Average Meas. CEDE (rem)
	Meas. 0.020	0.020-0.100	0.100-0.250	0.250-0.500	0.500-0.750	0.750-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0			
1994	3,425	577	287	683	237	141	293	69	2	-	5,714	1,170.453	0.205
1995	2,869	691	338	730	254	147	290	49	2	-	5,370	1,167.105	0.217
1996	3,096	598	305	584	324	138	187	22	2	2	5,258	931.799	0.177
1997	3,835	869	381	827	267	148	169	30	-	-	6,526	998.406	0.153
1998	3,310	932	426	746	246	140	153	21	2	-	5,976	922.935	0.154
1999	3,423	752	466	438	206	117	173	29	-	-	5,604	813.605	0.145
2000	3,275	1001	570	383	216	98	224	58	7	1	5,833	988.640	0.169
2001	1,774	827	716	364	128	53	146	82	15	1	4,106	884.134	0.215
2002	1,760	746	647	531	144	33	23	3	-	-	3,887	494.821	0.127
2003	2,208	778	726	388	116	17	5	-	-	-	4,238	395.573	0.093
2004	1,989	838	657	381	105	17	3	-	-	-	3,990	375.021	0.094
2005	1,205	706	685	341	98	33	2	-	-	-	3,070	365.258	0.119
2006	1,302	726	686	346	96	18	3	-	-	-	3,177	346.918	0.109
2007	1,480	805	646	310	52	5	3	-	-	-	3,301	300.863	0.091
2008	1,008	761	526	303	41	8	4	-	-	-	2,651	267.415	0.101
2009	1,115	711	597	229	80	21	7	-	-	-	2,760	293.251	0.106
2010	1,216	884	669	210	67	30	6	-	-	-	3,082	308.332	0.100
2011	1,243	916	628	270	72	19	14	1	-	-	3,163	322.615	0.102
2012	1,158	933	554	155	52	6	3	-	-	-	2,861	232.462	0.081
2013	1,632	758	353	149	20	1	-	-	-	-	2,913	164.799	0.057
2014	1,175	829	417	86	24	1	-	-	-	-	2,532	157.191	0.062
2015	1,036	838	442	103	16	-	-	-	-	-	2,435	162.670	0.067
2016	1,100	920	407	69	7	-	-	-	-	-	2,503	144.627	0.058
2017	1,073	766	324	99	6	-	-	-	-	-	2,268	128.373	0.057
2018	1,159	489	297	99	1	-	-	-	-	-	2,045	112.004	0.055
2019	1,096	482	318	91	3	1	-	-	-	-	1,991	111.187	0.056

* Dose values exactly equal to the values separating ranges are reported in the next higher range.

4 COMMERCIAL POWER REACTORS

4.1 Introduction

General trends in occupational radiation exposure at commercial nuclear power reactors are best analyzed within the context of other pertinent information. In this section, some of the tables and appendices that summarize dose data also show the type, capacity, amount of electricity generated, and age of the reactor. Dose data are then presented as a function of these data.

4.2 Definition of Terms and Sources of Data

4.2.1 Number of Reactors

The number of reactors shown in Tables 4.1, 4.2, and 4.3 are the number of BWRs, PWRs, and LWRs that were in commercial operation during the year listed. This is the number of reactors that the average number of individuals with a measurable dose and the average collective dose per reactor are based. Excluded are reactors that have not yet completed a first full year of commercial operation and those reactors that have been permanently defueled. The date that each reactor was declared to be in commercial operation was taken from licensed operating reactors, *Monthly Operating Report Data* [Ref. 1].

In May 2019, Pilgrim 1 ceased operation, dropping the number of active BWRs from 33 to 32. Three Mile Island (TMI) Unit 1 permanently shut down in September 2019, dropping the number of active PWRs from 65 to 64. The dose information for these operational reactors and for others that are no longer in commercial operation is listed at the end of Appendix B and the current status of plants no longer in operation can be found in Appendix E. Watts Bar Unit 2 began commercial power operation on November 21, 2016, and reported its dose information with Watts Bar Unit 1 beginning in 2017.

4.2.2 Electric Energy Generated

The electric energy generated in megawatt-years (MW-yr) each year by each reactor is graphically represented in Appendix D. This number was obtained by dividing the megawatt-hours (MW-hr) of electricity annually produced by each facility by 8,760, the number of hours in the year, except for leap years, when the number was 8,784 hours. The number of MW-hr of electricity produced each year was obtained from licensed operating reactors, *Monthly Operating Report Data* [Ref. 1].

For the years 1973 to 1996, the electricity generated is the gross electricity output of the reactor. For 1997 to 2019, the number reflects the net electricity produced, which is the gross electricity minus the amount the plant used for operations. This change is the result of a change in NRC power generation reporting requirements. The electricity generated in MW-yr that is presented in Tables 4.1, 4.2, and 4.3 is the summation of electricity generated by the number of reactors included in each year. These sums are divided by the number of operating reactors included in each year to yield the average amount of electric energy generated per reactor, which is also shown in Tables 4.1, 4.2, and 4.3.

As shown in Table 4.3, in 2019, the net electricity generated at LWRs was nearly equivalent to 2018 and not significantly different from the 5-year trend. Twenty-three reactor sites had decreased power production and 34 reactor sites had increased power production from 2018 to 2019. Waterford 3 had the largest percentage of decreased power production (26 percent), while

Perry and Callaway 1 experienced a 14 and 13 percent decrease in power production, respectively. Waterford 3 was shut down 72.8 days due to refueling and 20.1 days for equipment failure for a total of 92.9 days off line. Perry and Callaway 1 were shut down 41.5 and 48.2 total outage days, respectively. From 2018 to 2019, Grand Gulf had the largest increase in power production (59 percent).

4.2.3 Collective Dose per Megawatt-Year

The number of MW-yr of electricity generated was used in determining the ratio of the average value of the annual collective dose (TEDE) to the number of MW-yr of electricity generated. The ratio was calculated by dividing the total collective dose in person-rem by the electric energy generated in MW-yr and is a measure of the dose incurred by individuals at commercial nuclear power reactors in relation to the electric energy produced.

For the years 1973 to 1996, the electricity generated is the gross electricity output of the reactor. For 1997 to 2019, the number reflects the net electricity produced. The ratio of collective dose to the number of MW-yr is calculated by year for BWRs, PWRs, and LWRs, and the ratios are presented in Tables 4.1, 4.2, and 4.3. This ratio is also calculated for each reactor site (see Appendix C). The average collective dose per MW-yr for LWRs remained at 0.06 rem/MW-yr in 2019. This value is not statistically different from the 5-year average of 0.07 rem/MW-yr.

4.2.4 Average Maximum Dependable Capacity

The average maximum dependable capacity, as shown in Tables 4.1, 4.2, and 4.3, is calculated by dividing the sum of the net maximum dependable capacities of the reactors in megawatts (net megawatts electric [MWe]) by the number of reactors included each year. The net maximum dependable capacity is defined as the gross electrical output as measured at the output terminals of the turbine generator during the most restrictive seasonal conditions less the normal station service loads. The capacity of each plant was found in *Monthly Operating Report Data* [Ref. 1]. As shown in Table 4.3 for 2019, the value for the average electricity generated per reactor was the highest reported since 1994 (955 MW-yr).

4.2.5 Percent of Maximum Dependable Capacity Achieved

The percent of maximum dependable capacity achieved is shown for all LWRs in Table 4.3. This parameter gives an indication of the overall power generation performance of LWRs as compared with the maximum dependable capacity that could have been obtained in a given year. It is calculated by dividing the average electricity generated per reactor by the average maximum dependable capacity for each year.

Table 4.1 Summary of Information Reported by Commercial Boiling-Water Reactors 1994–2019

Year	Number of Reactors Included*	No. of Individuals with Measurable Dose**	Annual Collective Dose (person-rem)	Average Measurable Dose per Individual (rem)**	Average Collective Dose per Reactor (person-rem)	Average No. Individuals with Measurable Doses per Reactor**	Electricity Generated*** (MW-yr)	Average Collective Dose per MW-yr (person-rem/ MW-yr)	Average Electricity Generated per Reactor (MW-yr)	Average Maximum Dependable Capacity Net (MWe)	Maximum Dependable Capacity Achieved
1994	37	39,171	12,098	0.31	327	1,059	22,139.0	0.55	598	801	75%
1995	37	35,686	9,471	0.27	256	964	24,737.0	0.38	669	835	80%
1996	37	37,792	9,466	0.25	256	1,021	24,322.2	0.39	657	838	78%
1997	37	34,021	7,603	0.22	205	919	22,866.1	0.33	618	845	73%
1998	36	32,899	6,829.296	0.21	190	914	23,781.2	0.29	661	874	76%
1999	35	31,482	6,434.430	0.20	184	899	26,962.6	0.24	770	885	87%
2000	35	31,186	6,089.676	0.20	174	891	28,476.9	0.21	814	893	91%
2001	35	28,797	4,835.397	0.17	138	823	28,730.4	0.17	821	895	92%
2002	35	30,978	6,107.767	0.20	175	885	29,460.0	0.21	842	907	93%
2003	35	30,759	5,659.434	0.18	162	879	29,094.4	0.19	831	912	91%
2004	35	33,948	5,450.982	0.16	156	970	29,424.8	0.19	841	893	94%
2005	35	33,544	5,995.975	0.18	171	958	29,386.8	0.20	840	946	89%
2006	35	34,159	4,989.761	0.15	143	976	30,238.4	0.17	864	954	91%
2007	35	37,515	5,388.416	0.14	154	1,072	30,189.3	0.18	863	955	90%
2008	35	34,642	4,522.413	0.13	129	990	31,248.3	0.14	893	957	93%
2009	35	36,207	5,282.869	0.15	151	1,034	30,762.7	0.17	879	959	92%
2010	35	37,214	4,807.656	0.13	137	1,063	31,274.6	0.15	894	961	93%
2011	35	38,202	4,976.503	0.13	142	1,091	30,549.7	0.16	873	937	93%
2012	35	38,164	4,200.281	0.11	120	1,090	30,485.4	0.14	871	968	90%
2013	35	36,513	4,459.270	0.12	127	1,043	31,221.1	0.14	892	967	92%
2014	35	33,706	3,798.108	0.11	109	963	31,904.2	0.12	912	976	93%
2015	34	35,346	4,155.273	0.12	122	1,040	31,720.1	0.13	933	992	94%
2016	34	31,299	3,339.055	0.11	98	921	31,464.8	0.11	925	995	93%
2017	34	32,234	4,007.342	0.12	118	948	31,820.0	0.13	936	995	94%
2018	33	31,169	3,659.588	0.12	111	945	30,722.7	0.12	931	1,008	92%
2019	32	29,100	3,372.909	0.12	105	909	31,237.4	0.11	976	1,018	96%

* Includes only those reactors that had been in commercial operation for at least 1 full year as of December 31 of each of the indicated years.
** Figures are not adjusted for the multiple reporting of transient individuals (see Section 5).
*** Beginning in 1997, the electricity reflects the net electricity generated.

Table 4.2 Summary of Information Reported by Commercial Pressurized-Water Reactors 1994–2019

Year	Number of Reactors Included*	No. of Individuals with Measurable Dose**	Annual Collective Dose (person-rem)	Average Measurable Dose per Individual (rem)**	Average Collective Dose per Reactor (person-rem)	Average No. Individuals with Measurable Doses per Reactor**	Electricity Generated*** (MW-yr)	Average Collective Dose per MW-yr (person-rem/ MW-yr)	Average Electricity Generated per Reactor (MW-yr)	Average Maximum Dependable Capacity Net (MWe)	Maximum Dependable Capacity Achieved
1994	70	44,283	9,574	0.22	137	633	52,397.6	0.18	749	928	81%
1995	70	49,985	11,762	0.24	168	714	54,138.2	0.22	773	929	83%
1996	72	46,852	9,417	0.20	131	651	55,337.8	0.17	769	935	82%
1997	72	50,690	9,546	0.19	133	704	48,985.3	0.19	680	943	72%
1998	69	38,586	6,358.096	0.16	92	559	53,288.7	0.12	772	942	82%
1999	69	43,938	7,231.281	0.16	105	637	56,235.0	0.13	815	942	87%
2000	69	42,922	6,562.006	0.15	95	622	57,529.9	0.11	834	943	88%
2001	69	38,773	6,273.155	0.16	91	562	58,822.4	0.11	852	946	90%
2002	69	42,264	6,018.423	0.14	87	613	59,369.7	0.10	860	947	91%
2003	69	44,054	6,296.136	0.14	91	638	57,920.6	0.11	839	949	88%
2004	69	35,901	4,916.915	0.14	71	520	60,398.7	0.08	875	943	93%
2005	69	44,583	5,459.832	0.12	79	646	59,790.9	0.09	867	955	91%
2006	69	46,106	6,031.425	0.13	87	668	59,751.3	0.10	866	960	90%
2007	69	42,015	4,731.597	0.11	69	609	61,955.6	0.08	898	961	93%
2008	69	44,808	4,673.527	0.10	68	649	60,586.0	0.08	878	964	91%
2009	69	45,547	4,741.935	0.10	69	660	60,467.9	0.08	876	966	91%
2010	69	37,796	3,823.728	0.10	55	548	60,859.4	0.06	882	967	91%
2011	69	43,119	3,795.601	0.09	55	625	59,682.5	0.06	865	937	92%
2012	69	41,385	3,835.112	0.09	56	600	57,272.5	0.07	830	974	85%
2013	65	30,723	2,300.277	0.07	35	473	58,785.5	0.04	904	987	92%
2014	65	37,141	3,326.411	0.09	51	571	59,262.2	0.06	912	989	92%
2015	65	35,452	2,863.815	0.08	44	545	59,377.2	0.05	913	990	92%
2016	65	28,054	2,026.654	0.07	31	432	60,052.5	0.03	924	1,001	92%
2017	65	32,527	2,409.206	0.07	37	500	60,148.9	0.04	925	1,001	92%
2018	65	29,845	2,169.883	0.07	34	459	61,113.7	0.04	940	1,002	94%
2019	64	24,515	1,707.886	0.07	27	383	60,400.6	0.03	944	1,008	94%

* Includes only those reactors that had been in commercial operation for at least 1 full year as of December 31 of each of the indicated years.
** Figures are not adjusted for the multiple reporting of transient individuals (see Section 5).
*** Beginning in 1997, the electricity reflects the net electricity generated.

Table 4.3 Summary of Information Reported by Commercial Light-Water Reactors 1994–2019

Year	Number of Reactors Included*	No. of Individuals with Measurable Dose**	Annual Collective Dose (person-rem)	Average Measurable Dose per Individual (rem)**	Average Collective Dose per Reactor (person-rem)	Average No. Individuals with Measurable Doses per Reactor**	Electricity Generated*** (MW-yr)	Average Collective Dose per MW-yr (person-rem/ MW-yr)	Average Electricity Generated per Reactor (MW-yr)	Average Maximum Dependable Capacity Net (MWe)	Maximum Dependable Capacity Achieved
1994	107	83,454	21,672	0.26	203	780	74,536.6	0.29	697	884	79%
1995	107	85,671	21,233	0.25	198	801	78,875.2	0.27	737	896	82%
1996	109	84,644	18,883	0.22	173	777	79,660.0	0.24	731	902	81%
1997	109	84,711	17,149	0.20	157	777	71,851.4	0.24	659	910	72%
1998	105	71,485	13,187.392	0.18	126	681	77,069.9	0.17	734	918	80%
1999	104	75,420	13,665.711	0.18	131	725	83,197.6	0.16	800	923	87%
2000	104	74,108	12,651.682	0.17	122	713	86,006.8	0.15	827	926	89%
2001	104	67,570	11,108.552	0.16	107	650	87,552.8	0.13	842	929	91%
2002	104	73,242	12,126.190	0.17	117	704	88,829.7	0.14	854	934	91%
2003	104	74,813	11,955.570	0.16	115	719	87,015.0	0.14	837	936	89%
2004	104	69,849	10,367.897	0.15	100	672	89,823.5	0.12	864	926	93%
2005	104	78,127	11,455.807	0.15	110	751	89,177.7	0.13	857	952	90%
2006	104	80,265	11,021.186	0.14	106	772	89,989.7	0.12	865	958	90%
2007	104	79,530	10,120.013	0.13	97	765	92,144.9	0.11	886	959	92%
2008	104	79,450	9,195.940	0.12	88	764	91,834.3	0.10	883	961	92%
2009	104	81,754	10,024.804	0.12	96	786	91,230.6	0.11	877	964	91%
2010	104	75,010	8,631.384	0.12	83	721	92,134.0	0.09	886	965	92%
2011	104	81,321	8,771.326	0.11	84	782	90,232.2	0.10	868	967	90%
2012	104	79,549	8,035.393	0.10	77	765	87,757.9	0.09	844	972	87%
2013	100	67,236	6,759.547	0.10	68	672	90,006.6	0.08	900	980	92%
2014	100	70,847	7,124.519	0.10	71	708	91,166.4	0.08	912	985	93%
2015	99	70,798	7,019.088	0.10	71	715	91,097.3	0.08	920	991	93%
2016	99	59,353	5,365.709	0.09	54	600	91,517.3	0.06	924	999	93%
2017	99	64,761	6,416.548	0.10	65	654	91,968.8	0.07	929	999	93%
2018	98	61,014	5,829.471	0.10	59	623	91,836.4	0.06	937	1,004	93%
2019	96	53,615	5,080.795	0.09	53	558	91,638.0	0.06	955	1,011	94%

* Includes only those reactors that had been in commercial operation for at least 1 full year as of December 31 of each of the indicated years.
** Figures are not adjusted for the multiple reporting of transient individuals (see Section 5).
*** Beginning in 1997, the electricity reflects the net electricity generated.

The decrease in maximum dependable capacity from 1996 to 1997 was due to the change from measuring the gross electricity generated to the net electricity generated. At 94 percent in 2019, the percent of maximum dependable capacity for LWRs was the highest value reported since 1994.

4.3 Annual TEDE Distributions

Table 4.4a summarizes the distribution of the annual TEDE doses received by individuals (unadjusted for transient workers) at all commercial LWRs during each of the years 1994 through 2019. This distribution is the sum of the annual dose distributions reported by each licensed LWR each year. As previously noted, Appendix B shows the distribution reported by each LWR site for 2019. Table 4.4a includes only those reactors that have been in operation for at least a full year. In 2019, the total collective dose decreased by 13 percent to a value of 5,081 person-rem.

Each year, this report identifies the reactors with the largest increases and decreases in collective dose from the previous year and identifies the main reasons for these changes. The changes generally are driven by whether the sites had an increase or decrease in outages from one year to the next. During an outage, more work is performed by individuals working in radiation areas, thereby resulting in increased collective doses. This is particularly true during a refueling outage, which entails the opening of the reactor vessel by removing the vessel head and transferring spent fuel to the spent fuel pool. In addition, the sites usually schedule maintenance and inspections during a refueling outage, which tend to increase the collective dose. If a site does not have a refueling outage during a year, the collective dose for that site is normally much lower. For example, in 2019 Waterford 3 was the PWR with the largest percentage increase in collective dose which increased from 1.130 person-rem in 2018, to 69.780 person-rem in 2019. PWR collective dose decreased by 21 percent which coincided with a decrease in refueling outage days in 2019, decreasing from a total of 1,766 days in 2018 to 1,665 days in 2019. Outage days for PWRs ranged from 0 to 124 days during 2019. Seabrook had the largest percentage decrease in collective dose (33.418 to 1.084 person-rem) along with the fewest number of total outage days (0) in 2019.

For BWRs from 2018 to 2019, Perry had the highest percent increase in collective dose. In 2018, Perry had 0 total outage days and reported a collective dose of 29.848 person-rem, while in 2019, Perry had over 41 total outage days (refueling and equipment outages) and reported a collective dose of 301.067 person-rem. In 2019, Fitzpatrick had a 90 percent decrease in collective dose. In 2018, Fitzpatrick had 27.6 total outage days and reported a dose of 231.548 person-rem, while in 2019, Fitzpatrick had 0 total outage days and reported a collective dose of 24.160 person-rem.

Combined, the refueling outage hours declined by 15 percent from 2018 to 2019 (15 percent decrease for BWRs and 15 percent decrease for PWRs) which was a factor in the decreased collective dose.

Table 4.4b summarizes the distribution of the annual TEDE doses received by unique individuals (adjusted for transient workers) at all commercial LWRs during each of the years 1994 through 2019. The values do not include reactors that have been permanently shut down or reactors that have not been in commercial operation for 1 full year. See Section 5 for a detailed analysis of the impact of transient individuals on the distribution of annual doses in 2019.

Table 4.4a Summary of Distribution of Annual Doses* at Commercial Light-Water Reactors** 1994–2019

Year	Number of Individuals with Annual Doses* in the Ranges (rem) *** Note: Numbers of individuals shown have not been adjusted for the multiple reporting of transient individuals (see Section 5).												Total Number Monitored	Number with Measurable Exposure	Collective Dose (person-rem)	Average Measurable Dose (person-rem)
	No. Measurable Exposure	Measurable <0.1	0.10-0.25	0.25-0.50	0.50-0.75	0.75-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-6.0	>6.0				
1994	85,145	36,528	18,633	14,246	6,800	3,502	3,323	215	6	-	-	-	168,398	83,253	21,534.000	0.259
1995	81,032	38,575	20,245	15,279	6,884	3,336	3,077	125	5	-	-	-	168,558	87,526	21,674.000	0.248
1996	78,197	39,426	19,955	14,201	5,809	2,648	2,342	68	-	-	-	-	162,646	84,449	18,874.000	0.223
1997	80,163	41,759	19,951	13,396	5,394	2,240	1,671	59	3	-	-	-	164,636	84,473	17,136.000	0.203
1998	77,080	37,039	17,189	10,467	3,930	1,562	1,129	35	-	-	-	-	148,431	71,351	13,169.366	0.185
1999	74,867	39,663	18,063	10,964	3,994	1,569	1,141	24	2	-	-	-	150,287	75,420	13,665.711	0.181
2000	73,793	40,301	17,598	10,310	3,525	1,375	976	23	-	-	-	-	147,901	74,108	12,651.682	0.171
2001	73,206	37,461	16,078	9,231	2,930	1,060	747	63	-	-	-	-	140,776	67,570	11,108.552	0.164
2002	76,270	41,588	16,752	9,426	3,121	1,245	1,003	105	2	-	-	-	149,512	73,242	12,126.190	0.166
2003	77,889	42,720	17,231	9,589	3,139	1,233	864	37	-	-	-	-	152,702	74,813	11,955.570	0.160
2004	80,473	41,583	15,626	8,245	2,733	978	668	16	-	-	-	-	150,322	69,849	10,367.897	0.148
2005	82,574	46,444	17,754	9,191	2,934	1,104	683	17	-	-	-	-	160,701	78,127	11,455.807	0.147
2006	84,558	48,571	18,269	9,312	2,675	904	532	2	-	-	-	-	164,823	80,265	11,021.186	0.137
2007	84,551	49,998	17,672	8,294	2,329	824	402	11	-	-	-	-	164,081	79,530	10,120.013	0.127
2008	89,875	51,831	17,337	7,578	1,847	583	269	5	-	-	-	-	169,325	79,450	9,195.940	0.116
2009	94,627	52,670	17,417	8,352	2,161	741	413	-	-	-	-	-	176,381	81,754	10,024.804	0.123
2010	104,638	49,571	16,042	6,656	1,801	602	333	5	-	-	-	-	179,648	75,010	8,631.384	0.115
2011	110,217	55,407	16,651	6,753	1,675	559	276	-	-	-	-	-	191,538	81,321	8,771.326	0.108
2012	114,428	55,735	15,593	6,072	1,509	385	242	13	-	-	-	-	193,977	79,549	8,035.393	0.101
2013	107,378	47,190	13,158	5,088	1,227	380	191	2	-	-	-	-	174,614	67,236	6,759.547	0.101
2014	104,006	50,110	13,650	5,231	1,167	421	235	33	-	-	-	-	174,853	70,847	7,124.519	0.101
2015	106,088	50,067	13,856	4,980	1,230	421	242	2	-	-	-	-	176,886	70,798	7,019.088	0.099
2016	96,221	43,386	10,938	3,829	865	243	92	-	-	-	-	-	155,574	59,353	5,365.709	0.090
2017	92,311	45,920	12,376	4,745	1,184	382	154	-	-	-	-	-	157,072	64,761	6,416.548	0.099
2018	89,205	44,206	11,030	4,207	1,086	316	168	1	-	-	-	-	150,219	61,014	5,829.471	0.096
2019	81,282	39,068	9,512	3,636	942	300	156	1	-	-	-	-	134,897	53,615	5,080.795	0.095

* These doses are annual TEDE doses.

** Summary of reports submitted in accordance with 10 CFR 20.2206 by BWRs and PWRs that had been in commercial operation for at least 1 full year as of December 31 of each of the indicated years. Figures shown have not been adjusted for the multiple reporting of transient individuals (see Table 4.4b and Section 5).

*** Dose values exactly equal to the values separating ranges are reported in the next higher range.

Table 4.4b Summary of Distribution of Annual Doses* at Commercial Light-Water Reactors**, Adjusted for Transients 1994–2019

Year	Number of Individuals with Annual Doses* in the Ranges (rem) *** Note: Numbers of individuals shown have been adjusted for the multiple reporting of transient individuals (see Section 5).												Total Number Monitored	Number with Measurable Exposure	Collective Dose (person-rem)	Average Measurable Dose (person-rem)
	No. Measurable Exposure	Measurable <0.1	0.10-0.25	0.25-0.50	0.50-0.75	0.75-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-6.0	>6.0				
1994	67,700	29,847	14,841	11,716	6,124	3,586	4,222	508	40	-	-	-	138,584	70,884	21,534.000	0.304
1995	61,505	29,588	15,097	12,020	6,121	3,300	3,906	595	133	2	-	-	132,267	70,762	21,674.000	0.306
1996	58,292	30,021	14,831	11,340	5,418	2,831	3,194	408	67	-	-	-	126,402	68,110	18,874.000	0.277
1997	58,647	31,751	14,881	10,902	5,228	2,447	2,598	286	41	-	-	-	126,781	68,134	17,136.000	0.252
1998	57,041	27,905	12,829	8,802	3,930	1,839	1,829	182	15	1	-	-	114,373	57,332	13,169.366	0.230
1999	55,121	29,271	13,278	9,017	3,806	1,908	1,898	245	18	-	-	-	114,562	59,441	13,665.711	0.230
2000	53,324	28,480	12,921	8,679	3,571	1,644	1,734	186	18	-	-	-	110,557	57,233	12,651.682	0.221
2001	52,636	27,246	11,491	7,659	2,907	1,323	1,392	221	53	-	-	-	104,928	52,292	11,108.552	0.212
2002	53,440	28,523	11,610	7,668	3,004	1,479	1,820	320	35	1	-	-	107,900	54,460	12,126.190	0.223
2003	54,028	29,161	11,971	8,190	3,253	1,527	1,651	184	18	-	-	-	109,983	55,955	11,955.570	0.214
2004	57,420	28,863	11,178	7,335	2,873	1,233	1,190	188	13	-	-	-	110,293	52,873	10,367.897	0.196
2005	56,709	31,035	12,422	7,813	3,106	1,537	1,490	147	3	-	-	-	114,262	57,553	11,455.807	0.199
2006	57,546	32,439	12,687	7,802	2,971	1,415	1,407	82	2	-	-	-	116,351	58,805	11,021.186	0.187
2007	57,314	32,706	11,961	7,396	2,714	1,284	1,100	97	9	-	-	-	114,581	57,267	10,120.013	0.177
2008	61,336	33,832	12,322	6,786	2,430	1,026	922	38	-	-	-	-	118,692	57,356	9,195.940	0.160
2009	66,310	35,877	12,318	7,317	2,562	1,174	1,144	68	4	-	-	-	126,774	60,464	10,024.804	0.166
2010	74,218	33,873	11,670	6,356	2,231	946	832	42	3	-	-	-	130,171	55,953	8,631.384	0.154
2011	78,090	36,745	12,119	6,307	2,226	1,008	837	23	-	-	-	-	137,355	59,265	8,771.326	0.148
2012	79,222	36,990	11,943	5,904	1,962	774	672	37	-	-	-	-	137,504	58,282	8,035.393	0.138
2013	76,261	32,326	10,166	5,231	1,680	674	430	18	-	-	-	-	126,786	50,525	6,759.547	0.134
2014	73,390	32,917	10,285	5,212	1,685	695	589	58	-	-	-	-	124,831	51,441	7,124.519	0.138
2015	71,980	31,806	10,208	5,034	1,686	708	647	27	3	-	-	-	122,099	50,119	7,019.088	0.140
2016	67,685	29,063	8,736	4,196	1,236	429	332	16	1	-	-	-	111,694	44,009	5,365.709	0.122
2017	62,882	29,448	9,210	4,695	1,666	671	532	11	-	-	-	-	109,115	46,233	6,416.548	0.139
2018	59,356	28,012	8,146	4,205	1,488	663	462	20	2	-	-	-	102,354	42,998	5,829.471	0.136
2019	55,718	25,322	7,167	3,798	1,272	554	402	4	-	-	-	-	94,237	38,519	5,080.795	0.132

* These doses are annual TEDE doses.

** Summary of reports submitted in accordance with 10 CFR 20.2206 by BWRs and PWRs that had been in commercial operation for at least 1 full year as of December 31 of each of the indicated years.

*** Dose values exactly equal to the values separating ranges are reported in the next higher range.

4.4 Average Annual TEDE Doses

Some of the data presented in Tables 4.1, 4.2, and 4.3 are graphically displayed in Figure 4.1, where it can be seen that the average collective dose and average number of individuals per BWR have been higher than those for PWRs for all years depicted. BWRs generally have higher collective doses because the steam produced directly from the reactor is used to drive turbines to produce electricity, which results in radioactivity being present in both the reactor and turbine systems. PWR systems are designed to keep the radioactivity within the reactor vessel and primary system and not in the turbine systems.

In 2019, the average collective dose per reactor for BWRs was 105 person-rem and the average collective dose per reactor for PWRs was 27 person-rem. In comparison with the 2018 values, the average collective dose per reactor for BWRs decreased by 5 percent and the average collective dose per reactor for PWRs decreased by 20 percent which was significantly different from the 5-year average. The average collective dose per reactor for LWRs decreased by 11 percent from 2018 which was significantly different from the 5-year trend. This is the tenth year in a row that the average collective dose per reactor for LWRs has been below 90 person-rem. The overall decreasing trend in average reactor collective doses since 1994 indicates that licensees are continuing to successfully implement as low as is reasonably achievable (ALARA) dose reduction processes at their facilities. Further impacting this decreasing trend, in 2019, eleven LWRs reported substantial decreases (> 75 percent) in collective dose due to fewer outages. In 2019, the number of individuals with a measurable dose per reactor decreased to 909 for BWRs and decreased to 383 for PWRs. The decrease in PWR was significantly different from the 5-year average.

Figures 4.2 and 4.3 are plots of most of the other information that is presented in Tables 4.1, 4.2, and 4.3. Table 4.3 shows that the net electricity generated at LWRs decreased slightly from 91,836 MW-yr in 2018 to 91,638 MW-yr in 2019, while the number of operating reactors decreased to 96 in 2019. The net electricity generated in 2019 was not significantly different than the 5-year trend. Table 4.3 also shows that the value for the total collective dose for all LWRs decreased by 13 percent to 5,081 person-rem in 2019 from 5,829 person-rem in 2018, and was a statistically significant decrease from the 5-year trend. Table 4.3 shows that the average measurable dose per individual decreased slightly to 0.09 rem (not adjusted for transient individuals). The average collective dose for all LWRs per MW-yr was not significantly lower than the 5-year average.

The decrease seen in dose trends since 1994 may be attributed to several factors. For example, utilities have completed the tasks initiated as a result of the lessons learned from the 1979 TMI accident, and they are increasing efforts to avoid and reduce exposure. The concept of keeping exposures to ALARA levels is continually being stressed, and most utilities have established programs to collect and share information relative to exposure control processes, techniques, and procedures.

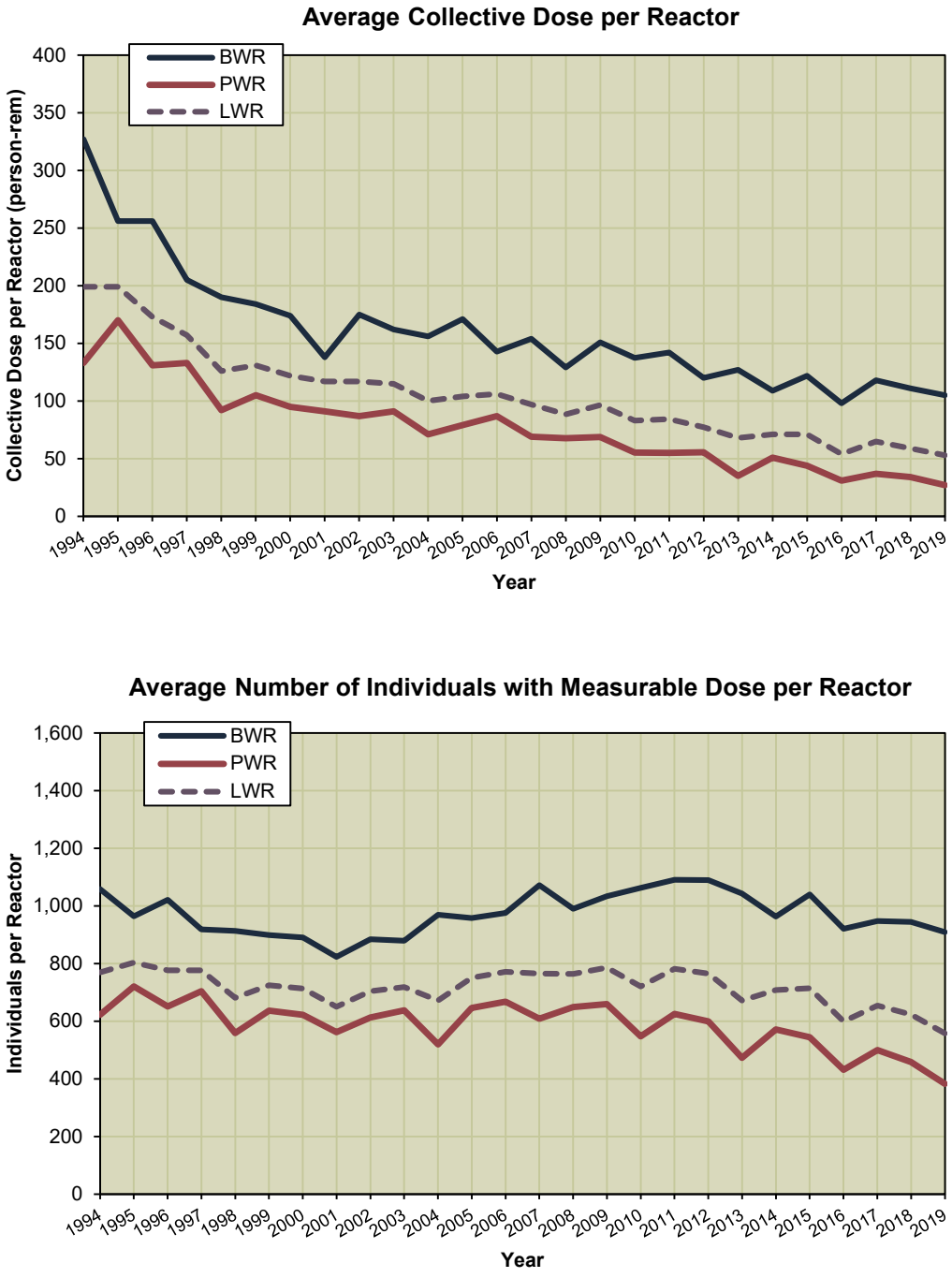
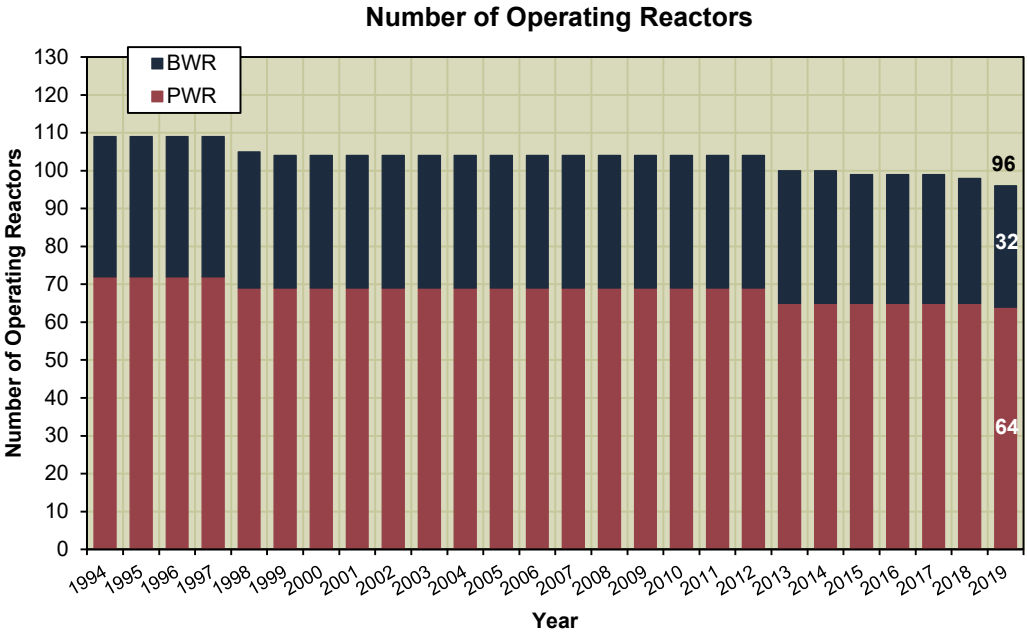
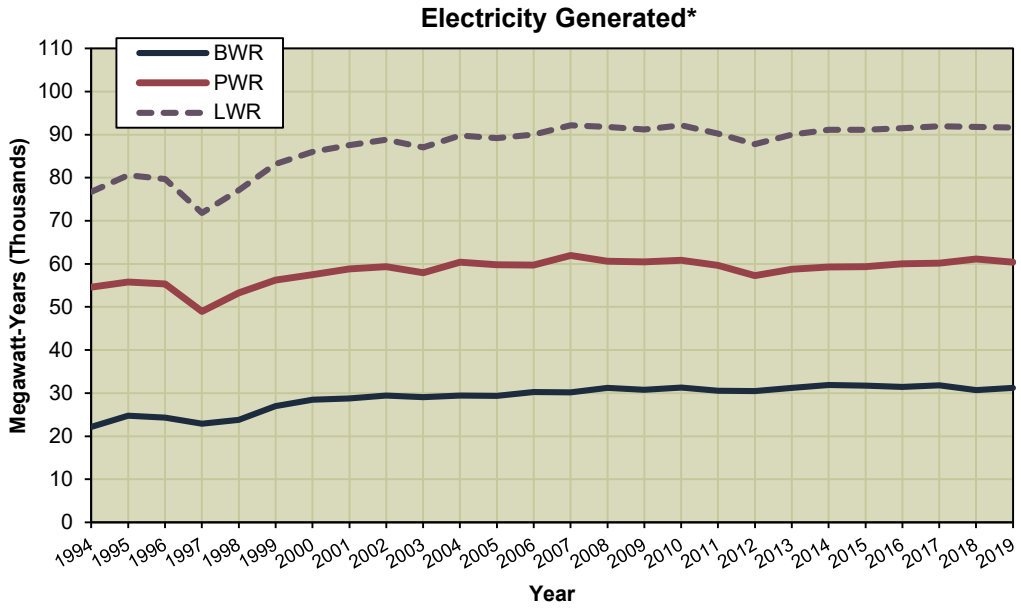


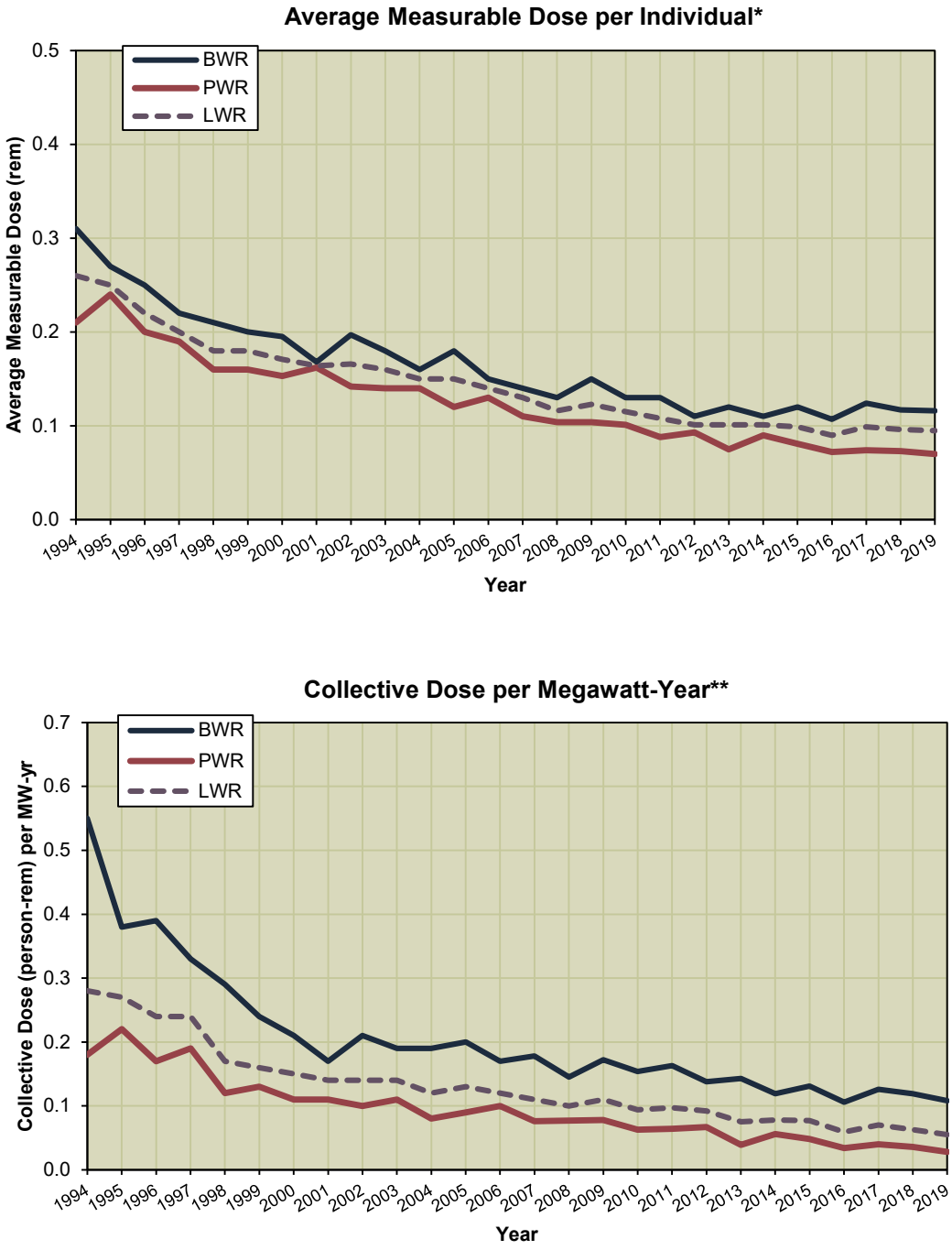
Figure 4.1 Average Collective Dose per Reactor and Average Number of Individuals with Measurable Dose per Reactor 1994–2019





* Gross electricity is shown for 1994–1996, net electricity is shown for 1997–2019.

Figure 4.2 Number of Operating Reactors and Electricity Generated 1994–2019



* Not adjusted for transient workers. See Section 5.
** Gross electricity is shown for 1994–1996, net electricity is shown for 1997–2019.

Figure 4.3 Average Measurable Dose per Individual and Collective Dose per Megawatt-Year 1994–2019

To further assist in the identification of any trends that might exist, Figures 4.4a and 4.4b display the average and median values of the collective dose per reactor for BWRs and for PWRs for the years 1994 through 2019. The median values are included here for statistical completeness and are not used in other sections of this report. The ranges of the values reported each year are shown by the vertical lines with a small bar at each end marking the two extreme values.

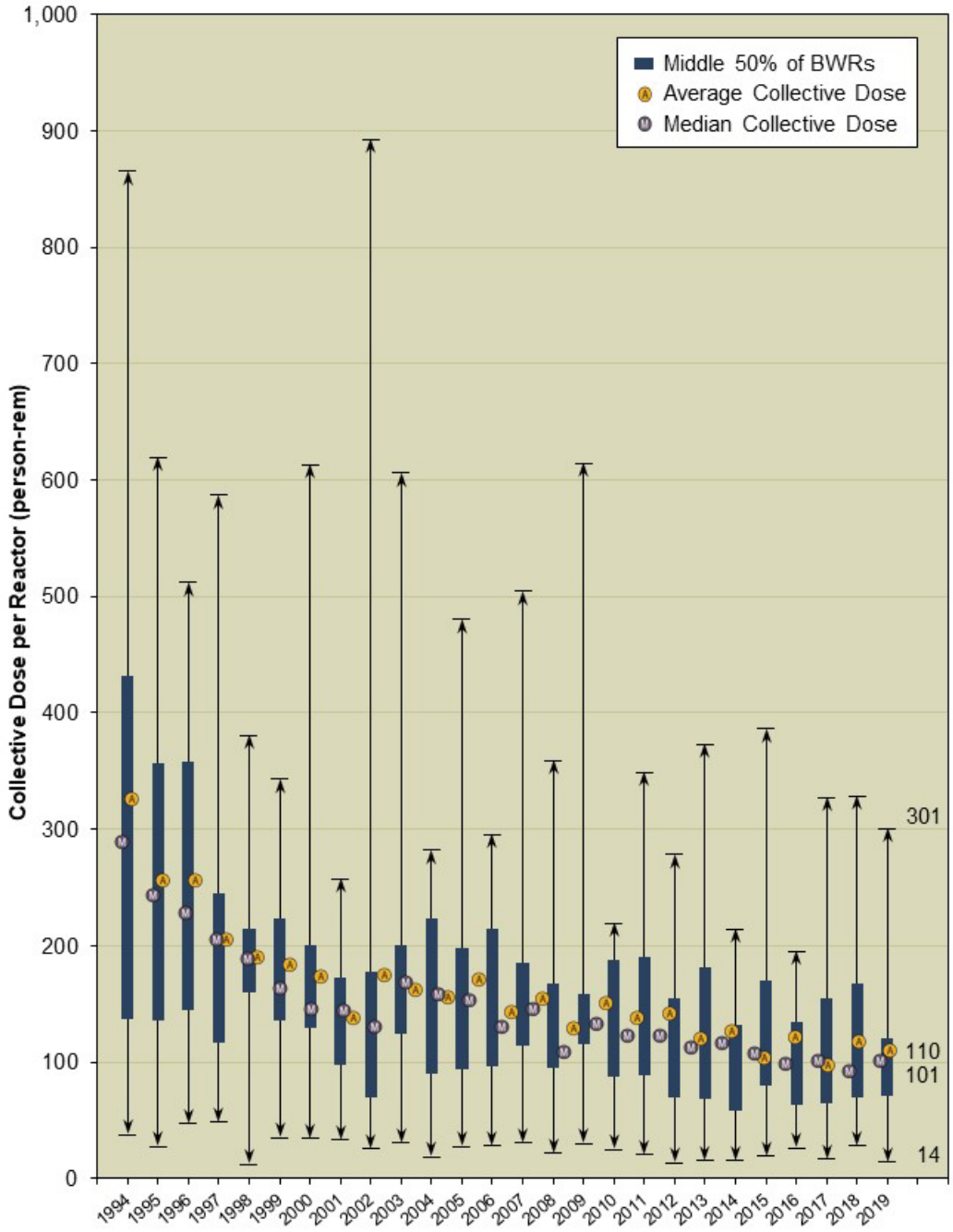


Figure 4.4a Average, Median, and Extreme Values of the Collective Dose per BWR Reactor 1994–2019

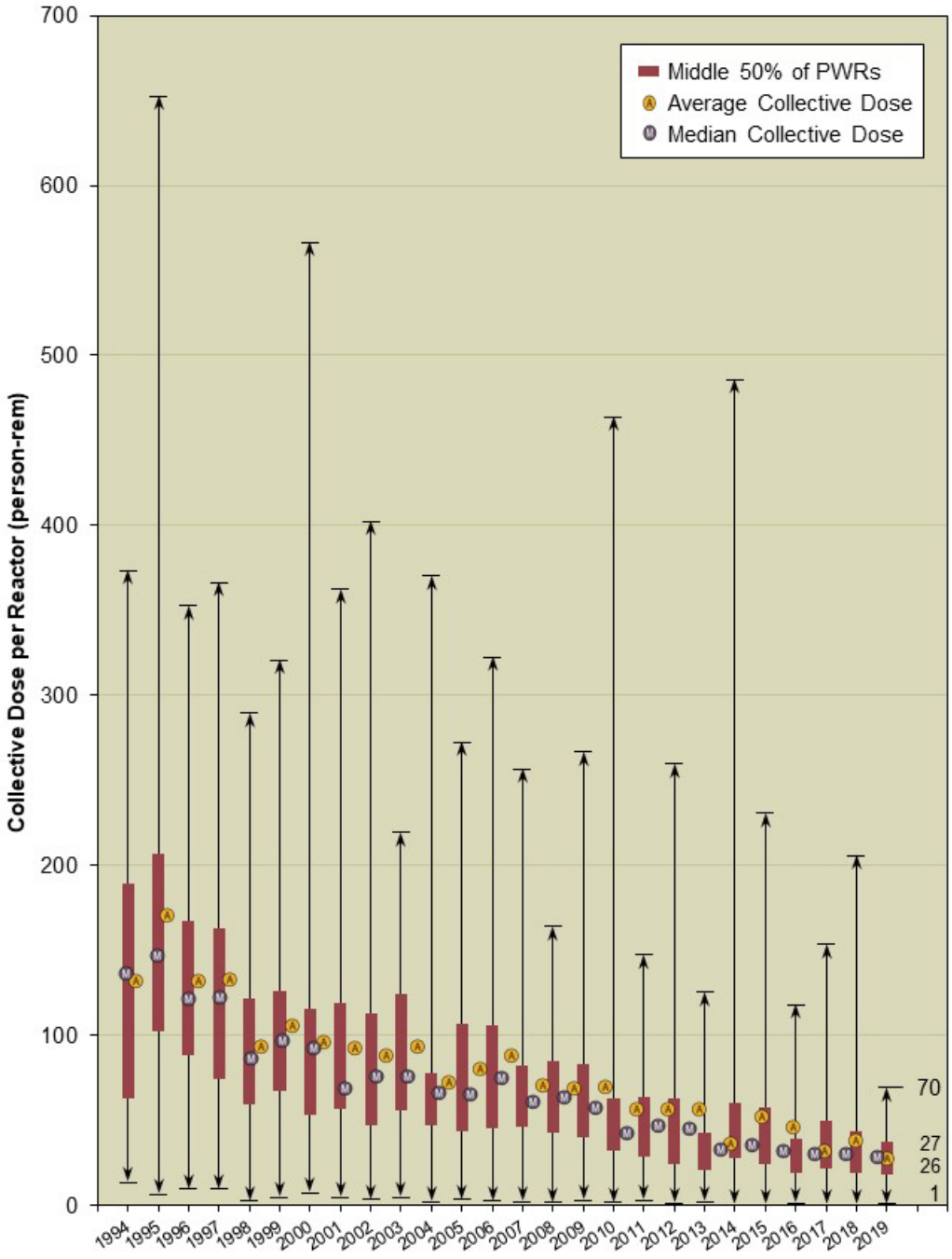


Figure 4.4b Average, Median, and Extreme Values of the Collective Dose per PWR Reactor 1994–2019

The rectangles indicate the range of values of the collective dose exhibited by those plants ranked in the 25th through the 75th percentiles. Figure 4.4a shows that the median collective dose for BWRs increased from 89 person-rem in 2018 to 101 person-rem in 2019, but this change was not significant. The median collective dose for PWRs decreased to 27 person-rem in 2019 and was not significantly lower than the 5-year median of 30 person-rem. Figure 4.4a and Figure 4.4b show that, in 2019, 50 percent of the BWRs reported collective doses between 71 and

121 person-rem, while 50 percent of the PWRs reported collective doses between 18 and 37 person-rem. The middle 50 percent of BWRs and PWRs in Figures 4.4a and 4.4b are the reactors between the 25 percent and 75 percent dose ranges. These values are based on annual collective dose values, not the 3-year rolling average that is presented in Section 4.5. Nearly every year, the median collective dose is less than the average, which indicates that more of the reactors tend to be at lower collective doses than is reflected by the average. This is a result of the wide difference between the maximum and minimum annual collective doses at power plants and the fact that some plants accrue higher collective doses during refueling outages. The plants that have outages during the year (and thus higher collective doses) increase the value of the average collective dose, while the median (or middle-point of the doses) remains lower.

4.5 Three-Year Average Collective TEDE per Reactor

The 3-year average collective dose per reactor is one of the metrics that the NRC uses in the Reactor Oversight Process for inspection planning and in the Significance Determination Process. Tables 4.5 and 4.6 list the sites that had been in commercial operation for at least 3 years as of December 31, 2019, and show the values of several parameters for each of the sites. These tables also give averages for the two types of reactors.

Based on the 96 reactor-years of operation accumulated over a 3-year period by the 32 BWRs listed, the average 3-year collective TEDE per reactor was found to be 113 person-rem, the average measurable TEDE per individual was 0.120 rem, and the average collective TEDE per MW-yr was 0.12 rem. For BWRs, only the average measurable TEDE per individual was statistically significant when compared to the 5-year average.

Based on the 192 reactor-years of operation accumulated over a 3-year period at the 64 PWRs listed, the average annual collective TEDE per reactor, average measurable TEDE per individual, and average collective TEDE per MW-yr were found to be 32 person-rem, 0.072 rem, and 0.03 rem, respectively. All three values were significantly lower in 2019 when compared to the 5-year trend.

In addition to the listings provided in Tables 4.5 and 4.6, the quartile ranking is used by the NRC as a factor in planning the number of inspection hours assigned per site. For this reason, Tables 4.7 and 4.8 are included in the 2019 annual report for BWRs and PWRs, respectively. These tables show the plant name, 3-year collective TEDE per reactor year, the percent change in the 3-year average from the previous 3-year period, and the quartile ranking from the previous period if the ranking has changed.

Table 4.5 Three-Year Totals and Averages Listed in Ascending Order of Collective TEDE per BWR 2017–2019

Plant Name*	Reactor Years	Three-year Collective TEDE per Reactor Year 2017-2019 (person-rem)	Three-year Collective TEDE per Site (person-rem)	Number of Workers with Measurable TEDE	Average TEDE per Worker (rem)	Total MW-Yrs	Average TEDE per MW-Yr (rem)
DUANE ARNOLD	3	36.963	110.889	1,114	0.100	1,751.7	0.06
HATCH 1,2	6	55.816	334.894	3,577	0.094	4,891.7	0.07
COOPER STATION	3	59.213	177.640	1,681	0.106	2,225.6	0.08
DRESDEN 2,3	6	75.161	450.963	5,966	0.076	5,261.9	0.09
SUSQUEHANNA 1,2	6	75.646	453.873	4,036	0.112	7,113.1	0.06
LIMERICK 1,2	6	77.043	462.260	5,390	0.086	6,551.1	0.07
GRAND GULF	3	80.766	242.298	2,787	0.087	2,902.8	0.08
QUAD CITIES 1,2	6	90.049	540.296	5,462	0.099	5,288.6	0.10
PEACH BOTTOM 2,3	6	90.372	542.234	5,308	0.102	7,501.2	0.07
MONTICELLO	3	91.159	273.477	2,143	0.128	1,797.0	0.15
BRUNSWICK 1,2	6	103.671	622.023	4,964	0.125	5,104.3	0.12
NINE MILE POINT 1,2	6	113.060	678.360	4,644	0.146	5,363.4	0.13
HOPE CREEK 1	3	117.061	351.183	3,362	0.104	3,311.5	0.11
CLINTON	3	130.408	391.224	3,850	0.102	2,870.4	0.14
BROWNS FERRY 1,2,3	9	134.634	1,211.709	8,825	0.137	9,491.1	0.13
COLUMBIA GENERATING	3	138.009	414.027	3,607	0.115	3,048.4	0.14
FITZPATRICK	3	139.301	417.904	2,976	0.140	2,290.5	0.18
RIVER BEND 1	3	199.501	598.502	3,520	0.170	2,359.3	0.25
LASALLE 1,2	6	204.798	1,228.786	8,042	0.153	6,591.8	0.19
PERRY	3	219.544	658.632	2,888	0.228	3,390.9	0.19
FERMI 2	3	219.793	659.379	6,015	0.110	2,970.8	0.22
Totals and Averages	**96**	**-**	**10,820.553**	**90,157**	**0.120**	**92,077.1**	**0.12**
Average per Reactor-Year	**-**	**112.714**	**-**	**939**	**-**	**959.1**	**-**

* Sites where not all reactors had completed 3 full years of commercial operations as of December 31, 2019, are not included.

Table 4.6 Three-Year Totals and Averages Listed in Ascending Order of Collective TEDE per PWR 2017–2019

Plant Name*	Reactor Years	Three-year Collective TEDE per Reactor Year 2017-2019 (person-rem)	Three-year Collective TEDE per Site (person-rem)	Number of Workers with Measurable TEDE	Average TEDE per Worker (rem)	Total MW-Yrs	Average TEDE per MW-Yr (rem)
OCONEE 1,2,3	9	13.960	125.639	2,822	0.045	7,417.5	0.02
PALO VERDE 1,2,3	9	15.139	136.253	3,150	0.043	10,886.6	0.01
PRAIRIE ISLAND 1,2	6	16.108	96.646	1,534	0.063	3,067.2	0.03
SEABROOK	3	21.231	63.693	1,055	0.060	3,533.9	0.02
DAVIS-BESSE 1	3	21.343	64.029	986	0.065	2,636.5	0.02
CALLAWAY 1	3	21.518	64.554	1,027	0.063	3,221.9	0.02
FARLEY 1,2	6	21.838	131.026	2,063	0.064	4,909.4	0.03
DIABLO CANYON 1,2	6	21.843	131.058	2,292	0.057	5,991.5	0.02
HARRIS 1	3	23.059	69.176	1,234	0.056	2,672.1	0.03
BYRON 1,2	6	24.887	149.323	2,588	0.058	6,771.9	0.02
GINNA	3	25.376	76.127	1,133	0.067	1,642.8	0.05
BEAVER VALLEY 1,2	6	25.654	153.924	2,222	0.069	5,185.1	0.03
WATTS BAR 1,2	6	26.268	157.609	2,685	0.059	5,686.7	0.03
BRAIDWOOD 1,2	6	26.554	159.321	2,510	0.063	6,794.5	0.02
CALVERT CLIFFS 1,2	6	27.504	165.023	2,398	0.069	5,149.8	0.03
VOGTLE 1,2	6	29.680	178.079	2,204	0.081	6,722.4	0.03
COOK 1,2	6	30.233	181.398	2,748	0.066	5,863.3	0.03
SOUTH TEXAS 1,2	6	30.327	181.962	1,999	0.091	7,350.1	0.02
CATAWBA 1,2	6	31.318	187.908	2,739	0.069	6,630.1	0.03
NORTH ANNA 1,2	6	32.836	197.017	2,311	0.085	5,416.5	0.04
POINT BEACH 1,2	6	34.199	205.192	1,804	0.114	3,404.0	0.06
SUMMER 1	3	34.705	104.116	1,750	0.059	2,571.7	0.04
COMANCHE PEAK 1,2	6	36.787	220.724	2,397	0.092	6,512.6	0.03
MILLSTONE 2,3	6	37.730	226.381	2,610	0.087	5,734.6	0.04
SURRY 1,2	6	37.992	227.950	2,665	0.086	4,773.9	0.05
ST. LUCIE 1,2	6	39.563	237.378	2,981	0.080	5,361.9	0.04
MCGUIRE 1,2	6	40.304	241.824	3,346	0.072	6,649.1	0.04
INDIAN POINT 2,3	6	40.393	242.360	5,132	0.047	5,510.2	0.04
WOLF CREEK 1	3	40.501	121.502	2,211	0.055	3,319.6	0.04
TURKEY POINT 3,4	6	40.650	243.898	2,674	0.091	4,636.5	0.05
SEQUOYAH 1,2	6	40.785	244.711	3,044	0.080	6,163.9	0.04
ROBINSON 2	3	40.802	122.405	1,889	0.065	2,007.3	0.06
WATERFORD 3	3	43.879	131.638	1,923	0.068	3,003.7	0.04
SALEM 1,2	6	47.399	284.393	3,068	0.093	6,279.2	0.05
ARKANSAS 1,2	6	51.161	306.963	5,186	0.059	4,462.0	0.07
PALISADES	3	123.492	370.477	1,924	0.193	2,102.5	0.18
Totals and Averages	**192**	**-**	**6,201.677**	**86,304**	**0.072**	**180,042.5**	**0.03**
Average per Reactor-Year	**-**	**32.300**	**-**	**450**	**-**	**937.7**	**-**

* Sites where not all reactors had completed 3 full years of commercial operation as of December 31, 2019, are not included.

Table 4.7 Three-Year Collective TEDE per Reactor-Year for BWRs 2017–2019

	Plant Name	Three-Year Coll. TEDE per Reactor Year 2017-2019	Percent Change From 2016-2018	2016-2018 Quartile (if changed)
1st Quartile	DUANE ARNOLD	36.963	-46% ▼	-
	HATCH 1,2	55.816	-28% ▼	-
	COOPER STATION	59.213	-50% ▼	3
	DRESDEN 2,3	75.161	16% ▲	-
	SUSQUEHANNA 1,2	75.646	-17% ▼	2
	LIMERICK 1,2	77.043	7% ▲	-
2nd Quartile	GRAND GULF	80.766	-40% ▼	4
	QUAD CITIES 1,2	90.049	13% ▲	1
	PEACH BOTTOM 2,3	90.372	-6% ▼	3
	MONTICELLO	91.159	58% ▲	1
	BRUNSWICK 1,2	103.671	10% ▲	-
3rd Quartile	NINE MILE POINT 1,2	113.060	-13% ▼	-
	HOPE CREEK 1	117.061	9% ▲	-
	CLINTON	130.408	47% ▲	2
	BROWNS FERRY 1,2,3	134.634	-3% ▼	4
	COLUMBIA GENERATING	138.009	66% ▲	2
4th Quartile	FITZPATRICK	139.301	-1% ▼	-
	RIVER BEND 1	199.501	45% ▲	-
	LASALLE 1,2	204.798	-2% ▼	-
	PERRY	219.544	67% ▲	3
	FERMI 2	219.793	2% ▲	-
	Average per Reactor-Year	**112.714**	**3%** ▲	-

< Average 112.714

Table 4.8 Three-Year Collective TEDE per Reactor-Year for PWRs 2017–2019

	Plant Name	Three-Year Coll. TEDE per Reactor Year 2017-2019	Percent Change From 2016-2018	2016-2018 Quartile (if changed)
1st Quartile	OCONEE 1,2,3	13.960	-15% ▼	-
	PALO VERDE 1,2,3	15.139	-15% ▼	-
	PRAIRIE ISLAND 1,2	16.108	-20% ▼	-
	SEABROOK	21.231	-1% ▼	-
	DAVIS-BESSE 1	21.343	-63% ▼	4
	CALLAWAY 1	21.518	-12% ▼	-
	FARLEY 1,2	21.838	3% ▲	-
	DIABLO CANYON 1,2	21.843	11% ▲	-
	HARRIS 1	23.059	-9% ▼	-
2nd Quartile	BYRON 1,2	24.887	-11% ▼	-
	GINNA	25.376	0% ▲	-
	BEAVER VALLEY 1,2	25.654	-11% ▼	-
	WATTS BAR 1,2	26.268	12% ▲	1
	BRAIDWOOD 1,2	26.554	-11% ▼	-
	CALVERT CLIFFS 1,2	27.504	-14% ▼	-
	VOGTLE 1,2	29.680	-4% ▼	-
	COOK 1,2	30.233	-6% ▼	-
	SOUTH TEXAS 1,2	30.327	15% ▲	-
3rd Quartile	CATAWBA 1,2	31.318	-4% ▼	-
	NORTH ANNA 1,2	32.836	-11% ▼	-
	POINT BEACH 1,2	34.199	9% ▲	2
	SUMMER 1	34.705	2% ▲	-
	COMANCHE PEAK 1,2	36.787	11% ▲	-
	MILLSTONE 2,3	37.730	-7% ▼	-
	SURRY 1,2	37.992	3% ▲	-
	ST. LUCIE 1,2	39.563	-9% ▼	4
	MCGUIRE 1,2	40.304	-5% ▼	4
4th Quartile	INDIAN POINT 2,3	40.393	-8% ▼	-
	WOLF CREEK 1	40.501	-27% ▼	-
	TURKEY POINT 3,4	40.650	4% ▲	3
	SEQUOYAH 1,2	40.785	-11% ▼	-
	ROBINSON 2	40.802	-2% ▼	3
	WATERFORD 3	43.879	102% ▲	1
	SALEM 1,2	47.399	2% ▼	-
	ARKANSAS 1,2	51.161	-8% ▼	-
	PALISADES	123.492	1% ▲	-
	Average per Reactor-Year	**32.300**	**-42% ▼**	

< *Average 32.300*

4.6 International Occupational Radiation Exposure

In 1992, the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (NEA/OECD), with sponsorship from the International Atomic Energy Agency (IAEA), created the Information System on Occupational Exposure (ISOE) Program as an international forum for representatives from nuclear electric utilities and regulatory agencies to share dose reduction information, operational experience, and information to improve the optimization of radiological protection at commercial nuclear power plants. The ISOE database, ISOEDAT, includes occupational exposure information for 400 operating units and 80 units in cold-shutdown or some stage of decommissioning in 29 countries, covering about 90 percent of the world's operating commercial nuclear power reactors. One of the purposes of ISOEDAT is to allow a comparison of radiation protection effectiveness and trends among the participating countries and among the various types of commercial nuclear power reactors.

As part of the agency's international cooperative research program initiatives, the NRC joined the ISOE Program as a regulatory member in December 1994. The NRC's REIRS database is the U.S. system comparable with ISOEDAT on the global scale. Since joining the ISOE Program, the NRC has leveraged experience in data management and analysis of the REIRS database, as well as provided input to NEA/OECD and IAEA for streamlining certain ISOEDAT methods for capturing, maintaining, and displaying data.

Figures 4.5 and 4.6 show the average collective dose per reactor for both PWRs and BWRs for the United States and participating reactors from ISOEDAT. For PWRs, the international average collective dose per unit increased from 49 to 54 person-rem per reactor in 2019, while the U.S. average decreased from 34 to 27 person-rem per reactor. The international average for BWRs remained the same at 26 person-rem per reactor in 2019, which is approximately 25 percent of the average for U.S. BWRs (105 person-rem per reactor).

It should be noted that the information from reactor sites in Japan has been affected by the Fukushima Daiichi event that occurred in 2011. Following the earthquake and tsunami at the Fukushima Daiichi and Daini reactor sites, all Japanese reactors were shut down to assess safety concerns. While these plants ceased power production, they were still officially counted as "operational" reactors. The collective dose at these sites decreased significantly as most operational activities were not required when the reactors were not producing power. Similarly, the collective dose data for German reactors in the ISOE database includes reactors that were shut down in 2011 by the German government following the Fukushima event. This resulted in a significant reduction in the average collective dose per reactor as operational activities ceased. The decrease in the average collective dose per reactor from these two countries decreased the overall international averages for both types of reactors since 2011. Since the Japan data represent a large percent (30 percent of the total BWRs), the decrease in the average collective dose per BWR in Japan is the primary factor in the decrease for international BWRs since 2011 as can be seen in Figure 4.6.

The data were compiled from the ISOEDAT online database. The NEA publishes an annual report entitled "Occupational Exposures at Nuclear Power Plants" that is available on the ISOE Web site at www.isoe-network.net [Ref. 19].

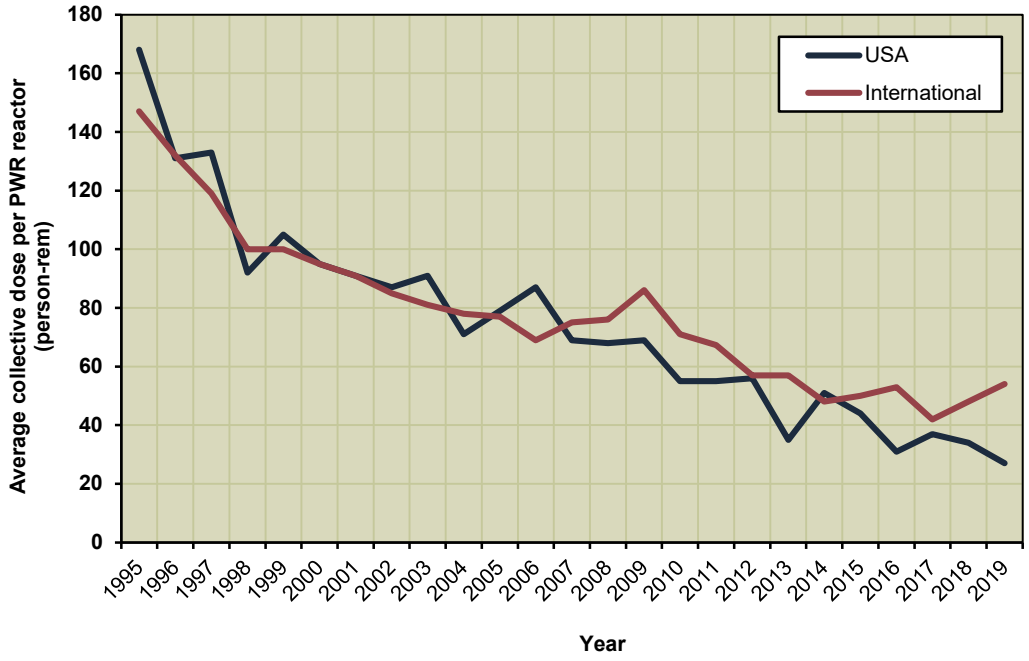


Figure 4.5 Average Collective Dose per PWR Reactor 1995–2019

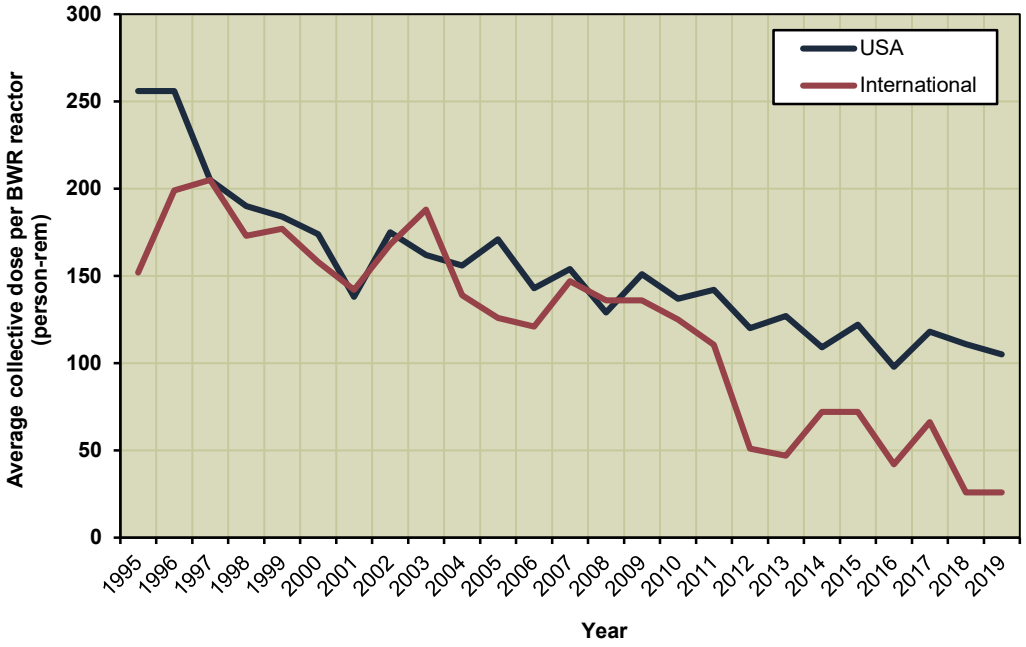


Figure 4.6 Average Collective Dose per BWR Reactor 1995–2019

4.7 Decontamination and Decommissioning of Commercial Nuclear Power Reactors

The NRC regulates the decontamination and decommissioning (D&D) of commercial nuclear power reactors. The purpose of the NRC Decommissioning Program is to ensure that NRC-licensed sites are decommissioned in a safe, timely, and effective manner so that they can be returned to beneficial use and to ensure that stakeholders are informed and involved in the process, as appropriate.

The NRC Office of Nuclear Material Safety and Safeguards (NMSS) has project management responsibilities for decommissioning commercial nuclear power reactors. The NRC's commercial nuclear power reactor decommissioning activities include project management, technical review of licensee submittals in support of decommissioning, licensing amendments and exemptions in support of the progressive stages of decommissioning, inspections of decommissioning activities, support for the development of rulemaking guidance, public outreach efforts, international activities, and participation in industry conferences and workshops. The NMSS staff regularly coordinates with other offices on issues affecting all commercial nuclear power reactors, both operating and decommissioning, and specifically in regard to the ISFSIs at reactor sites undergoing decommissioning [Ref. 20].

Decommissioning Process

The decommissioning process begins when a licensee decides to permanently cease operations. The major steps that comprise the commercial nuclear power reactor decommissioning process are notification of cessation of operations; submittal and review of the post-shutdown decommissioning activities report (PSDAR); submittal, review, and approval of the license termination plan (LTP); implementation of the LTP; and completion of decommissioning. The flowchart in Figure 4.7 illustrates the D&D process.

Notification

When a licensee has decided to permanently cease operations, it is required to submit a written notification to the NRC. In addition, the licensee is required to notify the NRC in writing once fuel has been permanently removed from the reactor vessel.

Post-Shutdown Decommissioning Activities Report

Within 2 years of cessation of operations, the licensee must submit a PSDAR to the NRC and a copy to the affected State(s). The PSDAR must include a description and schedule for the planned decommissioning activities, an estimate of the expected costs, and a discussion of the means for concluding that the environmental impacts associated with site-specific decommissioning activities will be bounded by appropriate, previously issued environmental impact statements. The NRC will provide notice of receipt of the PSDAR in the *Federal Register* and make the PSDAR available for public comment. In addition, the NRC will hold a public meeting in the vicinity of the licensee's facility to discuss the PSDAR.

License Termination Plan

Each commercial nuclear power reactor licensee must submit an application for termination of its license. An LTP must be submitted at least 2 years before the license termination date. The NRC and licensee hold pre-submittal meetings to agree on the format and content of the LTP. These

meetings are intended to improve the efficiency of the LTP development and review process. The LTP must include the following: a site characterization; the identification of remaining dismantlement activities; plans for site remediation; detailed plans for the final radiation survey; a description of the end use of the site, if restricted; an updated site-specific estimate of remaining decommissioning costs; and a supplement to the environmental report describing any new information or significant environmental change associated with the licensee's proposed termination activities. In addition, the licensee must demonstrate that it will meet the applicable requirements of the License Termination Rule in 10 CFR Part 20, Subpart E, "Radiological Criteria for License Termination."

The NRC will provide notice of receipt of the LTP in the *Federal Register* and make the LTP available for public comment. In addition, the NRC will hold a public meeting in the vicinity of the licensee's facility to discuss the LTP and the LTP review process.

Implementation of the License Termination Plan

After approval of the LTP, the licensee or responsible party must complete decommissioning in accordance with the approved LTP. The NRC staff will periodically inspect the decommissioning activities at the site to ensure compliance with the LTP. These inspections will normally include in-process and confirmatory radiological surveys.

Decommissioning must be completed within 60 years of permanent cessation of operations, unless otherwise approved by the NRC.

Completion of Decommissioning

At the conclusion of decommissioning activities, the licensee will submit a final status survey report (FSSR), which identifies the final radiological conditions of the site and requests that the NRC either (1) terminate the 10 CFR Part 50 license, or (2) reduce the 10 CFR Part 50 license boundary to the footprint of the ISFSI. For decommissioning commercial nuclear power reactors with no ISFSI or an ISFSI holding a specific license under 10 CFR Part 72, completion of reactor decommissioning will result in the termination of the 10 CFR Part 50 license. The NRC will approve the FSSR and the licensee's request if it determines that the licensee has met both of the following conditions: the remaining dismantlement has been performed in accordance with the approved LTP, and the final radiation survey and associated documentation demonstrate that the facility and site are suitable for release in accordance with the License Termination Rule.

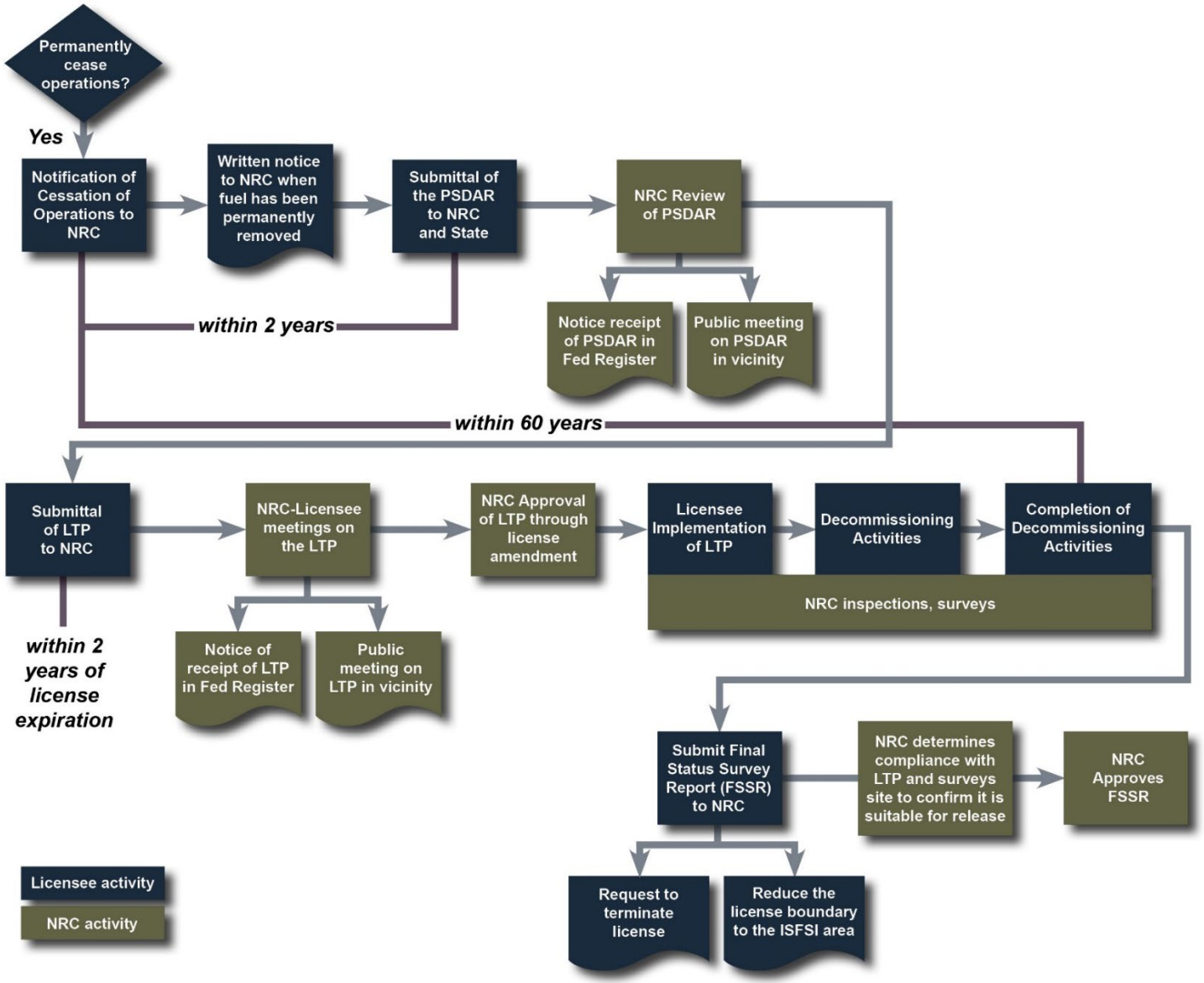


Figure 4.7 D&D Process Flowchart

Status of Decommissioning Activities at Commercial Nuclear Power Reactors

While 96 commercial nuclear power reactors are currently in operation, several shutdown power reactors have undergone the D&D process. As more commercial nuclear power reactors permanently shut down, either because they have reached the end of their operating license or shut down for other reasons, there will be a commensurate increase in activities involving radiation exposure related to D&D. For this reason, there is an increased need to provide further information on plants undergoing D&D.

Appendix B contains a list of the plants that are no longer in commercial operation, along with the dose distribution and collective dose for these plants. It should be noted that these plants may be in different stages of D&D, so that a comparison of the dose at one plant versus another would not be meaningful. In addition, Appendix B lists the plant units that are no longer in commercial operation but report along with other units at the site. Under the licensing conditions and reporting requirements, it is permissible to report this information together in one report. Table 4.9 lists the plants that have ceased operation and have changed operational status as of the date shown [Ref. 21]. In addition, Appendix E provides descriptions of the decommissioning activities currently underway at these commercial nuclear power reactors, as well as the total collective TEDE for each plant, based on available data through 2019.

Table 4.9 Plants No Longer in Operation 2019

Plant Name	Date of First Commercial Operation	Ceased Operations	License Termination Plan Approved by NRC	PSDAR Submitted	Plant Status	Completion of Decommissioning
CRYSTAL RIVER 3	12/1/1976	2/2013	TBD	12/2013	SAFSTOR	2074
DRESDEN 1	8/1/1960	10/1978	TBD	6/1998	SAFSTOR	2036
FERMI 1	5/10/1963	9/1972	TBD	4/1998	SAFSTOR	2032
FORT CALHOUN	6/20/1974	10/2016	TBD	3/2017	SAFSTOR	2065
HUMBOLDT BAY 3	8/1/1963	7/1976	2012	2/1998	DECON	2020
INDIAN POINT 1	3/26/1962	10/1974	TBD	1/1996	SAFSTOR	2034
KEWAUNEE	12/1/1973	5/2013	TBD	2/2013	SAFSTOR	2073
LACROSSE	11/1/1969	4/1987	TBD	5/1991	DECON	2020
MILLSTONE 1	12/28/1970	7/1998	TBD	6/1999	SAFSTOR	2056
OYSTER CREEK	12/1/1969	9/2018	TBD	5/2018	DECON	2035
PEACH BOTTOM 1	6/1/1967	10/1974	TBD	6/1998	SAFSTOR	2034
PILGRIM 1	12/1/1972	5/2019	TBD	11/2018	SAFSTOR	2080
SAN ONOFRE 1	1/1/1968	11/1992	TBD	12/1998	SAFSTOR	2032
SAN ONOFRE 2	1/1/1983	6/2013	TBD	9/2014	DECON	2032
SAN ONOFRE 3	1/1/1984	6/2013	TBD	9/2014	DECON	2032
THREE MILE ISLAND 1	9/2/1974	9/2019	TBD	4/2019	SAFSTOR	2079
THREE MILE ISLAND 2	12/30/1978	3/1979	TBD	TBD	SAFSTOR	2053
VERMONT YANKEE	11/30/1972	12/2014	TBD	12/2014	DECON	2030
ZION 1	12/31/1973	2/1997	TBD	2/2000	DECON	2020
ZION 2	9/17/1974	9/1996	TBD	2/2000	DECON	2020
DECOMMISSIONING COMPLETED						
BIG ROCK POINT	3/29/1963	8/1997	TBD	9/1997	ISFSI only	2007
HADDAM NECK	12/27/1974	12/1996	TBD	8/1997	ISFSI only	2007
MAINE YANKEE	6/29/1973	8/1997	TBD	8/1997	ISFSI only	2005
RANCHO SECO	4/17/1975	6/1989	TBD	3/1997	ISFSI only	2009
TROJAN	5/20/1976	11/1992	2/2001	8/1995	ISFSI only	2004
YANKEE ROWE	12/24/1963	10/1991	TBD	-	ISFSI only	2007

NOTE: Information regarding the latest decommissioning status of plants listed in this table can be found in Status of the Decommissioning Program: 2019 Annual Report from the NRC's public library under ADAMS Accession No. ML19282A393. Rows displayed in gray represent plants that have completed decommissioning [Refs. 21–21].

TBD = To Be Determined.

SAFSTOR = (often considered 'delayed DECON'): a nuclear facility that is maintained and monitored in a condition that allows the radioactivity to decay; afterwards, it is dismantled.

DECON = (immediate dismantlement): soon after the nuclear facility closes, equipment, structures, and portions of the facility containing radioactive contaminants are removed or decontaminated to a level that permits release of the property and termination of the NRC license.

5 TRANSIENT INDIVIDUALS AT NRC-LICENSED FACILITIES

The following analysis examines the individuals who had more than one Form 5 dose record at more than one NRC-licensed facility during the monitoring year. These individuals are defined as transient because they worked at more than one facility during the monitoring year.

The term “monitoring year” is used here in accordance with the definition given in 10 CFR 20.1003, which defines a year as “the period of time beginning in January used to determine compliance with the provisions of 10 CFR Part 20. The licensee may change the start date of the monitoring year used to determine compliance, provided that the change is made at the beginning of the monitoring/calendar year and that no day is omitted or duplicated in consecutive years.”

Examination of the data reported for individuals who began and terminated two or more periods of employment with two or more different facilities within one monitoring year is useful in many ways. For example, the number of transients and the individual doses received by them can be determined from examining these data.

Additionally, the distribution of the doses received by transient individuals can be useful in determining the impact that the inclusion of these individuals in each of two or more licensees’ annual reports has on the annual summary (as reported in Appendix B) for all commercial nuclear power reactors and all NRC licensees combined (one of the issues mentioned in Section 2). Table 5.1 shows the actual distribution of transient individual doses as determined from the NRC Form 5 termination reports and compares it with the reported distribution of the doses of these individuals as they would have appeared in a summation of the annual reports submitted by each of the licensees.

In 2019, over 98 percent of the transient individuals were reported by commercial nuclear power reactors. For this reason, these data are shown separately in Table 5.1.

Table 5.1 illustrates the impact that the multiple reporting of these transient individuals had on the summation of the dose reports for 2019. Each licensee reports the radiation dose received by individuals monitored at its facility. Many of these individuals are monitored at more than one facility during the year. When these dose records are summed for all licensees, they appear to be separate individuals reported by each facility. If an individual visited five facilities during a year, this individual would appear in the summation to be five different people, with one dose record for each of the five facilities. When these dose records are summed per individual, these records appear as one person, with a total annual dose that accurately represents the dose received for the entire monitoring year. Thus, while the total collective dose would remain the same, the number of individuals, their dose distributions, and average doses would be affected by this multiple reporting.

For example, in 2019, Table 5.1 shows that the initial summation (see line [2] Transients, As Reported) of the Form 5 reports for reactor licensees indicated that no individuals received a dose greater than 2.0 rem. After accounting for those individuals who were reported more than once, the corrected distribution indicated that there were 3 transient individuals who received doses between 2.0 and 3.0 rem. One individual that was not transient received a dose above 2 rem bringing the total to 4. Correcting for the multiple counting of individuals also had a significant effect (see line [3] Transients, Actual) on the average measurable dose for these individuals. The corrected average measurable dose for transient individuals is twice as high as the value calculated by the summation of the Form 5 records. For all reporting licensees, the transient individuals represent 35 percent of the workforce that received a measurable dose. The correction

for the transient individuals increased the average measurable dose from 0.10 rem to 0.20 rem for the transient workforce for all licensees. It should be noted that the analysis of transient individuals does not include individuals who may have been exposed at facilities that are not required to report to the NRC (see Section 1), such as Agreement State licensees and DOE facilities.

One purpose of the REIRS database, which tracks occupational radiation exposures at NRC-licensed facilities, is to identify individuals who may have exceeded the occupational radiation dose limits because of multiple exposures at different facilities throughout the year. The REIRS database stores the radiation dose information for an individual by his/her unique identification number and identification type [Ref. 14, Section 1.5] and sums the dose for all facilities during the monitoring year. An individual exceeding the 5 rem per year regulatory limit (TEDE) would be identified in Table 5.1 in one of the dose ranges greater than 5 rem. In 2019, there were 83 unique individuals receiving doses between 2 to 3 rem, 21 individuals receiving between 3 to 4 rem, and 3 individuals receiving between 4 to 5 rem, as reported by NRC licensees to the REIRS database. See Section 6 for more information on individuals who received exposures in excess of the NRC regulatory limits.

Table 5.1 Effects of Transient Individuals on Annual Statistical Compilations 2019

License Category	Number of Individuals with TEDE in the Ranges (rem)*												Total Number Monitored	Number with Measurable TEDE	Collective TEDE (person-rem)	Average Meas. TEDE (rem)
	No Measurable Exposure	Measurable <0.10	0.10-0.25	0.25-0.50	0.50-0.75	0.75-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-6.0	>6.0				
COMMERCIAL LIGHT-WATER REACTORS																
(1) Form 5 Summation	81,282	39,068	9,512	3,636	942	300	156	1	-	-	-	-	134,897	53,615	5,080.795	0.09
(2) Transients, As Reported	32700	21472	5924	2272	581	178	90	-	-	-	-	-	63,217	30,517	3,630.988	0.12
(3) Transients, Actual	7,136	7,726	3,579	2,434	911	432	336	3	-	-	-	-	22,557	15,421	3,630.988	0.24
Corrected Distribution (1-[2-3]) **	**55,718**	**25,322**	**7,167**	**3,798**	**1,272**	**554**	**402**	**4**	**-**	**-**	**-**	**-**	**94,237**	**38,519**	**5,080.795**	**0.13**
ALL LICENSEES																
(1) Form 5 Summation	83,954	42,353	10,634	4,571	1,429	564	631	83	21	3	-	-	144,243	60,289	7,149.591	0.12
(2) Transients, As Reported	34,011	22,013	6,045	2,310	598	178	102	-	-	-	-	-	65,257	31,246	3,174.410	0.10
(3) Transients, Actual	7,391	7,932	3,669	2,477	938	433	353	3	-	-	-	-	23,196	15,805	3,174.410	0.20
Corrected Distribution (1-[2-3]) **	**57,334**	**28,272**	**8,258**	**4,738**	**1,769**	**819**	**882**	**86**	**21**	**3**	**-**	**-**	**102,182**	**44,848**	**7,149.591**	**0.18**

* Dose values exactly equal to the values separating ranges are reported in the next higher range.
** The corrected distribution only applies to the number of individuals.

6 EXPOSURES TO PERSONNEL IN EXCESS OF REGULATORY LIMITS

6.1 Reporting Categories

Doses in excess of regulatory limits are sometimes referred to as “overexposures.” The phrase “doses in excess of regulatory limits” is preferred to “overexposures” because the latter suggests that an individual has been subjected to an unacceptable biological risk, which may or may not be the case.

Regulations in 10 CFR 20.2202 and 10 CFR 20.2203 require that all licensees submit reports of all incidents involving personnel radiation doses that exceed certain levels, thus providing for investigations and corrective actions as necessary. Based on the magnitude of the dose, the occurrence may be placed into one of three categories as follows:

1. Category A

   10 CFR 20.2202(a)(1) — a TEDE to any individual of 25 rem or more, a lens dose equivalent of 75 rem or more, or a shallow dose equivalent to the skin or extremities of 250 rad or more. The Commission must be notified immediately of these events and the U.S. Congress is notified annually through the U.S. NRC Abnormal Occurrence Report.

2. Category B

   10 CFR 20.2202(b)(1) — in a 24-hour period, the Commission must be notified of the following events: a TEDE to any individual exceeding 5 rem, a lens dose equivalent exceeding 15 rem, or a shallow dose equivalent to the skin or extremities exceeding 50 rem.

3. Category C

   10 CFR 20.2203 — in addition to the notification required by 10 CFR 20.2202 (Category A or B events), each licensee must submit a written report within 30 days after learning of any of the following occurrences:

   a. any incident for which notification is required by 10 CFR 20.2202; or

   b. doses that exceed the limits in §20.1201, §20.1207, §20.1208, or §20.1301 (for adults, minors, the embryo/fetus of a declared pregnant woman, and the public, respectively) or any applicable limit in the license; or

   c. levels of radiation or concentrations of radioactive material that exceed any applicable license limit for restricted areas or that, for unrestricted areas, are in excess of 10 times any applicable limit set forth in 10 CFR Part 20 or in the license (whether or not involving a dose of any individual in excess of the limits in §20.1301); or

   d. for licensees subject to the provisions of the U.S. Environmental Protection Agency’s generally applicable environmental radiation standards in 40 CFR Part 190, levels of radiation or releases of radioactive material in excess of those standards or license conditions related to those standards.

Doses in excess of regulatory limits that are reported as either Category A, B, or C typically undergo a review and evaluation process by the licensee, NRC inspectors, and NRC Headquarters staff. Preliminary dose estimates submitted by licensees are often conservatively high and do not represent the final (legal) dose of record assigned for the event. It is, therefore,

not uncommon for a dose in excess of a regulatory limit event to be reassessed and the final assigned dose to be categorized as not having been in excess of a regulatory limit. In other cases, the exposure event may not be identified until a later date, such as during the next scheduled audit or inspection of the licensee's event records.

6.2 Summary of Occupational Radiation Doses in Excess of NRC Regulatory Limits

The exposure events summary presented here is for events that occurred in 2019. An event that has been reassessed and determined not to be a dose in excess of a regulatory limit is not included in this report. In addition, events that occurred in prior years are added to the summary in the appropriate year of occurrence. The reader should note that the summary presented here represents a snapshot of the status of events as of the publication date of this report. Previous or future reports may not correlate in the exact number of events because of the review cycle and reassessment of the events.

It is important to note that this summary of events includes:

- occupational radiation doses in excess of the annual 5 rem regulatory limit;
- events at NRC-licensed facilities; and
- the dose of record assigned to an individual.

It **does not** include:

- medical events as defined in 10 CFR Part 35;
- doses in excess of the regulatory limits to the general public;
- Agreement State-licensed activities or DOE facilities; or
- exposures to dosimeters that, upon evaluation, have been determined to be high dosimeter readings only and are not assigned to an individual as the dose of record by the licensee.

In 2019, there were no Category A occurrences, Category B, or Category C occurrences reported under the licensed activities included in this report.

6.3 Summary of Annual Dose Distributions for Certain NRC Licensees

Table 6.1 gives a summary of the annual occupational dose records reported to the NRC, as required by 10 CFR 20.2206, by certain categories of NRC licensees. Table 6.1 shows that for the past 11 years, the percentage of individuals with less than 2 rem has been greater than 99 percent.

6.4 Maximum Occupational Radiation Doses Below NRC Regulatory Limits

Certain researchers have expressed an interest in a listing of the maximum doses received at NRC licensees that do not exceed the regulatory limits. This information allows for an examination of these doses and could possibly provide insights into where certain improvements could be made in the licensee's radiation protection program. Table 6.2 shows the maximum doses for each dose category required to be reported to the NRC. In addition, the number of doses in certain dose ranges is shown to reflect the number of doses that approach NRC regulatory limits. As shown in Table 6.2, 52 individuals exceed half of the TEDE dose limit, 5 individuals exceeded

75 percent of the TEDE dose limit, and 0 individuals exceeded 95 percent of the TEDE dose limit. The other dose categories where individuals exceeded 50 percent of the dose limit were the shallow dose equivalent to the maximally exposed extremity (SDE-ME).

Table 6.1 Summary of Annual Dose Distributions for Certain* NRC Licensees 2009–2019

Year	Total Number of Monitored Individuals		Individuals with Dose (TEDE) ***			
			< 2 rem	> 2 rem	< 5 rem	> 5 rem
	Reported Number	Corrected Number **	%	Number	%	Number
2009	189,972	139,381	99.9%	181	100%	-
2010	192,436	142,523	99.9%	185	100%	-
2011	204,575	149,971	99.9%	199	100%	-
2012	205,134	148,316	99.9%	207	100%	-
2013	186,062	138,233	99.8%	142	100%	-
2014	185,843	135,817	99.8%	224	100%	-
2015	186,614	131,827	99.9%	133	99.9%	2
2016	164,984	121,129	99.9%	81	100%	-
2017	166,526	118,715	99.9%	164	99.9%	2
2018	159,988	110,861	99.8%	188	99.9%	1
2019	144,243	102,182	99.9%	110	100.0%	-

* Licensees required to submit radiation exposure reports to the NRC under 10 CFR 20.2206.
** This column lists the actual number of persons who may have been counted more than once because they worked at more than one facility during the calendar year (see Section 5).
*** Data for 2009–2019 are based on the distribution of individual doses after adjusting for the multiple counting of transient individuals (see Section 5).

Table 6.2 Maximum Occupational Doses for Each Exposure Category* 2019

Dose Category**	Annual Dose Limit 10CFR20***	Maximum Dose Reported (rem)	Max Dose Percent of the Limit	Number of Individuals with Measurable Dose	Number of Individuals >25% of the Limit	Number of Individuals >50% of the Limit	Number of Individuals >75% of the Limit	Number of Individuals >95% of the Limit	Number of Individuals > Limit
SDE-ME	50 rem	40.826	82%	45,891	54	8	1	-	-
SDE-WB	50 rem	4.389	9%	50,974	-	-	-	-	-
LDE	15 rem	4.268	28%	50,027	6	-	-	-	-
CEDE		0.905		2,046					
CDE		7.567		2,051					
DDE		4.255		50,721					
TEDE	5 rem	4.255	85%	51,734	554	52	5	-	-
TODE	50 rem	7.692	15%	51,743	-	-	-	-	-

* Only records reported by licensees required to report under 10 CFR 20.2206 are included. Numbers have been adjusted for the multiple reporting of transient individuals.
** SDE-ME = shallow dose equivalent to the maximally exposed extremity
SDE-WB= shallow dose equivalent to the whole body
LDE = lens dose equivalent to the lens of the eye
CEDE = committed effective dose equivalent
CDE = committed dose equivalent
DDE = deep dose equivalent
TEDE = total effective dose equivalent
TODE = total organ dose equivalent
*** Shaded boxes represent dose categories that do not have specific dose limits defined in 10 CFR Part 20.

7 RADIATION PROTECTION EVALUATION DISCUSSION

The purpose of the outcome evaluation of the "Radiation Protection Program" is to measure the effectiveness NRC's Radiation Protection Program as it pertains to as low is reasonably achievable (ALARA) regulations of 10 CFR 20.1101(b) for each of the five NRC-licensee categories.[1] The outcome evaluation was limited in scope in that the evaluation solely evaluated the radiation protection programs based upon the data pertaining to number of licensees reporting exposure, the number of individuals monitored, the collective dose, and exposure trends (i.e., average individual and measurable doses) across the five categories of licensees. The evaluation does not take into consideration other factors related to ALARA practices but solely relies on exposure data to make conclusions.

This section describes the evidence to assess the effectiveness of the NRC's ALARA regulations in 10 CFR Part 20, and the licensee's implementation of ALARA regulations for each licensee category (10 CFR Parts 30, 31, 32, 33, 34, 36, 40, 50, 72, 73, 74 and 76).

7.1 Individual Licensee Category Results

Sections 3 and 4 of the report provides the definition of data terms and methodologies used to evaluate the radiation exposure data reported for the five categories of licensees. Some of these terms used in the evaluation include, for each licensee category, the number of individuals monitored, the collective dose, and a discussion of the trends in that data.

7.1.1 Industrial Radiography Licensees

As noted in Section 3.3.1, the industrial radiography licensee group data was broken into fixed location and temporary job sites subsets; however, the analyses were done for the overall licensee group. The data in Section 3.3.1 indicate that even though the number of individuals with measurable TEDE and collective TEDE were higher than the 5-year average these results were not statistically significant[2] in 2019. Additionally, the average measurable TEDE decreased to 0.53 rem (5.3 mSv) for 2019 but was not statistically different than the 5-year average of 0.57 rem (5.7 mSv). The results of the 2019 exposure data for industrial radiography licensees were statistically significant and validate the effectiveness of the NRC's ALARA regulations in 10 CFR Parts 20 and 34 and the licensee's implementation of this regulation for this licensee category.

7.1.2 Manufacturing and Distribution Licensees

As stated in Section 3.3.2, the manufacturing and distribution licensees include Broad-Type A , Broad-Type B, Other and nuclear pharmacies. For the manufacturing and distribution licensees, the number of individuals with a measurable dose increased by 12 percent and the collective.

TEDE increased by 8 percent. While the number of individuals with a measurable dose in 2019 was 24 percent more than the 5-year average of 646, the average measurable dose in 2019 (0.18 rem) was statistically lower than the 5-year average of 0.22 rem. While the results of the

[1] Commercial nuclear power reactors and test reactor facilities; industrial radiographers; fuel processors (including uranium enrichment facilities), fabricators, and reprocessors; manufacturing and distribution of byproduct material; independent spent fuel storage installations; facilities for land disposal of low-level waste; and geologic repositories for high-level waste. There are currently no NRC licensees involved in low-level waste disposal or geologic repositories for high-level waste.

[2] See Section 2.2 for a discussion about statistical significance.

2019 exposure data for manufacturing and distribution licensees were not statistically significant, the decrease in the average measurable dose is a strong indicator of the effectiveness of manufacturing and distribution licensee ALARA programs. The number of individuals monitored, and the measurable doses reported by manufacturing and distribution licenses increased in 2019 while keeping average measurable doses lower. This indicates that while production at these manufacturing and distribution licensee facilities appear to be rising these licensees are continuing to successfully implement ALARA dose reduction processes at their facilities.

7.1.3 Independent Spent Fuel Storage Installation Licensees

As stated in Section 3.3.4, the majority of ISFSI facilities are located on site at commercial nuclear power reactors and the occupational dose information from these facilities are usually included with the dose information reported by the commercial nuclear power reactors and is not reported separately to the NRC. Since 2005, two ISFSI licensees reported dose information to the NRC. The ISFSI facilities saw the collective TEDE increase by 11 percent from 2018 to 2019, but it should be noted that the dose increase was relatively small (less than 0.2 person-rem) and was statistically insignificant. The effect of a slight increase in the collective TEDE and the increase in number of individuals with a measurable dose resulted in a slight (but not significantly different) decrease in the average measurable TEDE per individual which decreased to 0.07 rem. The average measurable dose was not significantly different from the 5-year average. This indicates that the ISFSI licensees are continuing to successfully implement ALARA dose reduction processes at their facilities.

7.1.4 Fuel Cycle Licensees

As stated in Section 3.3.5, the fuel cycle facilities that are currently operational fall into three different categories: uranium enrichment, uranium conversion, and fuel fabrication. Fuel cycle licensees' collective TEDE and DDE increased in 2019 by 9 percent and 19 percent, respectively, and the collective CEDE decreased by 2 percent from 2018. When compared to the 5-year average, the increases in collective TEDE and collective DDE were not statistically significant, whereas the decrease in collective CEDE was statistically significant. Since the 2011 Fukushima Daiichi event, demand for nuclear fuel has dropped while global supply overall has increased, resulting in decreased fuel production by one licensee. In addition, this same licensee suspended operations at the UF6 production plant in November 2017 which has remained in a "ready-idle" status since that time. The shift from production related activities to maintaining minimal operations is a major factor contributing to the reduction in collective TEDE in 2019. This indicates that while production at these fuel cycle licensee facilities is at lower rates these licensees are continuing to successfully implement ALARA dose reduction processes at their facilities.

7.1.5 Commercial Power Reactor Licensees

As noted in Section 4, the average annual collective doses for both the PWR and BWR licensees decreased in 2019 and were lower than the 5-year average annual collective dose by 32 percent and 6 percent, respectively. While both the average annual collective doses per PWR and BWR are lower when compared to the 5-year average annual collective dose only the PWR value is statistically significant. The primary driver for the decrease in collective dose was the closure of Three Mile Island 1 (PWR) and Pilgrim 1 (BWR). Additionally, the overall decreasing trend in average reactor collective doses since 1994 indicates that licensees are continuing to successfully implement ALARA dose reduction processes at their facilities.

The decrease seen in dose trends since 1994 may be attributed to several factors. For example, utilities have completed the tasks initiated as a result of the lessons learned from the 1979 TMI accident, and they are increasing efforts to avoid and reduce exposure. The concept of keeping exposures to ALARA levels is continually being stressed, and most utilities have established programs to collect and share information relative to exposure control processes, techniques, and procedures.

Finally, based on the 192 reactor-years of operation accumulated over a 3-year period at the 64 PWRs listed, the average annual collective TEDE per reactor, average measurable TEDE per individual, and average collective TEDE per MW-yr were found to be 32 person-rem, 0.072 rem, and 0.03 rem, respectively. All three values were significantly lower in 2019 when compared to the 5-year trend. The results of the 2019 exposure data for PWR licensees were statistically significant and validate the effectiveness of the NRC's ALARA regulations in 10 CFR Parts 20 and 50 and the licensee's implementation of those regulations for this licensee category.

7.2 Collective Results

As noted in Table 3.2, annual reports for 2019 were received from a total of 181 NRC licensees from the five categories included in this report. The summation of reports submitted by the 181 licensees indicated that 144,243 individuals were monitored, 60,289 of whom received a measurable dose. When adjusted for transient individuals, there were actually 102,182 unique individuals that were monitored, 44,848 (44 percent) of whom received a measurable dose (see Section 5). These doses are all below the annual occupational dose limit for adults of 5 rem and commensurate with the ALARA regulations of 10 CFR 20.1101(b).

As noted in Table 3.1, the collective dose incurred by these individuals was 7,150 person-rem (71,500 person-millisieverts [mSv]), which represents a 12 percent decrease from the 2018 value. Additionally, the 2019 collective dose is 14 percent lower than the 5-year average of 8,348 person-rem (2014 – 2018), which is a statistically significant change.[3] The decrease in collective dose in 2019 was due to decreases in two categories offsetting increases in the remaining three reporting categories as discussed in Sections 7.1.1 and 7.1.5. The increases or decreases for the remaining three categories were not statistically significant as noted in Sections 7.1.2 through 7.1.4.

Finally, one of the purposes of the REIRS database is to identify individuals who may have exceeded the occupational radiation dose limits because of multiple exposures at different facilities throughout the year. The REIRS database stores the radiation dose information for an individual by his/her unique identification number and identification type [Ref. 14] and sums the dose for all facilities during the monitoring year. An individual exceeding the 5 rem per year regulatory limit (TEDE) would be identified in Table 5.1 in one of the dose ranges greater than 5 rem. In 2019, there were 882 individuals (8E-03 percent) receiving dose between 1 to 2 rem, 86 individuals (8E-04 percent) receiving doses between 2 to 3 rem, 21 individuals (2E-04 percent) receiving between 3 to 4 rem, and 3 individuals (3E-05 percent) receiving between 4 to 5 rem, as reported by NRC licensees to the REIRS database. These low percentages when accompanied with the 57,334 individuals (56 percent) of whom received no measurable dose support the strong measure of effectiveness of the NRC's ALARA regulations and the licensee's ALARA programs.

[3] This report presents additional Statistical Comparisons in Section 2.2.

7.3 Conclusions

As noted in Section 1.3.2, the objective of the NRC Radiation Protection Program Outcome Evaluation was to assess the effectiveness NRC's as low as is reasonably achievable (ALARA) regulations of 10 CFR 20.1101(b) along with the licensee's implementation of this regulation by reviewing the trends in of the occupational exposure data for each of the NRC-licensee categories.

The outcome evaluation fulfilled this objective by answering questions such as the following:

- How can the agency use radiation exposure data from NRC-licensed facilities to assess whether the NRC's radiation protection regulatory programs are achieving their intended outcomes?
- What do the trends in radiation exposure data at NRC licensed facilities suggest about the radiation protection programs' effectiveness over time?
- Does the data suggest differences in the effectiveness across the agency's radiation protection programs?
- Will increased data use provide insights into potential performance measures or process improvements relating to risk-informed regulation?

With respect to the first question the occupational exposure data from the REIRS database can be used to glean insights with respect to the ALARA programs across each of the licensee categories and overall. The trends of the occupational exposure overall indicate that the 2019 collective occupational exposures are 14 percent lower than the 5-year average (2014 – 2018), which is a statistically significant change validating the effectiveness of the Agency's regulatory programs and the licensees' implementation for radiation protection. Additionally, the evaluation of the radiation exposure data for the various NRC-licensee categories validates that the radiation protection program meets the intended outcome of minimizing risk from occupational exposure to radiation for all licensee categories.

8 REFERENCES

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* Report is available for purchase from the National Technical Information Service, Springfield, VA, 22161, and/or the Superintendent of Documents, U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20402-9328.

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APPENDIX A

ANNUAL TEDE FOR NONREACTOR NRC LICENSEES AND OTHER FACILITIES REPORTING TO THE NRC

2019

ANNUAL TEDE FOR NONREACTOR NRC LICENSEES AND OTHER FACILITIES REPORTING TO THE NRC

Table A1 Annual TEDE for Nonreactor NRC Licensees

PROGRAM CODE - LICENSEE NAME	LICENSE #	Number of Individuals with Whole Body Doses in the Ranges (rem)*												Total Number Monitored	Number with Meas. Dose	Total Collective TEDE (person-rem)	Average Meas. TEDE (rem)
		No Meas. Exposure	Meas. <0.10	0.10-0.25	0.25-0.50	0.50-0.75	0.75-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-6.0	>6.0				
INDUSTRIAL RADIOGRAPHY — FIXED LOCATION — 03310																	
HARRISON STEEL CASTINGS CO.	13-02141-01	4	1	-	-	-	-	-	-	-	-	-	-	**5**	1	0.050	0.050
METALTEK INTERNATIONAL	24-26136-01	-	3	-	1	-	-	-	-	-	1	-	-	**5**	**5**	**4.645**	**0.929**
Total	**2**	**4**	**4**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**10**	**6**	**4.695**	**0.783**
INDUSTRIAL RADIOGRAPHY — TEMPORARY JOB SITE — 03320																	
ABB, INC.	04-24888-01	4	4	1	2	1	-	-	-	-	-	-	-	12	8	1.545	0.193
ACUREN INSPECTION, INC.	22-27593-01	31	27	13	40	33	19	19	-	-	-	-	-	182	151	80.170	0.531
ADVANCED CORROSION TECH & TRAINING	42-35135-02	1	1	3	2	2	1	-	-	-	-	-	-	10	9	3.092	0.344
ADVEX CORPORATION	45-16452-01	2	4		-	-	-	-	-	-	-	-	-	6	4	0.187	0.047
ALASKA INDUSTRIAL X-RAY	50-16084-01	2	2	1	1	2	-	2	-	-	-	-	-	10	8	4.537	0.567
ALONSO & CARUS IRON WORKS, INC.	52-21350-01	1	3		-	-	-	-	-	-	-	-	-	4	3	0.136	0.045
AMERICAN ENGINEERING TESTING, INC.	22-20271-02	-	2	1	5	1	-	-	-	-	-	-	-	9	9	3.151	0.350
AMERICAN PIPING INSPECTION	35-35011-01	12	10	12	28	10	8	21	4	3	-	-	-	108	96	76.741	0.799
APPLUS RTD USA WEST	04-29076-02	29	45	13	18	19	14	44	2	-	-	-	-	184	155	101.218	0.653
CALUMET TESTING SERVICES, INC.	13-16347-01	2	3		-	-	1	6	-	-	-	-	-	12	10	8.312	0.831
CENTURY INSPECTION INC.	42-08456-02	17	9	7	10	5	-	2	1	-	-	-	-	51	34	13.649	0.401
CONCRETE IMAGING, INC.	47-31316-01	-	1	2	1	1	-	1	-	-	-	-	-	6	6	3.006	0.501
CONSUMERS ENERGY LAB. SERVICES	21-08606-03	14	9	12	6	1	-	-	-	-	-	-	-	42	28	4.557	0.163
DBI, INC	15-29301-02	2	23	17	18	15	12	46	15	6	-	-	-	154	152	151.530	0.997
DIAMOND TECHNICAL SERVICES, INC.	37-31259-01	5	1	5	4	3	1	6	-	-	-	-	-	25	20	12.328	0.616
DOMINION NDT SERVICES, INC.	45-35118-01	-	2	1	1	3	1	3	-	-	-	-	-	11	11	7.948	0.723
ELECTRIC BOAT CORPORATION	06-01781-08	8	35	1	-	-	-	-	-	-	-	-	-	44	36	0.888	0.025
ENGINEERING & INSPECTIONS - HAWAII	53-27731-01	3	3	-	3	4	1	8	-	-	-	-	-	22	19	16.634	0.875
GENERAL TESTING & INSPECTION CO.	47-32191-01	-	-	2	-	-	-	-	-	-	-	-	-	2	2	0.290	0.145
H & H X-RAY SERVICES, INC	17-19236-01	26	28	22	30	19	19	50	11	2	-	-	-	207	181	142.819	0.789
HIGH COUNTRY FABRICATION	49-29300-01	-	1	1	1	2	-	-	-	-	-	-	-	5	5	1.832	0.366
HIGH MOUNTAIN INSPECTION SERVICES	49-26808-02	1	10	8	14	12	8	28	9	5	1	-	-	96	95	104.918	1.104

NOTE: The data values shown bolded and in boxes represent the highest value in each category. These values have not been adjusted for the multiple counting of transient workers (see section 5).

* Dose values exactly equal to the values separating ranges are reported in the next higher range.

Table A1 Annual TEDE for Nonreactor NRC Licensees (continued)

PROGRAM CODE - LICENSEE NAME	LICENSE #	Number of Individuals with Whole Body Doses in the Ranges (rem)*												Total Number Monitored	Number with Meas. Dose	Total Collective TEDE (person-rem)	Average Meas. TEDE (rem)
		No Meas. Exposure	Meas. <0.10	0.10-0.25	0.25-0.50	0.50-0.75	0.75-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-6.0	>6.0				
INDUSTRIAL RADIOGRAPHY — TEMPORARY JOB SITE — 03320 (Continued)																	
HUNTINGTON INGALLS, INC.	45-09428-02	13	23	5	-	-	-	-	-	-	-	-	-	41	28	1.713	0.061
INTEGRITY TESTLAB	07-30791-01	4	13	8	7	3	5	5	1	-	-	-	-	46	42	19.110	0.455
INTERTEK	17-29308-01	3	42	8	13	7	7	6	1	-	1	-	-	88	85	31.452	0.370
J CORE DRILLING, INC.	45-30846-01	2	3		-	-	-	-	-	-	-	-	-	5	3	0.094	0.031
JAN X-RAY SERVICES, INC.	21-16560-01	98	53	79	96	61	31	40	3	-	-	-	-	**461**	**363**	**173.263**	0.477
KAKIVIK ASSET MANAGEMENT	50-27667-01	56	98	40	68	40	27	22	-	-	-	-	-	351	295	110.350	0.374
LEHIGH TESTING LABORATORIES, INC.	07-01173-03	1	1	-	-	-	-	-	-	-	-	-	-	2	1	0.002	0.002
LKS INSPECTION SERVICES, LLC	53-27795-01	1	2	-	1	-	-	-	-	-	-	-	-	4	3	0.398	0.133
MAGNUM NIS	37-35141-01	-	8	4	4	2	3	6	1	-	-	-	-	28	28	16.225	0.579
MARYLAND Q.C. LABORATORIES, INC.	19-28683-01	5	8	1	2	-	-	-	-	-	-	-	-	16	11	1.205	0.110
MATERIALS INTEGRITY, INC.	50-27722-01	3	2	-	-	-	-	-	-	-	-	-	-	5	2	0.070	0.035
METALS TESTING SERVICES, INC.	37-29406-02	4	8	8	6	9	3	11	2	-	-	-	-	51	47	34.010	0.724
MID AMERICAN INSPECTION SERVICES	21-26060-01	-	-	4	8	6	1	1	-	-	-	-	-	20	20	9.565	0.478
MISTRAS GROUP, INC.	12-16559-02	16	28	17	5	4	3	-	-	-	-	-	-	73	57	10.294	0.181
NATIONAL INSPECTION SERVICE	17-35438-01	-	-	1	3	1	5	15	6	1	-	-	-	32	32	47.135	**1.473**
NONDESTRUCTIVE & VISUAL INSPECTION	17-29410-01	-	3	10	7	5	11	18	9	2	-	-	-	65	65	69.849	1.075
PREMIER TECHNOLOGY, INC.	11-27746-01	4	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-
PRIME NDT SERVICES, INC.	37-23370-01	25	50	55	36	28	4	9	1	-	-	-	-	208	183	61.952	0.339
QCI TESTING LAB	11-29245-01	2	2		3	-	1	-	-	-	-	-	-	8	6	2.035	0.339
QUALITY INSPECTION & TESTING	17-35492-01	-	7	8	8	8	8	7	-	-	-	-	-	46	46	25.368	0.551
QUALITY INSPECTION & TESTING	50-29038-01	-	1	2	1	-	-	2	-	-	-	-	-	6	6	3.010	0.502
QUALITY TESTING SERVICES, INC.	24-32292-01	10	16	6	4	3	-	-	-	-	-	-	-	39	29	4.902	0.169
SCIENTIFIC TECHNICAL, INC.	45-24882-01	3	3	-	-	-	-	-	-	-	-	-	-	6	3	0.054	0.018
SHAW PIPELINE SERVICES, INC.	35-23193-03	43	83	59	49	17	7	5	-	-	-	-	-	263	220	53.675	0.244
SOUTHERN SERVICES, INC. - AK	50-35494-01	3	4	3	-	1	-	-	-	-	-	-	-	11	8	1.167	0.146
ST. LOUIS TESTING LABORATORIES, INC	24-00188-02	4	2	7	3	2	4	2	2	-	-	-	-	26	22	15.119	0.687
STANLEY PIPELINE INSPECTION LLC	35-35301-01	70	45	40	48	37	22	38	5	-	-	-	-	305	235	132.748	0.565
SYSTEM ONE HOLDINGS, LLC.	37-27891-02	17	11	6	4	3	1	2	-	-	-	-	-	44	27	7.689	0.285

NOTE: The data values shown bolded and in boxes represent the highest value in each category. These values have not been adjusted for the multiple counting of transient workers (see section 5).

* Dose values exactly equal to the values separating ranges are reported in the next higher range.

Table A1 Annual TEDE for Nonreactor NRC Licensees (continued)

PROGRAM CODE - LICENSEE NAME	LICENSE #	Number of Individuals with Whole Body Doses in the Ranges (rem)*												Total Number Monitored	Number with Meas. Dose	Total Collective TEDE (person-rem)	Average Meas. TEDE (rem)
		No Meas. Exposure	Meas. <0.10	0.10-0.25	0.25-0.50	0.50-0.75	0.75-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-6.0	>6.0				
INDUSTRIAL RADIOGRAPHY — TEMPORARY JOB SITE — 03320 (Continued)																	
TEAM INDUSTRIAL SERVICES, INC.	42-32219-01	18	62	29	50	19	13	10	2	-	-	-	-	203	185	65.902	0.356
TECH CORR USA, LLC	42-29261-01	-	4	3	1	2	-	3	2	1	-	-	-	16	16	14.008	0.876
TERRACON CONSULTANTS	24-35241-01	-	-	1	-	1	-	-	-	-	-	-	-	2	2	0.706	0.353
TESTING TECHNOLOGIES, INC.	45-25007-01	1	6	2	3	3	2	1	-	-	-	-	-	18	17	6.210	0.365
THERMAL ENGINEERING INTERNATIONAL	24-19500-01	3	1	-	-	-	-	-	-	-	-	-	-	4	1	0.039	0.039
TUV RHEINLAND	37-32340-02	1	-	1	-	1	-	2	-	-	-	-	-	5	4	2.995	0.749
TVA ADMIN PROGRAM	41-06832-06	6	5	4	-	-	-	-	-	-	-	-	-	15	9	0.797	0.089
XCEL NDT LLC	15-35544-01	-	-	2	-	-	-	1	-	-	-	-	-	3	3	1.114	0.371
Total	**58**	**576**	**817**	**535**	**614**	**396**	**243**	**442**	**77**	**20**	**2**	**0**	**0**	**3722**	**3146**	**1,663.713**	**0.529**
MANUFACTURING AND DISTRIBUTION – NUCLEAR PHARMACIES – 02500																	
ADVANCED ISOTOPES OF IDAHO	11-29216-01MD	-	1	-	1	-	-	-	-	-	-	-	-	2	2	0.383	0.192
CARDINAL HEALTH	34-29200-01MD	137	313	52	15	5	1	1	3	1	-	-	-	**528**	**391**	**37.516**	0.096
CARDINAL HEALTH	34-31473-02MD	1	11	1	-	-	-	-	-	-	-	-	-	13	12	0.613	0.051
GE HEALTHCARE - KENTWOOD	21-26707-01MD	12	7	1	-	-	-	-	-	-	-	-	-	20	8	0.337	0.042
GE HEALTHCARE - LIVONIA	21-24828-01MD	10	7	1	-	-	-	-	-	-	-	-	-	18	8	0.466	0.058
GE HEALTHCARE - ST. LOUIS/OVERLAND	24-32462-01MD	5	5	-	-	-	-	-	-	-	-	-	-	10	5	0.089	0.018
JUBILANT RADIOPHARMA - ST. LOUIS	09-32781-01MD	-	9	3	-	-	-	-	-	-	-	-	-	12	12	0.758	0.063
MID-AMERICA ISOTOPES, INC.	24-26241-01MD	28	-	2	2	-	-	-	-	-	-	-	-	32	4	0.914	0.229
PHARMALOGIC MT, INC.	09-29398-01MD	4	19	1	-	-	-	-	-	-	-	-	-	24	20	0.449	0.022
PHARMALOGIC WY, INC.	49-27629-01MD	14	4	-	-	-	-	-	-	-	-	-	-	18	4	0.063	0.016
RADIOPHARMACY OF INDIANAPOLIS	13-32637-01MD	21	-	3	2	1	-	-	-	-	-	-	-	27	6	1.886	**0.314**
RADIOPHARMACY, INC.	13-26246-01MD	26	4	2	2	-	-	-	-	-	-	-	-	34	8	1.059	0.132
TRIAD ISOTOPES - MI	09-32781-02MD	2	15	4	-	-	-	-	-	-	-	-	-	21	19	1.015	0.053
TRIAD ISOTOPES	09-32781-04MD	-	12	-	-	-	-	-	-	-	-	-	-	12	12	0.272	0.023
Total	**14**	**260**	**407**	**70**	**22**	**6**	**1**	**1**	**3**	**1**	**0**	**0**	**0**	**771**	**511**	**45.820**	**0.090**
MANUFACTURING AND DISTRIBUTION – TYPE "A" BROAD – 03211																	
INTERNATIONAL ISOTOPES IDAHO, INC.	11-27680-01	1	17	2	6	2	1	9	2	-	-	-	-	40	39	24.519	**0.629**
CURIUM US, LLC	24-04206-01	123	124	37	41	16	15	21	-	-	-	-	-	**377**	**254**	**77.588**	0.305
Total	**2**	**124**	**141**	**39**	**47**	**18**	**16**	**30**	**2**	**0**	**0**	**0**	**0**	**417**	**293**	**102.107**	**0.348**

NOTE: The data values shown bolded and in boxes represent the highest value in each category. These values have not been adjusted for the multiple counting of transient workers (see section 5).

* Dose values exactly equal to the values separating ranges are reported in the next higher range.

APPENDIX A
Table A1 Annual TEDE for Nonreactor NRC Licensees (continued)

PROGRAM CODE - LICENSEE NAME	LICENSE #	Number of Individuals with Whole Body Doses in the Ranges (rem)*												Total Number Monitored	Number with Meas. Dose	Total Collective TEDE (person-rem)	Average Meas. TEDE (rem)
		No Meas. Exposure	Meas. <0.10	0.10-0.25	0.25-0.50	0.50-0.75	0.75-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-6.0	>6.0				
INDEPENDENT SPENT FUEL STORAGE INSTALLATION – 23200																	
GENERAL ELECTRIC - MORRIS ISFSI	SNM-2500	2	21	5	2	-	-	-	-	-	-	-	-	30	**28**	**1.939**	**0.069**
PORTLAND GENERAL ELECTRIC CO.	SNM-2509	49	-	-	-	-	-	-	-	-	-	-	-	**49**	-	-	-
Total	**2**	**51**	**21**	**5**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	79	**28**	**1.939**	**0.069**
URANIUM HEXAFLUORIDE (UF_6) PRODUCTION PLANTS - 11400																	
HONEYWELL INTERNATIONAL, INC.	SUB-0526	31	122	8	5	-	-	-	-	-	-	-	-	**166**	**135**	**6.362**	**0.047**
Total	**1**	**31**	**122**	**8**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	166	135	6.362	0.047
FUEL CYCLE URANIUM ENRICHMENT PLANTS – 21200																	
LOUISIANA ENERGY SERVICES, INC.	SNM-2010	54	24	24	3	-	-	-	-	-	-	-	-	**105**	**51**	**5.841**	**0.115**
Total	**1**	**54**	**24**	**24**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	105	51	5.841	0.115
FUEL CYCLE FUEL FABRICATION FACILITIES – 21210																	
BWXT NUCLEAR OPERATIONS GROUP, INC	SNM-0042	43	216	39	7	3	-	1	-	-	-	-	-	309	266	17.149	0.064
FRAMATOME INC.	SNM-1227	419	509	82	68	6	-	-	-	-	-	-	-	1,084	**665**	48.118	0.072
GLOBAL NUCLEAR FUEL - AMERICAS, LLC	SNM-1097	210	332	134	46	1	1	-	-	-	-	-	-	724	514	49.220	0.096
NUCLEAR FUEL SERVICES, INC.	SNM-0124	714	515	32	-	-	-	-	-	-	-	-	-	**1,261**	547	9.869	0.018
WESTINGHOUSE ELECTRIC COMPANY	SNM-1107	186	177	154	120	57	3	1	-	-	-	-	-	698	512	**113.963**	**0.223**
Total	**5**	**1,572**	**1,749**	**441**	**241**	**67**	**4**	**2**	**0**	**0**	**0**	**0**	**0**	4,076	2,504	238.319	0.095

NOTE: The data values shown bolded and in boxes represent the highest value in each category. These values have not been adjusted for the multiple counting of transient workers (see section 5).

* Dose values exactly equal to the values separating ranges are reported in the next higher range.

APPENDIX A
Table A2 Other Facilities Reporting to the NRC

PROGRAM CODE - LICENSEE NAME	LICENSE #	Number of Individuals with Whole Body Doses in the Ranges (rem)*												Total Number Monitored	Number with Meas. Dose	Total Collective TEDE (person-rem)	Average Meas. TEDE (rem)
		No Meas. Exposure	Meas. <0.10	0.10-0.25	0.25-0.50	0.50-0.75	0.75-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-6.0	>6.0				
OTHER SERVICES - 03225																	
VEGA AMERICAS, INC.	34-00639-04	10	20	4	-	1	1	1	-	-	-	-	-	**37**	**27**	**3.866**	**0.143**
Total	**1**	**10**	**20**	**4**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**37**	**27**	**3.866**	**0.143**
MASTER MATERIALS - ISSUED TO GOVERNMENT AGENCIES - 03614																	
NAVY, DEPARTMENT OF THE	45-23645-01NP	74	139	4	2	-	-	-	-	-	-	-	-	**219**	**145**	**2.757**	**0.019**
Total	**1**	**74**	**139**	**4**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**219**	**145**	**2.757**	**0.019**
RESEARCH AND DEVELOPMENT, OTHER - 03620																	
APS TECHNOLOGY	06-35157-01	5	2	-	-	-	-	-	-	-	-	-	-	**7**	**2**	**0.100**	**0.050**
HEALTH & HUMAN SERVICES, DEPT. OF	19-07538-05	4	-	-	-	-	-	-	-	-	-	-	-	**4**	**-**	**-**	**-**
Total	**1**	**9**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**11**	**2**	**0.000**	**0.000**
PROGRAM CODE - 02120																	
MADISON MEMORIAL HOSPITAL	11-27358-01	-	-	5	-	-	-	-	-	-	-	-	-	**5**	**5**	**0.787**	**0.157**
Total	**1**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**5**	**0.787**	**-**
WASTE DISPOSAL SERVICE PROCESSING AND/OR REPACKAGING - 03234																	
ENERGYSOLUTIONS	39-35044-01	30	23	3	-	-	-	-	-	-	-	-	-	**56**	**26**	**1.114**	**0.043**
Total	**1**	**30**	**23**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**56**	**26**	**1.114**	**0.043**
TEST REACTOR FACILITIES – 42140*																	
NAT'L INSTITUTE OF STANDARDS & TECH	TR-5	23	119	19	3	1	-	-	-	-	-	-	-	**165**	**142**	**8.669**	**0.061**
Total	**1**	**23**	**119**	**19**	**3**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**165**	**142**	**8.669**	**0.061**
PROGRAM CODE - 42150																	
AEROTEST OPERATIONS, INC.	R-98	7	-	-	-	-	-	-	-	-	-	-	-	**7**	**-**	**-**	**-**
Total	**1**	**7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**0**	**0.000**	**-**

NOTE: The data values shown bolded and in boxes represent the highest value in each category. These values have not been adjusted for the multiple counting of transient workers (see section 5).

* Dose values exactly equal to the values separating ranges are reported in the next higher range.

** Test reactor facilities are required to report to the NRC, but only two facilities report under this category and one of the facilities is in decommissioning.

APPENDIX A

Table A2 Other Facilities Reporting to the NRC 2018 (continued)

PROGRAM CODE - LICENSEE NAME	LICENSE #	Number of Individuals with Whole Body Doses in the Ranges (rem)*												Total Number Monitored	Number with Meas. Dose	Total Collective TEDE (person-rem)	Average Meas. TEDE (rem)
		No Meas. Exposure	Meas. <0.10	0.10-0.25	0.25-0.50	0.50-0.75	0.75-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-6.0	>6.0				
LEAK TEST SERVICE ONLY - 03220																	
NATIONAL INSPECTION SERVICE	17-35438-01	-	-	-	-	1	-	6	2	2	-	-	-	11	11	21.148	1.923
QUALITY INSPECTION & TESTING	17-35492-01	-	5	4	2	2	7	7	5	-	-	-	-	**32**	**32**	**32.855**	**1.027**
Total	**2**	**0**	**5**	**4**	**2**	**3**	**7**	**13**	**7**	**2**	**0**	**0**	**0**	**43**	**43**	**54**	**1.256**
WASTE DISPOSAL SERVICE PROCESSING AND/OR REPACKAGING - 03234																	
ENERGYSOLUTIONS	39-35044-01	31	12	-	-	-	-	-	-	-	-	-	-	**43**	**12**	**0.212**	**0.018**
Total	**1**	**31**	**12**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**43**	**12**	**0.212**	**0.018**
TEST REACTOR FACILITIES – 42140*																	
NAT'L INSTITUTE OF STANDARDS & TECH	TR-5	27	121	17	7	2	-	-	-	-	-	-	-	**174**	**147**	**11.284**	**0.077**
Total	**1**	**25**	**111**	**21**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**174**	**147**	**11.284**	**0.077**
PROGRAM CODE - 42150																	
AEROTEST OPERATIONS, INC.	R-98	5	3	-	-	-	-	-	-	-	-	-	-	**8**	**3**	**0.044**	**0.015**
Total	**1**	**5**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**8**	**3**	**0.044**	**0.015**

NOTE: The data values shown bolded and in boxes represent the highest value in each category. These values have not been adjusted for the multiple counting of transient workers (see section 5).

* Dose values exactly equal to the values separating ranges are reported in the next higher range.

** Test reactor facilities are required to report to the NRC, but only two facilities report under this category and one of the facilities is in decommissioning.

APPENDIX B

ANNUAL DOSES AT LICENSED NUCLEAR POWER FACILITIES

2019

ANNUAL DOSES AT LICENSED NUCLEAR POWER FACILITIES

APPENDIX B
Annual Doses* at Licensed Nuclear Power Facilities

PLANT NAME	TYPE	Number of Individuals with Annual Doses* in the Ranges (rem)**												Total Number Monitored	Number with Meas. Dose	Total Collective TEDE per Site (person-rem)
		No Meas. Exposure	Meas. <0.10	0.10-0.25	0.25-0.50	0.50-0.75	0.75-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-6.0	>6.0			
ARKANSAS 1, 2	PWR	1,297	1,183	240	35	1	-	-	-	-	-	-	-	2,756	1,459	84.085
BEAVER VALLEY 1, 2	PWR	1,709	399	47	13	2	-	-	-	-	-	-	-	2,170	461	25.416
BRAIDWOOD 1, 2	PWR	2,058	500	31	1	-	-	-	-	-	-	-	-	2,590	532	19.553
BROWNS FERRY 1, 2, 3	BWR	1,382	1,638	516	323	105	20	15	-	-	-	-	-	**3,999**	**2,617**	**362.997**
BRUNSWICK 1, 2	BWR	1,737	1,057	343	181	69	14	9	-	-	-	-	-	3,410	1,673	222.735
BYRON 1, 2	PWR	1,925	597	84	12	-	-	-	-	-	-	-	-	2,618	693	36.322
CALLAWAY 1	PWR	1,246	348	51	24	7	5	1	-	-	-	-	-	1,682	436	37.630
CALVERT CLIFFS 1, 2	PWR	1,378	640	173	24	-	-	-	-	-	-	-	-	2,215	837	59.246
CATAWBA 1, 2	PWR	1,687	671	164	47	4	-	-	-	-	-	-	-	2,573	886	68.370
CLINTON	BWR	1,802	891	317	113	35	14	2	-	-	-	-	-	3,174	1,372	158.832
COLUMBIA GENERATING	BWR	1,066	874	270	154	62	21	8	-	-	-	-	-	2,455	1,389	190.694
COMANCHE PEAK 1, 2	PWR	1,383	620	130	36	4	-	-	-	-	-	-	-	2,173	790	58.051
COOK 1, 2	PWR	2,352	809	206	49	7	-	-	-	-	-	-	-	3,423	1,071	82.888
COOPER STATION	BWR	666	240	45	1	-	-	-	-	-	-	-	-	952	286	14.463
DAVIS-BESSE 1	PWR	830	139	29	7	-	-	-	-	-	-	-	-	1,005	175	11.405
DIABLO CANYON 1, 2	PWR	1,655	629	119	22	4	-	-	-	-	-	-	-	2,429	774	51.135
DRESDEN 2, 3	BWR	1,367	1,582	387	135	34	7	10	-	-	-	-	-	3,522	2,155	202.866
DUANE ARNOLD	BWR	587	137	38	12	-	-	-	-	-	-	-	-	774	187	15.569
FARLEY 1, 2	PWR	1,576	721	140	33	2	-	-	-	-	-	-	-	2,472	896	63.320
FERMI 2	BWR	550	1,219	141	49	7	1	-	-	-	-	-	-	1,967	1,417	65.282
FITZPATRICK	BWR	599	302	67	12	-	-	-	-	-	-	-	-	980	381	24.160
GINNA	PWR	777	54	3	-	-	-	-	-	-	-	-	-	834	57	2.023
GRAND GULF	BWR	1,217	848	78	16	6	-	-	-	-	-	-	-	2,165	948	35.139
HARRIS 1	PWR	1,498	502	118	6	-	-	-	-	-	-	-	-	2,124	626	37.223
HATCH 1, 2	BWR	1,944	878	198	69	8	1	-	-	-	-	-	-	3,098	1,154	94.104
HOPE CREEK 1	BWR	1,198	902	231	156	40	16	11	-	-	-	-	-	2,554	1,356	169.220
INDIAN POINT 2, 3	PWR	856	1,414	117	20	1	-	-	-	-	-	-	-	2,408	1,552	51.414
LASALLE 1, 2	BWR	1,174	1,445	469	240	88	39	14	-	-	-	-	-	3,469	2,295	309.129
LIMERICK 1, 2	BWR	1,356	1,447	315	115	20	8	1	-	-	-	-	-	3,262	1,906	157.471
MCGUIRE 1, 2	PWR	1,696	707	130	18	3	-	-	-	-	-	-	-	2,554	858	54.230
MILLSTONE 2, 3	PWR	1,969	555	136	23	1	-	-	-	-	-	-	-	2,684	715	47.673
MONTICELLO	BWR	942	704	200	94	40	7	9	1	-	-	-	-	1,997	1,055	128.425
NINE MILE POINT 1, 2	BWR	1,497	898	267	127	32	10	4	-	-	-	-	-	2,835	1,338	151.719
NORTH ANNA 1, 2	PWR	2,598	587	152	64	21	7	6	-	-	-	-	-	3,435	837	95.288

NOTE: The data values shown bolded and in boxes represent the highest value in each category. Totals corrected for transients on page B-2.

* These doses are annual TEDE doses.
** Dose values exactly equal to the values separating ranges are reported in the next higher range.

APPENDIX B
Annual Doses* at Licensed Nuclear Power Facilities (continued)

PLANT NAME	TYPE	Number of Individuals with Annual Doses* in the Ranges (rem)**												Total Number Monitored	Number with Meas. Dose	Total Collective TEDE per Site (person-rem)
		No Meas. Exposure	Meas. <0.10	0.10-0.25	0.25-0.50	0.50-0.75	0.75-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-6.0	>6.0			
OCONEE 1, 2, 3	PWR	2,500	641	72	2	-	-	-	-	-	-	-	-	3,215	715	31.137
PALISADES	PWR	784	136	18	7	-	-	-	-	-	-	-	-	945	161	10.051
PALO VERDE 1, 2, 3	PWR	2,973	833	88	15	1	-	-	-	-	-	-	-	3,910	937	41.262
PEACH BOTTOM 2, 3	BWR	1,372	1,254	350	139	21	3	-	-	-	-	-	-	3,139	1,767	167.083
PERRY	BWR	1,276	509	296	223	105	55	34	-	-	-	-	-	2,498	1,222	301.067
POINT BEACH 1, 2	PWR	760	290	154	69	16	4	-	-	-	-	-	-	1,293	533	74.485
PRAIRIE ISLAND 1, 2	PWR	1,205	343	68	5	1	-	-	-	-	-	-	-	1,622	417	24.593
QUAD CITIES 1, 2	BWR	1,379	1,172	516	194	14	-	-	-	-	-	-	-	3,275	1,896	204.958
RIVER BEND 1	BWR	1,387	802	299	198	87	40	21	-	-	-	-	-	2,834	1,447	255.918
ROBINSON 2	PWR	1,020	46	2	-	-	-	-	-	-	-	-	-	1,068	48	1.668
SALEM 1, 2	PWR	708	534	137	93	24	9	6	-	-	-	-	-	1,511	803	100.110
SEABROOK	PWR	847	69	-	-	-	-	-	-	-	-	-	-	916	69	1.084
SEQUOYAH 1, 2	PWR	1,769	667	109	41	18	8	3	-	-	-	-	-	2,615	846	76.085
SOUTH TEXAS 1, 2	PWR	1,621	484	144	45	3	-	-	-	-	-	-	-	2,297	676	56.887
ST LUCIE 1, 2	PWR	1,354	576	111	40	2	-	-	-	-	-	-	-	2,083	729	53.336
SUMMER 1	PWR	1,097	124	9	2	-	-	-	-	-	-	-	-	1,232	135	4.557
SURRY 1, 2	PWR	2,738	540	139	31	2	2	-	-	-	-	-	-	3,452	714	52.101
SUSQUEHANNA 1, 2	BWR	1,872	786	300	115	30	6	2	-	-	-	-	-	3,111	1,239	141.078
TURKEY POINT 3, 4	PWR	1,240	605	231	60	7	2	-	-	-	-	-	-	2,145	905	84.610
VOGTLE 1, 2	PWR	1,641	448	141	35	1	-	-	-	-	-	-	-	2,266	625	50.668
WATERFORD 3	PWR	1,438	735	129	59	7	1	-	-	-	-	-	-	2,369	931	69.780
WATTS BAR 1, 2	PWR	1,942	686	139	7	-	-	-	-	-	-	-	-	2,774	832	45.017
WOLF CREEK 1	PWR	785	651	108	25	-	-	-	-	-	-	-	-	1,569	784	45.183
Totals BWRs (32 Units)	**BWR**	**26,370**	**19,585**	**5,643**	**2,666**	**803**	**262**	**140**	**1**	**0**	**0**	**0**	**0**	**55,470**	**29,100**	**3,372.909**
Totals PWRs (64 Units)	**PWR**	**54,912**	**19,483**	**3,869**	**970**	**139**	**38**	**16**	**0**	**0**	**0**	**0**	**0**	**79,427**	**24,515**	**1,707.886**
Total LWRs (96 Units)	**LWRs**	**81,282**	**39,068**	**9,512**	**3,636**	**942**	**300**	**156**	**1**	**0**	**0**	**0**	**0**	**134,897**	**53,615**	**5,080.795**
Corrected for Transients †	**LWRs**	**55,718**	**25,322**	**7,167**	**3,798**	**1,272**	**554**	**402**	**4**	**0**	**0**	**0**	**0**	**94,237**	**38,519**	**5,080.795**

* These doses are annual TEDE doses.

** Dose values exactly equal to the values separating ranges are reported in the next higher range.

† Totals corrected for transients and include all LWRs in commercial operation for a full year.

APPENDIX B
Annual Doses* at Licensed Nuclear Power Facilities (continued)

PLANT NAME	TYPE	Number of Individuals with Annual Doses* in the Ranges (rem)**												Total Number Monitored	Number with Meas. Dose	Total Collective TEDE per Site (person-rem)
		No Meas. Exposure	Meas. <0.10	0.10-0.25	0.25-0.50	0.50-0.75	0.75-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-6.0	>6.0			
REACTORS NO LONGER IN COMMERCIAL OPERATION																
CRYSTAL RIVER 3	PWR	125	2	-	-	-	-	-	-	-	-	-	-	127	2	0.022
FERMI 1	FBR	51	-	-	-	-	-	-	-	-	-	-	-	51	-	-
FT CALHOUN	PWR	471	86	12	8	1	3	-	-	-	-	-	-	581	110	11.120
GE VALLECITOS	VBWR	113	55	12	1	5	-	-	-	-	-	-	-	186	73	6.113
GE ESADA VALLECITOS	EVESR	No longer required to report.														
HUMBOLDT BAY 3	BWR	No longer required to report.														
KEWAUNEE	PWR	55	2	-	-	-	-	-	-	-	-	-	-	57	2	0.021
LACROSSE	BWR	85	-	-	-	-	-	-	-	-	-	-	-	85	-	-
OYSTER CREEK	BWR	383	82	18	9	2	5	7	-	-	-	-	-	506	123	21.886
PEACH BOTTOM 1	HTGR	No longer required to report.														
PILGRIM 1	BWR	557	314	50	3	-	-	-	-	-	-	-	-	**924**	**367**	18.041
SAN ONOFRE 1, 2, 3	PWR	612	30	30	11	5	-	-	-	-	-	-	-	688	76	12.774
SAVANNAH, NUCLEAR SHIP	NS	No longer required to report.														
THREE MILE ISLAND 1	PWR	723	177	11	1	-	-	-	-	-	-	-	-	912	189	7.252
VERMONT YANKEE	BWR	35	115	18	21	5	4	11	5	-	-	-	-	214	179	**45.432**
ZION 1, 2	PWR	209	4	-	-	-	-	-	-	-	-	-	-	213	4	0.123
Total Reporting* **	**12**	**3,419**	**867**	**151**	**54**	**18**	**12**	**18**	**5**	**0**	**0**	**0**	**0**	**4,544**	**1,125**	**122.784**
REACTORS NO LONGER IN COMMERCIAL OPERATION, REPORTED WITH OTHER UNITS																
DRESDEN 1	BWR	Reported with Dresden 2, 3.														
INDIAN POINT 1	PWR	Reported with Indian Point 2, 3.														
MILLSTONE 1	BWR	Reported with Millstone 2, 3.														
THREE MILE ISLAND 2	PWR	Reported with Three Mile Island 1.														
REACTORS NO LONGER IN COMMERCIAL OPERATION, DECOMMISSIONED																
BIG ROCK POINT	BWR	27	-	-	-	-	-	-	-	-	-	-	-	27	-	-
HADDAM NECK	PWR	No longer required to report.														
MAINE YANKEE	PWR	25	14	-	-	-	-	-	-	-	-	-	-	25	**14**	**0.188**
TROJAN	PWR	Reported as ISFSI (See Appendix A, Portland General Electric Company).														
YANKEE-ROWE	PWR	31	7	-	-	-	-	-	-	-	-	-	-	**31**	7	0.113
Total Reporting* **	**3**	**83**	**21**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**83**	**21**	**0.301**

NOTE: Totals corrected for transients on page B-2.

* These doses are annual TEDE doses.
** Dose values exactly equal to the values separating ranges are reported in the next higher range.
*** These numbers are for the reactors no longer in commercial operation that report their doses separately (i.e., do not report their doses with other units).

APPENDIX C

PERSONNEL, DOSE, AND POWER GENERATION SUMMARY

1969–2019

A discussion of the methods used to collect and calculate the information contained in this appendix is given in Sections 3.1 and 4.2.

PERSONNEL, DOSE, AND POWER GENERATION SUMMARY
1969–2019

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
ARKANSAS 1, 2	1975	588.0	76.5	147	21	0.14	0.04
Docket 50-313, 50-368;	1976	464.6	56.6	476	289	0.61	0.62
DPR-51; NPF-6	1977	610.3	76.8	601	256	0.43	0.42
1st com mercial operation	1978	627.2	77.5	722	189	0.26	0.30
12/74, 3/80	1979	397.0	55.3	1,321	369	0.28	0.93
Type - PWRs	1980	452.8	63.7	1,233	342	0.28	0.76
Capacity - 836, 988 MWe	1981	1,104.7	68.3	2,225	1,102	0.50	1.00
	1982	905.4	58.6	1,608	803	0.50	0.89
	1983	915.0	54.7	2,109	1,397	0.66	1.53
	1984	1,289.1	77.4	1,742	806	0.46	0.63
	1985	1,192.3	73.6	1,262	286	0.23	0.24
	1986	1,070.3	66.9	2,135	1,141	0.53	1.07
	1987	1,366.1	88.9	1,123	382	0.34	0.28
	1988	1,070.3	69.4	2,421	1,387	0.57	1.30
	1989	1,066.3	72.0	2,063	711	0.34	0.67
	1990	1,351.9	84.2	2,493	762	0.31	0.56
	1991	1,515.8	88.4	2,064	351	0.17	0.23
	1992	1,352.1	77.4	3,114	876	0.28	0.65
	1993	1,606.0	91.3	1,981	268	0.14	0.17
	1994	1,662.8	93.6	1,361	172	0.13	0.10
	1995	1,397.0	82.7	2,259	386	0.17	0.28
	1996	1,596.0	89.5	1,441	203	0.14	0.13
	1997	1,621.9	95.9	1,195	119	0.10	0.07
	1998	1,494.6	88.1	1,249	166.599	0.13	0.11
	1999	1,477.3	86.9	1,463	183.997	0.13	0.12
	2000	1,329.2	79.5	1,977	242.326	0.12	0.18
	2001	1,684.0	95.8	1,082	106.040	0.10	0.06
	2002	1,659.0	91.8	1,581	265.337	0.17	0.16
	2003	1,675.8	93.1	973	99.003	0.10	0.06
	2004	1,759.5	95.0	1,227	106.172	0.09	0.06
	2005	1,560.0	84.5	2,335	475.784	0.20	0.30
	2006	1,739.8	95.0	1,184	143.296	0.12	0.08
	2007	1,769.3	96.0	1,387	105.310	0.08	0.06
	2008	1,614.8	89.7	1,791	196.047	0.11	0.12
	2009	1,733.7	95.5	1,139	102.732	0.09	0.06
	2010	1,716.6	93.7	1,388	99.376	0.07	0.06
	2011	1,621.9	90.5	1,526	116.884	0.08	0.07
	2012	1,764.5	96.2	931	43.908	0.05	0.02
	2013	1,366.6	74.3	1,098	50.041	0.05	0.04
	2014	1,654.6	92.3	1,372	71.561	0.05	0.04
	2015	1,582.0	87.5	1,881	136.727	0.07	0.09
	2016	1,535.7	84.0	1,674	111.105	0.07	0.07
	2017	1,451.4	83.4	1,757	86.504	0.05	0.06
	2018	1,456.8	81.8	1,970	136.374	0.07	0.09
	2019	1,553.8	85.3	1,459	84.085	0.06	0.05
BEAVER VALLEY 1, 2	1977	355.6	57.0	331	87	0.26	0.24
Docket 50-334, 50-412;	1978	304.2	40.8	646	190	0.29	0.62
DPR-66; NPF-73	1979	221.0	40.0	704	132	0.19	0.60
1st commercial operation	1980	39.8	6.8	1,817	553	0.30	13.89
10/76, 11/87	1981	573.4	73.6	1,237	229	0.19	0.40
Type - PWRs	1982	326.7	41.6	1,755	599	0.34	1.83
Capacity - 908, 905 MWe	1983	561.2	68.2	1,485	772	0.52	1.38
	1984	576.7	71.8	1,393	504	0.36	0.87
	1985	717.7	91.9	619	60	0.10	0.08
	1986	581.3	70.7	1,575	627	0.40	1.08
	1987	684.1	83.8	1,282	210	0.16	0.31
	1988	1,386.1	87.4	1,764	530	0.30	0.38
	1989	1,017.4	69.6	2,349	1,378	0.59	1.35
	1990	1,271.0	85.3	1,675	348	0.21	0.27
	1991	1,267.5	78.6	1,689	495	0.29	0.39
	1992	1,441.9	89.1	1,414	289	0.20	0.20
	1993	1,157.9	73.1	2,087	621	0.30	0.54
	1994	1,514.6	88.6	487	44	0.09	0.03
	1995	1,389.2	83.1	1,536	453	0.29	0.33

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
BEAVER VALLEY 1, 2 (continued)	1996	1,269.0	76.5	1,688	449	0.27	0.35
	1997	1,159.3	72.1	1,391	306	0.22	0.26
	1998	523.1	33.5	700	59.311	0.08	0.11
	1999	1,353.7	85.9	841	99.461	0.12	0.07
	2000	1,378.7	87.3	1,730	337.867	0.20	0.25
	2001	1,500.8	92.3	1,202	184.361	0.15	0.12
	2002	1,548.0	95.4	1,048	90.479	0.09	0.06
	2003	1,437.0	88.4	1,623	277.168	0.17	0.19
	2004	1,593.1	96.3	1,270	156.509	0.12	0.10
	2005	1,590.4	96.7	978	79.055	0.08	0.05
	2006	1,385.6	84.0	2,174	370.146	0.17	0.27
	2007	1,664.1	96.0	955	86.595	0.09	0.05
	2008	1,670.2	94.4	991	83.394	0.08	0.05
	2009	1,599.3	89.6	1,504	224.516	0.15	0.14
	2010	1,714.2	95.6	750	49.983	0.07	0.03
	2011	1,705.5	95.1	831	72.206	0.09	0.04
	2012	1,622.6	90.4	1,272	125.166	0.10	0.08
	2013	1,687.4	93.3	746	41.712	0.06	0.02
	2014	1,684.6	92.5	907	62.951	0.07	0.04
	2015	1,659.6	91.1	1,115	95.208	0.09	0.06
	2016	1,737.4	94.8	687	44.146	0.06	0.03
	2017	1,747.9	95.5	776	53.706	0.07	0.03
	2018	1,672.8	93.0	985	74.802	0.08	0.04
	2019	1,764.4	96.9	461	25.416	0.06	0.01
BIG ROCK POINT[1] Docket 50-155; DPR-6 1st commercial operation 3/63 Type - BWR Capacity - (67) MWe	1969	48.1	---	165	136	0.82	2.83
	1970	43.5	---	290	194	0.67	4.46
	1971	44.4	---	260	184	0.71	4.14
	1972	43.5	---	195	181	0.93	4.16
	1973	50.9	---	241	285	1.18	5.60
	1974	40.7	70.3	281	276	0.98	6.78
	1975	35.1	59.8	300	180	0.60	5.13
	1976	29.5	50.1	488	289	0.59	9.80
	1977	43.6	73.4	465	334	0.72	7.66
	1978	48.5	77.9	285	175	0.61	3.61
	1979	13.0	23.5	623	455	0.73	35.00
	1980	48.9	79.0	599	354	0.59	7.24
	1981	56.9	90.6	479	160	0.33	2.81
	1982	43.6	70.8	521	328	0.63	7.52
	1983	42.3	71.0	493	263	0.53	6.22
	1984	50.3	78.6	297	155	0.52	3.08
	1985	43.8	73.5	435	291	0.67	6.64
	1986	61.0	95.5	202	84	0.42	1.38
	1987	45.3	71.0	251	222	0.88	4.90
	1988	46.1	72.8	303	170	0.56	3.69
	1989	50.2	79.0	418	177	0.42	3.53
	1990	51.3	77.2	351	232	0.66	4.52
	1991	59.1	85.2	435	226	0.52	3.82
	1992	32.7	54.5	496	277	0.56	8.47
	1993	51.2	79.4	419	152	0.36	2.97
	1994	49.5	75.3	310	119	0.38	2.40
	1995	62.2	95.0	205	54	0.26	0.87
	1996	41.5	76.5	1,688	449	0.27	0.35
	1997	22.4	54.1	258	55	0.21	2.46
	1998	0.0	0.0	432	104.130	0.24	---
	1999	0.0	0.0	285	86.577	0.30	---
	2000	0.0	0.0	226	89.271	0.40	---
	2001	0.0	0.0	167	47.556	0.28	---
	2002	0.0	0.0	170	43.538	0.26	---
	2003	0.0	0.0	336	121.045	0.36	---
	2004	0.0	0.0	227	57.599	0.25	---
	2005	0.0	0.0	223	20.227	0.09	---
	2006	0.0	0.0	27	0.382	0.01	---

[1] Big Rock Point ceased operations in August 1997 and is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
BIG ROCK POINT[1] (continued)	2007	0.0	0.0	0	0.000	---	---
	2008	0.0	0.0	0	0.000	---	---
	2009	0.0	0.0	0	0.000	---	---
BRAIDWOOD 1, 2	1989	1,381.8	75.4	1,460	296	0.20	0.21
Docket 50-456, 50-457;	1990	1,740.2	84.1	1,081	186	0.17	0.11
NPF-72, NPF-77	1991	1,377.2	68.9	1,641	550	0.34	0.40
1st commercial operation	1992	1,885.9	89.0	1,059	228	0.22	0.12
7/88, 10/88	1993	1,899.3	86.9	1,043	273	0.26	0.14
Type - PWRs	1994	1,666.1	77.2	1,237	298	0.24	0.18
Capacity - 1,166, 1,144 MWe	1995	1,914.7	85.4	1,134	236	0.21	0.12
	1996	1,854.9	82.1	1,356	334	0.25	0.18
	1997	1,863.3	85.4	1,693	321	0.19	0.17
	1998	1,979.1	88.9	1,869	259.236	0.14	0.13
	1999	2,161.6	95.8	1,153	145.976	0.13	0.07
	2000	2,142.8	94.9	1,562	194.126	0.12	0.09
	2001	2,186.4	95.8	881	100.570	0.11	0.05
	2002	2,284.0	96.8	975	90.716	0.09	0.04
	2003	2,279.9	95.6	1,572	244.860	0.16	0.11
	2004	2,277.8	97.3	986	94.942	0.10	0.04
	2005	2,253.7	96.6	926	88.084	0.10	0.04
	2006	2,234.1	95.0	1,624	199.168	0.12	0.09
	2007	2,244.0	96.0	1,258	98.040	0.08	0.04
	2008	2,252.5	96.3	1,235	103.180	0.08	0.05
	2009	2,195.0	93.8	1,397	142.066	0.10	0.06
	2010	2,111.9	94.0	870	63.856	0.07	0.03
	2011	2,257.5	96.8	1,071	70.165	0.07	0.03
	2012	2,141.0	92.1	1,818	167.655	0.09	0.08
	2013	2,244.2	96.2	633	31.847	0.05	0.01
	2014	2,313.9	97.3	866	42.493	0.05	0.02
	2015	2,250.0	94.9	986	52.468	0.05	0.02
	2016	2,265.9	96.0	733	39.695	0.05	0.02
	2017	2,281.4	96.4	1,052	78.668	0.07	0.03
	2018	2,201.3	93.8	926	61.100	0.07	0.03
	2019	2,311.8	97.9	532	19.553	0.04	0.01
BROWNS FERRY 1[2]**, 2, 3**	1975	161.7	17.8	2,743	347	0.13	2.15
Docket 50-259, 50-260, 50-296;	1976	337.6	26.9	2,530	232	0.09	0.69
DPR-33, DPR-52, DPR-68	1977	1,327.5	73.7	1,985	876	0.44	0.66
1st commercial operation	1978	1,992.1	73.5	2,479	1,776	0.72	0.89
8/74, 3/75, 3/77	1979	2,393.0	79.1	2,869	1,593	0.56	0.67
Type - BWRs	1980	2,182.1	73.6	2,838	1,768	0.62	0.81
Capacity - 1,101, 1,104,	1981	2,132.9	69.5	3,497	2,398	0.69	1.12
1,105 MWe	1982	2,025.4	67.6	3,360	2,230	0.66	1.10
	1983	1,641.0	54.3	3,410	3,375	0.99	2.06
	1984	1,431.9	54.2	3,172	1,954	0.62	1.36
	1985	368.2	11.9	2,854	1,164	0.41	3.16
	1986	0.0	0.0	3,074	1,054	0.34	---
	1987	0.0	0.0	3,184	1,186	0.37	---
	1988	0.0	0.0	3,390	1,158	0.34	---
	1989	0.0	0.0	2,707	657	0.24	---
	1990	0.0	0.0	2,725	1,311	0.48	---
	1991	445.0	17.7	1,831	356	0.19	0.80
	1992	979.9	32.2	2,670	519	0.19	0.53
	1993	675.1	66.8	3,594	870	0.24	1.29
	1994	860.2	83.4	3,362	861	0.26	1.00
	1995	1,165.8	98.6	2,567	413	0.16	0.35
	1996	1,972.8	93.0	1,904	389	0.20	0.20
	1997	1,928.8	90.2	2,268	522	0.23	0.27
	1998	1,961.9	87.7	1,612	367.716	0.23	0.19
	1999	2,091.0	85.1	1,741	446.941	0.26	0.21

[1] Big Rock Point ceased operations in August 1997 and is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

[2] All three Browns Ferry units were placed on administrative hold in 1985. Units 2 and 3 were restarted in 1991 and 1995, respectively. Browns Ferry Unit 1 was restarted during 2007.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
BROWNS FERRY 1[2], 2, 3 (continued)	2000	2,143.8	97.1	1,657	333.215	0.20	0.16
	2001	2,074.0	90.7	1,525	293.879	0.19	0.14
	2002	2,069.0	95.4	1,977	357.573	0.18	0.17
	2003	2,014.5	93.6	2,608	602.535	0.23	0.30
	2004	2,104.7	95.5	3,242	672.714	0.21	0.32
	2005	2,044.2	94.3	3,743	636.282	0.17	0.31
	2006	2,040.1	94.0	3,618	641.154	0.18	0.31
	2007	2,420.2	90.0	3,027	554.314	0.18	0.23
	2008	2,837.4	88.5	2,633	482.127	0.18	0.17
	2009	2,933.1	91.2	2,188	348.257	0.16	0.12
	2010	2,828.0	92.3	2,825	556.749	0.20	0.20
	2011	2,845.8	87.9	2,079	296.642	0.14	0.10
	2012	2,969.2	91.2	3,139	464.325	0.15	0.16
	2013	3,050.0	93.5	2,543	382.609	0.15	0.13
	2014	3,052.3	94.0	2,401	389.854	0.16	0.13
	2015	3,158.6	96.4	2,282	288.063	0.13	0.09
	2016	2,992.6	93.3	3,077	404.585	0.13	0.14
	2017	3,179.0	96.9	2,819	350.062	0.12	0.11
	2018	2,930.8	90.5	3,389	498.650	0.15	0.17
	2019	3,381.3	93.8	2,617	362.997	0.14	0.11
BRUNSWICK 1, 2 Docket 50-324, 50-325; DPR-62, DPR-71 1st commercial operation 3/77, 11/75 Type - BWRs Capacity - 938, 932 MWe	1976	297.2	56.0	1,265	326	0.26	1.10
	1977	291.1	55.7	1,512	1,120	0.74	3.85
	1978	1,173.1	83.7	1,458	1,004	0.69	0.86
	1979	810.0	60.1	2,891	2,602	0.90	3.21
	1980	687.2	52.2	3,788	3,870	1.02	5.63
	1981	925.2	56.9	3,854	2,638	0.68	2.85
	1982	540.3	50.3	4,957	3,792	0.76	7.02
	1983	636.7	44.3	5,602	3,475	0.62	5.46
	1984	761.3	51.5	5,046	3,260	0.65	4.28
	1985	822.2	58.4	4,057	2,804	0.69	3.41
	1986	1,051.3	69.1	3,370	1,909	0.57	1.82
	1987	1,152.4	80.6	3,052	1,419	0.46	1.23
	1988	990.8	70.1	2,648	1,747	0.66	1.76
	1989	990.9	65.8	3,844	1,786	0.46	1.80
	1990	991.6	67.8	3,182	1,548	0.49	1.56
	1991	952.8	64.5	2,586	778	0.30	0.82
	1992	375.9	27.9	2,690	623	0.23	1.66
	1993	470.0	33.8	2,921	872	0.30	1.86
	1994	1,268.4	83.0	3,049	999	0.33	0.79
	1995	1,411.7	92.9	2,657	683	0.26	0.48
	1996	1,261.1	85.9	2,784	716	0.26	0.57
	1997	1,474.0	94.1	2,212	411	0.19	0.28
	1998	1,521.0	94.3	2,005	395.526	0.20	0.26
	1999	1,494.7	92.8	1,818	418.417	0.23	0.28
	2000	1,571.2	95.6	1,648	321.785	0.20	0.20
	2001	1,576.0	95.8	1,623	302.812	0.19	0.19
	2002	1,568.0	94.5	1,743	275.534	0.16	0.18
	2003	1,676.9	95.6	1,794	248.622	0.14	0.15
	2004	1,690.6	94.5	2,140	244.577	0.11	0.14
	2005	1,654.9	92.2	1,944	305.978	0.16	0.18
	2006	1,661.2	90.0	2,103	280.465	0.13	0.17
	2007	1,714.9	92.0	2,186	290.093	0.13	0.17
	2008	1,694.5	91.7	2,546	354.212	0.14	0.21
	2009	1,647.9	89.6	2,683	350.347	0.13	0.21
	2010	1,690.7	91.3	3,227	407.424	0.13	0.24
	2011	1,662.7	90.5	2,778	381.057	0.14	0.23
	2012	1,629.3	89.4	3,368	369.873	0.11	0.23
	2013	1,650.6	89.9	3,978	361.148	0.09	0.22
	2014	1,750.6	94.5	3,498	261.897	0.07	0.15
	2015	1,745.6	93.7	2,660	230.570	0.09	0.13
	2016	1,756.7	95.7	1,756	167.236	0.10	0.10

[2] All three Browns Ferry units were placed on administrative hold in 1985. Units 2 and 3 were restarted in 1991 and 1995, respectively. Browns Ferry Unit 1 was restarted during 2007.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
BRUNSWICK 1, 2	2017	1,754.6	96.0	1,748	216.013	0.12	0.12
(continued)	2018	1,669.7	93.2	1,543	183.275	0.12	0.11
	2019	1,680.0	91.5	1,673	222.735	0.13	0.13
BYRON 1, 2	1986	894.5	88.6	1,081	76	0.07	0.08
Docket 50-454, 50-455;	1987	650.9	70.9	1,826	769	0.42	1.18
NPF-37, NPF-66	1988	1,534.7	86.3	1,222	459	0.38	0.30
1st commercial operation	1989	1,812.6	90.2	1,109	172	0.16	0.09
9/85, 8/87	1990	1,567.3	78.8	1,396	434	0.31	0.28
Type - PWRs	1991	1,816.3	89.9	1,077	268	0.25	0.15
Capacity - 1,157, 1,127 MWe	1992	1,888.4	90.1	1,021	199	0.19	0.11
	1993	1,785.6	83.5	1,370	432	0.32	0.24
	1994	1,953.3	90.7	962	280	0.29	0.14
	1995	1,900.6	85.5	1,107	306	0.28	0.16
	1996	1,758.4	79.3	1,610	455	0.28	0.26
	1997	1,856.7	86.6	1,546	241	0.16	0.13
	1998	1,869.8	85.9	1,809	275.221	0.15	0.15
	1999	2,064.2	92.3	1,478	239.102	0.16	0.12
	2000	2,196.9	97.4	959	193.871	0.20	0.09
	2001	2,301.5	97.8	719	59.451	0.08	0.03
	2002	2,205.0	93.8	1,287	195.013	0.15	0.09
	2003	2,294.8	97.2	824	87.129	0.11	0.04
	2004	2,277.4	97.7	906	89.147	0.10	0.04
	2005	2,175.6	94.2	1,542	199.812	0.13	0.09
	2006	2,223.3	95.0	1,163	134.497	0.12	0.06
	2007	2,152.1	93.0	1,311	128.797	0.10	0.06
	2008	2,203.7	94.6	1,483	140.809	0.09	0.06
	2009	2,250.9	96.7	985	83.443	0.08	0.04
	2010	2,266.6	97.4	922	56.425	0.06	0.02
	2011	2,077.9	91.0	1,849	244.104	0.13	0.12
	2012	2,085.4	94.6	924	50.973	0.06	0.02
	2013	2,231.4	96.8	1,002	57.708	0.06	0.03
	2014	2,197.8	94.2	1,184	80.774	0.07	0.04
	2015	2,222.8	96.8	878	42.935	0.05	0.02
	2016	2,237.5	96.0	884	54.012	0.06	0.02
	2017	2,186.4	93.7	1,280	87.846	0.07	0.04
	2018	2,288.9	97.9	615	25.155	0.04	0.01
	2019	2,296.6	97.9	693	36.322	0.05	0.02
CALLAWAY 1	1985	967.4	90.0	964	36	0.04	0.04
Docket 50-483;	1986	865.2	81.3	1,052	225	0.21	0.26
NPF-30	1987	759.0	71.1	1,082	393	0.36	0.52
1st commercial operation 12/84	1988	1,069.2	93.4	353	27	0.08	0.03
Type - PWR	1989	1,000.3	85.4	1,055	283	0.27	0.28
Capacity - 1,190 MWe	1990	960.7	84.1	1,134	442	0.39	0.46
	1991	1,193.1	99.7	280	21	0.08	0.02
	1992	967.5	83.0	1,133	336	0.30	0.35
	1993	1,002.9	86.4	1,126	225	0.20	0.22
	1994	1,196.4	100.0	191	14	0.07	0.01
	1995	989.6	84.7	1,062	187	0.18	0.19
	1996	1,066.0	90.5	980	248	0.25	0.23
	1997	1,022.2	100.0	248	12	0.05	0.01
	1998	972.2	91.3	929	200.729	0.22	0.21
	1999	981.3	88.7	1,098	320.554	0.29	0.33
	2000	1,137.5	99.8	244	16.058	0.07	0.01
	2001	954.5	86.7	873	106.782	0.12	0.11
	2002	955.0	86.2	983	95.648	0.10	0.10
	2003	1,104.3	96.2	252	8.297	0.03	0.01
	2004	892.8	78.9	1,124	120.621	0.11	0.14
	2005	913.2	80.7	1,600	222.629	0.14	0.24
	2006	1,152.8	95.0	225	6.308	0.03	0.01
	2007	1,069.7	89.0	1,079	73.236	0.07	0.07
	2008	1,067.6	89.8	729	45.738	0.06	0.04
	2009	1,170.3	97.6	164	4.821	0.03	0.00
	2010	1,029.9	84.8	800	58.735	0.07	0.06
	2011	1,071.7	88.9	838	80.215	0.10	0.07

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
CALLAWAY 1	2012	1,220.2	100.0	169	4.525	0.03	0.00
(continued)	2013	959.9	80.9	680	43.123	0.06	0.04
	2014	1,061.3	88.0	649	37.173	0.06	0.04
	2015	1,192.2	99.1	96	3.128	0.03	0.00
	2016	1,078.3	89.8	641	46.770	0.07	0.04
	2017	951.9	80.3	507	23.713	0.05	0.02
	2018	1,216.6	100.0	84	3.211	0.04	0.00
	2019	1,053.4	87.3	436	37.630	0.09	0.04
CALVERT CLIFFS 1, 2	1976	753.4	95.2	507	74	0.15	0.10
Docket 50-317, 50-318;	1977	583.0	72.1	2,265	547	0.24	0.94
DPR-53, DPR-69	1978	1,188.5	75.8	1,391	500	0.36	0.42
1st commercial operation	1979	1,161.0	74.0	1,428	805	0.56	0.69
5/75, 4/77	1980	1,309.9	84.1	1,496	677	0.45	0.52
Type - PWRs	1981	1,379.7	83.1	1,555	607	0.39	0.44
Capacity - 877, 855 MWe	1982	1,238.3	73.7	1,805	1,057	0.59	0.85
	1983	1,397.2	81.6	1,915	668	0.35	0.48
	1984	1,389.4	79.3	1,369	479	0.35	0.34
	1985	1,189.8	68.4	1,598	694	0.43	0.58
	1986	1,530.0	87.2	1,296	347	0.27	0.23
	1987	1,207.3	71.8	1,384	412	0.30	0.34
	1988	1,397.7	81.0	1,296	291	0.22	0.21
	1989	333.6	20.1	1,786	346	0.19	1.04
	1990	161.1	11.0	2,019	304	0.15	1.89
	1991	1,085.0	64.7	1,974	132	0.07	0.12
	1992	1,271.2	73.9	1,979	330	0.17	0.26
	1993	1,462.1	83.9	1,462	405	0.28	0.28
	1994	1,342.1	79.4	1,482	454	0.31	0.34
	1995	1,542.8	89.9	1,203	235	0.20	0.15
	1996	1,438.5	82.4	1,167	239	0.20	0.17
	1997	1,499.6	89.1	1,091	229	0.21	0.15
	1998	1,523.1	89.3	1,042	186.887	0.18	0.12
	1999	1,521.4	90.1	1,134	191.778	0.17	0.13
	2000	1,575.7	92.7	912	134.689	0.15	0.09
	2001	1,554.7	91.7	895	166.864	0.19	0.11
	2002	1,380.0	81.7	1,582	245.075	0.16	0.18
	2003	1,558.4	90.9	1,671	265.164	0.16	0.17
	2004	1,653.7	95.7	1,205	143.944	0.12	0.09
	2005	1,678.1	97.2	942	168.390	0.18	0.10
	2006	1,581.8	92.0	1,215	203.790	0.17	0.13
	2007	1,641.6	95.0	1,191	153.335	0.13	0.09
	2008	1,670.7	97.4	745	74.149	0.10	0.04
	2009	1,660.9	96.6	891	95.756	0.11	0.06
	2010	1,597.3	93.5	834	128.581	0.15	0.08
	2011	1,635.9	95.7	703	95.233	0.14	0.06
	2012	1,545.6	89.9	725	115.525	0.16	0.07
	2013	1,632.6	94.0	580	61.079	0.11	0.04
	2014	1,638.3	94.9	586	62.065	0.11	0.04
	2015	1,672.4	95.6	583	45.624	0.08	0.03
	2016	1,685.6	96.3	904	85.891	0.10	0.05
	2017	1,725.0	97.2	686	49.283	0.07	0.03
	2018	1,711.0	96.5	875	56.494	0.06	0.03
	2019	1,713.8	96.5	837	59.246	0.07	0.03
CATAWBA 1, 2	1986	638.9	49.9	1,724	286	0.17	0.45
Docket 50-413, 50-414;	1987	1,651.2	75.9	1,865	449	0.24	0.27
NPF-35, NPF-52	1988	1,675.2	77.2	2,009	556	0.28	0.33
1st commercial operation	1989	1,733.6	79.5	1,660	334	0.20	0.19
6/85, 8/86	1990	1,616.3	70.8	2,174	809	0.37	0.50
Type - PWRs	1991	1,691.5	74.6	1,871	462	0.25	0.27
Capacity - 1,160, 1,150 MWe	1992	1,962.8	83.9	1,515	414	0.27	0.21
	1993	1,896.1	81.5	1,564	396	0.25	0.21
	1994	2,105.2	90.2	1,268	207	0.16	0.10
	1995	2,011.9	85.3	1,892	462	0.24	0.23
	1996	1,879.1	80.5	1,588	302	0.19	0.16
	1997	2,028.2	89.3	1,561	266	0.17	0.13

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
CATAWBA 1, 2	1998	2,006.4	89.6	1,123	162.068	0.14	0.08
(continued)	1999	2,046.7	90.2	1,024	118.662	0.12	0.06
	2000	2,038.3	90.3	1,185	186.532	0.16	0.09
	2001	2,119.9	92.9	960	116.241	0.12	0.05
	2002	2,238.0	97.2	884	81.325	0.09	0.04
	2003	1,991.8	89.2	1,409	210.617	0.15	0.11
	2004	2,111.4	93.0	1,123	122.831	0.11	0.06
	2005	2,194.5	96.0	1,019	83.679	0.08	0.04
	2006	1,928.6	85.0	1,792	212.570	0.12	0.11
	2007	2,102.5	92.0	1,399	144.218	0.10	0.07
	2008	2,160.3	93.5	1,110	85.080	0.08	0.04
	2009	2,044.8	89.1	1,385	169.409	0.12	0.08
	2010	2,164.8	94.8	1,045	97.010	0.09	0.04
	2011	2,144.2	93.9	961	52.321	0.05	0.02
	2012	2,029.7	88.8	1,157	94.734	0.08	0.05
	2013	2,187.9	95.5	1,053	82.906	0.08	0.04
	2014	2,136.0	93.3	996	50.777	0.05	0.02
	2015	2,098.6	92.2	1,299	97.678	0.08	0.05
	2016	2,232.7	96.1	1,000	77.097	0.08	0.03
	2017	2,249.6	96.8	642	32.236	0.05	0.01
	2018	2,143.8	93.0	1,211	87.302	0.07	0.04
	2019	2,236.7	96.7	886	68.370	0.08	0.03
CLINTON	1988	701.3	84.2	769	130	0.17	0.19
Docket 50-461;	1989	348.3	48.5	1,196	372	0.31	1.07
NPF-62	1990	435.8	55.1	1,390	553	0.40	1.27
1st commercial operation 11/87	1991	722.7	80.8	1,010	233	0.23	0.32
Type - BWR	1992	589.7	68.6	1,195	431	0.36	0.73
Capacity - 1,022 MWe	1993	701.5	79.6	1,253	498	0.40	0.71
	1994	883.3	94.8	409	63	0.15	0.07
	1995	731.1	83.0	1,182	316	0.27	0.43
	1996	634.7	66.7	1,154	350	0.30	0.55
	1997	0.0	0.0	738	172	0.23	---
	1998	0.0	0.0	866	144.140	0.17	---
	1999	537.0	63.5	637	87.489	0.14	0.16
	2000	784.2	87.8	1,248	253.382	0.20	0.32
	2001	896.8	98.5	329	33.770	0.10	0.04
	2002	872.0	90.5	1,418	208.094	0.15	0.24
	2003	990.5	99.1	372	57.118	0.15	0.06
	2004	910.8	92.6	1,622	282.833	0.17	0.31
	2005	989.1	97.4	298	36.019	0.12	0.04
	2006	939.9	92.0	1,649	295.720	0.18	0.32
	2007	1,049.2	100.0	310	30.618	0.10	0.03
	2008	973.0	93.3	1,381	205.086	0.15	0.21
	2009	1,014.6	96.6	435	48.009	0.11	0.05
	2010	983.1	93.5	1,540	219.954	0.14	0.22
	2011	989.9	94.4	1,683	228.447	0.14	0.23
	2012	1,067.1	100.0	215	14.250	0.07	0.01
	2013	950.2	91.9	1,182	128.781	0.11	0.14
	2014	1,038.6	98.8	186	17.866	0.10	0.02
	2015	922.9	94.1	1,197	97.634	0.08	0.11
	2016	1,017.8	97.2	480	33.218	0.07	0.03
	2017	954.1	91.9	1,341	154.579	0.12	0.16
	2018	958.7	92.3	1,137	77.813	0.07	0.08
	2019	957.6	91.2	1,372	158.832	0.12	0.17
COLUMBIA GENERATING[3]	1985	616.0	87.6	755	119	0.16	0.19
Docket 50-397;	1986	616.0	74.4	1,013	222	0.22	0.36
NPF-21	1987	639.0	70.8	1,201	406	0.34	0.64
1st commercial operation 12/84	1988	707.7	71.8	1,050	353	0.34	0.50
Type - BWR	1989	727.2	78.3	1,299	492	0.38	0.68
Capacity - 1,131 MWe	1990	684.7	67.5	1,348	536	0.40	0.78
	1991	508.5	50.3	1,088	387	0.36	0.76
	1992	682.3	65.6	1,489	612	0.41	0.90

[3] Energy Northwest changed the name of Washington Nuclear 2 to Columbia Generating Station in 2001.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
COLUMBIA GENERATING[3] (continued)	1993	849.6	79.5	1,385	469	0.34	0.55
	1994	803.8	75.2	1,870	866	0.46	1.08
	1995	824.7	83.8	1,694	456	0.27	0.55
	1996	662.9	82.2	1,453	373	0.26	0.56
	1997	697.0	72.7	1,218	251	0.21	0.36
	1998	789.5	75.3	1,220	286.020	0.23	0.36
	1999	694.7	70.0	1,022	155.109	0.15	0.22
	2000	979.6	96.3	706	53.152	0.08	0.05
	2001	939.3	88.1	1,515	226.675	0.15	0.24
	2002	1,023.0	97.5	647	46.650	0.07	0.05
	2003	866.9	81.8	1,618	205.225	0.13	0.24
	2004	1,022.5	94.6	716	66.130	0.09	0.06
	2005	938.3	87.3	1,718	325.025	0.19	0.35
	2006	1,064.9	98.0	623	55.817	0.09	0.05
	2007	925.6	87.0	2,147	306.443	0.14	0.33
	2008	1,055.3	98.3	715	54.957	0.08	0.05
	2009	757.2	76.3	1,958	305.163	0.16	0.40
	2010	1,054.9	100.0	733	54.712	0.07	0.05
	2011	548.7	54.4	2,309	335.657	0.15	0.61
	2012	1,062.6	97.6	1,155	45.462	0.04	0.04
	2013	965.9	88.4	1,787	223.809	0.13	0.23
	2014	1,084.2	100.0	775	33.771	0.04	0.03
	2015	931.6	87.0	2,088	289.135	0.14	0.31
	2016	1,098.8	97.8	586	26.825	0.05	0.02
	2017	927.9	87.7	1,724	180.255	0.10	0.19
	2018	1,108.3	98.6	494	43.078	0.09	0.04
	2019	1,012.2	89.7	1,389	190.694	0.14	0.19
COMANCHE PEAK 1, 2 Docket 50-445, 50-446; NPF-87, NPF-89 1st commercial operation 8/90, 8/93 Type - PWR Capacity - 1,205, 1,195 MWe	1991	644.4	82.2	985	148	0.15	0.23
	1992	830.8	84.0	1,128	188	0.17	0.23
	1993	853.8	81.2	945	109	0.12	0.13
	1994	1,750.0	93.7	970	90	0.09	0.05
	1995	2,022.6	92.5	951	179	0.19	0.09
	1996	1,804.8	81.4	1,462	288	0.20	0.16
	1997	2,002.4	93.4	870	146	0.17	0.07
	1998	2,037.8	94.9	967	232.026	0.24	0.11
	1999	1,981.5	90.9	1,316	251.276	0.19	0.13
	2000	2,104.7	95.3	759	77.679	0.10	0.04
	2001	2,085.9	94.7	853	114.968	0.13	0.06
	2002	1,887.0	86.9	1,106	225.317	0.20	0.12
	2003	2,020.6	91.6	639	66.313	0.10	0.03
	2004	2,169.5	95.1	864	135.388	0.16	0.06
	2005	2,099.6	91.5	1,365	242.481	0.18	0.12
	2006	2,271.3	97.0	686	59.959	0.09	0.03
	2007	2,151.3	93.0	1,616	219.799	0.14	0.10
	2008	2,189.7	94.3	1,037	168.836	0.16	0.08
	2009	2,299.3	96.7	938	51.420	0.05	0.02
	2010	2,316.8	96.3	1,037	70.807	0.07	0.03
	2011	2,216.8	92.6	1,580	154.716	0.10	0.07
	2012	2,279.9	94.6	1,001	66.742	0.07	0.03
	2013	2,353.5	96.8	745	45.237	0.06	0.02
	2014	2,141.7	88.6	1,123	139.246	0.12	0.07
	2015	2,294.6	94.7	641	42.889	0.07	0.02
	2016	2,340.7	96.0	624	36.648	0.06	0.02
	2017	1,947.3	81.5	1,052	120.996	0.12	0.06
	2018	2,346.3	96.5	554	41.677	0.08	0.02
	2019	2,219.0	93.0	790	58.051	0.07	0.03
COOK 1, 2 Docket 50-315, 50-316; DPR-58, DPR-74 1st commercial operation 8/75, 7/78 Type - PWRs Capacity - 1,030, 1,168 MWe	1976	807.4	83.1	395	116	0.29	0.14
	1977	573.0	76.1	802	300	0.37	0.52
	1978	744.8	73.6	778	336	0.43	0.45
	1979	1,373.0	65.3	1,445	718	0.50	0.52
	1980	1,552.4	74.1	1,345	493	0.37	0.32
	1981	1,557.3	73.4	1,341	656	0.49	0.42
	1982	1,461.6	69.8	1,527	699	0.46	0.48

[3] Energy Northwest changed the name of Washington Nuclear 2 to Columbia Generating Station in 2001.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
COOK 1, 2 (continued)	1983	1,456.5	71.2	1,418	658	0.46	0.45
	1984	1,526.0	75.3	1,559	762	0.49	0.50
	1985	925.4	47.6	1,984	945	0.48	1.02
	1986	1,307.1	73.4	1,774	745	0.42	0.57
	1987	1,199.5	70.2	1,696	666	0.39	0.56
	1988	1,160.4	63.5	2,266	867	0.38	0.75
	1989	1,433.1	72.8	1,575	493	0.31	0.34
	1990	1,318.5	67.9	1,851	580	0.31	0.44
	1991	1,837.4	90.2	815	69	0.08	0.04
	1992	760.9	50.8	1,954	492	0.25	0.65
	1993	1,927.7	98.5	587	44	0.07	0.02
	1994	1,105.2	65.2	1,748	479	0.27	0.43
	1995	1,656.0	82.1	1,310	203	0.15	0.12
	1996	1,938.9	92.7	1,114	214	0.19	0.11
	1997	1,189.7	59.7	1,864	550	0.30	0.46
	1998	0.0	0.0	1,155	104.638	0.09	---
	1999	0.0	0.0	1,662	171.479	0.10	---
	2000	560.1	28.1	2,506	337.584	0.13	0.60
	2001	1,794.3	89.2	423	27.290	0.06	0.02
	2002	1,756.0	87.3	1,624	278.001	0.17	0.16
	2003	1,557.6	75.7	1,408	209.526	0.15	0.13
	2004	1,909.2	91.4	1,015	156.213	0.15	0.08
	2005	1,989.0	95.0	852	91.192	0.11	0.05
	2006	1,790.5	86.0	1,780	312.214	0.18	0.17
	2007	1,983.7	93.0	1,310	238.829	0.18	0.12
	2008	1,711.8	80.8	971	76.460	0.08	0.04
	2009	950.5	45.3	693	40.007	0.06	0.04
	2010	1,786.1	86.7	1,116	83.276	0.07	0.05
	2011	1,981.5	94.2	842	57.169	0.07	0.03
	2012	2,017.5	94.7	754	49.112	0.07	0.02
	2013	1,858.5	87.1	1,187	103.772	0.09	0.06
	2014	2,012.7	94.3	727	53.798	0.07	0.03
	2015	1,885.7	87.4	626	29.827	0.05	0.02
	2016	1,753.5	82.3	1,123	93.715	0.08	0.05
	2017	2,008.2	89.7	830	57.999	0.07	0.03
	2018	2,010.4	90.5	825	40.511	0.05	0.02
	2019	1,844.7	84.4	1,071	82.888	0.08	0.04
COOPER STATION Docket 50-298; DPR-46 1st commercial operation 7/74 Type - BWR Capacity - 769 MWe	1975	456.4	83.6	579	117	0.20	0.26
	1976	433.3	75.5	763	350	0.46	0.81
	1977	538.2	86.2	315	198	0.63	0.37
	1978	576.0	91.0	297	158	0.53	0.27
	1979	591.0	87.6	426	221	0.52	0.37
	1980	448.3	71.2	785	859	1.09	1.92
	1981	457.1	71.2	935	579	0.62	1.27
	1982	622.3	84.6	743	542	0.73	0.87
	1983	396.6	63.3	1,383	1,293	0.93	3.26
	1984	411.9	67.2	1,598	799	0.50	1.94
	1985	127.3	21.5	1,980	1,333	0.67	10.47
	1986	480.0	74.7	895	320	0.36	0.67
	1987	652.3	96.2	549	103	0.19	0.16
	1988	493.4	67.9	942	251	0.27	0.51
	1989	564.3	76.2	1,202	343	0.29	0.61
	1990	602.0	79.4	1,174	379	0.32	0.63
	1991	566.3	78.8	1,099	405	0.37	0.72
	1992	731.0	96.4	463	84	0.18	0.11
	1993	436.1	58.8	1,130	391	0.35	0.90
	1994	262.2	35.1	333	79	0.24	0.30
	1995	486.5	66.8	1,095	228	0.21	0.47
	1996	742.1	97.9	468	48	0.10	0.06
	1997	622.8	84.4	1,125	174	0.15	0.28
	1998	555.9	75.9	977	181.858	0.19	0.33
	1999	743.2	98.1	318	47.815	0.15	0.06
	2000	539.2	74.2	963	199.589	0.21	0.37
	2001	592.7	80.9	1,309	168.665	0.13	0.28

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
COOPER STATION (continued)	2002	719.0	98.6	362	38.739	0.11	0.05
	2003	511.4	74.1	882	135.249	0.15	0.26
	2004	702.6	94.7	481	47.064	0.10	0.07
	2005	670.8	89.4	1,266	275.652	0.22	0.41
	2006	674.7	90.0	1,265	270.135	0.21	0.40
	2007	761.6	99.0	730	49.902	0.07	0.07
	2008	679.0	89.9	1,715	359.926	0.21	0.53
	2009	654.6	86.6	1,638	254.032	0.16	0.39
	2010	775.4	100.0	773	61.303	0.08	0.08
	2011	658.5	84.8	1,737	349.247	0.20	0.53
	2012	662.9	87.6	1,800	279.301	0.16	0.42
	2013	776.5	100.0	548	35.870	0.07	0.05
	2014	675.3	88.8	1,274	202.670	0.16	0.30
	2015	776.1	99.4	408	27.634	0.07	0.04
	2016	676.1	88.2	1,291	195.518	0.15	0.29
	2017	789.1	100.0	394	30.193	0.08	0.04
	2018	642.9	84.5	996	132.984	0.13	0.21
	2019	793.6	100.0	286	14.463	0.05	0.02
CRYSTAL RIVER 3[4] Docket 50-302; DPR-72 1st commercial operation 3/77 Type - PWR Capacity - (860) MWe	1978	311.5	41.4	643	321	0.50	1.03
	1979	453.0	58.9	1,150	495	0.43	1.09
	1980	404.1	53.2	1,053	625	0.59	1.55
	1981	490.4	62.2	1,120	408	0.36	0.83
	1982	589.8	76.0	780	177	0.23	0.30
	1983	452.1	58.8	1,720	552	0.32	1.22
	1984	774.2	94.5	549	49	0.09	0.06
	1985	344.2	47.6	1,976	689	0.35	2.00
	1986	319.5	41.8	1,057	472	0.45	1.48
	1987	436.0	60.9	1,384	488	0.35	1.12
	1988	690.2	84.0	569	64	0.11	0.09
	1989	352.8	48.8	880	234	0.27	0.66
	1990	497.8	63.8	1,441	476	0.33	0.96
	1991	654.6	82.0	821	116	0.14	0.18
	1992	632.1	76.1	1,403	424	0.30	0.67
	1993	722.4	85.0	683	60	0.09	0.08
	1994	711.9	84.3	1,079	228	0.21	0.32
	1995	866.3	100.0	209	8	0.04	0.01
	1996	290.8	37.7	1,192	353	0.30	1.21
	1997	0.0	0.0	973	179	0.18	---
	1998	739.9	90.3	313	19.298	0.06	0.03
	1999	727.5	87.8	1,324	251.077	0.19	0.35
	2000	819.4	97.6	257	14.649	0.06	0.02
	2001	741.6	89.2	902	147.946	0.16	0.20
	2002	831.0	99.4	128	5.039	0.04	0.01
	2003	749.0	90.8	961	126.554	0.13	0.17
	2004	831.4	98.1	131	4.044	0.03	0.00
	2005	723.0	88.5	939	122.608	0.13	0.17
	2006	793.8	95.0	138	4.474	0.03	0.01
	2007	761.7	91.0	1,135	184.554	0.16	0.24
	2008	796.9	93.7	282	16.110	0.06	0.02
	2009	615.0	72.5	1,705	222.344	0.13	0.36
	2010	0.0	0.0	666	31.922	0.05	---
	2011	0.0	0.0	251	8.292	0.03	---
	2012	0.0	0.0	94	1.876	0.02	---
	2013	0.0	0.0	40	0.794	0.02	---
	2014	0.0	0.0	26	0.696	0.03	---
	2015	0.0	0.0	20	0.700	0.04	---
	2016	0.0	0.0	95	14.746	0.16	---
	2017	0.0	0.0	68	4.133	0.06	---
	2018	0.0	0.0	25	1.215	0.05	---
	2019	0.0	0.0	2	0.022	0.01	---

[4] Crystal River ceased power generation in 2010 due to problems associated with containment building delamination. In June 2013, it was decided that it would not be put in commercial operation again and, therefore, it is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
DAVIS-BESSE 1	1978	326.4	48.7	421	48	0.11	0.15
Docket 50-346;	1979	381.0	67.0	304	30	0.10	0.08
NPF-3	1980	256.4	36.2	1,283	154	0.12	0.60
1st commercial operation 7/78	1981	531.4	67.4	578	58	0.10	0.11
Type - PWR	1982	390.8	51.5	1,350	164	0.12	0.42
Capacity - 894 MWe	1983	592.1	73.0	718	80	0.11	0.14
	1984	518.5	62.5	1,088	177	0.16	0.34
	1985	238.3	31.2	718	71	0.10	0.30
	1986	3.3	1.3	981	124	0.13	37.58
	1987	618.0	89.6	625	47	0.08	0.08
	1988	144.1	27.1	1,183	307	0.26	2.13
	1989	880.0	98.6	404	38	0.09	0.04
	1990	500.0	56.7	1,377	489	0.36	0.98
	1991	703.6	81.8	1,000	216	0.22	0.31
	1992	915.2	100.0	287	19	0.07	0.02
	1993	729.5	83.4	1,244	348	0.28	0.48
	1994	768.4	88.0	861	144	0.17	0.19
	1995	920.4	100.0	256	7	0.03	0.01
	1996	775.8	85.3	949	167	0.18	0.22
	1997	820.0	94.0	213	10	0.05	0.01
	1998	699.8	83.2	980	155.269	0.16	0.22
	1999	841.3	95.6	397	27.951	0.07	0.03
	2000	770.8	87.3	1,109	168.044	0.15	0.22
	2001	875.6	100.0	119	5.505	0.05	0.01
	2002	106.0	12.6	1,983	402.766	0.20	3.80
	2003	0.0	0.0	1,047	219.696	0.21	---
	2004	657.8	77.6	161	6.594	0.04	0.01
	2005	817.1	93.3	577	51.332	0.09	0.06
	2006	727.8	84.0	1,331	204.201	0.15	0.28
	2007	879.7	100.0	189	7.088	0.04	0.01
	2008	777.5	89.4	985	106.603	0.11	0.14
	2009	868.7	95.7	115	3.621	0.03	0.00
	2010	598.0	67.1	1,649	464.095	0.28	0.78
	2011	723.7	80.7	1,182	73.360	0.06	0.10
	2012	808.5	90.0	659	43.071	0.07	0.05
	2013	876.6	96.6	92	2.558	0.03	0.00
	2014	681.8	74.1	2,029	200.466	0.10	0.29
	2015	901.1	99.5	32	0.995	0.03	0.00
	2016	730.0	84.7	996	118.472	0.12	0.16
	2017	899.1	100.0	69	1.621	0.02	0.00
	2018	842.5	93.7	742	51.003	0.07	0.06
	2019	894.9	98.9	175	11.405	0.07	0.01
DIABLO CANYON 1, 2	1986	641.5	80.6	1,260	304	0.24	0.47
Docket 50-275, 50-323;	1987	1,688.6	83.0	1,170	336	0.29	0.20
DPR-80, DPR-82	1988	1,386.1	67.6	1,826	877	0.48	0.63
1st commercial operation	1989	1,899.0	87.5	1,646	465	0.28	0.24
5/85, 3/86	1990	1,952.6	91.0	1,441	323	0.22	0.17
Type - PWRs	1991	1,809.6	83.8	2,040	546	0.27	0.30
Capacity - 1,122, 1,118 MWe	1992	1,995.7	90.9	1,850	459	0.25	0.23
	1993	2,008.6	91.4	1,508	281	0.19	0.14
	1994	1,832.6	83.3	2,317	590	0.25	0.32
	1995	1,950.3	90.0	1,615	286	0.18	0.15
	1996	2,003.6	90.7	1,462	176	0.12	0.09
	1997	1,948.7	92.7	1,331	219	0.16	0.11
	1998	1,955.1	92.8	1,313	173.238	0.13	0.09
	1999	1,902.8	90.1	1,566	448.634	0.29	0.24
	2000	1,940.1	92.0	1,057	180.792	0.17	0.09
	2001	2,067.7	96.4	1,074	117.804	0.11	0.06
	2002	1,860.0	88.4	1,016	148.690	0.15	0.08
	2003	1,970.7	91.6	1,004	135.482	0.13	0.07
	2004	1,736.3	83.5	1,230	254.367	0.21	0.15
	2005	2,022.4	94.8	955	124.469	0.13	0.06
	2006	2,109.0	94.0	1,086	82.248	0.08	0.04

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
DIABLO CANYON 1, 2 (continued)	2007	2,131.4	95.0	1,269	111.866	0.09	0.05
	2008	1,952.1	87.7	2,121	235.034	0.11	0.12
	2009	1,873.0	85.3	2,534	337.831	0.13	0.18
	2010	2,115.2	94.7	1,367	125.457	0.09	0.06
	2011	2,131.1	94.6	747	31.625	0.04	0.01
	2012	2,023.0	91.8	894	43.531	0.05	0.02
	2013	2,064.1	92.4	760	28.767	0.04	0.01
	2014	1,947.1	88.8	979	67.599	0.07	0.03
	2015	2,116.8	94.9	807	57.244	0.07	0.03
	2016	2,162.2	95.7	794	37.734	0.05	0.02
	2017	2,051.4	92.0	787	47.910	0.06	0.02
	2018	2,088.4	94.6	718	32.013	0.04	0.02
	2019	1,851.7	84.1	774	51.135	0.07	0.03
DRESDEN 1[5], 2, 3	1969	99.7	---	---	286	---	2.87
Docket 50-010, 50-237, 50-249;	1970	163.1	---	---	143	---	0.88
DPR-2, DPR-19, DPR-25	1971	394.5	---	---	715	---	1.81
1st commercial operation 8/60,	1972	1,243.7	---	---	728	---	0.59
6/70, 11/71	1973	1,112.2	---	1,341	939	0.70	0.84
Type - BWRs	1974	842.5	54.9	1,594	1,662	1.04	1.97
Capacity - (197), 870, 869 MWe	1975	708.1	54.6	2,310	3,423	1.48	4.83
	1976	1,127.2	80.8	1,746	1,680	0.96	1.49
	1977	1,132.9	77.0	1,862	1,694	0.91	1.50
	1978	1,242.2	79.5	1,946	1,529	0.79	1.23
	1979	1,013.0	74.7	2,407	1,800	0.75	1.78
	1980	1,074.4	55.0	2,717	2,105	0.77	1.96
	1981	1,035.7	51.5	2,331	2,802	1.20	2.71
	1982	1,085.3	77.9	2,572	2,923	1.14	2.69
	1983	913.6	65.6	2,854	3,582	1.26	3.92
	1984	789.8	55.3	2,261	1,774	0.78	2.25
	1985	903.0	64.5	2,817	1,686	0.60	1.87
	1986	740.5	52.6	3,111	2,668	0.86	3.60
	1987	933.9	74.0	2,052	1,145	0.56	1.23
	1988	1,014.7	75.8	2,414	1,409	0.58	1.39
	1989	1,184.2	83.1	2,259	1,131	0.50	0.96
	1990	1,107.8	76.6	2,235	1,400	0.63	1.26
	1991	675.2	60.7	2,044	1,005	0.49	1.49
	1992	872.4	75.4	1,812	619	0.34	0.71
	1993	960.1	68.5	2,751	1,655	0.60	1.72
	1994	690.2	51.7	2,336	833	0.36	1.21
	1995	643.1	49.8	2,482	875	0.35	1.36
	1996	612.6	47.7	1,788	456	0.26	0.74
	1997	1,096.2	79.5	2,747	467	0.17	0.43
	1998	1,354.7	90.6	2,311	426.918	0.18	0.32
	1999	1,410.9	92.5	3,243	591.443	0.18	0.42
	2000	1,506.4	97.3	2,341	261.684	0.11	0.17
	2001	1,427.4	94.5	2,769	400.702	0.14	0.28
	2002	1,547.0	95.7	2,819	355.011	0.13	0.23
	2003	1,555.9	93.5	2,098	356.572	0.17	0.23
	2004	1,405.5	84.8	2,044	381.054	0.19	0.27
	2005	1,550.8	92.0	2,006	258.799	0.13	0.17
	2006	1,649.0	96.0	2,042	289.167	0.14	0.18
	2007	1,658.8	97.0	2,310	275.697	0.12	0.17
	2008	1,638.0	95.9	2,307	198.153	0.09	0.12
	2009	1,628.7	95.4	1,932	231.688	0.12	0.14
	2010	1,665.9	96.3	2,152	213.825	0.10	0.13
	2011	1,679.7	96.7	2,382	236.427	0.10	0.14
	2012	1,685.5	96.3	2,084	139.615	0.07	0.08
	2013	1,759.9	96.8	1,823	136.942	0.08	0.08
	2014	1,727.8	95.9	1,782	116.933	0.07	0.07
	2015	1,734.4	95.8	1,900	138.864	0.07	0.08
	2016	1,763.2	97.8	1,878	141.827	0.08	0.08

[5] Dresden 1 ceased power generation in 1978, and in 1985, it was decided that it would not be put in commercial operation again. Therefore, it is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
DRESDEN 1[5], 2, 3 (continued)	2017	1,763.3	97.5	1,928	129.266	0.07	0.07
	2018	1,776.9	98.1	1,883	118.831	0.06	0.07
	2019	1,721.7	96.6	2,155	202.866	0.09	0.12
DUANE ARNOLD	1976	305.2	78.0	350	105	0.30	0.34
Docket 50-331;	1977	353.6	78.9	538	299	0.56	0.85
DPR-49	1978	149.2	33.2	1,112	974	0.88	6.53
1st commercial operation 2/75	1979	352.0	78.0	757	275	0.36	0.78
Type - BWR	1980	339.1	73.3	1,108	671	0.61	1.98
Capacity - 602 MWe	1981	277.7	69.8	1,286	790	0.61	2.84
	1982	278.5	74.7	524	229	0.44	0.82
	1983	283.0	62.9	1,468	1,135	0.77	4.01
	1984	329.4	72.9	611	189	0.31	0.57
	1985	236.2	53.8	1,414	1,112	0.79	4.71
	1986	365.5	82.0	476	187	0.39	0.51
	1987	308.4	64.7	1,094	667	0.61	2.16
	1988	386.5	75.2	1,136	614	0.54	1.59
	1989	388.5	79.0	425	194	0.46	0.50
	1990	367.4	75.8	1,460	861	0.59	2.34
	1991	503.7	94.5	336	202	0.60	0.40
	1992	416.5	81.9	1,043	502	0.48	1.21
	1993	393.4	79.5	1,043	407	0.39	1.03
	1994	498.6	94.0	493	120	0.24	0.24
	1995	452.5	83.8	1,129	357	0.32	0.79
	1996	476.8	90.7	1,093	270	0.25	0.57
	1997	474.4	94.4	352	63	0.18	0.13
	1998	438.3	86.6	1,019	236.693	0.23	0.54
	1999	416.6	84.3	834	201.196	0.24	0.48
	2000	507.3	98.4	317	44.181	0.14	0.09
	2001	439.5	86.8	898	137.564	0.15	0.31
	2002	522.0	94.4	319	35.061	0.11	0.07
	2003	455.2	84.8	829	124.402	0.15	0.27
	2004	561.2	98.3	220	18.993	0.09	0.03
	2005	517.4	90.5	879	139.622	0.16	0.27
	2006	581.7	99.0	254	29.392	0.12	0.05
	2007	515.8	88.0	1,062	183.609	0.17	0.36
	2008	601.4	100.0	276	24.187	0.09	0.04
	2009	534.1	91.3	960	140.206	0.15	0.26
	2010	508.1	86.9	1,093	200.601	0.18	0.39
	2011	595.3	98.6	400	29.663	0.07	0.05
	2012	494.9	84.9	1,169	134.515	0.12	0.27
	2013	598.6	100.0	262	16.414	0.06	0.03
	2014	474.0	86.0	1,043	121.986	0.12	0.26
	2015	598.6	100.0	391	20.441	0.05	0.03
	2016	536.8	92.5	1,106	110.613	0.10	0.21
	2017	595.2	99.3	228	17.336	0.08	0.03
	2018	558.8	94.7	697	77.984	0.11	0.14
	2019	597.7	99.6	187	15.569	0.08	0.03
FARLEY 1, 2	1978	713.8	86.5	527	108	0.20	0.15
Docket 50-348, 50-364;	1979	211.0	28.6	1,227	643	0.52	3.05
NPF-2, NPF-8	1980	557.3	69.3	1,330	435	0.33	0.78
1st commercial operation	1981	310.2	41.4	1,331	512	0.38	1.65
12/77, 7/81	1982	1,271.5	79.2	1,453	484	0.33	0.38
Type - PWRs	1983	1,356.5	83.0	1,938	1,021	0.53	0.75
Capacity - 874, 883 MWe	1984	1,447.0	86.6	2,046	902	0.44	0.62
	1985	1,368.2	81.1	2,551	799	0.31	0.58
	1986	1,409.4	83.8	2,314	858	0.37	0.61
	1987	1,369.7	84.7	1,871	598	0.32	0.44
	1988	1,567.7	92.3	1,840	552	0.30	0.35
	1989	1,402.9	84.6	2,206	749	0.34	0.53
	1990	1,464.0	86.7	1,700	457	0.27	0.31
	1991	1,464.0	88.1	1,645	648	0.39	0.44

[5] Dresden 1 ceased power generation in 1978, and in 1985, it was decided that it would not be put in commercial operation again. Therefore, it is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
FARLEY 1, 2 (continued)	1992	1,331.7	81.8	2,018	805	0.40	0.60
	1993	1,455.5	88.3	1,284	333	0.26	0.23
	1994	1,587.2	93.0	1,035	250	0.24	0.16
	1995	1,311.2	83.8	1,574	460	0.29	0.35
	1996	1,549.2	90.9	1,150	232	0.20	0.15
	1997	1,449.7	89.0	1,105	278	0.25	0.19
	1998	1,313.9	80.9	1,380	431.821	0.31	0.33
	1999	1,436.0	91.4	1,102	190.463	0.17	0.13
	2000	1,430.1	88.6	1,683	359.855	0.21	0.25
	2001	1,384.3	84.4	1,810	320.509	0.18	0.23
	2002	1,558.0	93.5	772	96.431	0.12	0.06
	2003	1,592.6	95.3	788	111.016	0.14	0.07
	2004	1,496.8	89.4	1,141	107.227	0.09	0.07
	2005	1,564.2	93.3	810	67.826	0.08	0.04
	2006	1,602.7	94.0	747	66.189	0.09	0.04
	2007	1,495.8	88.0	1,226	139.716	0.11	0.09
	2008	1,602.6	94.4	669	40.833	0.06	0.03
	2009	1,595.2	94.1	657	41.851	0.06	0.03
	2010	1,503.4	89.0	1,321	121.313	0.09	0.08
	2011	1,647.4	95.1	723	37.510	0.05	0.02
	2012	1,680.7	95.8	563	29.817	0.05	0.02
	2013	1,609.4	92.8	775	53.212	0.07	0.03
	2014	1,655.9	94.5	713	37.703	0.05	0.02
	2015	1,631.0	93.6	888	55.942	0.06	0.03
	2016	1,563.7	90.0	957	59.840	0.06	0.04
	2017	1,690.0	96.1	575	31.351	0.05	0.02
	2018	1,605.6	94.2	592	36.355	0.06	0.02
	2019	1,613.8	92.3	896	63.320	0.07	0.04
FERMI 2	1989	624.0	68.5	1,270	255	0.20	0.41
Docket 50-341;	1990	848.2	84.7	462	83	0.18	0.10
NPF-43	1991	739.0	77.0	1,223	228	0.19	0.31
1st commercial operation 1/88	1992	874.3	81.3	1,213	245	0.20	0.28
Type - BWR	1993	984.3	92.9	360	35	0.10	0.04
Capacity - 1,096 MWe	1994	0.0	2.2	1,130	213	0.19	---
	1995	618.3	86.9	390	28	0.07	0.05
	1996	577.5	69.1	1,402	157	0.11	0.27
	1997	637.0	66.6	623	49	0.08	0.08
	1998	815.8	79.9	1,362	207.593	0.15	0.25
	1999	1,082.7	99.5	461	36.152	0.08	0.03
	2000	939.6	87.6	1,266	145.964	0.12	0.16
	2001	975.0	90.9	1,202	168.689	0.14	0.17
	2002	1,059.0	98.7	463	38.235	0.08	0.04
	2003	925.3	86.9	1,207	168.138	0.14	0.18
	2004	962.3	90.0	1,302	145.090	0.11	0.15
	2005	998.1	91.7	538	61.626	0.11	0.06
	2006	855.9	83.0	1,430	181.300	0.13	0.21
	2007	950.2	87.0	1,484	194.039	0.13	0.20
	2008	1,094.5	99.5	460	35.186	0.08	0.03
	2009	847.8	79.3	1,497	148.846	0.10	0.18
	2010	885.0	86.4	1,625	146.490	0.09	0.17
	2011	1,017.9	95.7	387	24.080	0.06	0.02
	2012	589.3	65.2	1,420	144.973	0.10	0.25
	2013	754.5	93.0	704	26.179	0.04	0.03
	2014	891.5	85.9	1,806	199.698	0.11	0.22
	2015	838.6	75.8	1,866	234.853	0.13	0.28
	2016	1,045.0	96.2	779	54.761	0.07	0.05
	2017	993.0	91.2	2,025	265.082	0.13	0.27
	2018	849.2	78.3	2,451	329.015	0.13	0.39
	2019	1,128.6	100.0	1,417	65.282	0.05	0.06
FITZPATRICK	1976	489.0	71.6	600	202	0.34	0.41
Docket 50-333;	1977	460.5	68.4	1,380	1,080	0.78	2.35
DPR-59	1978	497.0	72.1	904	909	1.01	1.83
1st commercial operation 7/75	1979	349.0	50.8	850	859	1.01	2.46
Type - BWR	1980	509.5	70.3	2,056	2,040	0.99	4.00
Capacity - 813 MWe	1981	562.9	74.7	2,490	1,425	0.57	2.53

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
FITZPATRICK (continued)	1982	583.6	75.0	2,322	1,190	0.51	2.04
	1983	546.2	70.6	1,715	1,090	0.64	2.00
	1984	576.2	76.8	1,610	971	0.60	1.69
	1985	492.3	63.7	1,845	1,051	0.57	2.13
	1986	711.2	90.6	1,185	411	0.35	0.58
	1987	496.2	70.3	1,578	940	0.60	1.89
	1988	514.0	69.0	1,553	786	0.51	1.53
	1989	727.5	92.3	1,027	377	0.37	0.52
	1990	543.8	72.6	1,536	884	0.58	1.63
	1991	399.7	53.4	1,269	333	0.26	0.83
	1992	0.0	0.0	2,374	674	0.28	---
	1993	559.6	81.7	1,427	232	0.16	0.41
	1994	588.4	83.2	1,595	322	0.20	0.55
	1995	569.8	74.5	1,249	327	0.26	0.57
	1996	623.3	83.1	1,384	357	0.26	0.57
	1997	756.2	95.9	662	91	0.14	0.12
	1998	562.8	78.0	1,781	357.826	0.20	0.64
	1999	749.7	95.5	558	68.409	0.12	0.09
	2000	685.9	88.4	1,267	300.997	0.24	0.44
	2001	807.2	98.9	665	63.229	0.10	0.08
	2002	751.0	93.3	1,234	230.523	0.19	0.31
	2003	793.0	97.9	298	51.156	0.17	0.06
	2004	735.0	92.1	1,091	186.055	0.17	0.25
	2005	802.9	96.3	382	62.697	0.16	0.08
	2006	771.5	93.0	1,527	234.425	0.15	0.30
	2007	790.1	96.0	526	58.741	0.11	0.07
	2008	761.7	92.9	1,430	184.772	0.13	0.24
	2009	844.5	100.0	487	35.119	0.07	0.04
	2010	726.2	91.3	1,429	219.887	0.15	0.30
	2011	826.9	100.0	513	35.217	0.07	0.04
	2012	691.1	87.2	1,546	169.886	0.11	0.25
	2013	780.8	98.9	603	39.392	0.07	0.05
	2014	665.4	87.8	1,674	135.890	0.08	0.20
	2015	842.7	100.0	250	20.785	0.08	0.02
	2016	668.7	95.4	362	28.304	0.08	0.04
	2017	705.8	89.0	1,139	162.196	0.14	0.23
	2018	745.2	92.6	1,456	231.548	0.16	0.31
	2019	839.5	100.0	381	24.160	0.06	0.03
FORT CALHOUN[6] Docket 50-285; DPR-40 1st commercial operation 6/74 Type - PWR Capacity - (482) MWe	1975	252.3	67.4	469	294	0.63	1.17
	1976	265.9	69.5	516	313	0.61	1.18
	1977	351.8	79.4	535	297	0.56	0.84
	1978	342.3	75.1	596	410	0.69	1.20
	1979	440.0	95.7	451	126	0.28	0.29
	1980	242.3	60.4	891	668	0.75	2.76
	1981	260.9	72.3	822	458	0.56	1.76
	1982	418.0	89.7	604	217	0.36	0.52
	1983	330.4	73.1	860	433	0.50	1.31
	1984	279.2	59.9	913	563	0.62	2.02
	1985	367.0	73.7	982	373	0.38	1.02
	1986	431.8	94.3	756	75	0.10	0.17
	1987	366.0	75.4	1,247	388	0.31	1.06
	1988	315.5	74.1	1,594	272	0.17	0.86
	1989	395.7	89.2	1,210	93	0.08	0.24
	1990	290.0	64.2	760	290	0.38	1.00
	1991	391.1	91.7	284	57	0.20	0.15
	1992	303.4	65.9	802	272	0.34	0.90
	1993	369.7	80.8	713	157	0.22	0.42
	1994	492.8	99.6	211	23	0.11	0.05
	1995	402.8	83.2	627	139	0.22	0.35
	1996	374.9	79.5	740	226	0.31	0.60
	1997	435.9	93.6	258	41	0.16	0.09
	1998	387.7	82.5	788	223.847	0.28	0.58
	1999	409.2	89.2	676	158.843	0.23	0.39

[6] Fort Calhoun ceased power generation in October 2016 and is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
FORT CALHOUN[6] (continued)	2000	443.8	93.5	249	35.215	0.14	0.08
	2001	401.2	88.3	770	225.891	0.29	0.56
	2002	434.0	92.3	742	163.806	0.22	0.38
	2003	399.6	87.0	914	212.422	0.23	0.53
	2004	463.5	97.0	215	21.574	0.10	0.05
	2005	332.4	72.2	1,069	272.876	0.26	0.82
	2006	353.9	75.0	1,591	289.100	0.18	0.82
	2007	499.9	100.0	100	3.990	0.04	0.01
	2008	400.4	82.2	839	96.155	0.11	0.24
	2009	422.7	87.0	870	110.918	0.13	0.26
	2010	486.5	98.5	171	9.763	0.06	0.02
	2011	134.4	26.8	1,042	79.226	0.08	0.59
	2012	0.0	0.0	494	39.377	0.08	---
	2013	10.9	3.6	678	63.853	0.09	5.86
	2014	477.7	97.7	159	5.053	0.03	0.01
	2015	402.5	81.5	747	75.987	0.10	0.19
	2016	0.0	0.0	166	11.255	0.07	0.00
	2017	0.0	0.0	72	2.770	0.04	---
	2018	0.0	0.0	74	6.939	0.09	---
	2019	0.0	0.0	110	11.120	0.10	---
GINNA Docket 50-244; DPR-18 1st commercial operation 7/70 Type - PWR Capacity - 560 MWe	1971	327.8	---	340	430	1.26	1.31
	1972	293.6	---	677	1,032	1.52	3.51
	1973	409.5	---	319	224	0.70	0.55
	1974	253.7	62.4	884	1,225	1.39	4.83
	1975	365.2	76.7	685	538	0.79	1.47
	1976	248.8	58.2	758	636	0.84	2.56
	1977	365.6	85.5	530	401	0.76	1.10
	1978	386.5	80.6	657	450	0.68	1.16
	1979	355.0	72.8	878	592	0.67	1.67
	1980	370.5	76.0	1,073	708	0.66	1.91
	1981	399.0	82.1	925	655	0.71	1.64
	1982	289.0	58.8	1,117	1,140	1.02	3.94
	1983	365.0	74.6	969	855	0.88	2.34
	1984	378.1	77.2	713	395	0.55	1.04
	1985	436.7	87.9	845	426	0.50	0.98
	1986	433.3	87.4	901	357	0.40	0.82
	1987	459.0	91.5	773	344	0.45	0.75
	1988	423.1	87.4	897	295	0.33	0.70
	1989	369.2	75.9	1,254	605	0.48	1.64
	1990	414.3	84.4	991	347	0.35	0.84
	1991	418.6	86.7	947	328	0.35	0.78
	1992	417.6	86.9	832	261	0.31	0.63
	1993	419.6	86.3	856	193	0.23	0.46
	1994	405.3	83.2	679	138	0.20	0.34
	1995	437.0	89.6	738	136	0.18	0.31
	1996	347.9	71.1	976	168	0.17	0.48
	1997	444.6	91.8	533	81	0.15	0.18
	1998	491.8	100.0	161	14.892	0.09	0.03
	1999	403.4	85.6	641	175.173	0.27	0.43
	2000	434.2	91.6	429	76.435	0.18	0.18
	2001	488.0	100.0	140	10.156	0.07	0.02
	2002	438.0	91.3	535	80.432	0.15	0.18
	2003	440.4	91.1	510	74.533	0.15	0.17
	2004	490.5	99.5	111	7.486	0.07	0.02
	2005	455.0	93.9	564	72.841	0.13	0.16
	2006	470.2	94.0	514	44.580	0.09	0.09
	2007	564.4	99.0	111	4.412	0.04	0.01
	2008	540.1	94.5	976	101.996	0.10	0.19
	2009	529.2	94.3	633	41.809	0.07	0.08
	2010	564.9	98.9	75	3.168	0.04	0.01
	2011	492.1	86.4	931	100.711	0.11	0.20
	2012	523.9	92.1	654	54.636	0.08	0.10

[6] Fort Calhoun ceased power generation in October 2016 and is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
GINNA	2013	570.0	99.1	104	3.434	0.03	0.01
(continued)	2014	532.2	93.5	621	58.380	0.09	0.11
	2015	544.5	95.1	415	24.163	0.06	0.04
	2016	575.6	100.0	79	1.882	0.02	0.00
	2017	536.3	94.5	614	46.173	0.08	0.09
	2018	536.4	94.9	462	27.931	0.06	0.05
	2019	570.1	99.5	57	2.023	0.04	0.00
GRAND GULF	1986	494.7	60.9	1,486	436	0.29	0.88
Docket 50-416;	1987	920.7	82.2	1,358	420	0.31	0.46
NPF-29	1988	1,136.6	96.7	692	147	0.21	0.13
1st commercial operation 7/85	1989	932.6	80.0	1,972	498	0.25	0.53
Type - BWR	1990	883.5	78.9	1,765	482	0.27	0.55
Capacity - 1,428 MWe	1991	1,085.2	94.0	699	94	0.13	0.09
	1992	969.0	83.7	2,032	484	0.24	0.50
	1993	936.4	81.5	1,807	332	0.18	0.35
	1994	1,143.2	96.6	455	56	0.12	0.05
	1995	952.9	80.4	1,589	342	0.22	0.36
	1996	1,096.2	88.7	1,564	357	0.23	0.33
	1997	1,234.9	100.0	514	105	0.20	0.09
	1998	1,049.2	88.9	1,410	303.695	0.22	0.29
	1999	962.1	81.3	1,180	226.277	0.19	0.23
	2000	1,217.5	99.4	289	34.877	0.12	0.03
	2001	1,129.8	93.0	1,109	185.214	0.17	0.16
	2002	1,145.0	93.6	1,060	176.396	0.17	0.15
	2003	1,241.2	98.6	290	31.250	0.11	0.03
	2004	1,165.2	92.2	1,243	158.112	0.13	0.14
	2005	1,147.3	91.9	1,326	167.914	0.13	0.15
	2006	1,233.7	98.0	1,016	59.935	0.06	0.05
	2007	1,070.5	88.0	1,750	177.884	0.10	0.17
	2008	1,072.1	89.5	1,843	167.859	0.09	0.16
	2009	1,255.5	100.0	521	30.721	0.06	0.02
	2010	1,102.0	91.5	1,822	188.370	0.10	0.17
	2011	1,180.0	100.0	530	21.084	0.04	0.02
	2012	835.2	67.8	2,446	276.378	0.11	0.33
	2013	1,231.1	92.2	396	35.449	0.09	0.03
	2014	1,173.5	89.5	1,726	181.746	0.11	0.15
	2015	1,337.8	98.2	587	25.241	0.04	0.02
	2016	682.8	52.4	1,443	194.755	0.13	0.29
	2017	849.1	75.4	538	40.251	0.07	0.05
	2018	794.3	69.4	1,284	166.908	0.13	0.21
	2019	1,259.4	93.8	948	35.139	0.04	0.03
HADDAM NECK[7]	1969	438.5	---	138	106	0.77	0.24
Docket 50-213;	1970	424.7	---	734	689	0.94	1.62
DPR-61	1971	502.2	---	289	342	1.18	0.68
1st commercial operation 1/68	1972	515.6	---	355	325	0.92	0.63
Type - PWR	1973	293.1	---	951	697	0.73	2.38
Capacity - (560) MWe	1974	521.4	91.2	550	201	0.37	0.39
	1975	494.3	89.9	795	703	0.88	1.42
	1976	482.9	82.5	644	449	0.70	0.93
	1977	480.7	83.9	894	641	0.72	1.33
	1978	563.4	98.6	216	117	0.54	0.21
	1979	493.0	87.5	1,226	1,162	0.95	2.36
	1980	426.8	75.0	1,860	1,353	0.73	3.17
	1981	487.5	84.3	1,554	1,036	0.67	2.13
	1982	543.9	93.4	559	126	0.23	0.23
	1983	453.7	77.8	1,645	1,384	0.84	3.05
	1984	404.0	71.7	1,430	1,216	0.85	3.01
	1985	556.1	98.4	384	101	0.26	0.18
	1986	294.8	53.6	1,945	1,567	0.81	5.32
	1987	304.6	54.0	1,763	750	0.43	2.46
	1988	397.4	70.3	735	237	0.32	0.60
	1989	356.4	67.2	1,455	596	0.41	1.67

[7] Haddam Neck (also known as Connecticut Yankee) ceased operations on December 4, 1996, and is no longer in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
HADDAM NECK[7]	1990	142.7	32.2	979	421	0.43	2.95
(continued)	1991	444.4	76.4	1,168	590	0.51	1.33
	1992	465.2	80.1	797	202	0.25	0.43
	1993	448.6	81.6	1,004	408	0.41	0.91
	1994	455.6	77.7	463	135	0.29	0.30
	1995	439.4	77.7	1,006	442	0.44	1.01
	1996	331.8	55.7	673	175	0.26	0.53
	1997	-1.3	0.0	219	11	0.05	---
	1998	0.0	0.0	423	93.743	0.22	---
	1999	0.0	0.0	545	108.602	0.20	---
	2000	0.0	0.0	555	262.192	0.47	---
	2001	0.0	0.0	361	95.348	0.26	---
	2002	0.0	0.0	258	51.668	0.20	---
	2003	0.0	0.0	400	82.022	0.21	---
	2004	0.0	0.0	564	91.981	0.16	---
	2005	0.0	0.0	350	36.479	0.10	---
	2006	0.0	0.0	124	11.883	0.10	---
	2007	0.0	0.0	0	0.000	---	---
	2008	0.0	0.0	1	0.011	0.01	---
	2009	0.0	0.0	1	0.010	0.01	---
	2010	0.0	0.0	2	0.024	0.01	---
	2011	0.0	0.0	6	0.364	0.06	---
	2012	0.0	0.0	2	0.024	0.01	---
	2013	0.0	0.0	9	0.182	0.02	---
	2014	0.0	0.0	11	0.185	0.02	---
	2015	0.0	0.0	13	0.204	0.02	---
	2016	0.0	0.0	15	0.244	0.02	---
	2017	0.0	0.0	11	0.182	0.02	---
	2018	0.0	0.0	15	0.25	0.02	---
	2019	0.0	0.0	0	0	0.00	---
HARRIS 1	1988	652.9	75.0	721	169	0.23	0.26
Docket 50-400;	1989	690.6	79.5	929	156	0.17	0.23
NPF-63	1990	776.4	89.6	453	85	0.19	0.11
1st commercial operation 5/87	1991	724.8	81.5	872	226	0.26	0.31
Type - PWR	1992	661.8	74.9	930	213	0.23	0.32
Capacity - 964 MWe	1993	913.0	99.7	327	31	0.09	0.03
	1994	740.8	82.7	1,089	222	0.20	0.30
	1995	731.1	83.8	1,068	174	0.16	0.24
	1996	860.6	95.4	444	17	0.04	0.02
	1997	673.6	80.4	1,131	149	0.13	0.22
	1998	766.2	90.4	931	133.497	0.14	0.17
	1999	827.0	97.9	247	15.538	0.06	0.02
	2000	783.0	92.5	888	100.981	0.11	0.13
	2001	611.2	72.4	1,586	252.241	0.16	0.41
	2002	892.0	99.4	145	6.674	0.05	0.01
	2003	823.9	93.2	786	68.463	0.09	0.08
	2004	797.9	88.2	747	57.103	0.08	0.07
	2005	902.9	99.5	164	8.483	0.05	0.01
	2006	802.4	89.0	917	87.225	0.10	0.11
	2007	845.1	94.0	870	64.808	0.07	0.08
	2008	890.4	97.4	192	10.356	0.05	0.01
	2009	845.1	92.7	742	41.401	0.06	0.05
	2010	808.3	89.0	1,069	82.578	0.08	0.10
	2011	926.0	100.0	157	4.724	0.03	0.01
	2012	810.8	87.4	1,066	79.845	0.07	0.10
	2013	786.3	85.4	861	54.874	0.06	0.07
	2014	918.8	97.5	52	1.275	0.02	0.00
	2015	830.2	88.4	875	57.978	0.07	0.07
	2016	857.7	91.1	687	43.876	0.06	0.05
	2017	937.1	99.7	12	0.217	0.02	0.00
	2018	866.2	90.0	596	31.736	0.05	0.04
	2019	868.8	90.0	626	37.223	0.06	0.04

[7] Haddam Neck (also known as Connecticut Yankee) ceased operations on December 4, 1996, and is no longer in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
HATCH 1, 2	1976	496.3	83.8	630	134	0.21	0.27
Docket 50-321, 50-366;	1977	446.8	66.3	1,303	465	0.36	1.04
DPR-57; NPF-5	1978	513.0	72.8	1,304	248	0.19	0.48
1st commercial operation	1979	401.0	54.6	2,131	582	0.27	1.45
12/75, 9/79	1980	1,008.7	70.9	1,930	449	0.23	0.45
Type - BWRs	1981	870.9	64.3	2,899	1,337	0.46	1.54
Capacity - 876, 883 MWe	1982	768.0	56.6	3,418	1,460	0.43	1.90
	1983	934.7	68.6	3,428	1,299	0.38	1.39
	1984	658.6	47.3	4,110	2,218	0.54	3.37
	1985	1,211.0	79.6	2,841	818	0.29	0.68
	1986	872.0	64.8	3,486	1,497	0.43	1.72
	1987	1,295.4	89.7	2,202	816	0.37	0.63
	1988	1,001.4	70.4	2,509	1,401	0.56	1.40
	1989	1,271.1	87.1	1,350	556	0.41	0.44
	1990	1,268.0	83.5	2,902	1,455	0.50	1.15
	1991	1,152.4	77.4	2,508	1,161	0.46	1.01
	1992	1,293.8	88.6	1,615	550	0.34	0.43
	1993	1,189.6	85.5	1,733	669	0.39	0.56
	1994	1,289.0	87.1	2,243	864	0.39	0.67
	1995	1,376.3	90.6	1,458	488	0.33	0.35
	1996	1,519.6	94.0	1,495	441	0.29	0.29
	1997	1,374.7	88.1	1,945	722	0.37	0.53
	1998	1,458.4	91.7	1,610	320.469	0.20	0.22
	1999	1,487.4	90.0	1,866	328.583	0.18	0.22
	2000	1,515.0	88.7	1,913	401.891	0.21	0.27
	2001	1,603.0	93.5	1,407	230.242	0.16	0.14
	2002	1,600.0	94.0	1,299	214.441	0.17	0.13
	2003	1,606.3	94.5	1,295	168.281	0.13	0.10
	2004	1,641.3	95.3	1,209	180.129	0.15	0.11
	2005	1,562.1	91.3	1,288	207.295	0.16	0.13
	2006	1,604.9	94.0	1,405	259.313	0.18	0.16
	2007	1,626.5	94.0	1,341	137.273	0.10	0.08
	2008	1,584.0	92.7	1,397	189.433	0.14	0.12
	2009	1,416.5	83.2	1,310	186.013	0.14	0.13
	2010	1,586.9	93.0	1,734	245.797	0.14	0.15
	2011	1,550.4	93.1	1,681	176.976	0.11	0.11
	2012	1,637.5	94.5	1,592	191.189	0.12	0.12
	2013	1,578.1	92.1	1,348	140.994	0.10	0.09
	2014	1,656.4	95.6	1,608	189.428	0.12	0.11
	2015	1,654.9	95.6	1,584	83.419	0.05	0.05
	2016	1,672.1	95.8	1,669	222.865	0.13	0.13
	2017	1,658.8	95.7	1,126	101.422	0.09	0.06
	2018	1,644.2	95.9	1,297	139.368	0.11	0.08
	2019	1,588.7	92.3	1,154	94.104	0.08	0.06
HOPE CREEK 1	1987	869.2	86.4	589	117	0.20	0.13
Docket 50-354;	1988	832.7	80.7	1,734	287	0.17	0.34
NPF-57	1989	791.1	77.8	1,873	465	0.25	0.59
1st commercial operation 12/86	1990	966.4	91.6	1,394	196	0.14	0.20
Type - BWR	1991	882.5	84.2	1,700	373	0.22	0.42
Capacity - 1,172 MWe	1992	841.9	80.8	1,694	436	0.26	0.52
	1993	1,049.2	97.8	688	98	0.14	0.09
	1994	852.0	81.2	1,779	326	0.18	0.38
	1995	844.5	79.8	1,571	196	0.12	0.23
	1996	806.9	77.4	1,069	158	0.15	0.20
	1997	731.8	77.8	1,747	350	0.20	0.48
	1998	993.2	98.0	620	54.816	0.09	0.06
	1999	879.1	86.7	1,111	279.063	0.25	0.32
	2000	827.8	87.9	1,236	188.295	0.15	0.23
	2001	918.2	91.1	1,532	156.180	0.10	0.17
	2002	1,007.0	99.2	220	25.922	0.12	0.03
	2003	826.6	84.6	1,597	139.295	0.09	0.17

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
HOPE CREEK 1	2004	688.6	71.3	2,440	239.540	0.10	0.35
(continued)	2005	874.9	88.6	881	67.063	0.08	0.08
	2006	983.8	93.0	2,135	133.570	0.06	0.14
	2007	929.3	91.0	2,221	191.068	0.09	0.21
	2008	1,139.1	100.0	999	34.510	0.03	0.03
	2009	1,111.4	93.3	2,090	169.362	0.08	0.15
	2010	1,082.0	92.1	1,985	160.910	0.08	0.15
	2011	1,199.3	99.4	426	24.677	0.06	0.02
	2012	1,091.3	93.4	2,207	153.866	0.07	0.14
	2013	1,040.3	89.7	2,019	150.568	0.07	0.14
	2014	1,187.9	98.8	853	36.543	0.04	0.03
	2015	1,078.9	91.7	2,915	169.862	0.06	0.16
	2016	1,100.4	92.8	1,661	139.883	0.08	0.13
	2017	1,216.7	100.0	412	31.919	0.08	0.03
	2018	1,094.0	92.6	1,593	150.044	0.09	0.14
	2019	1,000.8	89.2	1,356	169.220	0.12	0.17
HUMBOLDT BAY[8]	1969	44.6	---	125	164	1.31	3.68
Docket 50-133;	1970	49.3	---	115	209	1.82	4.24
DPR-7	1971	39.6	---	140	292	2.09	7.37
1st commercial operation 8/63	1972	43.1	---	127	253	1.99	5.87
Type - BWR	1973	50.1	---	210	266	1.27	5.31
Capacity - (63) MWe	1974	43.4	83.8	296	318	1.07	7.33
	1975	45.3	83.9	265	339	1.28	7.48
	1976	23.5	46.4	523	683	1.31	29.06
	1977	0.0	0.0	1,063	1,905	1.79	---
	1978	0.0	0.0	320	335	1.05	---
	1979	0.0	0.0	135	31	0.23	---
	1980	0.0	0.0	142	22	0.15	---
	1981	0.0	0.0	75	9	0.12	---
	1982	0.0	0.0	71	19	0.27	---
	1983	0.0	0.0	84	17	0.20	---
	1984			"Data not available"			
	1985	0.0	0.0	178	51	0.29	---
	1986	0.0	0.0	115	50	0.43	---
	1987			"Data not available"			
	1988	0.0	0.0	10	1	0.10	---
	1989	0.0	0.0	0	0	0.00	---
	1990	0.0	0.0	0	0	0.00	---
	1991	0.0	0.0	0	0	0.00	---
	1992	0.0	0.0	8	0	0.00	---
	1993	0.0	0.0	24	1	0.04	---
	1994	0.0	0.0	21	1	0.05	---
	1995	0.0	0.0	42	2	0.05	---
	1996	0.0	0.0	66	5	0.08	---
	1997	0.0	0.0	105	16	0.15	---
	1998	0.0	0.0	38	0.929	0.02	---
	1999	0.0	0.0	28	0.720	0.03	---
	2000	0.0	0.0	20	0.911	0.05	---
	2001	0.0	0.0	10	0.360	0.04	---
	2002	0.0	0.0	18	1.504	0.08	---
	2003	0.0	0.0	14	0.351	0.03	---
	2004	0.0	0.0	11	0.454	0.04	---
	2005	0.0	0.0	11	0.547	0.05	---
	2006	0.0	0.0	40	4.086	0.10	---
	2007	0.0	0.0	45	3.271	0.07	---
	2008	0.0	0.0	56	2.051	0.04	---
	2009	0.0	0.0	30	0.631	0.02	---
	2010	0.0	0.0	136	7.691	0.06	---
	2011	0.0	0.0	158	6.709	0.04	---

[8] Humboldt Bay had been shut down since 1976, and in 1983, PG&E announced its intention to decommission the unit. Therefore, it is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
HUMBOLDT BAY[8]	2012	0.0	0.0	156	15.859	0.10	---
(continued)	2013	0.0	0.0	172	24.121	0.14	---
	2014	0.0	0.0	125	12.381	0.10	---
	2015	0.0	0.0	54	4.391	0.08	---
	2016	0.0	0.0	0	0.000	---	---
	2017	0.0	0.0	0	0.000	---	---
	2018	0.0	0.0	0	0.000	---	---
INDIAN POINT 1[9]**, 2, 3**[10]	1969	206.2	---	---	298	---	1.45
Docket 50-3, 50-247, 50-286;	1970	43.3	---	---	1,639	---	37.85
DPR-5, DPR-26, DPR-64	1971	154.0	---	---	768	---	4.99
1st commercial operation	1972	142.3	---	---	967	---	6.80
8/62, 8/74, 8/76	1973	0.0	---	2,998	5,262	1.76	---
Type - PWRs	1974	556.1	59.4	1,019	910	0.89	1.64
Capacity - (265), 998, 1,030 MWe	1975	584.4	74.8	891	705	0.79	1.21
	1976	273.9	34.8	1,590	1,950	1.23	7.12
	1977	1,278.3	75.3	1,391	1,070	0.77	0.84
	1978	1,172.3	67.8	1,909	2,006	1.05	1.71
INDIAN POINT 1[9]**, 2**	1979	574.0	71.4	1,349	1,279	0.95	2.23
Docket 50-3, 50-247;	1980	510.8	64.8	1,577	971	0.62	1.90
DPR-5, DPR-26	1981	367.5	46.0	2,595	2,731	1.05	7.43
1st commercial operation	1982	532.4	65.4	2,144	1,635	0.76	3.07
10/62, 8/74	1983	702.6	84.0	1,057	486	0.46	0.69
Type - PWRs	1984	416.7	51.9	2,919	2,644	0.91	6.35
Capacity - (265), 998 MWe	1985	791.4	95.7	708	192	0.27	0.24
	1986	457.5	56.2	1,926	1,250	0.65	2.73
	1987	611.4	73.4	1,980	1,217	0.61	1.99
	1988	719.3	86.9	890	235	0.26	0.33
	1989	532.5	64.6	2,093	1,436	0.69	2.70
	1990	618.0	66.6	1,061	608	0.57	0.98
	1991	461.2	55.7	1,810	1,468	0.81	3.18
	1992	930.9	99.1	489	97	0.20	0.10
	1993	702.1	75.7	1,514	675	0.45	0.96
	1994	903.8	100.0	381	48	0.13	0.05
	1995	582.4	70.8	1,690	548	0.32	0.94
	1996	927.8	94.8	388	54	0.14	0.06
	1997	360.6	45.1	1,340	367	0.27	1.02
	1998	282.8	31.5	1,154	289.600	0.25	1.02
	1999	831.8	88.2	350	40.931	0.12	0.05
	2000	115.4	13.0	2,003	567.224	0.28	4.92
	2001	887.2	97.2	399	22.067	0.06	0.02
	2002	860.0	91.3	1,361	248.487	0.18	0.29
	2003	953.0	98.9	241	11.778	0.05	0.01
	2004	0.0	0.0	156	3	0.02	---
INDIAN POINT 1[9]	2005	0.0	0.0	151	6.692	0.04	---
Docket 50-3;	2006	0.0	0.0	193	7.670	0.04	---
DPR-05	2007	0.0	0.0	210	2.554	0.01	---
1st commercial operation 10/62	2008	0.0	0.0	234	4.322	0.02	---
Type - PWR	2009	0.0	0.0	140	0.404	0.00	---
Capacity - (265) MWe	2010	0.0	0.0	157	0.833	0.01	---
	2011	0.0	0.0	103	0.262	0.00	---
	2012	0.0	0.0	106	0.343	0.00	---
	2013	0.0	0.0	3	0.283	0.09	---
INDIAN POINT 3[10]	1979	574.0	66.5	808	636	0.79	1.11
Docket 50-286;	1980	367.3	53.2	977	308	0.32	0.84
DPR-64	1981	367.5	59.8	677	364	0.54	0.99
1st commercial operation 8/76	1982	171.5	22.5	1,477	1,226	0.83	7.15
Type - PWR	1983	7.8	2.6	941	607	0.65	77.82
Capacity - 1,030 MWe	1984	714.4	76.3	658	230	0.35	0.32

[9] Indian Point 1 was defueled in 1975, and in 1984, it was decided that it would not be placed in operation again. Therefore, it is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

[10] Indian Point 3 was purchased by a different utility in 1979 and subsequently reported its dose separately. Indian Point 1, 2, and 3 have been owned by the same utility since 2001 and report together.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
INDIAN POINT 3[10]	1985	566.5	66.0	1,093	570	0.52	1.01
(continued)	1986	655.3	73.4	588	202	0.34	0.31
	1987	574.6	62.7	1,308	500	0.38	0.87
	1988	792.5	83.3	451	93	0.21	0.12
	1989	587.8	61.1	1,800	876	0.49	1.49
	1990	595.3	62.9	1,066	358	0.34	0.60
	1991	862.8	87.5	299	40	0.13	0.05
	1992	561.7	61.4	1,003	212	0.21	0.38
	1993	140.5	14.9	478	60	0.13	0.43
	1994	0.0	0.0	529	58	0.11	---
	1995	174.8	21.4	638	67	0.11	0.38
	1996	695.3	74.8	289	22	0.08	0.03
	1997	495.1	54.9	1,608	234	0.15	0.47
	1998	874.0	95.3	213	14.774	0.07	0.02
	1999	829.8	88.3	893	116.920	0.13	0.14
	2000	960.0	99.3	143	8.693	0.06	0.01
	2001	903.9	93.1	1,014	118.115	0.12	0.13
	2002	960.0	98.5	156	6.797	0.04	0.01
	2003	866.2	89.8	902	96.059	0.11	0.11
INDIAN POINT 2, 3[10]	2004	1,851.1	191.0	1,370	199.862	0.15	0.11
Docket 50-247, 50-286;	2005	1,922.2	191.7	1,363	85.280	0.06	0.04
DPR-26, DPR-64	2006	1,936.0	191.0	1,634	289.701	0.18	0.15
1st commercial operation	2007	1,899.3	188.0	1,971	109.969	0.06	0.06
8/74, 8/76	2008	1,977.2	192.6	1,456	142.728	0.10	0.07
Type - PWRs	2009	1,884.2	187.5	1,853	79.090	0.04	0.04
Capacity - 998, 1,030 MWe	2010	1,859.2	183.6	1,962	200.382	0.10	0.11
	2011	1,938.8	95.1	1,185	63.267	0.05	0.03
	2012	1,921.0	94.7	1,289	109.807	0.09	0.06
	2013	1,946.6	95.6	1,297	74.038	0.06	0.04
	2014	1,973.1	96.5	1,313	142.195	0.11	0.07
	2015	1,870.1	92.6	1,277	60.475	0.05	0.03
	2016	1,723.7	85.9	958	72.915	0.08	0.04
	2017	1,740.7	86.6	1,899	102.735	0.05	0.06
	2018	1,863.6	92.0	1,624	88.211	0.05	0.05
	2019	1,905.9	93.7	1,552	51.414	0.03	0.03
KEWAUNEE[11]	1975	401.9	88.2	104	28	0.27	0.07
Docket 50-305;	1976	405.9	78.9	381	270	0.71	0.67
DPR-43	1977	425.0	79.9	312	140	0.45	0.33
1st commercial operation 6/74	1978	466.6	89.5	335	154	0.46	0.33
Type - PWR	1979	412.0	79.0	343	127	0.37	0.31
Capacity - (556) MWe	1980	433.8	82.1	401	165	0.41	0.38
	1981	451.8	86.7	383	141	0.37	0.31
	1982	458.4	87.6	353	101	0.29	0.22
	1983	444.1	83.7	445	165	0.37	0.37
	1984	455.3	85.7	482	139	0.29	0.31
	1985	443.1	82.4	519	176	0.34	0.40
	1986	461.7	85.8	502	169	0.34	0.37
	1987	480.0	89.7	755	226	0.30	0.47
	1988	467.5	88.3	705	210	0.30	0.45
	1989	449.1	84.9	570	239	0.42	0.53
	1990	468.8	87.9	490	145	0.30	0.31
	1991	441.8	83.4	495	221	0.45	0.50
	1992	471.4	88.0	450	122	0.27	0.26
	1993	457.1	86.8	436	106	0.24	0.23
	1994	475.6	88.8	364	72	0.20	0.15
	1995	455.6	87.8	415	109	0.26	0.24
	1996	380.4	71.8	474	126	0.27	0.33
	1997	269.8	56.0	278	56	0.20	0.21
	1998	423.0	87.2	384	88.205	0.23	0.21
	1999	505.1	100.0	103	5.055	0.05	0.01

[10] Indian Point 3 was purchased by a different utility in 1979 and subsequently reported its dose separately. Indian Point 1, 2, and 3 have been owned by the same utility since 2001 and report together.

[11] Kewaunee ceased operations in May 2013 and is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
KEWAUNEE[11]	2000	432.6	88.8	394	99.864	0.25	0.23
(continued)	2001	394.1	80.8	1,110	200.245	0.18	0.51
	2002	509.0	97.4	102	4.449	0.04	0.01
	2003	473.5	90.5	439	73.108	0.17	0.15
	2004	441.0	81.0	565	91.168	0.16	0.21
	2005	346.4	62.7	97	4.000	0.04	0.01
	2006	419.4	77.0	539	74.734	0.14	0.18
	2007	528.0	95.0	145	11.126	0.08	0.02
	2008	499.5	88.9	598	92.951	0.16	0.19
	2009	515.4	92.0	595	56.215	0.09	0.11
	2010	569.7	100.0	135	4.690	0.03	0.01
	2011	524.5	92.3	757	79.396	0.10	0.15
	2012	514.1	90.9	585	39.093	0.07	0.08
	2013	0.0	0.0	114	4.915	0.04	---
	2014	0.0	0.0	57	1.964	0.03	---
	2015	0.0	0.0	7	0.156	0.02	---
	2016	0.0	0.0	5	0.092	0.02	---
	2017	0.0	0.0	64	6.167	0.10	---
	2018	0.0	0.0	8	1.002	0.13	---
	2019	0.0	0.0	2	0.021	0.01	---
LA CROSSE[12]	1970	15.3	---	---	111	---	7.25
Docket 50-409;	1971	33.1	---	218	158	0.72	4.77
DPR-45	1972	29.2	---	151	172	1.14	5.89
1st commercial operation 11/69	1973	24.4	---	157	221	1.41	9.06
Type - BWR	1974	37.9	81.0	115	139	1.21	3.67
Capacity - (48) MWe	1975	32.0	69.6	165	234	1.42	7.31
	1976	21.2	47.6	118	110	0.93	5.19
	1977	11.3	33.7	141	225	1.60	19.91
	1978	21.6	62.0	182	164	0.90	7.59
	1979	24.0	71.8	153	186	1.22	7.75
	1980	26.4	68.5	124	218	1.76	8.26
	1981	29.6	76.0	187	123	0.66	4.16
	1982	17.2	44.6	148	205	1.39	11.92
	1983	24.8	59.7	160	313	1.96	12.62
	1984	38.5	80.5	288	252	0.88	6.55
	1985	39.2	86.7	373	173	0.46	4.41
	1986	19.6	46.1	260	290	1.12	14.80
	1987	0.0	0.0	127	68	0.54	---
	1988	0.0	0.0	49	31	0.63	---
	1989	0.0	0.0	60	15	0.25	---
	1990	0.0	0.0	51	9	0.18	---
	1991	0.0	0.0	42	8	0.19	---
	1992	0.0	0.0	28	6	0.21	---
	1993	0.0	0.0	48	8	0.17	---
	1994	0.0	0.0	65	8	0.12	---
	1995	0.0	0.0	31	3	0.10	---
	1996	0.0	0.0	25	4	0.16	---
	1997	0.0	0.0	23	2	0.09	---
	1998	0.0	0.0	27	1.530	0.06	---
	1999	0.0	0.0	66	3.725	0.06	---
	2000	0.0	0.0	37	3.548	0.10	---
	2001	0.0	0.0	45	2.782	0.06	---
	2002	0.0	0.0	47	2.314	0.05	---
	2003	0.0	0.0	65	1.836	0.03	---
	2004	0.0	0.0	56	0.918	0.02	---
	2005	0.0	0.0	51	8.139	0.16	---
	2006	0.0	0.0	0	0.000	---	---
	2007	0.0	0.0	86	37.092	0.43	---
	2008	0.0	0.0	40	1.759	0.04	---
	2009	0.0	0.0	48	1.307	0.03	---

[11] Kewaunee ceased operations in May 2013 and is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

[12] La Crosse ceased operations in 1987 and will not be put in commercial operation again. Therefore, it is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
LA CROSSE[12]	2010	0.0	0.0	78	2.971	0.04	---
(continued)	2011	0.0	0.0	110	5.296	0.05	---
	2012	0.0	0.0	100	7.652	0.08	---
	2013	0.0	0.0	51	3.411	0.07	---
	2014	0.0	0.0	59	5.499	0.09	---
	2015	0.0	0.0	22	1.587	0.07	---
	2016	0.0	0.0	34	3.904	0.11	---
	2017	0.0	0.0	58	6.356	0.11	---
	2018	0.0	0.0	21	0.633	0.03	---
	2019	0.0	0.0	0	0.000	0.00	---
LASALLE 1, 2	1984	677.8	77.8	1,245	252	0.20	0.37
Docket 50-373, 50-374;	1985	987.9	53.0	1,635	685	0.42	0.69
NPF-11, NPF-18	1986	929.5	50.6	1,614	898	0.56	0.97
1st commercial operation	1987	1,030.0	59.3	1,744	1,396	0.80	1.36
1/84, 6/84	1988	1,317.6	71.6	2,737	2,471	0.90	1.88
Type - BWRs	1989	1,503.5	73.1	2,475	1,386	0.56	0.92
Capacity - 1,111, 1,111 MWe	1990	1,754.3	84.6	1,830	948	0.52	0.54
	1991	1,837.0	86.7	1,985	806	0.41	0.44
	1992	1,447.4	72.0	2,418	1,167	0.48	0.81
	1993	1,542.0	76.0	1,701	854	0.50	0.55
	1994	1,580.0	77.6	1,812	726	0.40	0.46
	1995	1,696.6	82.1	1,623	512	0.32	0.30
	1996	1,053.8	54.3	2,782	819	0.29	0.78
	1997	0.0	0.0	1,661	316	0.19	---
	1998	380.9	19.3	2,099	422.249	0.20	1.11
	1999	1,671.9	81.8	2,689	576.354	0.21	0.34
	2000	2,138.6	97.1	1,831	260.320	0.14	0.12
	2001	2,223.8	98.9	535	82.721	0.15	0.04
	2002	2,040.0	92.1	2,012	449.587	0.22	0.22
	2003	2,100.2	94.8	2,253	464.427	0.21	0.22
	2004	2,162.1	96.0	2,366	359.470	0.15	0.17
	2005	2,130.4	95.0	2,097	334.558	0.16	0.16
	2006	2,181.3	97.0	2,006	248.454	0.12	0.11
	2007	2,166.7	98.0	1,953	228.373	0.12	0.11
	2008	2,145.8	96.4	2,402	217.567	0.09	0.10
	2009	2,141.0	95.7	1,986	296.659	0.15	0.14
	2010	2,184.1	96.5	2,386	384.434	0.16	0.18
	2011	2,198.2	96.1	2,805	340.529	0.12	0.15
	2012	2,230.8	96.9	1,973	224.711	0.11	0.10
	2013	2,141.6	94.1	1,960	383.622	0.20	0.18
	2014	2,141.0	94.0	2,151	366.524	0.17	0.17
	2015	2,132.9	95.7	2,492	501.666	0.20	0.24
	2016	2,185.5	96.0	2,653	338.985	0.13	0.16
	2017	2,158.5	94.5	2,824	570.389	0.20	0.26
	2018	2,214.7	96.3	2,923	349.268	0.12	0.16
	2019	2,218.6	97.1	2,295	309.129	0.13	0.14
LIMERICK 1, 2	1987	636.1	70.2	2,156	174	0.08	0.27
Docket 50-352, 50-353;	1988	794.9	96.5	950	52	0.05	0.07
NPF-39, NPF-85	1989	628.4	66.0	1,818	266	0.15	0.42
1st commercial operation	1990	1,527.7	78.2	1,422	175	0.12	0.11
2/86, 1/90	1991	1,810.9	86.8	1,151	106	0.09	0.06
Type - BWRs	1992	1,741.4	84.8	1,559	330	0.21	0.19
Capacity - 1,099, 1,108 MWe	1993	1,913.2	91.6	1,287	217	0.17	0.11
	1994	1,944.4	94.9	1,543	275	0.18	0.14
	1995	1,957.1	93.0	1,581	260	0.16	0.13
	1996	2,026.2	93.3	1,654	234	0.14	0.12
	1997	2,001.7	95.8	1,463	234	0.16	0.12
	1998	1,907.2	89.5	1,854	357.139	0.19	0.19
	1999	2,089.6	94.2	1,800	271.547	0.15	0.13
	2000	2,154.9	95.8	1,279	260.611	0.20	0.12
	2001	2,205.9	97.3	1,127	210.336	0.19	0.10
	2002	2,197.0	97.1	1,248	160.324	0.13	0.07

[12] La Crosse ceased operations in 1987 and will not be put in commercial operation again. Therefore, it is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
LIMERICK 1, 2 (continued)	2003	2,213.6	97.2	1,298	147.047	0.11	0.07
	2004	2,218.9	97.6	1,265	149.433	0.12	0.07
	2005	2,168.9	96.3	1,460	187.609	0.13	0.09
	2006	2,207.2	97.0	1,509	193.429	0.13	0.09
	2007	2,185.8	96.0	1,570	197.104	0.13	0.09
	2008	2,169.2	96.0	1,393	176.825	0.13	0.08
	2009	2,211.4	97.2	1,606	234.742	0.15	0.11
	2010	2,165.2	96.7	1,525	167.797	0.11	0.08
	2011	2,112.7	94.5	2,007	184.415	0.09	0.09
	2012	2,071.4	92.8	2,011	159.812	0.08	0.08
	2013	2,235.7	96.8	1,663	133.531	0.08	0.06
	2014	2,182.1	94.8	1,523	138.396	0.09	0.06
	2015	2,165.6	95.9	1,516	124.787	0.08	0.06
	2016	2,219.1	96.3	1,626	126.799	0.08	0.06
	2017	2,123.1	93.4	1,808	183.736	0.10	0.09
	2018	2,214.9	97.2	1,676	121.053	0.07	0.05
	2019	2,213.1	97.2	1,906	157.471	0.08	0.07
MAINE YANKEE[13] Docket 50-309; DPR-36 1st commercial operation 12/72 Type - PWR Capacity - (860) MWe	1973	408.7	---	782	117	0.15	0.29
	1974	432.6	68.7	619	420	0.68	0.97
	1975	542.9	79.9	440	319	0.73	0.59
	1976	712.2	95.0	244	85	0.35	0.12
	1977	617.6	82.2	508	245	0.48	0.40
	1978	642.7	84.1	638	420	0.66	0.65
	1979	537.0	68.4	393	154	0.39	0.29
	1980	527.0	72.2	735	462	0.63	0.88
	1981	624.2	78.2	868	424	0.49	0.68
	1982	542.5	69.1	1,295	619	0.48	1.14
	1983	677.1	83.6	592	165	0.28	0.24
	1984	605.7	74.4	1,262	884	0.70	1.46
	1985	635.4	79.2	1,009	700	0.69	1.10
	1986	737.6	87.8	495	100	0.20	0.14
	1987	478.1	65.3	1,100	722	0.66	1.51
	1988	591.9	79.1	1,058	725	0.69	1.22
	1989	819.2	93.7	375	99	0.26	0.12
	1990	573.0	71.0	1,359	682	0.50	1.19
	1991	738.1	86.6	426	105	0.25	0.14
	1992	631.7	79.1	1,189	461	0.39	0.73
	1993	674.8	79.8	1,016	377	0.37	0.56
	1994	782.8	90.9	297	84	0.28	0.11
	1995	23.6	3.7	1,167	653	0.56	27.67
	1996	602.9	78.1	408	56	0.14	0.09
	1997	0.0	0.0	991	153	0.15	---
	1998	0.0	0.0	438	163.008	0.37	---
	1999	0.0	0.0	365	135.057	0.37	---
	2000	0.0	0.0	490	121.133	0.25	---
	2001	0.0	0.0	412	68.121	0.17	---
	2002	0.0	0.0	452	66.226	0.15	---
	2003	0.0	0.0	342	43.775	0.13	---
	2004	0.0	0.0	190	21.313	0.11	---
	2005	0.0	0.0	2	0.048	0.02	---
	2006	0.0	0.0	0	0.000	---	---
	2007	0.0	0.0	0	0.000	---	---
	2008	0.0	0.0	1	0.013	0.01	---
	2009	0.0	0.0	3	0.137	0.05	---
	2010	0.0	0.0	1	0.084	0.08	---
	2011	0.0	0.0	2	0.060	0.03	---
	2012	0.0	0.0	6	0.238	0.04	---
	2013	0.0	0.0	4	0.186	0.05	---
	2014	0.0	0.0	3	0.079	0.03	---
	2015	0.0	0.0	9	0.176	0.02	---
	2016	0.0	0.0	2	0.038	0.02	---

[13] Maine Yankee ceased operations in August 1997 and is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
MAINE YANKEE[13] (continued)	2017	0.0	0.0	3	0.054	0.02	---
	2018	0.0	0.0	6	0.089	0.01	---
	2019	0.0	0.0	14	0.188	0.01	---
MCGUIRE 1, 2	1982	524.9	80.4	1,560	169	0.11	0.32
Docket 50-369, 50-370;	1983	558.3	55.4	1,751	521	0.30	0.93
NPF-9, NPF-17	1984	764.1	68.5	1,663	507	0.30	0.66
1st commercial operation	1985	808.4	77.0	2,217	771	0.35	0.95
12/81, 3/84	1986	1,360.0	60.1	2,326	1,015	0.44	0.75
Type - PWRs	1987	1,774.7	79.2	2,865	1,043	0.36	0.59
Capacity - 1,158, 1,158 MWe	1988	1,830.7	80.2	2,808	1,104	0.39	0.60
	1989	1,810.2	80.8	1,994	620	0.31	0.34
	1990	1,340.3	61.3	2,289	727	0.32	0.54
	1991	1,945.1	85.0	1,723	361	0.21	0.19
	1992	1,696.8	74.4	1,619	418	0.26	0.25
	1993	1,470.4	66.2	1,685	463	0.27	0.31
	1994	1,848.0	80.2	1,637	397	0.24	0.21
	1995	2,132.3	92.9	1,259	138	0.11	0.06
	1996	1,881.8	82.8	1,622	238	0.15	0.13
	1997	1,558.2	73.0	2,193	492	0.22	0.32
	1998	2,139.8	95.1	1,045	142.245	0.14	0.07
	1999	1,961.7	88.9	1,274	256.524	0.20	0.13
	2000	2,100.1	94.2	940	132.513	0.14	0.06
	2001	2,113.3	93.9	963	136.581	0.14	0.06
	2002	2,051.0	91.7	1,167	180.618	0.15	0.09
	2003	2,156.2	96.0	841	71.323	0.08	0.03
	2004	2,075.7	91.8	1,116	196.193	0.18	0.09
	2005	1,993.9	89.2	1,401	173.972	0.12	0.09
	2006	2,100.2	93.0	1,218	108.285	0.09	0.05
	2007	2,011.4	89.0	1,375	156.035	0.11	0.08
	2008	1,943.3	86.2	1,613	165.767	0.10	0.09
	2009	2,170.6	95.3	1,165	79.773	0.07	0.04
	2010	2,151.9	94.8	1,225	81.321	0.07	0.04
	2011	2,038.3	89.9	1,648	119.637	0.07	0.06
	2012	2,045.6	90.4	1,222	62.690	0.05	0.03
	2013	2,157.3	94.4	1,447	109.423	0.08	0.05
	2014	2,008.0	87.0	1,760	138.257	0.08	0.07
	2015	2,230.1	95.5	1,074	49.399	0.05	0.02
	2016	2,269.9	96.1	1,201	67.654	0.06	0.03
	2017	2,145.6	92.0	1,607	147.589	0.09	0.07
	2018	2,267.4	96.2	881	40.005	0.05	0.02
	2019	2,236.1	96.6	858	54.230	0.06	0.02
MILLSTONE 1[14]	1972	377.6	---	612	596	0.97	1.58
Docket 50-245;	1973	225.1	---	1,184	663	0.56	2.95
DPR-21	1974	430.3	79.1	2,477	1,430	0.58	3.32
1st commercial operation 3/71	1975	465.4	75.6	2,587	2,022	0.78	4.34
Type - BWR	1976	449.8	76.1	1,387	1,194	0.86	2.65
Capacity - (641) MWe	1977	575.7	89.6	1,075	394	0.37	0.68
	1978	556.6	87.6	1,391	1,416	1.02	2.54
	1979	505.0	77.3	2,001	1,795	0.90	3.55
	1980	405.8	69.0	3,024	2,157	0.71	5.32
	1981	304.3	51.6	2,506	1,496	0.60	4.92
	1982	490.2	79.9	1,370	929	0.68	1.90
	1983	640.1	95.6	309	244	0.79	0.38
	1984	516.1	78.8	1,992	836	0.42	1.62
	1985	548.5	83.6	732	608	0.83	1.11
	1986	626.8	95.4	389	150	0.39	0.24
	1987	523.4	79.6	1,588	684	0.43	1.31
	1988	658.8	98.6	327	144	0.44	0.22

[13] Maine Yankee ceased operations in August 1997 and is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

[14] Millstone 1 ceased operations in 1998 and is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational. From 2008-2014, Millstone 1 voluntarily provided an estimate of the collective dose for Unit 1, but not the number of individuals with measurable dose.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
MILLSTONE 1[14] (continued)	1989	554.6	84.2	852	462	0.54	0.83
	1990	608.3	91.6	365	131	0.36	0.22
	1991	213.1	35.4	1,154	409	0.35	1.92
	1992	431.8	68.1	348	99	0.28	0.23
	1993	627.9	96.8	305	81	0.27	0.13
	1994	394.0	63.6	1,321	391	0.30	0.99
	1995	520.6	80.0	910	620	0.68	1.19
	1996	0.0	0.0	747	431	0.58	---
	1997	-2.9	0.0	1,053	195	0.19	---
	1998	-2.7	0.0	347	12.741	0.04	---
	1999	0.0	0.0	397	9.790	0.02	---
	2000	0.0	0.0	478	59.955	0.13	---
	2001	0.0	0.0	414	14.946	0.04	---
	2002	0.0	0.0	185	4.151	0.02	---
	2003	0.0	0.0	195	10.675	0.05	---
	2004	0.0	0.0	147	11.152	0.08	---
	2005	0.0	0.0	145	0.897	0.01	---
	2006	0.0	0.0	4	0.607	0.15	---
	2007	0.0	0.0	33	0.901	0.03	---
	2008	0.0	0.0	0	0.222	---	---
	2009	0.0	0.0	0	0.114	---	---
	2010	0.0	0.0	0	0.142	---	---
	2011	0.0	0.0	0	0.265	---	---
	2012	0.0	0.0	0	0.137	---	---
	2013	0.0	0.0	0	0.313	---	---
	2014	0.0	0.0	0	0.313	---	---
	2015	0.0	0.0	0	0.000	---	---
	2016	0.0	0.0	0	0.000	---	---
	2017	0.0	0.0	0	0.000	---	---
MILLSTONE 2, 3 Docket 50-336, 50-423; DPR-65; NPF-49 1st commercial operation 12/75, 4/86 Type - PWRs Capacity - 870, 1,210 MWe	1976	545.7	78.7	620	168	0.27	0.31
	1977	518.7	65.7	667	242	0.36	0.47
	1978	536.6	67.3	1,420	1,444	1.02	2.69
	1979	520.0	62.8	525	471	0.90	0.91
	1980	579.3	69.2	893	637	0.71	1.10
	1981	722.4	82.6	890	531	0.60	0.74
	1982	595.9	70.6	2,083	1,413	0.68	2.37
	1983	294.0	34.2	2,383	1,881	0.79	6.40
	1984	782.7	93.5	285	120	0.42	0.15
	1985	417.8	49.4	1,905	1,581	0.83	3.78
	1986	1,313.8	80.4	2,393	993	0.41	0.76
	1987	1,624.5	84.1	1,441	505	0.35	0.31
	1988	1,594.8	83.2	1,827	804	0.44	0.50
	1989	1,428.3	72.9	1,984	1,079	0.54	0.76
	1990	1,614.9	87.1	1,652	593	0.36	0.37
	1991	819.5	69.7	1,084	381	0.35	0.46
	1992	1,115.1	59.9	3,190	1,280	0.40	1.15
	1993	1,525.2	79.7	2,064	557	0.27	0.37
	1994	1,556.6	73.1	1,249	188	0.15	0.12
	1995	1,278.1	60.5	1,691	416	0.25	0.33
	1996	418.1	19.3	983	126	0.13	0.30
	1997	0.0	0.0	1,435	253	0.18	---
	1998	374.9	20.9	1,179	112.543	0.10	0.30
	1999	1,446.3	73.3	1,688	252.138	0.15	0.17
	2000	1,865.8	92.4	1,385	142.664	0.10	0.08
	2001	1,759.3	92.0	1,327	174.238	0.13	0.10
	2002	1,703.0	87.5	1,548	292.197	0.19	0.17
	2003	1,834.6	91.0	1,274	322.923	0.25	0.18
	2004	1,887.5	95.0	803	136.459	0.17	0.07
	2005	1,777.1	88.8	1,329	202.490	0.15	0.11
	2006	1,898.5	93.0	1,160	174.164	0.15	0.09
	2007	1,875.1	94.0	1,150	163.780	0.14	0.09
	2008	1,761.1	87.7	1,467	272.693	0.19	0.15

[14] Millstone 1 ceased operations in 1998 and is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational. From 2008-2014, Millstone 1 voluntarily provided an estimate of the collective dose for Unit 1, but not the number of individuals with measurable dose.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
MILLSTONE 2, 3 (continued)	2009	1,906.1	89.6	983	159.203	0.16	0.08
	2010	1,916.8	93.1	718	81.589	0.11	0.04
	2011	1,822.7	87.7	1,044	169.417	0.16	0.09
	2012	1,948.9	92.2	726	73.270	0.10	0.04
	2013	1,954.5	94.6	747	64.232	0.09	0.03
	2014	1,812.7	87.5	1,250	160.502	0.13	0.09
	2015	1,992.4	95.0	818	63.940	0.08	0.03
	2016	1,896.1	93.1	856	64.125	0.07	0.03
	2017	1,888.0	91.2	1,118	112.598	0.10	0.06
	2018	1,931.7	91.5	777	66.110	0.09	0.03
	2019	1,914.9	94.8	715	47.673	0.07	0.02
MONTICELLO Docket 50-263; DPR-22 1st commercial operation 6/71 Type - BWR Capacity - 628 MWe	1972	424.4	---	99	61	0.62	0.14
	1973	389.5	---	401	176	0.44	0.45
	1974	349.3	74.9	842	349	0.41	1.00
	1975	344.8	72.2	1,353	1,353	1.00	3.92
	1976	476.4	91.5	325	263	0.81	0.55
	1977	425.6	79.9	860	1,000	1.16	2.35
	1978	459.4	87.2	679	375	0.55	0.82
	1979	522.0	97.6	372	157	0.42	0.30
	1980	411.8	78.2	1,114	531	0.48	1.29
	1981	389.3	72.6	1,446	1,004	0.69	2.58
	1982	291.1	63.3	1,307	993	0.76	3.41
	1983	494.6	96.3	416	121	0.29	0.24
	1984	33.7	9.2	1,872	2,462	1.32	73.06
	1985	509.8	91.7	586	327	0.56	0.64
	1986	402.7	79.1	895	596	0.67	1.48
	1987	422.5	81.9	941	568	0.60	1.34
	1988	542.5	99.8	375	110	0.29	0.20
	1989	318.2	76.2	1,102	507	0.46	1.59
	1990	536.0	96.9	336	94	0.28	0.18
	1991	429.4	80.8	964	465	0.48	1.08
	1992	528.3	97.5	454	114	0.25	0.22
	1993	458.1	84.4	954	494	0.52	1.08
	1994	471.3	87.0	788	395	0.50	0.84
	1995	564.7	100.0	200	44	0.22	0.08
	1996	461.6	86.9	757	240	0.32	0.52
	1997	417.4	75.9	399	106	0.27	0.25
	1998	470.2	88.1	674	209.137	0.31	0.44
	1999	530.7	92.9	451	70.075	0.16	0.13
	2000	483.2	84.2	792	216.136	0.27	0.45
	2001	441.3	78.5	834	220.683	0.26	0.50
	2002	571.0	99.0	399	40.030	0.10	0.07
	2003	522.8	91.7	858	168.896	0.20	0.32
	2004	573.2	99.2	279	35.081	0.13	0.06
	2005	509.4	90.0	919	175.201	0.19	0.34
	2006	579.1	100.0	273	33.416	0.12	0.06
	2007	478.6	85.0	1,075	191.398	0.18	0.40
	2008	555.3	95.8	351	43.777	0.12	0.08
	2009	473.1	85.2	1,235	173.624	0.14	0.37
	2010	536.0	98.5	534	56.116	0.11	0.10
	2011	383.4	71.3	1,903	236.997	0.12	0.62
	2012	556.7	98.6	528	38.786	0.07	0.07
	2013	342.3	62.5	1,247	198.968	0.16	0.58
	2014	493.6	95.0	282	35.306	0.13	0.07
	2015	532.4	85.5	846	130.057	0.15	0.24
	2016	639.0	100.0	313	28.547	0.09	0.04
	2017	589.0	92.2	815	115.814	0.14	0.20
	2018	641.3	100.0	273	29.238	0.11	0.05
	2019	566.7	91.9	1,055	128.425	0.12	0.23

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
NINE MILE POINT 1, 2	1970	227.0	---	821	44	0.05	0.19
Docket 50-220, 50-410;	1971	346.5	---	1,006	195	0.19	0.56
DPR-63; NPF-69	1972	381.8	---	735	285	0.39	0.75
1st commercial operation	1973	411.0	---	550	567	1.03	1.38
12/69, 4/88	1974	385.9	70.5	740	824	1.11	2.14
Type - BWRs	1975	359.0	72.1	649	681	1.05	1.90
Capacity - 565, 1,277 MWe	1976	484.6	88.2	392	428	1.09	0.88
	1977	347.4	59.2	1,093	1,383	1.27	3.98
	1978	527.7	95.1	561	314	0.56	0.60
	1979	354.0	66.1	1,326	1,497	1.13	4.23
	1980	533.9	92.3	1,174	591	0.50	1.11
	1981	385.2	66.0	2,029	1,592	0.78	4.13
	1982	133.5	21.4	1,352	1,264	0.93	9.47
	1983	329.8	56.2	1,405	860	0.61	2.61
	1984	426.8	71.9	1,530	890	0.58	2.09
	1985	580.9	96.4	1,007	265	0.26	0.46
	1986	371.0	65.3	1,878	1,275	0.68	3.44
	1987	542.6	93.3	1,190	141	0.12	0.26
	1988	0.0	0.0	2,626	854	0.33	---
	1989	527.5	29.7	2,737	564	0.21	1.07
	1990	656.2	46.6	2,405	699	0.29	1.07
	1991	1,250.8	79.7	1,543	292	0.19	0.23
	1992	965.9	61.8	1,800	563	0.31	0.58
	1993	1,380.2	84.6	2,352	633	0.27	0.46
	1994	1,589.6	95.9	800	149	0.19	0.09
	1995	1,382.2	82.5	2,304	759	0.33	0.55
	1996	1,598.6	91.6	1,596	290	0.18	0.18
	1997	1,321.5	74.8	1,425	429	0.30	0.32
	1998	1,387.3	87.0	1,744	378.484	0.22	0.27
	1999	1,409.5	81.3	1,709	446.699	0.26	0.32
	2000	1,443.9	88.1	1,783	282.838	0.16	0.20
	2001	1,506.9	88.9	1,371	343.197	0.25	0.23
	2002	1,517.0	90.4	2,449	516.663	0.21	0.34
	2003	1,585.6	91.4	1,501	374.775	0.25	0.24
	2004	1,551.9	92.0	1,362	448.509	0.33	0.29
	2005	1,656.5	94.5	1,366	401.719	0.29	0.24
	2006	1,647.1	96.0	1,130	229.551	0.20	0.14
	2007	1,598.3	93.0	1,826	329.307	0.18	0.21
	2008	1,642.1	95.8	1,391	301.824	0.22	0.18
	2009	1,706.2	97.1	1,456	237.552	0.16	0.14
	2010	1,627.1	95.2	1,703	375.424	0.22	0.23
	2011	1,616.8	92.5	1,362	244.395	0.18	0.15
	2012	1,504.6	87.3	1,764	407.900	0.23	0.27
	2013	1,804.9	95.0	1,411	217.056	0.15	0.12
	2014	1,737.8	94.7	1,483	263.710	0.18	0.15
	2015	1,823.7	95.7	1,604	160.380	0.10	0.09
	2016	1,765.5	95.1	1,679	256.794	0.15	0.15
	2017	1,827.3	97.2	1,401	141.150	0.10	0.08
	2018	1,758.9	95.8	1,905	385.491	0.20	0.22
	2019	1,777.2	94.2	1,338	151.719	0.11	0.09
NORTH ANNA 1, 2	1979	507.0	61.7	2,025	449	0.22	0.89
Docket 50-338, 50-339;	1980	681.8	86.5	2,086	218	0.10	0.32
NPF-4, NPF-7	1981	1,241.9	71.5	2,416	680	0.28	0.55
1st commercial operation	1982	777.7	45.8	2,872	1,915	0.67	2.46
6/78, 12/80	1983	1,338.4	76.1	2,228	665	0.30	0.50
Type - PWRs	1984	1,021.3	58.8	3,062	1,945	0.64	1.90
Capacity - 948, 944 MWe	1985	1,516.9	86.1	2,436	838	0.34	0.55
	1986	1,484.5	83.0	2,831	722	0.26	0.49
	1987	1,112.6	67.8	2,624	1,521	0.58	1.37
	1988	1,772.7	96.7	992	112	0.11	0.06
	1989	1,226.8	72.5	2,861	1,471	0.51	1.20
	1990	1,590.4	90.5	2,161	590	0.27	0.37
	1991	1,597.5	88.6	2,085	629	0.30	0.39

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
NORTH ANNA 1, 2 (continued)	1992	1,403.2	84.1	2,159	576	0.27	0.41
	1993	1,428.4	80.1	2,768	908	0.33	0.64
	1994	1,717.1	95.9	1,036	193	0.19	0.11
	1995	1,666.4	90.8	1,551	367	0.24	0.22
	1996	1,569.6	89.1	1,203	291	0.24	0.19
	1997	1,711.5	96.2	856	103	0.12	0.06
	1998	1,632.8	92.7	1,201	265.922	0.22	0.16
	1999	1,747.7	96.1	727	94.402	0.13	0.05
	2000	1,734.1	95.8	730	65.405	0.09	0.04
	2001	1,491.0	84.8	1,231	308.907	0.25	0.21
	2002	1,557.0	84.3	914	143.312	0.16	0.09
	2003	1,569.1	87.2	1,041	187.014	0.18	0.12
	2004	1,685.6	92.0	965	129.686	0.13	0.08
	2005	1,751.5	96.0	686	58.844	0.09	0.03
	2006	1,723.0	95.0	749	82.069	0.11	0.05
	2007	1,596.7	88.0	1,581	309.237	0.20	0.19
	2008	1,643.1	91.2	795	61.003	0.08	0.04
	2009	1,735.5	95.6	745	78.126	0.10	0.05
	2010	1,529.6	84.9	1,032	182.289	0.18	0.12
	2011	1,429.1	76.5	792	90.763	0.11	0.06
	2012	1,745.6	91.4	762	106.518	0.14	0.06
	2013	1,712.9	89.2	948	121.803	0.13	0.07
	2014	1,813.8	94.1	753	71.914	0.10	0.04
	2015	1,857.4	96.6	663	43.838	0.07	0.02
	2016	1,726.2	90.0	1,109	119.339	0.11	0.07
	2017	1,840.9	95.6	678	44.884	0.07	0.02
	2018	1,826.2	95.1	796	56.845	0.07	0.03
	2019	1,749.4	91.9	837	95.288	0.11	0.05
OCONEE 1, 2, 3 Docket 50-269, 50-270, 50-287; DPR-38, DPR-47, DPR-55 1st commercial operation 7/73, 9/74, 12/74 Type - PWRs Capacity - 847, 848, 859 MWe	1974	650.6	60.1	844	517	0.61	0.79
	1975	1,838.3	75.5	829	497	0.60	0.27
	1976	1,561.4	63.0	1,215	1,026	0.84	0.66
	1977	1,566.4	65.9	1,595	1,329	0.83	0.85
	1978	1,909.0	75.8	1,636	1,393	0.85	0.73
	1979	1,708.0	67.7	2,100	1,001	0.48	0.59
	1980	1,703.7	70.1	2,124	1,055	0.50	0.62
	1981	1,661.5	66.8	2,445	1,211	0.50	0.73
	1982	1,293.1	52.5	2,445	1,792	0.73	1.39
	1983	2,141.5	82.2	1,902	1,207	0.63	0.56
	1984	2,242.9	85.7	2,085	1,106	0.53	0.49
	1985	2,036.3	80.5	2,729	1,304	0.48	0.64
	1986	1,995.6	79.0	2,499	949	0.38	0.48
	1987	1,962.6	82.4	2,672	1,142	0.43	0.58
	1988	2,228.9	87.2	2,672	871	0.33	0.39
	1989	2,188.6	85.4	2,205	684	0.31	0.31
	1990	2,405.2	91.4	1,948	404	0.21	0.17
	1991	2,275.0	86.7	1,966	551	0.28	0.24
	1992	2,110.7	82.0	1,954	612	0.31	0.29
	1993	2,399.2	91.3	1,499	237	0.16	0.10
	1994	2,144.3	82.2	1,923	537	0.28	0.25
	1995	2,366.1	89.5	1,586	304	0.19	0.13
	1996	1,847.9	70.3	1,479	257	0.17	0.14
	1997	1,563.7	67.7	1,379	223	0.16	0.14
	1998	1,989.1	81.3	1,695	366.028	0.22	0.18
	1999	2,264.5	90.3	1,568	202.025	0.13	0.09
	2000	2,321.0	91.6	1,686	272.697	0.16	0.12
	2001	2,167.6	86.8	2,002	579.209	0.29	0.27
	2002	2,355.0	92.5	1,723	224.672	0.13	0.10
	2003	2,177.7	86.3	2,180	245.349	0.11	0.11
	2004	2,125.2	84.1	2,295	367.891	0.16	0.17
	2005	2,349.5	92.3	1,516	148.694	0.10	0.06
	2006	2,274.8	90.0	1,859	221.222	0.12	0.10
	2007	2,347.8	92.0	1,915	252.936	0.13	0.11
	2008	2,298.5	90.9	1,924	186.335	0.10	0.08
	2009	2,385.7	92.6	1,830	180.868	0.10	0.08

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
OCONEE 1, 2, 3 (continued)	2010	2,391.1	93.3	1,953	193.088	0.10	0.08
	2011	2,321.6	90.7	2,142	182.261	0.09	0.08
	2012	2,351.0	91.8	1,777	131.442	0.07	0.06
	2013	2,400.1	93.1	1,549	106.414	0.07	0.04
	2014	2,419.3	94.1	2,005	109.011	0.05	0.05
	2015	2,504.5	97.4	1,339	69.050	0.05	0.03
	2016	2,417.5	93.9	1,179	53.398	0.05	0.02
	2017	2,488.4	96.7	966	37.301	0.04	0.01
	2018	2,430.8	94.4	1,141	57.201	0.05	0.02
	2019	2,498.3	97	715	31.137	0.04	0.01
OYSTER CREEK[15] Docket 50-219; DPR-16 1st commercial operation 12/69 Type - BWR Capacity - (619) MWe	1970	413.6	---	95	63	0.66	0.15
	1971	448.9	---	249	240	0.96	0.53
	1972	515.0	---	339	582	1.72	1.13
	1973	424.6	---	782	1,236	1.58	2.91
	1974	434.5	70.4	935	984	1.05	2.26
	1975	373.6	73.3	1,210	1,140	0.94	3.05
	1976	456.5	79.3	1,582	1,078	0.68	2.36
	1977	385.7	70.1	1,673	1,614	0.96	4.18
	1978	431.8	74.3	1,411	1,279	0.91	2.96
	1979	541.0	85.9	842	467	0.55	0.86
	1980	232.9	41.4	1,966	1,733	0.88	7.44
	1981	314.8	59.8	1,689	917	0.54	2.91
	1982	242.7	62.5	1,270	865	0.68	3.56
	1983	27.9	11.5	2,303	2,257	0.98	80.90
	1984	37.1	9.6	2,369	2,054	0.87	55.36
	1985	446.1	89.4	2,342	748	0.32	1.68
	1986	157.3	31.5	3,740	2,436	0.65	15.49
	1987	371.0	64.2	1,932	522	0.27	1.41
	1988	419.6	65.9	2,875	1,504	0.52	3.58
	1989	287.5	57.3	2,395	910	0.38	3.17
	1990	511.8	89.1	1,941	310	0.16	0.61
	1991	351.6	60.5	3,089	1,185	0.38	3.37
	1992	536.3	85.9	2,771	657	0.24	1.23
	1993	551.9	87.8	2,560	416	0.16	0.75
	1994	431.7	70.8	2,382	844	0.35	1.96
	1995	615.4	97.4	761	90	0.12	0.15
	1996	515.0	82.6	1,833	449	0.24	0.87
	1997	579.1	94.3	509	50	0.10	0.09
	1998	490.8	82.4	1,408	308.323	0.22	0.63
	1999	615.1	100.0	466	41.664	0.09	0.07
	2000	444.9	83.3	2,044	614.379	0.30	1.38
	2001	595.0	97.6	442	45.817	0.10	0.08
	2002	573.0	94.0	1,468	265.810	0.18	0.46
	2003	598.4	97.2	416	43.363	0.10	0.07
	2004	551.8	91.6	1,346	226.880	0.17	0.41
	2005	611.9	99.5	316	27.813	0.09	0.05
	2006	530.2	90.0	1,443	189.950	0.13	0.36
	2007	579.7	97.0	464	46.590	0.10	0.08
	2008	531.0	91.0	1,511	211.932	0.14	0.40
	2009	568.3	96.4	382	37.272	0.10	0.07
	2010	525.7	89.9	1,655	206.284	0.12	0.39
	2011	604.8	98.0	434	46.984	0.11	0.08
	2012	537.1	88.5	1,359	165.164	0.12	0.31
	2013	584.1	96.5	299	29.981	0.10	0.05
	2014	551.8	91.2	1,160	145.487	0.13	0.26
	2015	602.3	97.7	275	22.710	0.08	0.04
	2016	523.4	87.5	1,286	133.603	0.10	0.26
	2017	619.8	99.5	249	17.511	0.07	0.03
	2018	0.0	0.0	357	37.887	0.11	---
	2019	0.0	0.0	123	21.886	0.18	---

[15] Oyster Creek ceased operations in September 2018 and is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
PALISADES	1972	216.8	---	---	78	---	0.36
Docket 50-255;	1973	286.8	---	975	1,133	1.16	3.95
DPR-20	1974	10.7	5.5	774	627	0.81	58.60
1st commercial operation 12/71	1975	302.0	64.5	495	306	0.62	1.01
Type - PWR	1976	346.9	55.2	742	696	0.94	2.01
Capacity - 777 MWe	1977	616.6	91.4	332	100	0.30	0.16
	1978	320.2	49.7	849	764	0.90	2.39
	1979	415.0	59.9	1,599	854	0.53	2.06
	1980	288.3	42.9	1,307	424	0.32	1.47
	1981	418.2	57.2	2,151	902	0.42	2.16
	1982	404.3	54.7	1,554	330	0.21	0.82
	1983	454.4	60.3	2,167	977	0.45	2.15
	1984	98.7	15.2	1,344	573	0.43	5.81
	1985	639.2	83.8	1,355	507	0.37	0.79
	1986	102.3	15.1	1,438	672	0.47	6.57
	1987	319.2	48.2	1,122	456	0.41	1.43
	1988	413.4	56.8	1,472	730	0.50	1.77
	1989	442.8	69.1	1,026	314	0.31	0.71
	1990	366.7	58.7	2,414	766	0.32	2.09
	1991	587.0	78.1	1,315	211	0.16	0.36
	1992	581.9	76.1	1,267	295	0.23	0.51
	1993	424.4	53.7	908	289	0.32	0.68
	1994	541.8	67.0	397	60	0.15	0.11
	1995	583.5	75.8	1,230	462	0.38	0.79
	1996	638.2	81.4	1,109	318	0.29	0.50
	1997	662.5	89.9	338	48	0.14	0.07
	1998	615.4	83.5	895	216.563	0.24	0.35
	1999	585.4	80.2	939	218.451	0.23	0.37
	2000	654.4	88.0	255	26.305	0.10	0.04
	2001	268.2	36.3	1,032	362.723	0.35	1.35
	2002	725.0	94.8	224	24.380	0.11	0.03
	2003	701.1	90.7	822	202.571	0.25	0.29
	2004	608.6	82.3	974	370.895	0.38	0.61
	2005	756.6	98.0	156	10.459	0.07	0.01
	2006	675.5	86.0	882	239.652	0.27	0.35
	2007	665.6	85.0	1,065	256.632	0.24	0.39
	2008	778.4	98.2	272	23.478	0.09	0.03
	2009	698.5	89.0	975	267.295	0.27	0.38
	2010	712.5	90.8	908	219.873	0.24	0.31
	2011	758.1	96.5	340	21.654	0.06	0.03
	2012	589.5	77.1	1,096	245.129	0.22	0.42
	2013	689.7	86.7	339	15.830	0.05	0.02
	2014	665.6	83.4	1,231	486.062	0.39	0.73
	2015	721.3	90.9	940	230.687	0.25	0.32
	2016	803.8	100.0	161	5.667	0.04	0.01
	2017	696.1	91.3	794	154.142	0.19	0.22
	2018	622.8	78.8	958	206.284	0.22	0.33
	2019	783.6	98.2	161	10.051	0.06	0.01
PALO VERDE 1, 2, 3	1987	1,638.1	66.1	1,792	669	0.37	0.41
Docket 50-528, 50-529, 50-530;	1988	1,700.9	65.5	2,173	688	0.32	0.40
NPF-41, NPF-51, NPF-74	1989	965.3	26.5	2,615	720	0.28	0.75
1st commercial operation	1990	2,500.9	67.5	2,236	499	0.22	0.20
1/86, 9/86, 1/88	1991	3,043.9	78.9	2,242	605	0.27	0.20
Type - PWRs	1992	3,102.3	82.0	1,981	541	0.27	0.17
Capacity - 1,311, 1,314,	1993	2,677.1	74.3	2,124	592	0.28	0.22
1,312 MWe	1994	2,827.6	79.1	2,048	462	0.23	0.16
	1995	3,265.2	85.6	1,875	482	0.26	0.15
	1996	3,482.7	90.0	1,717	302	0.18	0.09
	1997	3,369.2	92.2	1,585	246	0.16	0.07
	1998	3,454.4	93.2	1,410	192.425	0.14	0.06
	1999	3,471.2	93.2	1,275	146.328	0.11	0.04
	2000	3,458.6	93.0	1,279	158.105	0.12	0.05
	2001	3,280.2	88.6	1,361	182.043	0.13	0.06

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
PALO VERDE 1, 2, 3 (continued)	2002	3,513.0	94.0	1,343	140.057	0.10	0.04
	2003	3,254.4	88.6	1,943	210.842	0.11	0.06
	2004	3,201.4	86.3	1,324	199.016	0.15	0.06
	2005	2,937.6	80.4	2,014	200.300	0.10	0.07
	2006	2,741.1	79.0	1,585	151.516	0.10	0.06
	2007	3,058.5	81.0	2,372	148.660	0.06	0.05
	2008	3,330.0	86.1	1,706	159.913	0.09	0.05
	2009	3,500.2	89.6	1,695	97.902	0.06	0.03
	2010	3,561.6	90.9	1,655	112.612	0.07	0.03
	2011	3,570.5	91.9	1,248	61.374	0.05	0.02
	2012	3,635.5	93.6	1,126	59.593	0.05	0.02
	2013	3,588.0	91.8	1,164	93.713	0.08	0.03
	2014	3,689.9	94.1	1,085	60.002	0.06	0.02
	2015	3,711.7	94.1	1,142	57.996	0.05	0.02
	2016	3,680.7	93.6	1,177	64.796	0.06	0.02
	2017	3,691.8	94.1	1,088	53.888	0.05	0.01
	2018	3,551.0	91.5	1,036	41.103	0.04	0.01
	2019	3,643.8	92.6	937	41.262	0.04	0.01
PEACH BOTTOM 2, 3 Docket 50-277, 50-278; DPR-44, DPR-56 1st commercial operation 7/74, 12/74 Type - BWRs Capacity - 1,232, 1,251 MWe	1975	1,234.3	80.9	971	228	0.23	0.18
	1976	1,379.2	73.0	2,136	840	0.39	0.61
	1977	1,052.4	58.7	2,827	2,036	0.72	1.93
	1978	1,636.3	84.0	2,244	1,317	0.59	0.80
	1979	1,740.0	84.5	2,276	1,388	0.61	0.80
	1980	1,374.2	66.3	2,774	2,302	0.83	1.68
	1981	1,161.8	58.0	2,857	2,506	0.88	2.16
	1982	1,583.3	76.9	2,734	1,977	0.72	1.25
	1983	824.7	41.0	3,107	2,963	0.95	3.59
	1984	1,165.8	57.5	3,313	2,450	0.74	2.10
	1985	682.7	37.5	4,209	3,354	0.80	4.91
	1986	1,395.0	71.7	2,454	1,080	0.44	0.77
	1987	365.7	20.3	4,363	2,195	0.50	6.00
	1988	0.0	0.0	4,204	2,327	0.55	---
	1989	491.0	35.0	2,301	728	0.32	1.48
	1990	1,684.0	85.7	1,585	377	0.24	0.22
	1991	1,210.9	62.3	2,702	934	0.35	0.77
	1992	1,516.6	78.7	1,911	502	0.26	0.33
	1993	1,654.0	81.9	1,757	552	0.31	0.33
	1994	1,927.4	93.8	2,133	579	0.27	0.30
	1995	1,955.9	95.1	1,940	398	0.21	0.20
	1996	2,012.4	96.9	1,657	282	0.17	0.14
	1997	1,956.3	95.0	1,872	490	0.26	0.25
	1998	1,881.2	93.2	1,903	366.040	0.19	0.19
	1999	2,057.2	96.0	1,630	319.307	0.20	0.16
	2000	2,058.3	96.7	1,729	330.928	0.19	0.16
	2001	2,037.1	95.8	1,445	344.283	0.24	0.17
	2002	2,105.0	96.7	1,915	333.056	0.17	0.16
	2003	2,072.4	94.9	1,641	355.969	0.22	0.17
	2004	2,148.8	96.4	1,422	264.727	0.19	0.12
	2005	2,102.0	95.6	1,801	306.201	0.17	0.15
	2006	2,169.1	97.0	1,513	247.676	0.16	0.11
	2007	2,163.8	97.0	1,906	384.795	0.20	0.18
	2008	2,115.3	95.1	1,816	212.741	0.12	0.10
	2009	2,130.4	95.5	2,032	310.517	0.15	0.15
	2010	2,145.3	96.2	1,716	219.372	0.13	0.10
	2011	2,152.0	95.7	2,758	389.814	0.14	0.18
	2012	2,142.5	94.8	2,460	305.431	0.12	0.14
	2013	2,143.5	94.7	2,902	483.936	0.17	0.23
	2014	2,142.3	94.2	3,053	430.941	0.14	0.20
	2015	2,267.6	95.6	2,938	395.597	0.13	0.17
	2016	2,498.1	97.7	2,052	202.221	0.10	0.08
	2017	2,481.1	98.0	1,824	197.814	0.11	0.08
	2018	2,474.9	96.6	1,717	177.337	0.10	0.07
	2019	2,545.2	97.9	1,767	167.083	0.09	0.07

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
PERRY	1988	869.3	79.0	782	105	0.13	0.12
Docket 50-440;	1989	642.2	57.0	1,883	767	0.41	1.19
NPF-58	1990	792.7	67.1	1,537	638	0.42	0.80
1st commercial operation 11/87	1991	1,074.2	91.9	600	146	0.24	0.14
Type - BWR	1992	856.2	75.5	1,487	571	0.38	0.67
Capacity - 1,240 MWe	1993	479.2	48.2	1,235	278	0.23	0.58
	1994	550.8	50.2	2,098	691	0.33	1.25
	1995	1,090.9	95.6	587	64	0.11	0.06
	1996	895.6	77.2	1,622	307	0.19	0.34
	1997	930.6	84.7	1,524	272	0.18	0.29
	1998	1,163.1	99.3	385	41.945	0.11	0.04
	1999	1,041.7	89.9	1,758	326.014	0.19	0.31
	2000	1,148.2	97.1	501	55.827	0.11	0.05
	2001	885.9	79.6	1,392	258.268	0.19	0.29
	2002	1,136.0	95.0	436	70.258	0.16	0.06
	2003	973.7	83.8	1,880	607.384	0.32	0.62
	2004	1,164.3	95.9	496	73.481	0.15	0.06
	2005	872.9	73.8	1,734	416.608	0.24	0.48
	2006	1,195.8	99.0	488	65.152	0.13	0.05
	2007	919.7	79.0	1,650	505.121	0.31	0.55
	2008	1,215.9	97.9	528	52.058	0.10	0.04
	2009	869.2	73.3	1,818	614.959	0.34	0.71
	2010	1,213.3	98.5	278	32.186	0.12	0.03
	2011	978.2	82.4	1,640	307.866	0.19	0.31
	2012	1,194.3	98.6	408	43.374	0.11	0.04
	2013	964.5	82.1	1,630	373.747	0.23	0.39
	2014	1,193.5	97.4	442	84.578	0.19	0.07
	2015	1,082.5	87.5	1,644	386.778	0.24	0.36
	2016	1,189.5	96.9	351	36.389	0.10	0.03
	2017	1,120.1	92.2	1,449	327.717	0.23	0.29
	2018	1,223.6	100.0	217	29.848	0.14	0.02
	2019	1,047.2	91.0	1,222	301.067	0.25	0.29
PILGRIM 1[16]	1973	484.0	---	230	126	0.55	0.26
Docket 50-293;	1974	234.1	39.2	454	415	0.91	1.77
DPR-35	1975	308.1	71.3	473	798	1.69	2.59
1st commercial operation 12/72	1976	287.8	60.7	1,317	2,648	2.01	9.20
Type - BWR	1977	316.6	61.4	1,875	3,142	1.68	9.92
Capacity - (685) MWe	1978	519.5	83.1	1,667	1,327	0.80	2.55
	1979	574.0	89.4	2,458	1,015	0.41	1.77
	1980	360.3	56.2	3,549	3,626	1.02	10.06
	1981	408.9	65.9	2,803	1,836	0.66	4.49
	1982	389.9	63.9	2,854	1,539	0.54	3.95
	1983	559.5	87.2	2,326	1,162	0.50	2.08
	1984	1.4	0.4	4,542	4,082	0.90	2,915.71
	1985	587.3	91.5	2,209	893	0.40	1.52
	1986	121.9	18.8	2,635	874	0.33	7.17
	1987	0.0	0.0	4,710	1,579	0.34	---
	1988	0.0	0.0	2,073	392	0.19	---
	1989	204.6	64.1	1,797	207	0.12	1.01
	1990	503.5	82.1	1,898	225	0.12	0.45
	1991	406.3	65.8	2,836	605	0.21	1.49
	1992	561.0	85.4	1,332	281	0.21	0.50
	1993	513.7	80.9	1,328	435	0.33	0.85
	1994	453.6	71.4	758	200	0.26	0.44
	1995	531.7	80.7	1,294	482	0.37	0.91
	1996	631.3	95.4	517	116	0.22	0.18
	1997	492.1	80.7	1,655	588	0.36	1.19
	1998	650.5	100.0	530	71.446	0.13	0.11
	1999	510.7	84.4	1,222	344.270	0.28	0.67
	2000	627.5	98.3	422	50.797	0.12	0.08
	2001	585.6	91.0	1,113	179.585	0.16	0.31

[16] Pilgrim 1 ceased operations in June of 2019 and is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
PILGRIM 1[16] (continued)	2002	657.0	100.0	463	38.280	0.08	0.06
	2003	566.6	87.5	1,437	250.192	0.17	0.44
	2004	676.1	99.5	427	41.109	0.10	0.06
	2005	623.2	93.7	1,212	206.089	0.17	0.33
	2006	665.4	100.0	654	43.531	0.07	0.07
	2007	584.5	90.0	1,407	240.526	0.17	0.41
	2008	668.1	99.0	377	22.568	0.06	0.03
	2009	616.0	91.7	1,301	264.215	0.20	0.43
	2010	675.5	100.0	303	25.739	0.08	0.04
	2011	580.5	89.0	1,179	241.402	0.20	0.42
	2012	669.0	99.4	284	21.620	0.08	0.03
	2013	493.9	80.4	1,188	176.012	0.15	0.36
	2014	658.6	98.9	421	36.716	0.09	0.06
	2015	570.0	86.9	1,392	218.609	0.16	0.38
	2016	617.9	94.7	634	44.242	0.07	0.07
	2017	576.1	88.2	1,614	162.998	0.10	0.28
	2018	507.0	83.8	629	38.777	0.06	0.08
	2019	0.0	0.0	367	18.041	0.05	---
POINT BEACH 1, 2 Docket 50-266, 50-301; DPR-24, DPR-27 1st commercial operation 12/70, 10/72 Type - PWRs Capacity - 576, 578 MWe	1971	393.4	---	---	164	---	0.42
	1972	378.3	---	---	580	---	1.53
	1973	693.7	---	501	588	1.17	0.85
	1974	760.2	81.3	400	295	0.74	0.39
	1975	801.2	82.9	339	459	1.35	0.57
	1976	857.3	86.7	313	370	1.18	0.43
	1977	873.9	87.3	417	430	1.03	0.49
	1978	914.4	90.9	336	320	0.95	0.35
	1979	808.0	80.8	610	644	1.06	0.80
	1980	727.2	82.5	561	598	1.07	0.82
	1981	760.4	83.6	773	596	0.77	0.78
	1982	757.2	84.3	767	609	0.79	0.80
	1983	648.2	72.7	1,702	1,403	0.82	2.16
	1984	788.9	78.6	1,372	789	0.58	1.00
	1985	831.3	82.5	671	482	0.72	0.58
	1986	858.9	85.7	664	402	0.61	0.47
	1987	857.5	85.5	720	554	0.77	0.65
	1988	899.3	88.6	734	410	0.56	0.46
	1989	847.8	85.5	736	504	0.68	0.59
	1990	875.5	86.5	617	378	0.61	0.43
	1991	874.8	87.1	724	265	0.37	0.30
	1992	866.7	85.8	617	256	0.41	0.30
	1993	911.0	90.0	559	186	0.33	0.20
	1994	914.5	91.2	548	170	0.31	0.19
	1995	858.4	86.1	548	190	0.35	0.22
	1996	831.6	84.7	1,029	276	0.27	0.33
	1997	186.8	21.8	670	92	0.14	0.49
	1998	649.7	69.7	881	169.253	0.19	0.26
	1999	806.0	83.1	962	194.489	0.20	0.24
	2000	872.0	88.7	765	138.989	0.18	0.16
	2001	915.9	93.4	740	131.667	0.18	0.14
	2002	909.0	91.1	945	180.654	0.19	0.20
	2003	917.2	92.1	627	84.965	0.14	0.09
	2004	912.3	90.1	627	109.515	0.17	0.12
	2005	782.5	78.1	851	128.646	0.15	0.16
	2006	977.2	96.0	453	39.597	0.09	0.04
	2007	958.5	94.0	535	52.023	0.10	0.05
	2008	889.4	87.8	958	144.021	0.15	0.16
	2009	902.3	92.9	766	93.270	0.12	0.10
	2010	952.8	93.8	869	95.695	0.11	0.10
	2011	796.2	75.8	1,027	159.684	0.16	0.20
	2012	1,114.3	95.2	581	69.755	0.12	0.06
	2013	1,135.3	95.9	547	63.146	0.12	0.06

[16] Pilgrim 1 ceased operations in June of 2019 and is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
POINT BEACH 1, 2	2014	1,079.4	91.4	759	127.523	0.17	0.12
(continued)	2015	1,142.9	95.8	446	47.473	0.11	0.04
	2016	1,159.0	96.8	515	57.294	0.11	0.05
	2017	1,102.0	93.1	755	87.479	0.12	0.08
	2018	1,156.7	97.2	511	43.228	0.08	0.04
	2019	1,145.3	96.4	533	74.485	0.14	0.07
PRAIRIE ISLAND 1, 2	1974	181.9	43.9	150	18	0.12	0.10
Docket 50-282, 50-306;	1975	836.0	83.3	477	123	0.26	0.15
DPR-42, DPR-60	1976	725.2	76.6	818	447	0.55	0.62
1st commercial operation	1977	922.9	87.2	718	300	0.42	0.33
12/73, 12/74	1978	941.1	92.2	546	221	0.40	0.23
Type - PWRs	1979	865.0	86.0	594	180	0.30	0.21
Capacity - 522, 519 MWe	1980	800.7	79.9	983	353	0.36	0.44
	1981	844.9	80.5	836	329	0.39	0.39
	1982	944.9	90.4	645	229	0.36	0.24
	1983	921.1	86.8	654	233	0.36	0.25
	1984	972.4	91.7	546	147	0.27	0.15
	1985	882.6	84.0	1,082	416	0.38	0.47
	1986	930.6	90.3	818	255	0.31	0.27
	1987	969.6	91.6	593	135	0.23	0.14
	1988	932.0	89.1	732	199	0.27	0.21
	1989	1,001.8	94.7	476	99	0.21	0.10
	1990	925.4	89.2	737	188	0.26	0.20
	1991	1,023.3	95.6	586	98	0.17	0.10
	1992	811.6	76.2	845	211	0.25	0.26
	1993	978.3	90.7	532	106	0.20	0.11
	1994	996.9	91.5	478	109	0.23	0.11
	1995	1,023.2	93.9	499	107	0.21	0.10
	1996	992.1	91.4	558	112	0.20	0.11
	1997	817.6	81.4	753	174	0.23	0.21
	1998	860.3	83.4	582	116.649	0.20	0.14
	1999	989.3	93.8	542	72.496	0.13	0.07
	2000	992.2	93.1	632	106.091	0.17	0.11
	2001	900.8	85.8	691	124.708	0.18	0.14
	2002	987.0	93.6	969	127.713	0.13	0.13
	2003	1,006.1	96.4	594	61.137	0.10	0.06
	2004	940.4	89.9	1,186	143.806	0.12	0.15
	2005	952.5	90.8	782	84.337	0.11	0.09
	2006	926.4	89.0	1,103	137.352	0.12	0.15
	2007	1,014.8	98.0	130	6.276	0.05	0.01
	2008	924.3	88.9	1,060	126.723	0.12	0.14
	2009	942.2	89.9	560	53.590	0.10	0.06
	2010	1,002.6	94.9	661	54.933	0.08	0.05
	2011	982.4	92.0	678	58.029	0.09	0.06
	2012	803.8	76.7	909	119.166	0.13	0.15
	2013	881.8	86.0	1,383	129.989	0.09	0.15
	2014	957.0	91.1	768	70.860	0.09	0.07
	2015	842.2	81.2	802	62.441	0.08	0.07
	2016	944.5	87.9	705	48.078	0.07	0.05
	2017	998.3	95.0	558	34.322	0.06	0.03
	2018	1,025.5	95.5	559	37.731	0.07	0.04
	2019	1,043.4	96.9	417	24.593	0.06	0.02
QUAD CITIES 1, 2	1974	958.1	72.3	678	482	0.71	0.50
Docket 50-254, 50-265;	1975	833.6	68.4	1,083	1,618	1.49	1.94
DPR-29, DPR-30	1976	951.2	73.1	1,225	1,651	1.35	1.74
1st commercial operation	1977	970.1	84.0	907	1,031	1.14	1.06
2/73, 3/73	1978	1,124.5	88.6	1,207	1,618	1.34	1.44
Type - BWRs	1979	1,075.0	84.6	1,688	2,158	1.28	2.01
Capacity - 887, 888 MWe	1980	866.9	64.4	3,089	4,838	1.57	5.58
	1981	1,156.9	81.1	2,246	3,146	1.40	2.72
	1982	1,018.7	76.0	2,314	3,757	1.62	3.69
	1983	1,088.5	79.2	1,802	2,491	1.38	2.29
	1984	994.6	65.7	1,678	1,579	0.94	1.59
	1985	1,268.0	82.7	1,184	990	0.84	0.78

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
QUAD CITIES 1, 2 (continued)	1986	1,093.2	71.0	1,451	950	0.65	0.87
	1987	1,126.6	75.3	1,429	720	0.50	0.64
	1988	1,173.7	84.1	1,486	827	0.56	0.70
	1989	1,196.3	85.9	1,721	900	0.52	0.75
	1990	1,148.9	77.8	2,186	1,028	0.47	0.89
	1991	1,044.5	73.2	1,722	509	0.30	0.49
	1992	960.8	68.0	2,413	1,157	0.48	1.20
	1993	974.9	67.0	2,150	849	0.39	0.87
	1994	681.5	48.7	2,163	1,128	0.52	1.66
	1995	1,002.5	70.4	2,041	736	0.36	0.73
	1996	876.6	60.1	2,248	1,025	0.46	1.17
	1997	935.3	66.5	2,474	654	0.26	0.70
	1998	794.8	55.1	2,177	760.596	0.35	0.96
	1999	1,476.5	95.9	1,000	200.556	0.20	0.14
	2000	1,410.4	93.9	2,840	893.766	0.31	0.63
	2001	1,478.2	95.9	736	143.849	0.20	0.10
	2002	1,396.0	89.0	3,818	1,786.021	0.47	1.28
	2003	1,569.4	93.1	998	438.144	0.44	0.28
	2004	1,443.8	95.5	2,334	510.521	0.22	0.35
	2005	1,516.2	94.2	2,869	961.026	0.33	0.63
	2006	1,524.9	93.0	2,329	559.362	0.24	0.37
	2007	1,650.3	97.0	1,945	249.927	0.13	0.15
	2008	1,619.4	95.2	2,065	274.444	0.13	0.17
	2009	1,662.6	95.4	2,366	318.418	0.13	0.19
	2010	1,688.9	95.0	2,267	241.444	0.11	0.14
	2011	1,735.3	95.9	2,453	288.618	0.12	0.17
	2012	1,765.3	95.9	2,173	194.311	0.09	0.11
	2013	1,776.0	96.3	2,210	192.059	0.09	0.11
	2014	1,756.7	95.2	2,068	156.168	0.08	0.09
	2015	1,776.5	96.9	1,860	170.123	0.09	0.10
	2016	1,787.1	97.6	1,875	142.607	0.08	0.08
	2017	1,758.2	96.8	1,888	173.167	0.09	0.10
	2018	1,766.7	97.1	1,678	162.171	0.10	0.09
	2019	1,763.7	96.8	1,896	204.958	0.11	0.12
RANCHO SECO[17] Docket 50-312; DPR-54 1st commercial operation 4/75 Type - PWR Capacity - (873) MWe	1976	268.1	30.4	297	58	0.20	0.22
	1977	706.4	77.1	515	391	0.76	0.55
	1978	607.7	80.5	508	323	0.64	0.53
	1979	687.0	91.1	287	126	0.44	0.18
	1980	530.9	60.4	890	412	0.46	0.78
	1981	321.2	40.2	772	402	0.52	1.25
	1982	409.5	53.3	766	337	0.44	0.82
	1983	347.9	46.8	1,338	787	0.59	2.26
	1984	460.0	58.3	802	222	0.28	0.48
	1985	238.7	30.8	1,764	756	0.43	3.17
	1986	0.0	0.0	1,513	402	0.27	---
	1987	0.0	0.0	1,533	300	0.20	---
	1988	355.8	63.1	693	78	0.11	0.22
	1989	179.9	54.7	603	81	0.13	0.45
	1990	0.0	0.0	111	13	0.12	---
	1991	0.0	0.0	101	9	0.09	---
	1992	0.0	0.0	70	7	0.10	---
	1993	0.0	0.0	35	4	0.11	---
	1994	0.0	0.0	18	1	0.06	---
	1995	0.0	0.0	16	1	0.06	---
	1996	0.0	0.0	16	1	0.06	---
	1997	0.0	0.0	16	0	0.00	---
	1998	0.0	0.0	61	2.661	0.04	---
	1999	0.0	0.0	302	11.191	0.04	---
	2000	0.0	0.0	219	25.795	0.12	---
	2001	0.0	0.0	210	18.432	0.09	---
	2002	0.0	0.0	193	27.346	0.14	---
	2003	0.0	0.0	121	18.300	0.15	---
	2004	0.0	0.0	122	14.890	0.12	---

[17] Rancho Seco ceased operations in June 1989 and is no longer in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
RANCHO SECO[17]	2005	0.0	0.0	157	33.444	0.21	---
(continued)	2006	0.0	0.0	143	31.793	0.22	---
	2007	0.0	0.0	129	12.524	0.10	---
	2008	0.0	0.0	84	2.434	0.03	---
RIVER BEND 1	1987	605.2	68.4	1,268	378	0.30	0.62
Docket 50-458;	1988	880.7	94.3	513	107	0.21	0.12
NPF-47	1989	584.5	69.1	1,566	558	0.36	0.95
1st commercial operation 6/86	1990	682.2	78.0	1,616	489	0.30	0.72
Type - BWR	1991	814.7	87.2	780	144	0.18	0.18
Capacity - 967 MWe	1992	336.1	39.7	2,022	710	0.35	2.11
	1993	640.0	71.6	847	180	0.21	0.28
	1994	595.7	64.9	2,209	519	0.23	0.87
	1995	967.1	99.6	667	85	0.13	0.09
	1996	836.1	85.3	2,093	473	0.23	0.57
	1997	778.8	86.3	1,671	347	0.21	0.45
	1998	894.2	96.2	466	57.749	0.12	0.06
	1999	651.2	75.2	1,327	343.858	0.26	0.53
	2000	837.1	89.7	1,104	216.053	0.20	0.26
	2001	889.3	93.6	1,249	207.614	0.17	0.23
	2002	965.0	98.5	373	35.145	0.09	0.04
	2003	871.3	92.7	1,296	216.950	0.17	0.25
	2004	845.6	90.1	1,378	235.749	0.17	0.28
	2005	890.5	94.4	498	55.816	0.11	0.06
	2006	853.7	92.0	1,494	214.409	0.14	0.25
	2007	823.0	92.0	1,131	131.373	0.12	0.16
	2008	724.8	78.7	1,809	311.697	0.17	0.43
	2009	895.6	92.6	1,978	219.446	0.11	0.25
	2010	955.1	98.9	888	40.356	0.05	0.04
	2011	878.6	91.9	1,880	211.212	0.11	0.24
	2012	890.2	94.5	648	34.178	0.05	0.04
	2013	867.6	90.8	1,915	188.331	0.10	0.22
	2014	935.8	98.1	343	16.138	0.05	0.02
	2015	791.6	87.9	888	128.492	0.14	0.16
	2016	811.5	86.6	532	71.142	0.13	0.09
	2017	804.5	87.7	1,500	273.004	0.18	0.34
	2018	804.3	88.6	573	69.580	0.12	0.09
	2019	750.5	86.0	1,447	255.918	0.18	0.34
ROBINSON 2	1972	580.0	---	245	215	0.88	0.37
Docket 50-261;	1973	455.1	---	831	695	0.84	1.53
DPR-23	1974	578.1	83.3	853	672	0.79	1.16
1st commercial operation 3/71	1975	501.8	72.7	849	1,142	1.35	2.28
Type - PWR	1976	585.5	84.7	597	715	1.20	1.22
Capacity - 741 MWe	1977	511.5	85.2	634	455	0.72	0.89
	1978	480.5	72.0	943	963	1.02	2.00
	1979	482.0	70.8	1,454	1,188	0.82	2.46
	1980	387.3	62.2	2,009	1,852	0.92	4.78
	1981	426.6	73.0	1,462	733	0.50	1.72
	1982	277.5	48.9	2,011	1,426	0.71	5.14
	1983	409.8	75.5	2,244	923	0.41	2.25
	1984	28.0	7.0	4,127	2,880	0.70	102.86
	1985	629.5	87.9	1,378	311	0.23	0.49
	1986	577.1	80.3	1,571	539	0.34	0.93
	1987	510.1	72.5	1,379	499	0.36	0.98
	1988	385.0	65.9	1,351	564	0.42	1.46
	1989	336.6	48.7	1,098	195	0.18	0.58
	1990	400.3	64.8	1,626	437	0.27	1.09
	1991	575.1	81.4	885	193	0.22	0.34
	1992	487.2	66.8	1,267	352	0.28	0.72
	1993	502.7	70.7	1,221	337	0.28	0.67
	1994	560.3	79.5	420	63	0.15	0.11
	1995	618.7	84.7	1,058	215	0.20	0.35
	1996	654.8	88.6	1,031	167	0.16	0.26
	1997	707.5	99.0	304	13	0.04	0.02

[17] Rancho Seco ceased operations in June 1989 and is no longer in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
ROBINSON 2 (continued)	1998	628.5	88.9	978	170.476	0.17	0.27
	1999	648.9	91.8	807	123.952	0.15	0.19
	2000	710.0	99.7	138	8.396	0.06	0.01
	2001	627.9	90.6	827	124.750	0.15	0.20
	2002	638.0	91.2	830	110.631	0.13	0.17
	2003	733.1	100.0	109	4.838	0.04	0.01
	2004	653.7	89.3	952	118.159	0.12	0.18
	2005	656.9	89.7	791	64.662	0.08	0.10
	2006	735.5	100.0	86	3.320	0.04	0.00
	2007	655.0	90.0	890	80.752	0.09	0.12
	2008	618.1	84.6	788	68.381	0.09	0.11
	2009	738.9	99.3	126	6.643	0.05	0.01
	2010	410.8	57.0	996	85.917	0.09	0.21
	2011	726.5	99.3	137	3.630	0.03	0.00
	2012	613.4	82.2	1,027	65.258	0.06	0.11
	2013	650.3	85.3	1,116	80.595	0.07	0.12
	2014	703.1	91.2	477	28.666	0.06	0.04
	2015	653.4	84.9	957	56.373	0.06	0.09
	2016	734.3	96.3	133	3.704	0.03	0.01
	2017	676.9	89.1	883	58.739	0.07	0.09
	2018	602.5	80.3	958	61.998	0.06	0.10
	2019	727.9	93.8	48	1.668	0.03	0.00
SALEM 1, 2 Docket 50-272, 50-311; DPR-70, DPR-75 1st commercial operation 6/77, 10/81 Type - PWRs Capacity - 1,116, 1,134 MWe	1978	546.4	55.6	574	122	0.21	0.22
	1979	250.0	25.5	1,488	584	0.39	2.34
	1980	680.6	69.2	1,704	449	0.26	0.66
	1981	743.0	78.1	1,652	254	0.15	0.34
	1982	1,440.4	72.6	3,228	1,203	0.37	0.84
	1983	742.0	30.5	2,383	581	0.24	0.78
	1984	650.1	31.8	1,395	681	0.49	1.05
	1985	1,657.7	75.8	1,112	204	0.18	0.12
	1986	1,484.3	70.4	3,554	599	0.17	0.40
	1987	1,478.2	73.3	2,543	600	0.24	0.41
	1988	1,591.6	73.6	1,609	503	0.31	0.32
	1989	1,675.4	79.5	2,944	338	0.11	0.20
	1990	1,362.6	65.1	3,636	272	0.07	0.20
	1991	1,726.4	79.3	4,201	458	0.11	0.27
	1992	1,200.9	61.1	4,376	431	0.10	0.36
	1993	1,366.3	65.4	3,559	408	0.11	0.30
	1994	1,367.4	73.8	950	188	0.20	0.14
	1995	558.1	29.3	1,195	218	0.18	0.39
	1996	0.0	0.0	1,671	300	0.18	---
	1997	279.3	17.8	894	175	0.20	0.63
	1998	1,629.3	79.1	408	41.100	0.10	0.03
	1999	1,821.8	86.8	1,200	317.545	0.27	0.17
	2000	1,973.4	93.0	1,191	198.068	0.17	0.10
	2001	1,961.2	91.1	1,274	153.088	0.12	0.08
	2002	1,934.0	89.4	2,460	292.692	0.12	0.15
	2003	1,957.2	90.7	1,301	124.042	0.10	0.06
	2004	1,850.2	85.8	1,496	148.694	0.10	0.08
	2005	2,086.4	91.7	3,162	240.567	0.08	0.12
	2006	2,211.8	97.0	1,446	90.541	0.06	0.04
	2007	2,158.2	96.0	1,365	117.604	0.09	0.05
	2008	1,998.6	87.8	3,362	328.761	0.10	0.16
	2009	2,252.9	96.2	1,249	101.186	0.08	0.04
	2010	2,147.3	93.9	964	77.828	0.08	0.04
	2011	2,054.6	91.4	2,180	126.716	0.06	0.06
	2012	2,123.8	93.4	674	47.003	0.07	0.02
	2013	2,213.1	94.7	797	59.430	0.07	0.03
	2014	1,870.1	81.7	2,558	109.633	0.04	0.06
	2015	2,131.3	93.8	580	33.810	0.06	0.02
	2016	1,800.9	84.2	1,108	93.255	0.08	0.05
	2017	2,060.5	89.7	1,745	135.197	0.08	0.07
	2018	2,165.1	95.2	521	49.086	0.09	0.02
	2019	2,053.6	90.4	803	100.110	0.12	0.05

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
SAN ONOFRE 1[18], 2, 3[19]	1969	314.1	---	123	42	0.34	0.13
Docket 50-206, 50-361, 50-362;	1970	365.9	---	251	155	0.62	0.42
DPR-13; NPF-10, NPF-15	1971	362.1	---	121	50	0.41	0.14
1st commercial operation	1972	338.5	---	326	256	0.79	0.76
1/68, 8/83, 4/84	1973	273.7	---	570	353	0.62	1.29
Type - PWRs	1974	377.8	86.1	219	71	0.32	0.19
Capacity - (436), (1,070),	1975	389.0	87.4	424	292	0.69	0.75
(1,080) MWe	1976	297.9	70.2	1,330	880	0.66	2.95
	1977	281.2	63.7	985	847	0.86	3.01
	1978	323.2	80.2	764	401	0.52	1.24
	1979	401.0	90.2	521	139	0.27	0.35
	1980	97.3	22.3	3,063	2,386	0.78	24.52
	1981	95.9	26.7	2,902	3,223	1.11	33.61
	1982	61.6	15.7	3,055	832	0.27	13.51
	1983	0.0	0.0	1,701	155	0.09	---
	1984	670.4	68.3	7,514	986	0.13	1.47
	1985	1,381.8	132.9	5,742	722	0.13	0.52
	1986	1,698.2	61.1	3,594	824	0.23	0.49
	1987	1,983.0	78.8	2,138	696	0.33	0.35
	1988	1,982.3	68.4	2,324	781	0.34	0.39
	1989	1,840.8	64.9	2,237	567	0.25	0.31
	1990	1,980.5	69.1	2,224	885	0.40	0.45
	1991	1,987.6	75.3	1,814	412	0.23	0.21
	1992	2,228.6	87.1	1,651	324	0.20	0.15
	1993	1,771.3	79.9	2,193	767	0.35	0.43
	1994	2,220.7	100.0	528	32	0.06	0.01
	1995	1,686.9	79.1	1,914	455	0.24	0.27
	1996	2,089.3	93.2	1,272	129	0.10	0.06
	1997	1,533.9	72.9	1,652	341	0.21	0.22
	1998	1,996.4	92.0	1,091	195.600	0.18	0.10
SAN ONOFRE 1[18]	1999	0.0	0.0	241	15.863	0.07	---
Docket 50-206;	2000	0.0	0.0	416	71.214	0.17	---
DPR-13	2001	0.0	0.0	338	57.785	0.17	---
1st commercial operation 1/68	2002	0.0	0.0	308	61.214	0.20	---
Type - PWR	2003	0.0	0.0	226	35.596	0.16	---
Capacity - (436) MWe	2004	0.0	0.0	169	14.899	0.09	---
	2005	0.0	0.0	198	20.624	0.10	---
	2006	0.0	0.0	183	22.490	0.12	---
	2007	0.0	0.0	20	0.417	0.02	---
	2008	0.0	0.0	2	0.043	0.02	---
SAN ONOFRE 2, 3[19]	1999	1,901.4	86.9	1,477	353.765	0.24	0.19
Docket 50-361, 50-362;	2000	2,067.2	94.7	1,073	115.499	0.11	0.06
NPF-10, NPF-15	2001	1,727.2	78.9	1,083	131.384	0.12	0.08
1st commercial operation	2002	2,056.0	93.4	1,140	136.443	0.12	0.07
8/83, 4/84	2003	2,084.3	94.0	1,275	163.804	0.13	0.08
Type - PWRs	2004	1,713.8	79.1	1,761	407.063	0.23	0.24
Capacity - (1,070), (1,080) MWe	2005	2,094.7	96.0	305	11.332	0.04	0.01
	2006	1,552.2	73.0	1,632	315.087	0.19	0.20
	2007	1,964.6	89.0	1,065	91.545	0.09	0.05
	2008	1,753.0	82.7	1,014	125.320	0.12	0.07
SAN ONOFRE 1[18], 2, 3[19]	2009	1,774.5	79.9	1,575	178.131	0.11	0.10
Docket 50-206, 50-361, 50-362;	2010	1,578.9	75.3	1,642	199.399	0.12	0.13
DPR-13; NPF-10, NPF-15	2011	2,067.1	93.0	641	29.658	0.05	0.01
1st commercial operation	2012	115.2	5.4	2,150	221.463	0.10	1.92
1/68, 8/83, 4/84	2013	0.0	0.0	210	5.701	0.03	---
Type - PWRs	2014	0.0	0.0	68	1.369	0.02	---
Capacity - (436), (1,070),	2015	0.0	0.0	136	1.202	0.01	---
(1,080) MWe	2016	0.0	0.0	87	1.787	0.02	---
SAN ONOFRE 1[17], 2, 3[18]	2017	0.0	0.0	1	0.005	0.01	---
(continued)	2018	0.0	0.0	127	24.574	0.19	---
	2019	0.0	0.0	76	12.774	0.17	---

[18] San Onofre 1 ceased operations in November 1992 and is no longer in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

[19] San Onofre 2, 3 ceased power generation in January 2012, and in June 2013 it was decided that they would not be put back into commercial operation. Therefore, they are no longer included in the count of operating reactors. Parentheses indicate plant capacities when plants were operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
SEABROOK	1991	810.4	75.9	699	92	0.13	0.11
Docket 50-443;	1992	932.4	81.3	806	147	0.18	0.16
NPF-86	1993	1,071.5	93.6	110	6	0.05	0.01
1st commercial operation 8/90	1994	736.4	63.5	852	113	0.13	0.15
Type - PWR	1995	995.5	87.5	800	102	0.13	0.10
Capacity - 1,246 MWe	1996	1,168.6	99.6	206	10	0.05	0.01
	1997	907.0	79.8	1,571	186	0.12	0.21
	1998	957.6	84.5	559	18.509	0.03	0.02
	1999	991.5	87.5	1,339	105.723	0.08	0.11
	2000	901.8	79.3	1,158	70.091	0.06	0.08
	2001	989.6	89.1	423	8.672	0.02	0.01
	2002	1,058.0	92.8	1,095	66.583	0.06	0.06
	2003	1,055.9	93.6	981	70.953	0.07	0.07
	2004	1,158.6	100.0	291	5.858	0.02	0.01
	2005	1,076.4	91.5	1,034	52.216	0.05	0.05
	2006	1,072.8	89.0	1,246	76.583	0.06	0.07
	2007	1,228.7	100.0	349	4.332	0.01	0.00
	2008	1,064.4	86.9	1,297	74.992	0.06	0.07
	2009	1,006.4	86.5	1,233	87.372	0.07	0.09
	2010	1,245.4	100.0	335	4.488	0.01	0.00
	2011	954.5	80.5	1,156	65.593	0.06	0.07
	2012	932.2	87.8	1,092	53.636	0.05	0.06
	2013	1,247.3	100.0	291	2.442	0.01	0.00
	2014	1,160.7	93.8	1,056	39.983	0.04	0.03
	2015	1,082.6	88.3	1,219	96.053	0.08	0.09
	2016	1,228.4	98.8	59	1.672	0.03	0.00
	2017	1,140.4	92.0	519	29.191	0.06	0.03
	2018	1,148.5	92.7	464	33.418	0.07	0.03
	2019	1,245.0	100.0	69	1.084	0.02	0.00
SEQUOYAH 1, 2	1982	583.5	52.8	1,968	570	0.29	0.98
Docket 50-327, 50-328;	1983	1,663.7	75.1	1,769	491	0.28	0.30
DPR-77, DPR-79	1984	1,481.9	69.0	2,373	1,119	0.47	0.76
1st commercial operation	1985	1,151.3	51.3	1,853	1,072	0.58	0.93
7/81, 6/82	1986	0.0	0.0	1,738	527	0.30	---
Type - PWR	1987	0.0	0.0	2,080	420	0.20	---
Capacity - 1,152, 1,140 MWe	1988	490.8	31.8	2,441	678	0.28	1.38
	1989	1,851.7	85.7	2,007	657	0.33	0.35
	1990	1,662.6	77.2	2,935	1,687	0.57	1.01
	1991	1,965.4	88.0	1,933	700	0.36	0.36
	1992	1,849.0	85.4	1,714	465	0.27	0.25
	1993	405.7	21.8	1,631	373	0.23	0.92
	1994	1,418.7	66.3	1,702	295	0.17	0.21
	1995	1,864.2	86.1	1,650	368	0.22	0.20
	1996	2,003.9	87.9	1,444	269	0.19	0.13
	1997	1,946.1	89.0	1,962	420	0.21	0.22
	1998	2,135.3	95.3	1,530	265.980	0.17	0.12
	1999	2,165.1	97.0	1,346	164.569	0.12	0.08
	2000	1,910.0	86.8	2,039	357.220	0.18	0.19
	2001	2,158.3	95.7	1,292	145.066	0.11	0.07
	2002	2,106.0	94.1	1,257	108.252	0.09	0.05
	2003	1,776.4	80.0	2,484	430.889	0.17	0.24
	2004	2,135.2	93.9	1,161	85.941	0.07	0.04
	2005	2,162.9	94.9	1,125	95.133	0.08	0.04
	2006	2,054.9	91.0	1,752	242.016	0.14	0.12
	2007	2,129.1	94.0	1,197	123.540	0.10	0.06
	2008	2,153.6	94.3	960	83.730	0.09	0.04
	2009	2,026.8	90.1	1,415	166.776	0.12	0.08
	2010	2,054.9	92.2	828	56.956	0.07	0.03
	2011	2,133.3	95.3	1,354	109.417	0.08	0.05
	2012	1,888.2	84.6	2,555	290.840	0.11	0.15
	2013	2,108.1	94.2	666	44.478	0.07	0.02
	2014	2,156.7	95.5	842	77.569	0.09	0.04
	2015	1,884.9	87.0	1,484	136.826	0.09	0.07

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
SEQUOYAH 1, 2	2016	1,971.4	88.8	1,133	105.764	0.09	0.05
(continued)	2017	2,080.7	94.0	831	47.200	0.06	0.02
	2018	2,021.0	90.8	1,367	121.426	0.09	0.06
	2019	2,062.2	93.1	846	76.085	0.09	0.04
SOUTH TEXAS 1, 2	1989	769.3	65.6	989	161	0.16	0.21
Docket 50-498, 50-499;	1990	1,504.1	65.9	1,136	206	0.18	0.14
NPF-76, NPF-80	1991	1,741.5	72.4	1,144	257	0.22	0.15
1st commercial operation	1992	2,096.0	83.8	923	147	0.16	0.07
8/88, 6/89	1993	163.1	8.3	1,138	251	0.22	1.54
Type - PWRs	1994	1,700.2	70.6	661	47	0.07	0.03
Capacity - 1,251, 1,251 MWe	1995	2,294.2	89.9	1,485	291	0.20	0.13
	1996	2,465.9	95.0	1,145	137	0.12	0.06
	1997	2,265.5	93.6	1,583	273	0.17	0.12
	1998	2,379.4	96.9	1,171	183.977	0.16	0.08
	1999	2,219.7	91.6	1,328	259.770	0.20	0.12
	2000	2,180.0	89.7	1,372	231.634	0.17	0.11
	2001	2,262.7	92.2	1,325	237.645	0.18	0.11
	2002	2,173.0	87.5	1,510	329.091	0.22	0.15
	2003	1,796.3	72.1	909	143.495	0.16	0.08
	2004	2,437.1	96.0	842	119.834	0.14	0.05
	2005	2,258.5	90.0	1,268	247.655	0.20	0.11
	2006	2,439.6	95.0	1,078	150.323	0.14	0.06
	2007	2,527.3	96.0	881	91.613	0.10	0.04
	2008	2,452.1	92.3	1,181	187.295	0.16	0.08
	2009	2,444.5	91.9	1,138	79.687	0.07	0.03
	2010	2,418.7	91.5	867	79.159	0.09	0.03
	2011	2,333.3	87.7	1,153	139.274	0.12	0.06
	2012	2,122.4	79.8	611	49.104	0.08	0.02
	2013	2,062.4	78.4	832	59.736	0.07	0.03
	2014	2,363.4	90.0	422	34.576	0.08	0.01
	2015	2,224.5	85.5	900	83.993	0.09	0.04
	2016	2,481.9	94.9	426	32.837	0.08	0.01
	2017	2,467.1	94.6	620	55.025	0.09	0.02
	2018	2,367.7	91.0	703	70.050	0.10	0.03
	2019	2,515.3	95.9	676	56.887	0.08	0.02
ST. LUCIE 1, 2	1977	649.1	84.7	445	152	0.34	0.23
Docket 50-335, 50-389;	1978	606.4	76.5	797	337	0.42	0.56
DPR-67; NPF-16	1979	592.0	74.0	907	438	0.48	0.74
1st commercial operation	1980	627.9	77.5	1,074	532	0.50	0.85
12/76, 8/83	1981	599.1	72.7	1,473	929	0.63	1.55
Type - PWRs	1982	816.8	94.0	1,045	272	0.26	0.33
Capacity - 981, 987 MWe	1983	290.3	15.4	2,211	1,204	0.54	4.15
	1984	1,183.0	69.6	2,090	1,263	0.60	1.07
	1985	1,445.8	82.5	1,971	1,344	0.68	0.93
	1986	1,588.6	89.1	1,279	491	0.38	0.31
	1987	1,407.9	81.9	2,012	951	0.47	0.68
	1988	1,639.7	93.0	1,448	611	0.42	0.37
	1989	1,493.1	85.1	1,414	495	0.35	0.33
	1990	1,188.4	70.0	1,876	777	0.41	0.65
	1991	1,592.8	90.8	1,282	479	0.37	0.30
	1992	1,511.9	87.3	1,251	264	0.21	0.17
	1993	1,227.6	77.7	1,462	492	0.34	0.40
	1994	1,424.8	85.0	1,896	505	0.27	0.35
	1995	1,306.6	76.0	1,498	413	0.28	0.32
	1996	1,473.4	86.5	1,433	385	0.27	0.26
	1997	1,394.6	83.6	2,314	646	0.28	0.46
	1998	1,572.5	94.2	1,170	134.459	0.11	0.09
	1999	1,569.1	93.8	1,107	176.878	0.16	0.11
	2000	1,630.0	96.0	990	98.691	0.10	0.06
	2001	1,527.5	91.6	1,375	228.071	0.17	0.15
	2002	1,633.0	96.6	992	155.946	0.16	0.10
	2003	1,524.7	91.5	937	141.734	0.15	0.09
	2004	1,492.0	89.3	1,157	159.436	0.14	0.11
	2005	1,408.4	85.1	2,262	406.171	0.18	0.29

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
ST. LUCIE 1, 2	2006	1,542.4	93.0	1,226	119.963	0.10	0.08
(continued)	2007	1,302.1	78.0	2,447	409.958	0.17	0.31
	2008	1,566.5	92.7	1,127	112.234	0.10	0.07
	2009	1,490.6	88.8	1,139	132.861	0.12	0.09
	2010	1,440.2	88.4	1,357	197.359	0.15	0.14
	2011	1,200.9	77.3	2,050	295.228	0.14	0.25
	2012	1,139.5	70.6	1,750	185.426	0.11	0.16
	2013	1,783.4	90.3	964	74.926	0.08	0.04
	2014	1,805.7	90.9	1,068	121.092	0.11	0.07
	2015	1,720.9	87.2	1,477	188.087	0.13	0.11
	2016	1,779.5	89.8	920	76.628	0.08	0.04
	2017	1,875.3	94.2	933	71.123	0.08	0.04
	2018	1,777.1	89.9	1,107	112.919	0.10	0.06
	2019	1,709.5	85.5	729	53.336	0.07	0.03
SUMMER 1	1984	504.6	61.1	1,120	295	0.26	0.58
Docket 50-395;	1985	627.7	71.6	1,201	379	0.32	0.60
NPF-12	1986	853.7	95.3	392	23	0.06	0.03
1st commercial operation 1/84	1987	618.7	71.0	1,075	560	0.52	0.91
Type - PWR	1988	605.3	69.1	1,127	511	0.45	0.84
Capacity - 966 MWe	1989	652.4	83.1	374	52	0.14	0.08
	1990	730.0	83.9	1,090	376	0.34	0.52
	1991	642.5	82.9	984	291	0.30	0.45
	1992	892.6	97.4	249	27	0.11	0.03
	1993	728.3	84.0	1,121	297	0.26	0.41
	1994	536.7	69.5	1,549	374	0.24	0.70
	1995	899.8	97.2	257	13	0.05	0.01
	1996	850.4	90.3	701	97	0.14	0.11
	1997	829.7	89.8	820	163	0.20	0.20
	1998	934.8	98.8	285	13.513	0.05	0.01
	1999	842.0	89.4	827	120.172	0.15	0.14
	2000	723.9	76.6	933	166.561	0.18	0.23
	2001	769.3	83.3	486	69.398	0.14	0.09
	2002	840.0	87.9	685	59.644	0.09	0.07
	2003	837.0	87.4	745	70.828	0.10	0.08
	2004	938.4	96.8	200	10.085	0.05	0.01
	2005	850.3	88.9	734	72.454	0.10	0.09
	2006	858.6	90.0	676	61.333	0.09	0.07
	2007	967.9	100.0	75	2.691	0.04	0.00
	2008	817.2	84.8	623	49.091	0.08	0.06
	2009	784.5	82.6	767	56.050	0.07	0.07
	2010	968.8	99.4	104	2.129	0.02	0.00
	2011	847.7	87.6	598	31.580	0.05	0.04
	2012	829.0	85.3	766	82.261	0.11	0.10
	2013	955.5	97.2	172	5.113	0.03	0.01
	2014	789.4	82.6	934	110.929	0.12	0.14
	2015	812.3	83.8	811	64.958	0.08	0.08
	2016	988.4	100.0	137	2.862	0.02	0.00
	2017	789.2	81.3	856	50.308	0.06	0.06
	2018	840.9	86.4	718	49.251	0.07	0.06
	2019	941.6	96.2	135	4.557	0.03	0.00
SURRY 1, 2	1973	420.6	---	936	152	0.16	0.36
Docket 50-280, 50-281;	1974	717.4	49.8	1,715	884	0.52	1.23
DPR-32, DPR-37	1975	1,079.0	70.8	1,948	1,649	0.85	1.53
1st commercial operation	1976	930.7	60.4	2,753	3,165	1.15	3.40
12/72, 5/73	1977	1,139.0	72.2	1,860	2,307	1.24	2.03
Type - PWRs	1978	1,210.6	77.2	2,203	1,837	0.83	1.52
Capacity - 838, 838 MWe	1979	343.0	42.3	5,065	3,584	0.71	10.45
	1980	568.2	40.3	5,317	3,836	0.72	6.75
	1981	907.6	59.3	3,753	4,244	1.13	4.68
	1982	1,323.3	88.5	1,878	1,490	0.79	1.13
	1983	916.2	61.3	2,754	3,220	1.17	3.51
	1984	1,026.7	71.0	3,198	2,247	0.70	2.19
	1985	1,166.4	78.2	3,206	1,815	0.57	1.56

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
SURRY 1, 2 (continued)	1986	1,080.5	69.0	3,763	2,356	0.63	2.18
	1987	1,132.7	72.7	2,675	712	0.27	0.63
	1988	750.4	50.0	3,184	1,542	0.48	2.05
	1989	489.3	33.0	3,100	836	0.27	1.71
	1990	1,276.4	83.9	1,947	575	0.30	0.45
	1991	1,271.9	84.5	1,547	510	0.33	0.40
	1992	1,396.3	88.9	1,660	539	0.32	0.39
	1993	1,283.1	84.6	1,402	383	0.27	0.30
	1994	1,320.9	85.2	1,530	378	0.25	0.29
	1995	1,333.0	84.2	1,883	406	0.22	0.30
	1996	1,562.9	93.1	983	209	0.21	0.13
	1997	1,380.3	87.1	1,335	320	0.24	0.23
	1998	1,476.2	91.6	1,165	188.831	0.16	0.13
	1999	1,483.0	93.5	995	137.891	0.14	0.09
	2000	1,490.0	92.7	1,197	193.169	0.16	0.13
	2001	1,441.5	89.5	1,243	328.650	0.26	0.23
	2002	1,557.0	96.0	799	87.778	0.11	0.06
	2003	1,255.9	79.7	1,628	325.729	0.20	0.26
	2004	1,537.9	94.6	1,028	119.654	0.12	0.08
	2005	1,506.7	94.2	877	87.717	0.10	0.06
	2006	1,427.0	90.0	1,227	234.978	0.19	0.16
	2007	1,516.2	94.0	1,111	207.130	0.19	0.14
	2008	1,536.6	95.7	1,069	150.269	0.14	0.10
	2009	1,485.1	93.1	1,241	193.703	0.16	0.13
	2010	1,503.7	93.7	958	111.129	0.12	0.07
	2011	1,487.4	88.1	1,121	113.718	0.10	0.08
	2012	1,549.9	91.6	1,205	168.755	0.14	0.11
	2013	1,644.4	95.7	770	67.528	0.09	0.04
	2014	1,636.1	95.2	743	57.491	0.08	0.04
	2015	1,345.9	80.1	1,275	182.980	0.14	0.14
	2016	1,667.9	96.8	645	44.432	0.07	0.03
	2017	1,647.0	96.0	781	58.012	0.07	0.04
	2018	1,509.0	88.6	1,170	117.837	0.10	0.08
	2019	1,617.9	94.4	714	52.101	0.07	0.03
SUSQUEHANNA 1, 2 Docket 50-387, 50-388; NPF-14; NPF-22 1st commercial operation 6/83, 2/85 Type - BWRs Capacity - 1,257, 1,257 MWe	1984	719.9	72.6	2,827	308	0.11	0.43
	1985	1,452.2	76.4	3,669	1,106	0.30	0.76
	1986	1,344.8	67.0	2,996	828	0.28	0.62
	1987	1,749.5	85.3	2,548	621	0.24	0.35
	1988	1,691.0	83.5	1,904	516	0.27	0.31
	1989	1,572.5	77.1	2,063	704	0.34	0.45
	1990	1,746.9	85.4	1,691	440	0.26	0.25
	1991	1,878.0	89.8	1,844	507	0.27	0.27
	1992	1,604.2	79.7	1,885	724	0.38	0.45
	1993	1,602.1	77.3	1,488	335	0.23	0.21
	1994	1,814.4	85.4	1,580	442	0.28	0.24
	1995	1,850.8	85.3	1,773	476	0.27	0.26
	1996	1,998.7	90.7	1,430	289	0.20	0.14
	1997	1,918.9	89.6	1,646	433	0.26	0.23
	1998	1,879.6	88.3	1,575	360.778	0.23	0.19
	1999	1,896.0	89.6	1,787	431.397	0.24	0.23
	2000	1,994.6	92.6	1,812	331.163	0.18	0.17
	2001	2,027.6	94.2	1,807	288.413	0.16	0.14
	2002	1,973.0	91.6	1,890	259.968	0.14	0.13
	2003	2,050.8	93.4	1,934	250.096	0.13	0.12
	2004	2,058.8	92.7	2,144	272.202	0.13	0.13
	2005	2,086.6	93.5	1,898	181.360	0.10	0.09
	2006	2,040.4	91.0	1,873	184.901	0.10	0.09
	2007	2,089.2	93.0	2,303	263.021	0.11	0.13
	2008	2,174.1	94.2	1,895	192.892	0.10	0.09
	2009	2,231.1	94.7	1,956	266.597	0.14	0.12
	2010	2,121.6	90.4	1,950	176.161	0.09	0.08
	2011	1,992.0	82.2	1,847	168.968	0.09	0.08
	2012	1,936.5	81.4	2,140	175.881	0.08	0.09
	2013	2,166.2	88.6	1,861	233.532	0.13	0.11

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
SUSQUEHANNA 1, 2	2014	2,153.1	87.3	1,956	214.467	0.11	0.10
(continued)	2015	2,354.3	93.3	1,763	206.154	0.12	0.09
	2016	2,217.2	89.4	2,210	237.336	0.11	0.11
	2017	2,375.6	95.1	1,440	165.468	0.11	0.07
	2018	2,343.4	95.2	1,357	147.327	0.11	0.06
	2019	2,394.1	96.2	1,239	141.078	0.11	0.06
THREE MILE ISLAND 1[20], 2[21]	1975	675.9	82.2	131	73	0.56	0.11
Docket 50-289, 50-320;	1976	530.0	65.4	819	286	0.35	0.54
DPR-50, DPR-73	1977	664.5	80.9	1,122	360	0.32	0.54
1st commercial operation	1978	690.0	85.1	1,929	504	0.26	0.73
9/74, 12/78	1979	266.0	21.9	3,975	1,392	0.35	5.23
Type - PWRs	1980	0.0	0.0	2,328	394	0.17	---
Capacity - (802), (880) MWe	1981	0.0	0.0	2,103	376	0.18	---
	1982	0.0	0.0	2,123	1,004	0.47	---
	1983	0.0	0.0	1,592	1,159	0.73	---
	1984	0.0	0.0	1,079	688	0.64	---
	1985	103.6	10.6	1,890	857	0.45	8.27
THREE MILE ISLAND 1[20]	1986	585.2	70.9	1,360	213	0.16	0.36
Docket 50-289;	1987	610.7	73.6	1,259	149	0.12	0.24
DPR-50	1988	661.0	77.8	1,012	210	0.21	0.32
1st commercial operation 9/74	1989	871.3	100.0	670	54	0.08	0.06
Type - PWR	1990	645.5	84.6	1,319	264	0.20	0.41
Capacity - (802) MWe	1991	688.7	86.4	1,542	198	0.13	0.29
	1992	836.8	100.0	558	34	0.06	0.04
	1993	722.0	88.5	1,835	206	0.11	0.29
	1994	798.7	95.5	434	40	0.09	0.05
	1995	772.9	90.8	1,220	213	0.17	0.28
	1996	857.4	100.0	267	16	0.06	0.02
	1997	675.7	84.3	1,049	204	0.19	0.30
	1998	805.8	100.0	280	16.722	0.06	0.02
	1999	722.4	89.7	1,171	154.936	0.13	0.21
	2000	813.4	100.0	183	8.689	0.05	0.01
	2001	616.7	84.2	1,196	196.699	0.16	0.32
	2002	833.0	100.0	172	6.533	0.04	0.01
	2003	706.4	87.1	1,230	155.101	0.13	0.22
	2004	828.0	100.0	105	3.573	0.03	0.00
	2005	769.1	93.2	955	65.576	0.07	0.09
	2006	825.0	99.0	125	5.155	0.04	0.01
	2007	758.6	92.0	1,266	114.203	0.09	0.15
	2008	838.5	100.0	64	2.219	0.03	0.00
	2009	672.6	81.7	2,019	241.780	0.12	0.36
	2010	757.3	93.1	790	38.994	0.05	0.05
	2011	744.2	91.4	1,224	129.775	0.11	0.17
	2012	820.7	96.3	280	13.073	0.05	0.02
	2013	762.5	92.2	1,294	125.803	0.10	0.16
	2014	834.3	100.0	204	12.518	0.06	0.02
	2015	753.2	92.1	1,454	171.431	0.12	0.23
	2016	808.5	97.0	309	16.843	0.05	0.02
	2017	783.3	94.4	1,009	82.657	0.08	0.11
	2018	837.4	100.0	78	2.641	0.03	0.00
	2019	0.0	0.0	189	7.252	0.04	---
THREE MILE ISLAND 2[21]	1986	0.0	0.0	1,497	915	0.61	---
Docket 50-320;	1987	0.0	0.0	1,378	977	0.71	---
DPR-73	1988	0.0	0.0	1,247	917	0.74	---
1st commercial operation 12/78	1989	0.0	0.0	1,014	639	0.63	---
Type - PWR	1990	0.0	0.0	484	136	0.28	---
Capacity - (880) MWe	1991	0.0	0.0	153	37	0.24	---

[20] Three Mile Island 1 resumed commercial power generation in October 1985 after being under regulatory restraint since 1979. Three Mile Island 1 ceased operations in September of 2019 and is no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

[21] Three Mile Island 2 has been shut down since the 1979 accident, but was still included in the count of reactors through 1988 since dose was still being accumulated to defuel and decontaminate the unit during this time period. Parentheses indicate plant capacity when plant was operational. From 2001-2015, TMI voluntarily provided an estimate of the collective dose for Unit 2, but not the number of individuals with measurable dose.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
THREE MILE ISLAND 2[21] (continued)	1992	0.0	0.0	315	157	0.50	---
	1993	0.0	0.0	167	33	0.20	---
	1994	0.0	0.0	259	7	0.03	---
	1995	0.0	0.0	191	2	0.01	---
	1996	0.0	0.0	122	2	0.02	---
	1997	0.0	0.0	232	1	0.00	---
	1998	0.0	0.0	105	0.697	0.01	---
	1999	0.0	0.0	203	0.512	0.00	---
	2000	0.0	0.0	70	0.401	0.01	---
	2001	0.0	0.0	0	0.228	---	---
	2002	0.0	0.0	0	---	---	---
	2003	0.0	0.0	0	0.260	---	---
	2004	0.0	0.0	0	0.216	---	---
	2005	0.0	0.0	0	---	---	---
	2006	0.0	0.0	0	0.372	---	---
	2007	0.0	0.0	0	0.082	---	---
	2008	0.0	0.0	0	0.138	---	---
	2009	0.0	0.0	0	0.113	---	---
	2010	0.0	0.0	0	0.359	---	---
	2011	0.0	0.0	0	0.291	---	---
	2012	0.0	0.0	0	0.194	---	---
	2013	0.0	0.0	0	0.229	---	---
	2014	0.0	0.0	0	0.188	---	---
	2015	0.0	0.0	0	0.255	---	---
TROJAN[22] Docket 50-344; NPF-1 1st commercial operation 5/76 Type - PWR Capacity - (1,080) MWe	1977	792.0	92.6	591	174	0.29	0.22
	1978	205.5	20.6	711	319	0.45	1.55
	1979	631.0	58.1	736	258	0.35	0.41
	1980	727.5	72.5	1,159	421	0.36	0.58
	1981	775.6	74.1	1,311	609	0.46	0.79
	1982	579.5	60.8	977	419	0.43	0.72
	1983	494.2	62.4	969	307	0.32	0.62
	1984	567.0	54.4	1,042	433	0.42	0.76
	1985	829.1	76.7	852	363	0.43	0.44
	1986	852.4	79.7	1,321	381	0.29	0.45
	1987	525.5	54.0	1,209	363	0.30	0.69
	1988	758.6	67.5	1,408	401	0.28	0.53
	1989	666.8	61.9	1,360	421	0.31	0.63
	1990	732.4	66.3	1,169	258	0.22	0.35
	1991	181.6	16.1	1,496	567	0.38	3.12
	1992	553.9	68.4	567	84	0.15	0.15
	1993	0.0	68.4	54	21	0.39	---
	1994	0.0	0.0	51	9	0.18	---
	1995	0.0	0.0	141	44	0.31	---
	1996	0.0	0.0	112	41	0.37	---
	1997	0.0	0.0	227	41	0.18	---
	1998	0.0	0.0	283	46.417	0.16	---
	1999	0.0	0.0	274	51.504	0.19	---
	2000	0.0	0.0	127	17.631	0.14	---
	2001	0.0	0.0	14	1.091	0.08	---
	2002	0.0	0.0	13	0.536	0.04	---
	2003	0.0	0.0	105	23.996	0.23	---
	2004	0.0	0.0	5	0.079	0.02	---
TURKEY POINT 3, 4 Docket 50-250, 50-251; DPR-31, DPR-41 1st commercial operation 12/72, 9/73 Type - PWRs Capacity - 837, 821 MWe	1973	401.9	---	444	78	0.18	0.19
	1974	953.6	---	794	454	0.57	0.48
	1975	1,003.7	74.9	1,176	876	0.74	0.87
	1976	974.2	71.2	1,647	1,184	0.72	1.22
	1977	979.5	72.1	1,319	1,036	0.79	1.06
	1978	1,000.2	78.8	1,336	1,032	0.77	1.03
	1979	811.0	62.4	2,002	1,680	0.84	2.07

[21] Three Mile Island 2 has been shut down since the 1979 accident, but was still included in the count of reactors through 1988 since dose was still being accumulated to defuel and decontaminate the unit during this time period. Parentheses indicate plant capacity when plant was operational. From 2001-2015, TMI voluntarily provided an estimate of the collective dose for Unit 2, but not the number of individuals with measurable dose.

[22] Trojan ceased operations in 1992 and will not be put in commercial operation again. It is no longer in the count of operating reactors. Parentheses indicate plant capacity when plant was operational. As of 2005, Trojan no longer reports under its reactor license, but does report under its ISFSI license (see Appendix A).

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
TURKEY POINT 3, 4 (continued)	1980	990.6	73.6	1,803	1,651	0.92	1.67
	1981	654.0	46.8	2,932	2,251	0.77	3.44
	1982	915.7	65.2	2,956	2,119	0.72	2.31
	1983	878.4	62.8	2,930	2,681	0.92	3.05
	1984	946.7	68.5	2,010	1,255	0.62	1.33
	1985	1,034.9	74.7	1,905	1,253	0.66	1.21
	1986	754.1	54.9	1,808	946	0.52	1.25
	1987	431.3	36.6	1,980	1,371	0.69	3.18
	1988	809.8	59.5	1,841	738	0.40	0.91
	1989	689.9	56.8	1,625	433	0.27	0.63
	1990	933.1	69.0	2,099	730	0.35	0.78
	1991	258.2	21.0	2,087	939	0.45	3.64
	1992	968.9	75.5	1,374	325	0.24	0.34
	1993	1,244.8	91.0	1,271	275	0.22	0.22
	1994	1,172.9	87.2	1,489	476	0.32	0.41
	1995	1,320.3	94.6	1,142	215	0.19	0.16
	1996	1,307.8	94.0	1,157	187	0.16	0.14
	1997	1,220.9	88.6	1,581	414	0.26	0.34
	1998	1,323.0	94.5	1,045	156.415	0.15	0.12
	1999	1,352.5	96.5	919	127.567	0.14	0.09
	2000	1,283.7	92.2	1,292	219.852	0.17	0.17
	2001	1,324.1	95.0	827	101.575	0.12	0.08
	2002	1,374.0	97.9	793	73.764	0.09	0.05
	2003	1,253.2	91.6	1,442	247.053	0.17	0.20
	2004	1,231.0	89.9	1,089	117.404	0.11	0.10
	2005	1,143.0	84.9	1,136	109.996	0.10	0.10
	2006	1,251.8	90.0	1,321	149.208	0.11	0.12
	2007	1,281.5	91.0	1,085	107.601	0.10	0.08
	2008	1,294.9	92.0	1,067	97.357	0.09	0.08
	2009	1,219.7	87.6	1,359	166.217	0.12	0.14
	2010	1,290.9	91.9	1,025	86.749	0.08	0.07
	2011	1,245.7	89.6	921	62.326	0.07	0.05
	2012	878.0	67.9	2,024	241.151	0.12	0.27
	2013	1,245.9	82.7	882	82.215	0.09	0.07
	2014	1,375.7	89.4	1,271	114.326	0.09	0.08
	2015	1,489.7	92.7	933	79.124	0.08	0.05
	2016	1,567.7	95.6	892	76.269	0.09	0.05
	2017	1,451.9	88.8	1,104	108.200	0.10	0.07
	2018	1,570.2	94.9	651	51.088	0.08	0.03
	2019	1,614.4	95.8	905	84.610	0.09	0.05
VERMONT YANKEE[23] Docket 50-271; DPR-28 1st commercial operation 11/72 Type - BWR Capacity - (605) MWe	1973	222.1	---	244	85	0.35	0.38
	1974	303.5	---	357	216	0.61	0.71
	1975	429.0	87.8	282	153	0.54	0.36
	1976	389.6	77.1	815	411	0.50	1.05
	1977	423.5	85.1	641	258	0.40	0.61
	1978	387.5	75.9	934	339	0.36	0.87
	1979	414.0	82.1	1,220	1,170	0.96	2.83
	1980	357.8	71.5	1,443	1,338	0.93	3.74
	1981	429.1	84.6	1,264	731	0.58	1.70
	1982	501.0	96.0	481	205	0.43	0.41
	1983	346.1	69.3	1,316	1,527	1.16	4.41
	1984	398.1	79.0	954	626	0.66	1.57
	1985	361.4	71.8	1,392	1,051	0.76	2.91
	1986	248.1	48.9	1,389	1,188	0.86	4.79
	1987	423.6	84.2	827	303	0.37	0.72
	1988	492.1	95.7	379	124	0.33	0.25
	1989	432.8	84.7	832	288	0.35	0.67
	1990	433.1	85.9	849	307	0.36	0.71
	1991	492.3	94.3	310	118	0.38	0.24
	1992	446.8	88.1	921	381	0.41	0.85
	1993	402.3	80.1	833	217	0.26	0.54

[23] Vermont Yankee ceased operations in December 2014 and is no longer in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
VERMONT YANKEE[22]	1994	515.8	98.7	220	38	0.17	0.07
(continued)	1995	462.1	87.0	737	182	0.25	0.39
	1996	452.7	85.2	951	231	0.24	0.51
	1997	487.1	96.0	260	57	0.22	0.12
	1998	383.4	77.9	944	199.399	0.21	0.52
	1999	463.4	91.0	854	175.795	0.21	0.38
	2000	517.8	99.6	198	37.846	0.19	0.07
	2001	474.9	93.5	863	143.010	0.17	0.30
	2002	451.0	91.7	946	150.446	0.16	0.33
	2003	505.9	98.8	359	54.348	0.15	0.11
	2004	439.2	87.2	1,379	211.529	0.15	0.48
	2005	467.5	94.2	1,105	198.003	0.18	0.42
	2006	582.9	100.0	380	49.537	0.13	0.08
	2007	537.0	93.0	1,191	171.200	0.14	0.32
	2008	557.3	94.1	1,402	213.680	0.15	0.38
	2009	611.9	100.0	392	61.105	0.16	0.10
	2010	548.6	91.2	1,071	206.321	0.19	0.38
	2011	562.1	93.3	1,029	176.129	0.17	0.31
	2013	555.5	92.9	1,034	170.340	0.16	0.31
	2014	580.4	99.3	196	21.350	0.11	0.04
	2015	0.0	0.0	413	49.557	0.12	---
	2016	0.0	0.0	128	12.513	0.10	---
	2017	0.0	0.0	128	13.698	0.11	---
	2018	0.0	0.0	185	17.807	0.10	---
	2019	0.0	0.0	179	45.432	0.25	---
VOGTLE 1, 2	1988	820.4	77.7	1,108	138	0.12	0.17
Docket 50-424; 50-425;	1989	1,045.8	96.0	427	32	0.07	0.03
NPF-68, NPF-81	1990	1,710.9	82.7	1,602	466	0.29	0.27
1st commercial operation	1991	1,966.5	89.2	1,357	362	0.27	0.18
6/87, 5/89	1992	2,047.9	90.0	1,262	426	0.34	0.21
Type - PWRs	1993	2,060.4	88.3	1,338	367	0.27	0.18
Capacity - 1,150, 1,152 MWe	1994	2,170.1	91.3	1,048	217	0.21	0.10
	1995	2,285.4	95.2	953	199	0.21	0.09
	1996	2,056.8	86.5	1,395	452	0.32	0.22
	1997	2,121.1	91.4	994	158	0.16	0.07
	1998	2,123.9	92.3	994	162.210	0.16	0.08
	1999	2,106.0	91.5	1,359	228.942	0.17	0.11
	2000	2,223.9	95.6	899	121.312	0.14	0.05
	2001	2,231.5	96.2	870	129.270	0.15	0.06
	2002	1,942.0	85.3	1,152	243.957	0.21	0.13
	2003	2,179.9	94.8	806	84.344	0.10	0.04
	2004	2,200.7	95.7	765	80.763	0.11	0.04
	2005	2,027.9	88.6	1,099	151.096	0.14	0.07
	2006	2,048.8	89.0	892	115.509	0.13	0.06
	2007	2,089.9	92.0	951	120.515	0.13	0.06
	2008	2,023.9	89.3	1,185	137.620	0.12	0.07
	2009	2,201.6	95.7	931	79.681	0.09	0.04
	2010	2,238.6	95.8	924	89.182	0.10	0.04
	2011	2,138.0	92.6	1,179	118.931	0.10	0.06
	2012	2,226.6	95.7	776	59.317	0.08	0.03
	2013	2,178.4	95.3	857	78.298	0.09	0.04
	2014	2,065.8	91.6	1,404	156.744	0.11	0.08
	2015	2,210.0	95.3	843	60.565	0.07	0.03
	2016	2,267.1	97.0	778	58.472	0.08	0.03
	2017	2,189.0	94.3	938	80.556	0.09	0.04
	2018	2,278.4	97.1	641	46.855	0.07	0.02
	2019	2,255.0	96.6	625	50.668	0.08	0.02
WATERFORD 3	1986	875.7	79.1	1,244	223	0.18	0.25
Docket 50-382;	1987	891.8	82.5	959	156	0.16	0.17
NPF-38	1988	784.3	75.4	1,246	259	0.21	0.33
1st commercial operation 9/85	1989	909.8	82.6	1,306	265	0.20	0.29
Type - PWR	1990	1,027.9	92.8	432	47	0.11	0.05
Capacity - 1,152 MWe	1991	870.6	79.8	1,301	364	0.28	0.42
	1992	909.6	83.2	1,213	226	0.19	0.25

[22] Vermont Yankee ceased operations in December 2014 and is no longer in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
WATERFORD 3	1993	1,088.3	99.4	195	15	0.08	0.01
(continued)	1994	949.1	87.0	1,167	191	0.16	0.20
	1995	927.4	83.4	1,092	153	0.14	0.16
	1996	1,064.8	94.2	342	27	0.08	0.03
	1997	767.2	71.2	1,186	148	0.13	0.19
	1998	984.1	91.9	282	24.032	0.09	0.02
	1999	849.5	79.6	833	123.198	0.15	0.15
	2000	965.1	88.8	825	131.701	0.16	0.14
	2001	1,086.0	99.6	91	4.677	0.05	0.00
	2002	1,007.0	93.2	811	109.439	0.13	0.11
	2003	968.0	90.9	710	95.332	0.13	0.10
	2004	1,099.1	100.0	60	2.517	0.04	0.00
	2005	900.9	80.2	902	136.318	0.15	0.15
	2006	1,059.3	92.0	1,190	109.682	0.09	0.10
	2007	1,130.2	96.0	469	20.125	0.04	0.02
	2008	1,030.7	88.0	1,268	134.221	0.11	0.13
	2009	1,023.4	88.0	1,479	255.088	0.17	0.25
	2010	1,173.1	100.0	216	4.913	0.02	0.00
	2011	1,020.8	90.4	1,144	100.053	0.09	0.10
	2012	897.1	78.0	1,919	260.202	0.14	0.29
	2013	1,071.6	93.7	130	3.129	0.02	0.00
	2014	1,046.4	91.5	965	69.462	0.07	0.07
	2015	959.5	85.1	979	65.826	0.07	0.07
	2016	1,152.5	98.4	248	3.392	0.01	0.00
	2017	959.1	83.8	894	60.728	0.07	0.06
	2018	1,175.6	100.0	98	1.130	0.01	0.00
	2019	869.0	75.8	931	69.780	0.07	0.08
WATTS BAR 1, 2	1997	867.6	83.8	1,103	113	0.10	0.13
Docket 50-390, 50-391;	1998	1,105.1	99.1	96	3.106	0.03	0.00
NPF-90, NPF-96	1999	943.1	87.2	975	98.946	0.10	0.10
1st commercial operation	2000	1,033.3	92.8	1,053	122.453	0.12	0.12
5/96, 10/16	2001	1,095.9	96.5	197	5.912	0.03	0.01
Type - PWR	2002	1,034.0	92.1	909	93.598	0.10	0.09
Capacity - 1,157, 1,164 MWe	2003	973.3	86.7	1,392	165.741	0.12	0.17
	2004	1,122.1	99.1	220	5.893	0.03	0.01
	2005	1,003.7	90.0	1,244	143.506	0.12	0.14
	2006	764.5	70.0	2,070	322.682	0.16	0.42
	2007	1,150.6	100.0	128	4.414	0.03	0.00
	2008	923.5	83.2	887	70.648	0.08	0.08
	2009	1,051.1	92.1	853	63.846	0.07	0.06
	2010	1,111.7	98.3	129	6.193	0.05	0.01
	2011	939.6	85.4	900	51.021	0.06	0.05
	2012	969.5	86.5	1,002	62.779	0.06	0.06
	2013	1,137.9	99.5	85	2.616	0.03	0.00
	2014	1,003.4	89.0	600	28.268	0.05	0.03
	2015	964.5	87.5	976	64.320	0.07	0.07
	2016	1,284.1	97.8	189	4.489	0.02	0.00
	2017	1,558.2	69.6	1,074	75.672	0.07	0.05
	2018	2,110.1	92.3	779	36.920	0.05	0.02
	2019	2,018.4	88.8	832	45.017	0.05	0.02
WOLF CREEK 1	1986	832.8	73.3	682	143	0.21	0.17
Docket 50-482;	1987	778.8	71.1	675	138	0.20	0.18
NPF-42	1988	794.7	70.7	1,010	297	0.29	0.37
1st commercial operation 9/85	1989	1,108.4	99.5	186	18	0.10	0.02
Type - PWR	1990	940.2	81.0	798	195	0.24	0.21
Capacity - 1,164 MWe	1991	707.6	71.9	1,010	331	0.33	0.47
	1992	1,010.8	86.7	446	78	0.17	0.08
	1993	940.5	80.6	975	183	0.19	0.19
	1994	1,017.2	86.8	1,082	235	0.22	0.23
	1995	1,198.0	98.7	242	14	0.06	0.01
	1996	980.6	81.2	986	171	0.17	0.17
	1997	964.3	83.8	989	265	0.27	0.27
	1998	1,187.3	100.0	184	10.382	0.06	0.01

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
WOLF CREEK 1	1999	1,045.3	90.1	812	147.704	0.18	0.14
(continued)	2000	1,032.7	89.5	861	143.417	0.17	0.14
	2001	1,177.9	100.0	105	5.176	0.05	0.00
	2002	1,029.0	88.7	816	99.987	0.12	0.10
	2003	1,013.5	87.2	820	88.941	0.11	0.09
	2004	1,153.5	98.8	93	3.388	0.04	0.00
	2005	1,004.2	86.7	856	106.870	0.12	0.11
	2006	1,067.4	91.0	789	96.788	0.12	0.09
	2007	1,183.7	100.0	91	4.307	0.05	0.00
	2008	968.3	83.1	911	94.997	0.10	0.10
	2009	1,001.0	86.9	1,504	73.637	0.05	0.07
	2010	1,090.8	94.2	463	10.516	0.02	0.01
	2011	839.1	73.0	1,266	133.960	0.11	0.16
	2012	944.4	80.0	306	7.888	0.03	0.01
	2013	819.2	72.5	1,452	111.257	0.08	0.14
	2014	978.2	81.9	709	27.500	0.04	0.03
	2015	987.9	82.5	1,190	74.804	0.06	0.08
	2016	942.0	78.5	1,267	90.631	0.07	0.10
	2017	1,215.5	100.0	238	3.437	0.01	0.00
	2018	1,047.5	86.9	1,153	72.882	0.06	0.07
	2019	1,056.6	87.4	784	45.183	0.06	0.04
YANKEE ROWE[24]	1969	138.3	---	193	215	1.11	1.55
Docket 50-29;	1970	146.1	---	355	255	0.72	1.75
DPR-3	1971	173.5	---	155	90	0.58	0.52
1st commercial operation 7/61	1972	78.7	---	282	255	0.90	3.24
Type - PWR	1973	127.1	---	133	99	0.74	0.78
Capacity - (175) MWe	1974	111.3	---	243	205	0.84	1.84
	1975	145.1	82.4	249	116	0.47	0.80
	1976	152.2	89.8	152	59	0.39	0.39
	1977	124.6	73.9	725	356	0.49	2.86
	1978	145.0	81.0	565	282	0.50	1.94
	1979	149.0	81.6	441	127	0.29	0.85
	1980	35.6	22.0	502	213	0.42	5.98
	1981	109.0	74.4	515	302	0.59	2.77
	1982	108.6	73.4	814	474	0.58	4.36
	1983	163.5	91.4	395	68	0.17	0.42
	1984	124.8	71.4	654	348	0.53	2.79
	1985	144.3	85.3	653	211	0.32	1.46
	1986	169.7	95.0	384	45	0.12	0.27
	1987	138.7	82.7	593	217	0.37	1.56
	1988	136.4	85.2	738	227	0.31	1.66
	1989	159.4	92.9	496	62	0.13	0.39
	1990	101.1	61.5	702	246	0.35	2.43
	1991	121.2	72.3	162	40	0.25	0.33
	1992	0.0	0.0	324	94	0.29	---
	1993	0.0	0.0	313	163	0.52	---
	1994	0.0	0.0	222	156	0.70	---
	1995	0.0	0.0	191	78	0.41	---
	1996	0.0	0.0	239	95	0.40	---
	1997	0.0	0.0	323	65	0.20	---
	1998	0.0	0.0	125	4.603	0.04	---
	1999	0.0	0.0	83	2.291	0.02	---
	2000	0.0	0.0	38	2.406	0.06	---
	2001	0.0	0.0	48	3.969	0.08	---
	2002	0.0	0.0	128	20.024	0.16	---
	2003	0.0	0.0	136	30.934	0.23	---
	2004	0.0	0.0	70	6.502	0.09	---
	2005	0.0	0.0	63	1.456	0.02	---

[24] Yankee Rowe ceased operations as of October 1991 and will not be put in commercial operation again. It is no longer in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

Reporting Organization	Year	Megawatt Years (MW-yr)	Unit Availability Factor	Total Personnel with Measurable Doses	Collective Dose per Site (person-rem)	Average Measurable Dose (rem)	Collective Dose/ MW-yr
YANKEE ROWE[24] (continued)	2006	0.0	0.0	45	0.975	0.02	---
	2007	0.0	0.0	0	0.000	---	---
	2008	0.0	0.0	1	0.019	0.02	---
	2009	0.0	0.0	5	0.114	0.02	---
	2010	0.0	0.0	3	0.083	0.03	---
	2011	0.0	0.0	8	0.113	0.01	---
	2012	0.0	0.0	1	0.013	0.01	---
	2013	0.0	0.0	2	0.043	0.02	---
	2014	0.0	0.0	10	0.145	0.01	---
	2015	0.0	0.0	25	0.463	0.02	---
	2016	0.0	0.0	5	0.073	0.01	---
	2017	0.0	0.0	7	0.112	0.02	---
	2018	0.0	0.0	4	0.045	0.01	---
	2019	0.0	0.0	7	0.113	0.02	---
ZION 1, 2[25] Docket 50-295; 50-304; DPR-39, DPR-48 1st commercial operation 12/73, 9/74 Type - PWRs Capacity - (1,040), (1,040) MWe	1974	425.3	71.1	306	56	0.18	0.13
	1975	1,181.5	74.9	436	127	0.29	0.11
	1976	1,134.9	61.9	774	571	0.74	0.50
	1977	1,358.6	75.0	784	1,003	1.28	0.74
	1978	1,613.5	80.2	1,104	1,017	0.92	0.63
	1979	1,238.0	67.6	1,472	1,274	0.87	1.03
	1980	1,411.2	74.1	1,363	920	0.67	0.65
	1981	1,366.9	72.3	1,754	1,720	0.98	1.26
	1982	1,186.4	64.3	1,575	2,103	1.34	1.77
	1983	1,222.3	69.4	1,285	1,311	1.02	1.07
	1984	1,389.9	69.6	1,110	786	0.71	0.57
	1985	1,187.9	62.9	1,498	1,166	0.78	0.98
	1986	1,462.0	73.2	967	474	0.49	0.32
	1987	1,337.0	71.0	1,046	653	0.62	0.49
	1988	1,549.1	78.3	1,926	1,260	0.65	0.81
	1989	1,514.1	77.6	1,282	624	0.49	0.41
	1990	860.4	46.9	1,385	696	0.50	0.81
	1991	1,125.7	58.2	902	173	0.19	0.15
	1992	1,128.8	59.0	1,732	1,043	0.60	0.92
	1993	1,458.2	70.9	1,772	643	0.36	0.44
	1994	1,224.9	59.9	1,176	306	0.26	0.25
	1995	1,471.6	72.4	1,807	797	0.44	0.54
	1996	1,538.4	75.8	1,567	437	0.28	0.28
	1997	123.2	7.1	924	119	0.13	0.97
	1998	0.0	0.0	246	12.417	0.05	---
	1999	0.0	0.0	67	4.194	0.06	---
	2000	0.0	0.0	26	3.015	0.12	---
	2001	0.0	0.0	6	0.274	0.05	---
	2002	0.0	0.0	12	0.276	0.02	---
	2003	0.0	0.0	2	0.049	0.02	---
	2004	0.0	0.0	6	0.167	0.03	---
	2005	0.0	0.0	5	0.109	0.02	---
	2006	0.0	0.0	7	0.109	0.02	---
	2007	0.0	0.0	8	0.224	0.03	---
	2008	0.0	0.0	7	0.147	0.02	---
	2009	0.0	0.0	0	0.000	---	---
	2010	0.0	0.0	17	0.562	0.03	---
	2011	0.0	0.0	128	28.794	0.22	---
	2012	0.0	0.0	183	75.801	0.41	---
	2013	0.0	0.0	218	44.689	0.20	---
	2014	0.0	0.0	358	78.730	0.22	---
	2015	0.0	0.0	340	142.605	0.42	---
	2016	0.0	0.0	194	45.788	0.24	---
	2017	0.0	0.0	75	4.542	0.06	---
	2018	0.0	0.0	7	0.085	0.01	---
	2019	0.0	0.0	4	0.123	0.03	---

[24] Yankee Rowe ceased operations as of October 1991 and will not be put in commercial operation again. It is no longer in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

[25] Zion 1, 2 ceased operations in 1997 and 1996, respectively, and are no longer included in the count of operating reactors. Parentheses indicate plant capacity when plant was operational.

APPENDIX D

DOSE PERFORMANCE TRENDS BY REACTOR SITE

1973–2019

Appendix D only contains data on plants still operating in 2019.

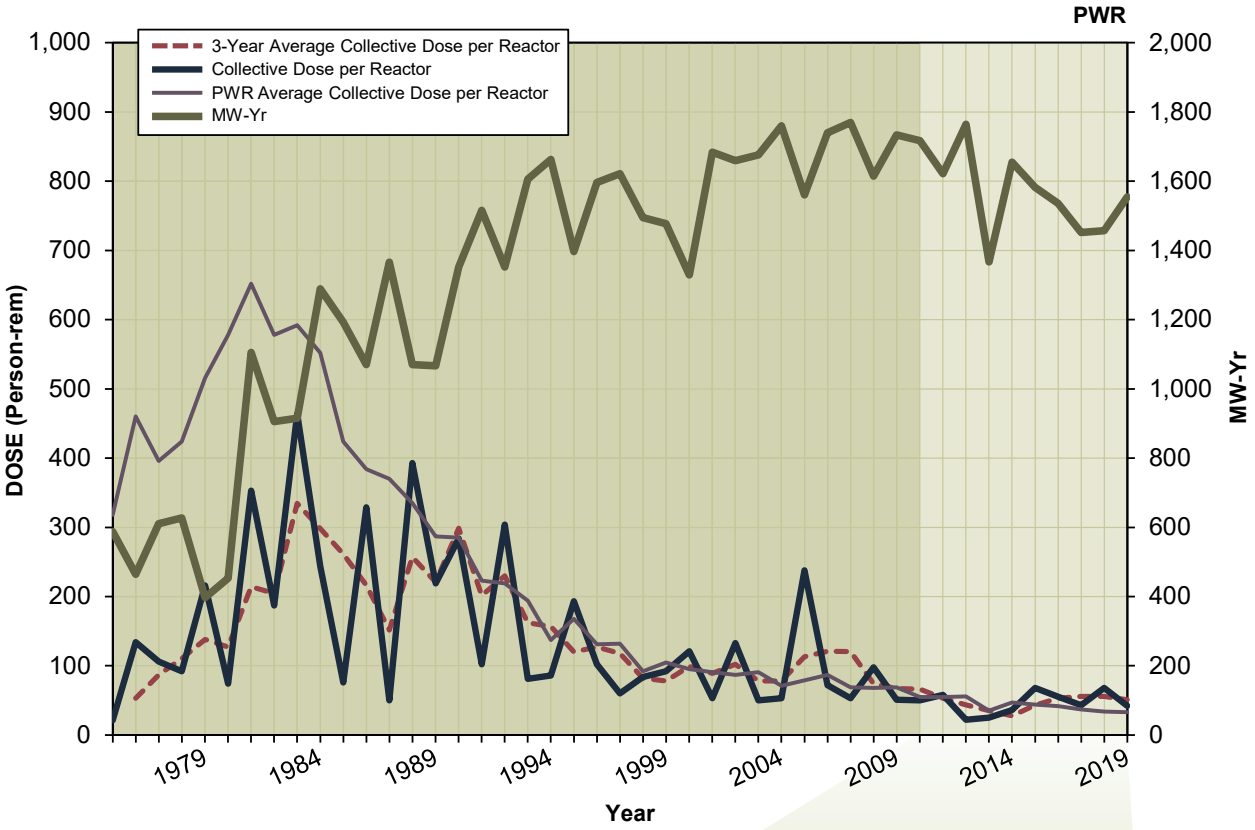
DOSE PERFORMANCE TRENDS BY REACTOR SITE 1973–2019

GRAPHICAL REPRESENTATION OF DOSE TRENDS IN APPENDIX D

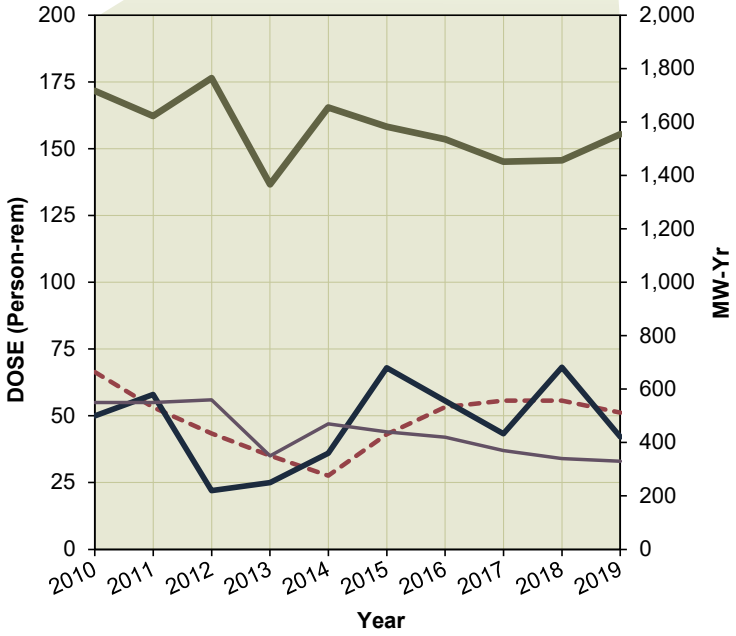
Each page of Appendix D presents a graph of selected dose performance trends from 1973 through 2019. The graphs illustrate the history of the collective dose per reactor for the site, the rolling 3-year average collective dose per reactor, and the electricity generated at the site. These data are plotted, beginning with each plant's first full year of commercial operation and continuing through 2019. Data for years when a plant was not in commercial operation have been included when available; however, any data reported before 1973 are not included. The 3-year average collective dose per reactor data are included because the data provide an overall indication of each plant's general trend in collective dose.

The 3-year average collective dose per reactor is also one of the metrics used by the NRC in the Reactor Oversight Program to evaluate a licensee's as low as is reasonably achievable program. This average is determined by summing the collective dose per reactor for the current year and the previous 2 years and then dividing this sum by 3, which is the number of years considered. Depicting dose trends by using a 3-year average reduces the sporadic effects on annual doses of refueling operations (usually an 18- to 24-month cycle) and occasional high-dose maintenance activities and provides a more representative depiction of collective dose trends over the life of a plant. The annual average collective dose per reactor for all reactors of the same type is also shown on the graph.

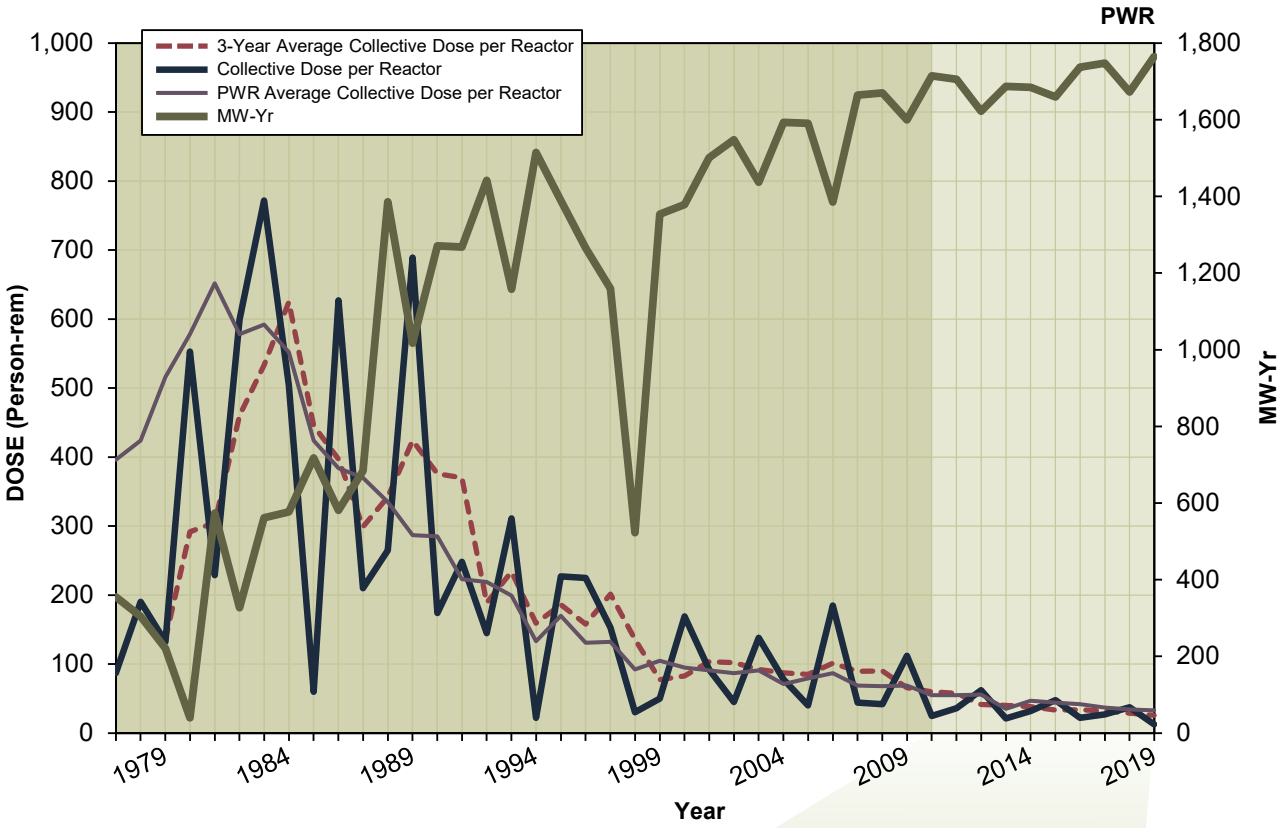
ARKANSAS 1, 2
Dose Performance Trends



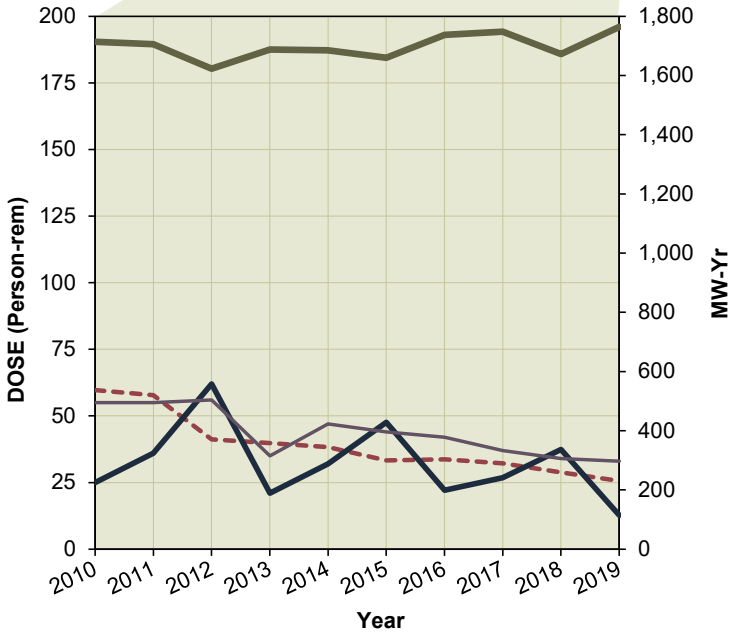
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	66.351	50.000	1,716.6
2011	53.165	58.000	1,621.9
2012	43.361	22.000	1,764.5
2013	35.139	25.000	1,366.6
2014	27.585	36.000	1,654.6
2015	43.055	68.000	1,582.0
2016	53.232	55.553	1,535.7
2017	55.723	43.250	1,451.4
2018	55.664	68.187	1,456.8
2019	51.161	42.043	1,553.8



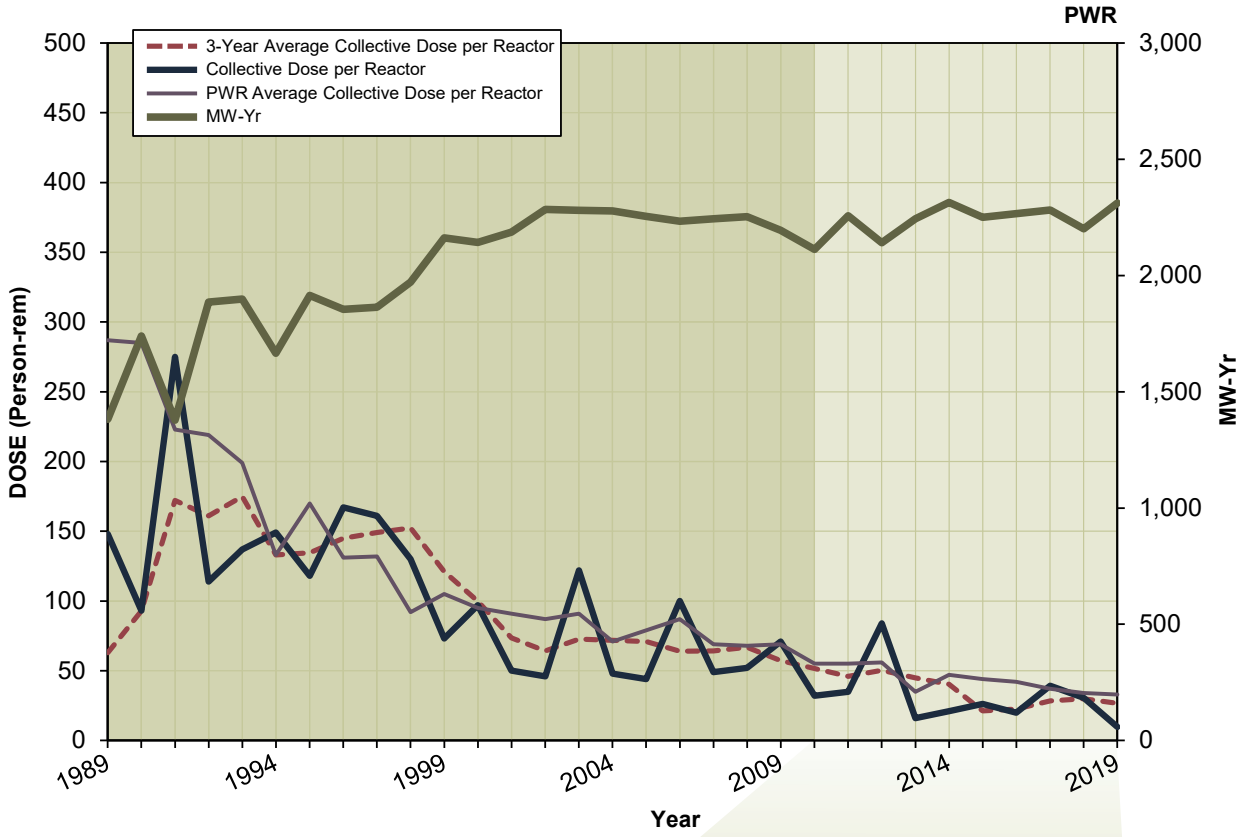
BEAVER VALLEY 1, 2
Dose Performance Trends



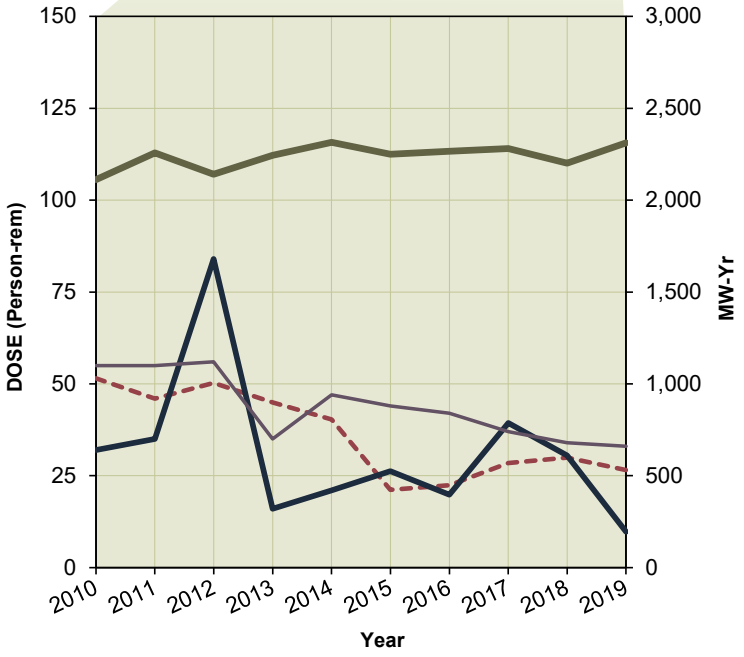
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	59.650	25.000	1,714.2
2011	57.784	36.000	1,705.5
2012	41.226	62.000	1,622.6
2013	39.847	21.000	1,687.4
2014	38.305	32.000	1,684.6
2015	33.312	47.604	1,659.6
2016	33.718	22.073	1,737.4
2017	32.177	26.853	1,747.9
2018	28.776	37.401	1,672.8
2019	25.654	12.708	1,764.4



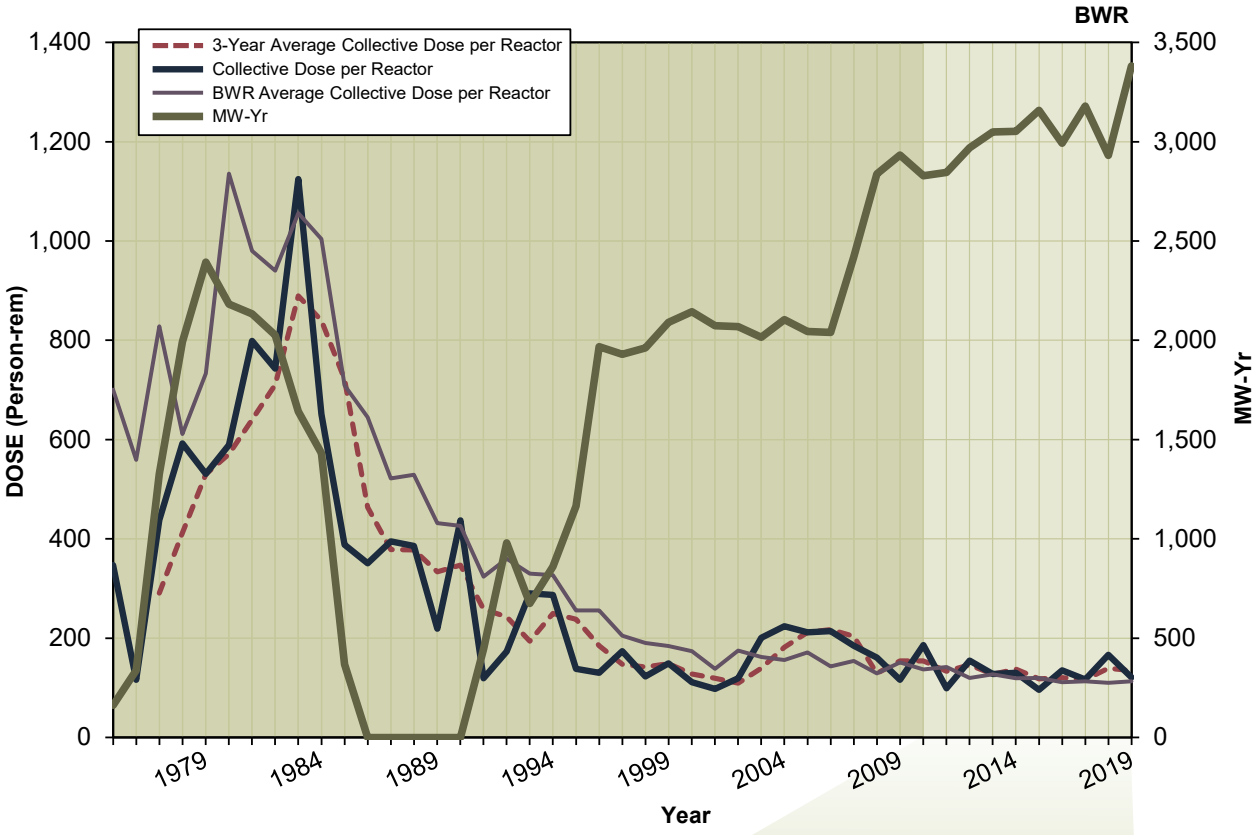
BRAIDWOOD 1, 2
Dose Performance Trends



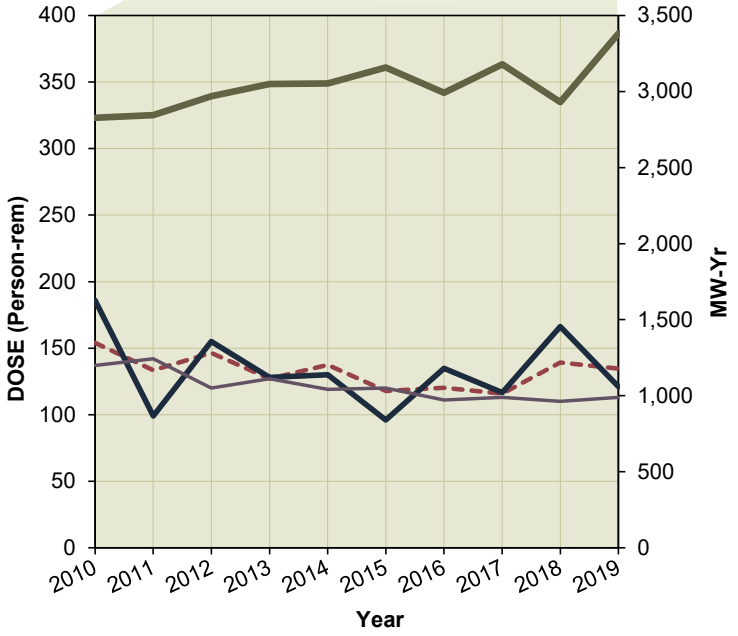
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	51.520	32.000	2,111.9
2011	46.014	35.000	2,257.5
2012	50.279	84.000	2,141.0
2013	44.944	16.000	2,244.2
2014	40.333	21.000	2,313.9
2015	21.135	26.234	2,250.0
2016	22.443	19.848	2,265.9
2017	28.472	39.334	2,281.4
2018	29.911	30.550	2,201.3
2019	26.554	9.777	2,311.8



BROWNS FERRY 1, 2, 3*
Dose Performance Trends



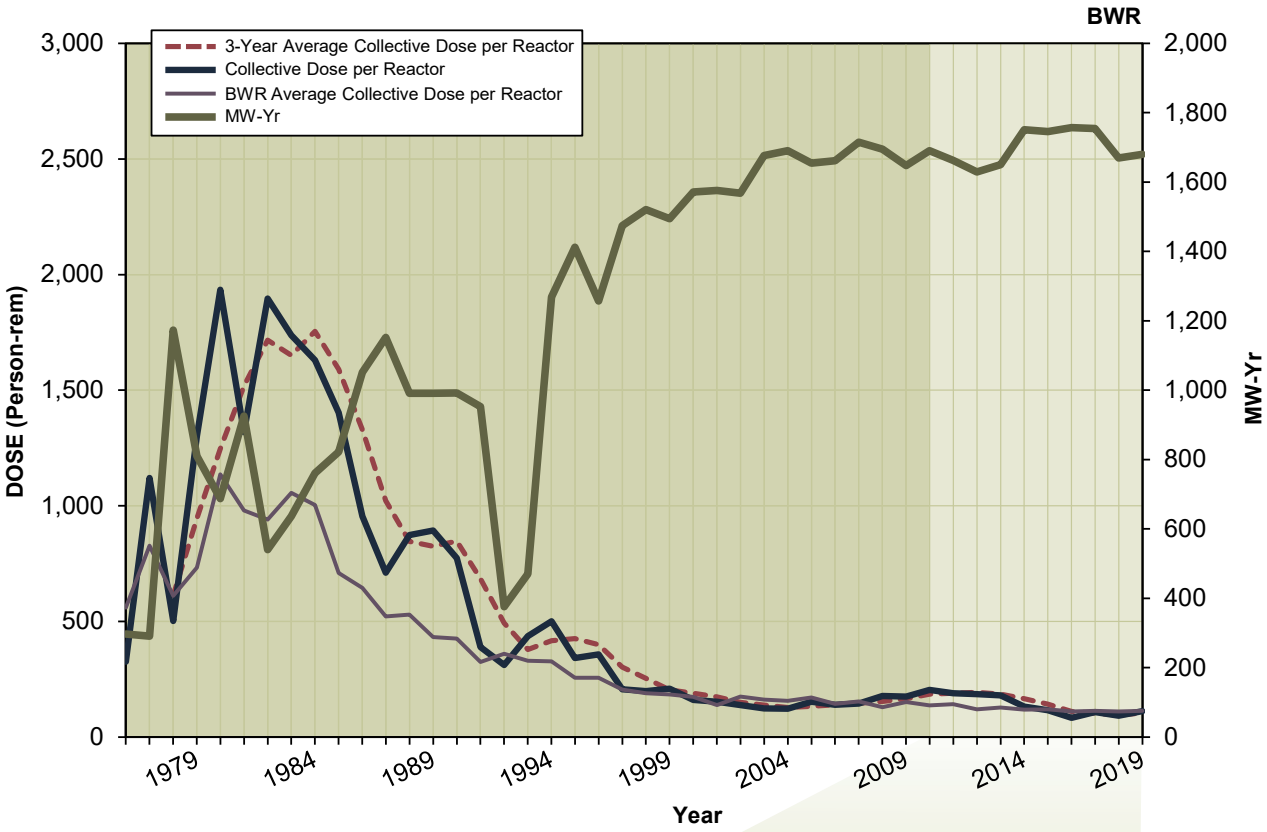
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	154.123	186.000	2,828.0
2011	133.516	99.000	2,845.8
2012	146.413	155.000	2,969.2
2013	127.064	128.000	3,050.0
2014	137.421	130.000	3,052.3
2015	117.836	96.021	3,158.6
2016	120.278	134.862	2,992.6
2017	115.857	116.687	3,179.0
2018	139.255	166.217	2,930.8
2019	134.634	120.999	3,381.3



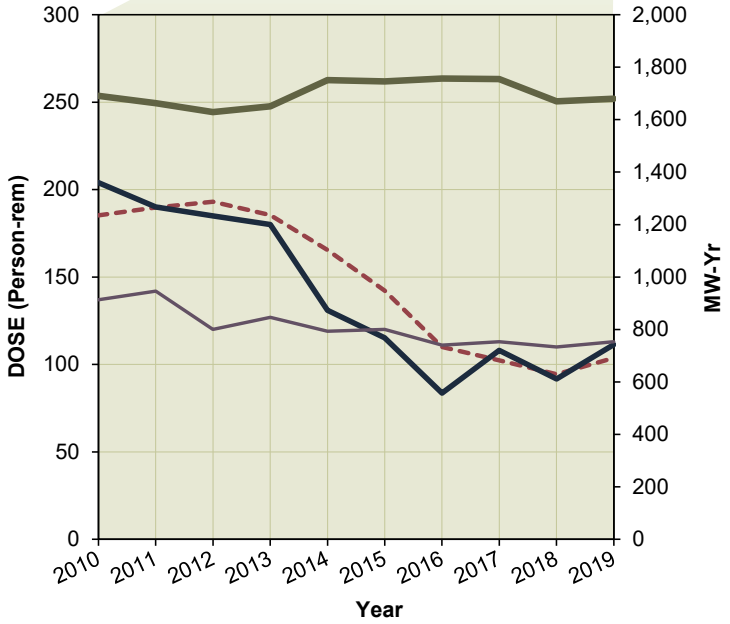
*Browns Ferry Unit 1 resumed power generation in 2007.

BRUNSWICK 1, 2

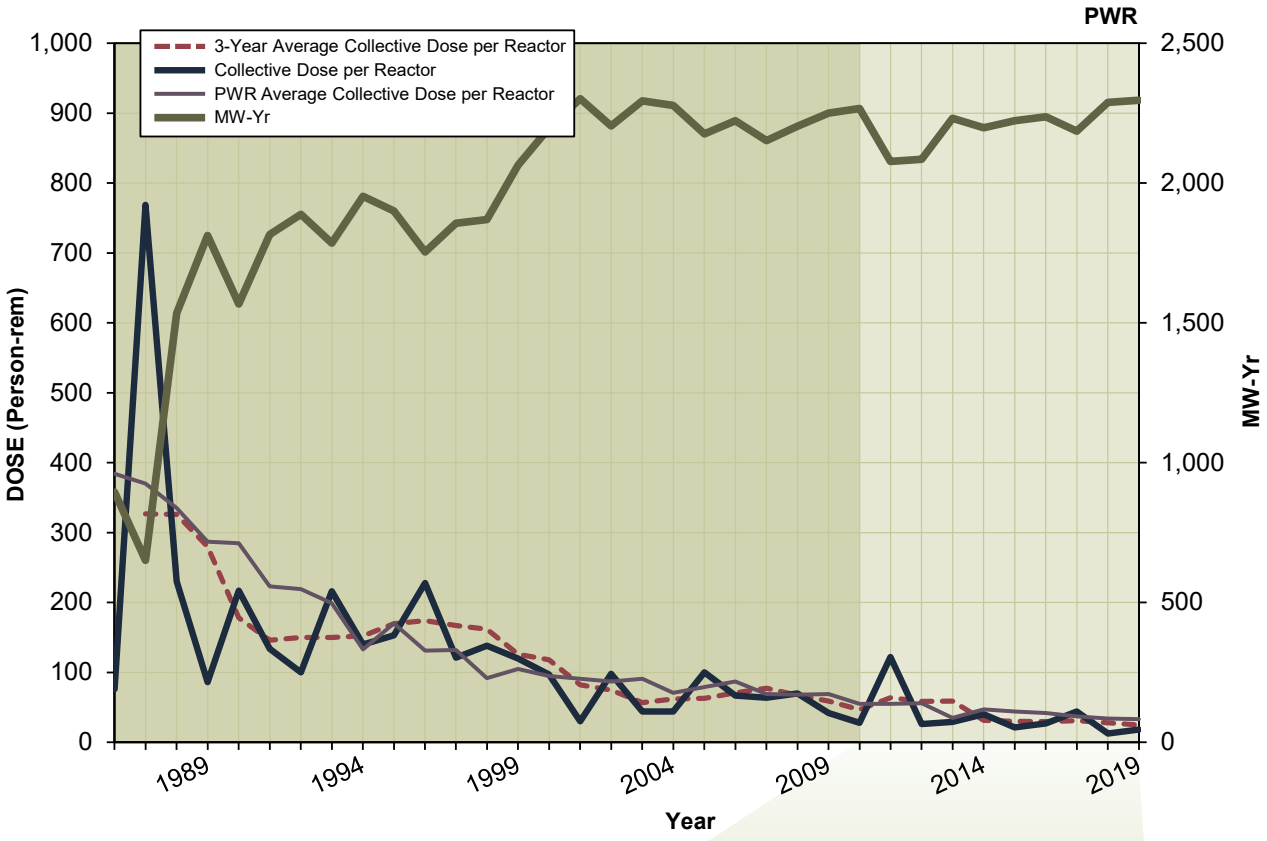
Dose Performance Trends



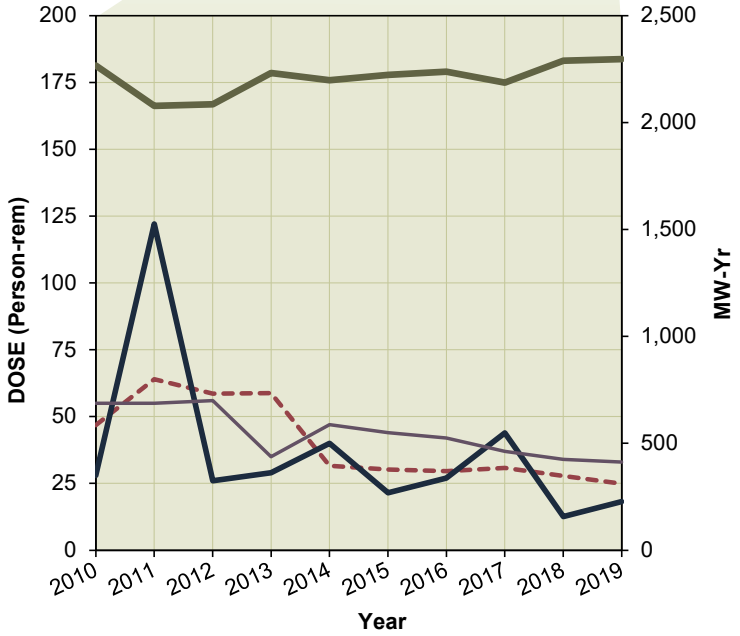
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	185.329	204.000	1,690.7
2011	189.805	190.000	1,662.7
2012	193.059	185.000	1,629.3
2013	185.346	180.000	1,650.6
2014	165.487	130.952	1,750.6
2015	142.270	115.285	1,745.6
2016	109.952	83.618	1,756.7
2017	102.303	108.007	1,754.6
2018	94.421	91.638	1,669.7
2019	103.671	111.368	1,680.0



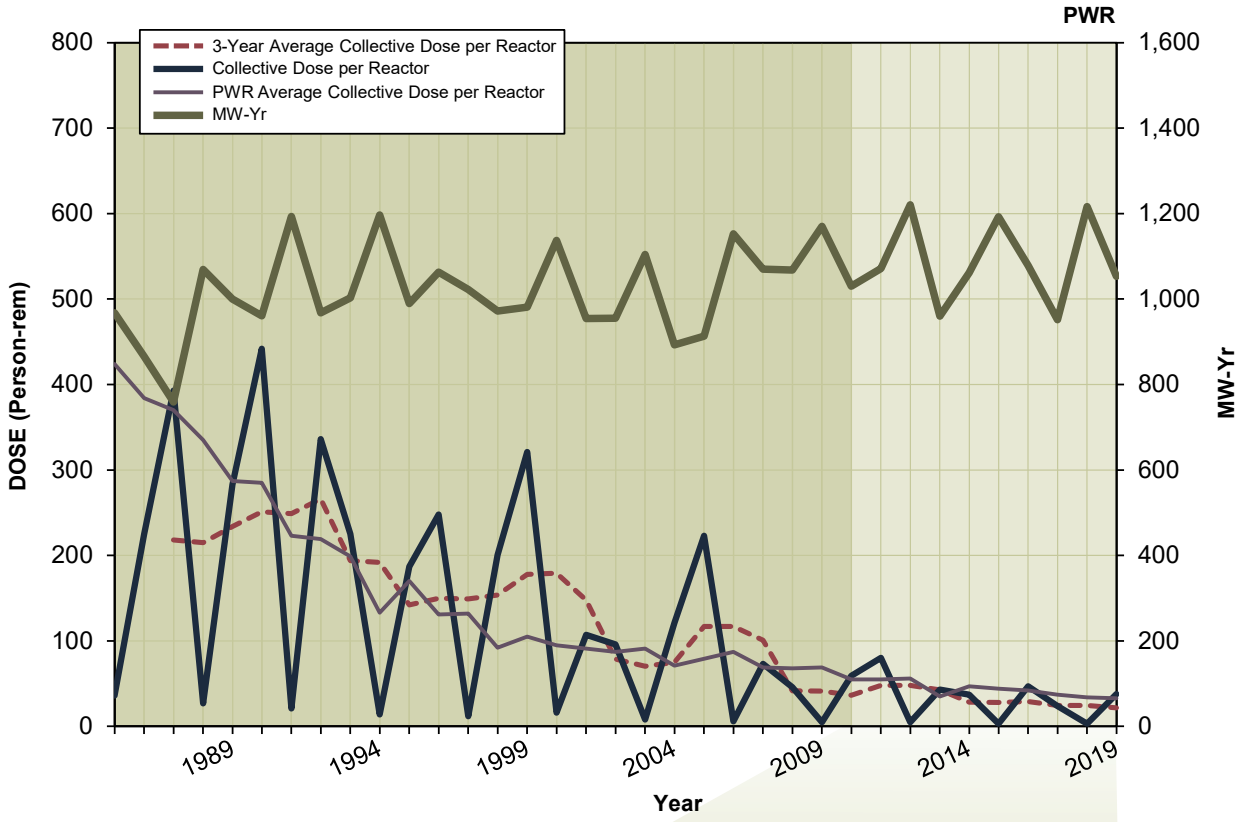
BYRON 1, 2
Dose Performance Trends



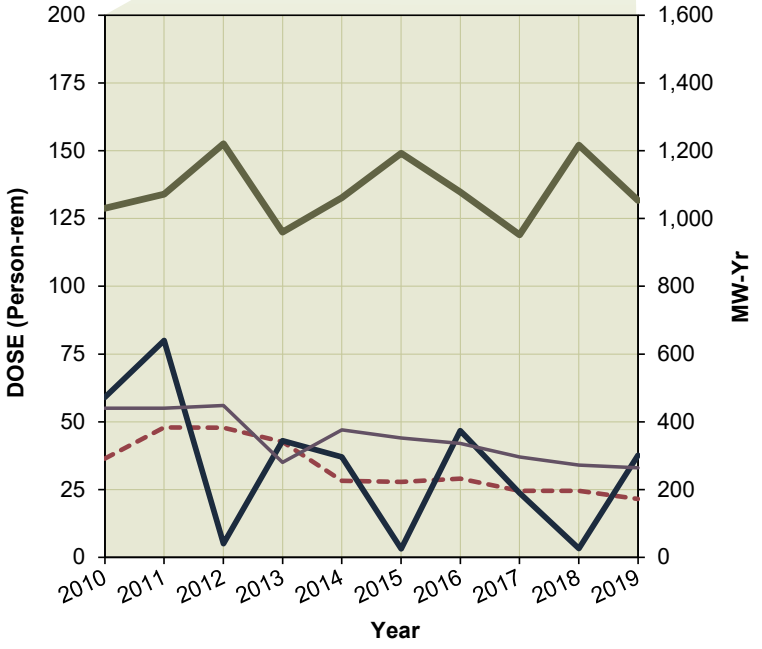
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	46.778	28.000	2,266.6
2011	63.996	122.000	2,077.9
2012	58.584	26.000	2,085.4
2013	58.798	29.000	2,231.4
2014	31.567	40.000	2,197.8
2015	30.236	21.468	2,222.8
2016	29.620	27.006	2,237.5
2017	30.799	43.923	2,186.4
2018	27.836	12.578	2,288.9
2019	24.887	18.161	2,296.6



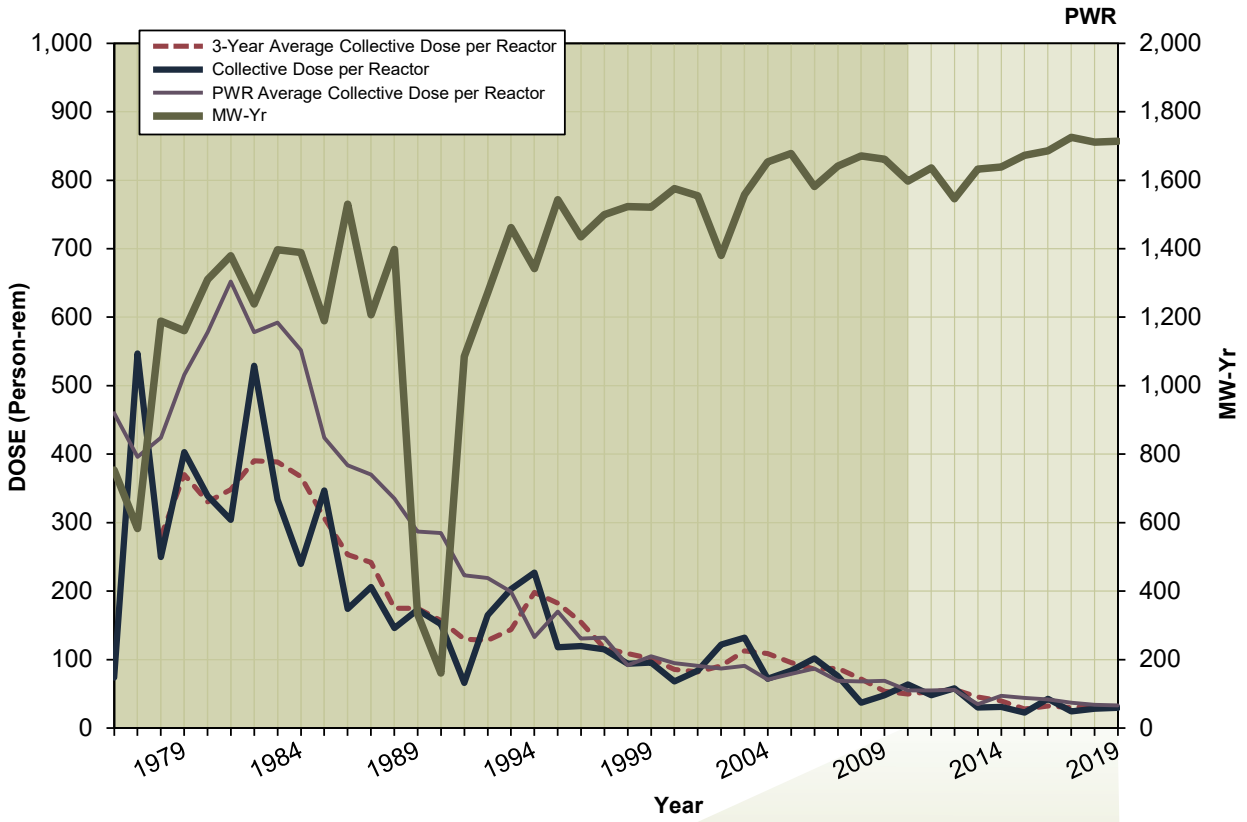
CALLAWAY 1
Dose Performance Trends



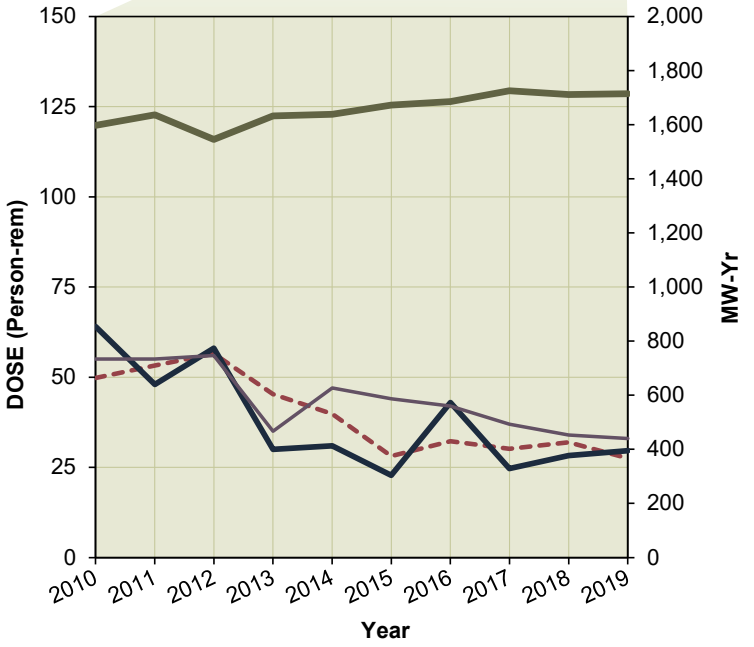
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	36.419	59.000	1,029.9
2011	47.927	80.000	1,071.7
2012	47.829	5.000	1,220.2
2013	42.621	43.000	959.9
2014	28.274	37.000	1,061.3
2015	27.808	3.128	1,192.2
2016	29.024	46.770	1,078.3
2017	24.537	23.713	951.9
2018	24.565	3.211	1,216.6
2019	21.518	37.630	1,053.4



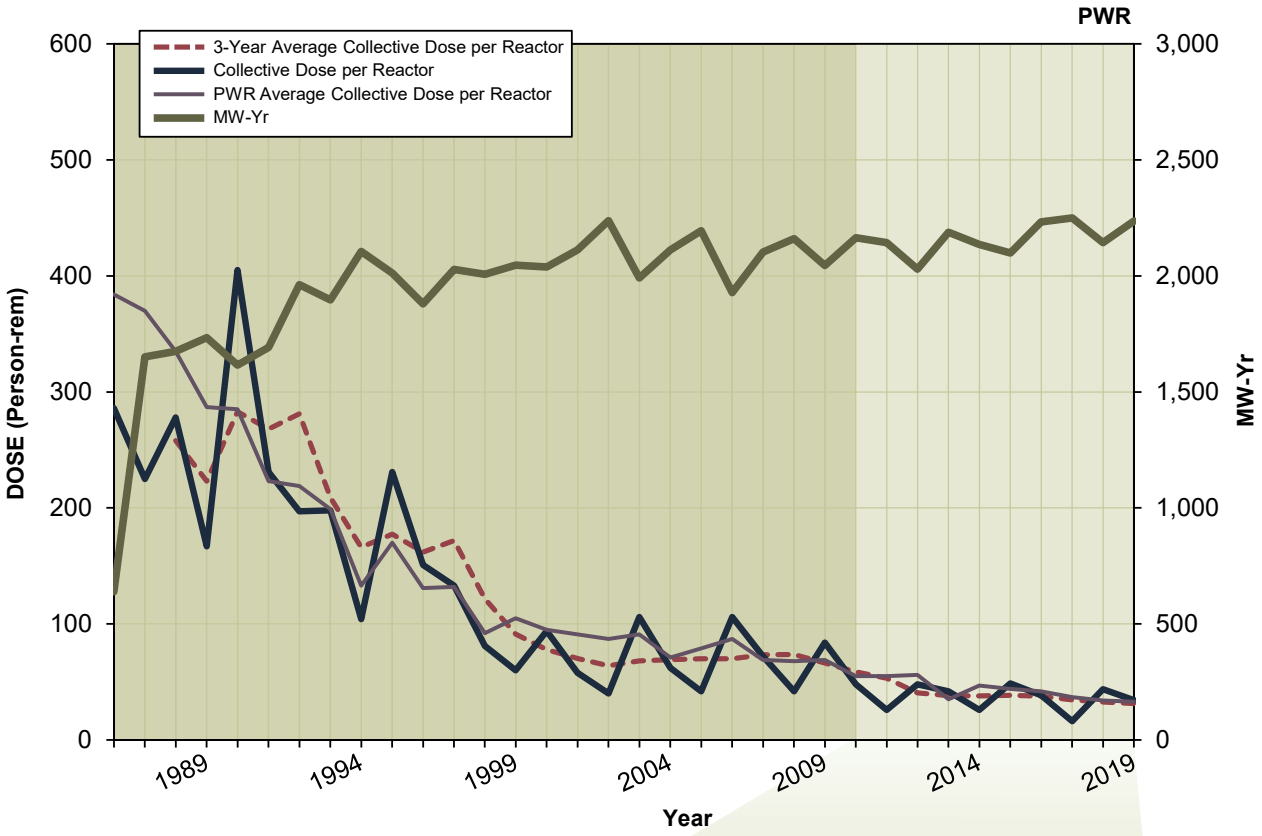
CALVERT CLIFFS 1, 2
Dose Performance Trends



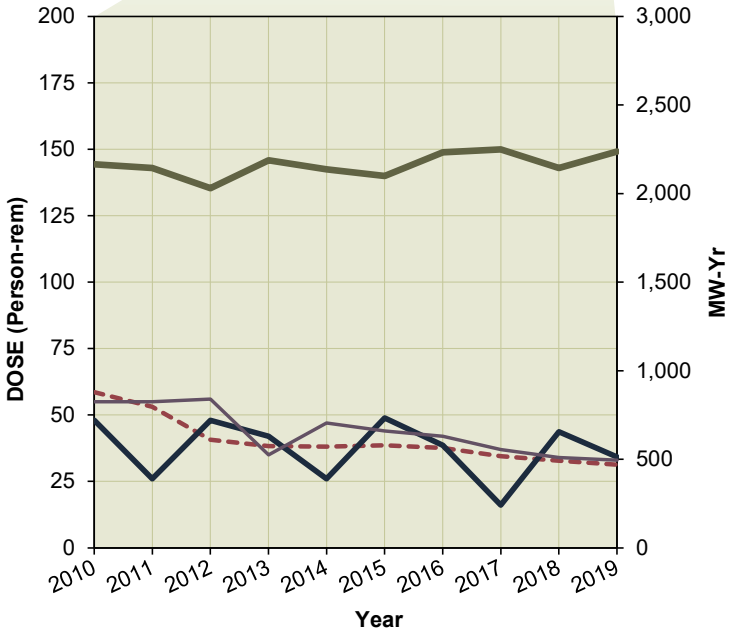
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	49.756	64.000	1,597.3
2011	53.262	48.000	1,635.9
2012	56.557	58.000	1,545.6
2013	45.306	30.000	1,632.6
2014	39.778	31.000	1,638.3
2015	28.128	22.812	1,672.4
2016	32.263	42.946	1,685.6
2017	30.133	24.642	1,725.0
2018	31.945	28.247	1,711.0
2019	27.504	29.623	1,713.8



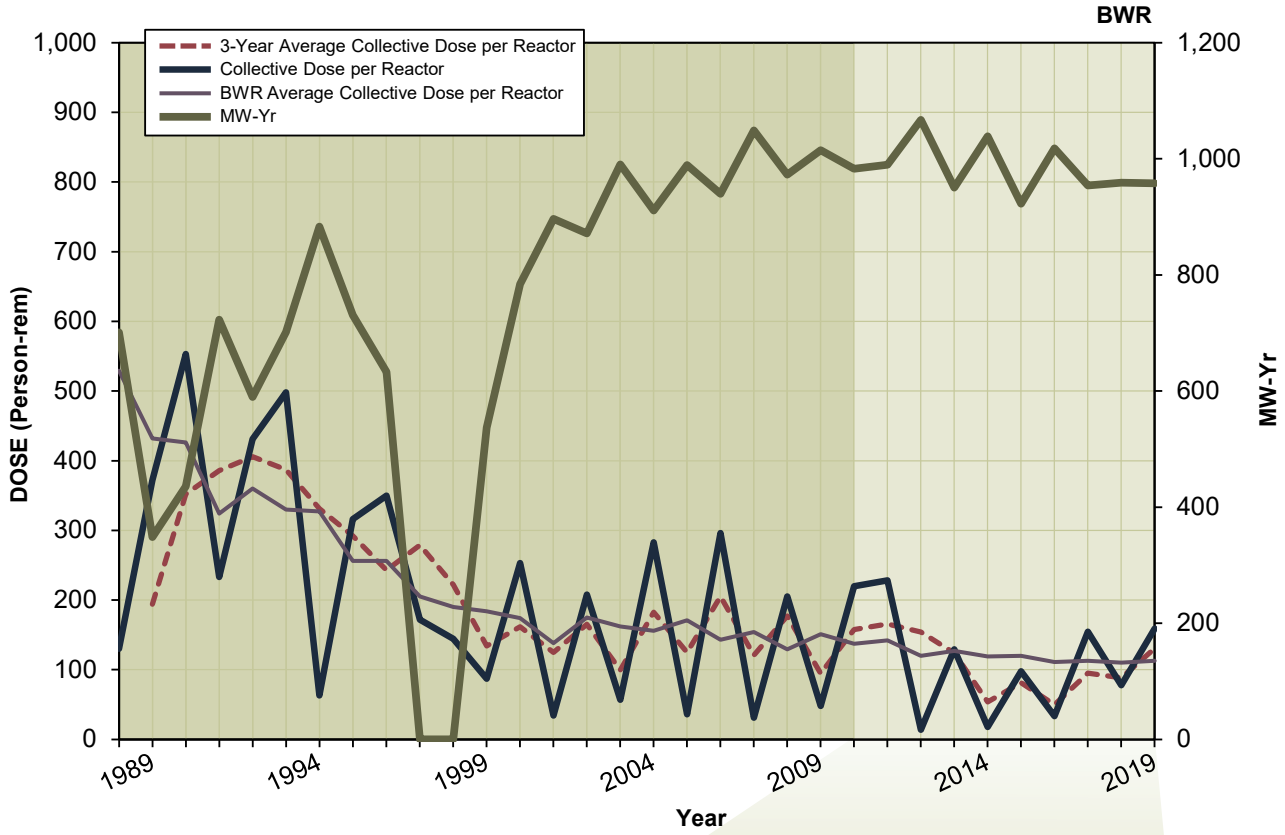
CATAWBA 1, 2
Dose Performance Trends



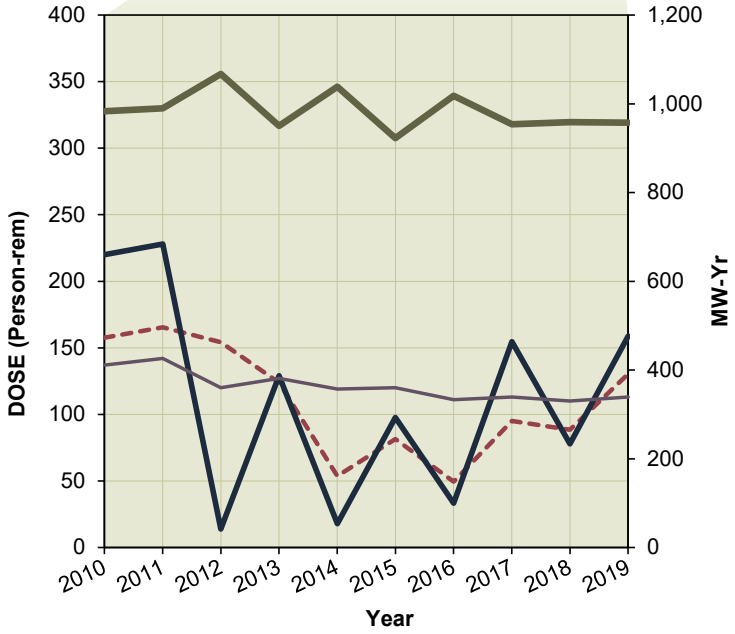
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	58.570	48.000	2,164.8
2011	53.124	26.000	2,144.2
2012	40.678	48.000	2,029.7
2013	38.327	42.000	2,187.9
2014	38.070	26.000	2,136.0
2015	38.560	48.839	2,098.6
2016	37.592	38.549	2,232.7
2017	34.502	16.118	2,249.6
2018	32.773	43.651	2,143.8
2019	31.318	34.185	2,236.7



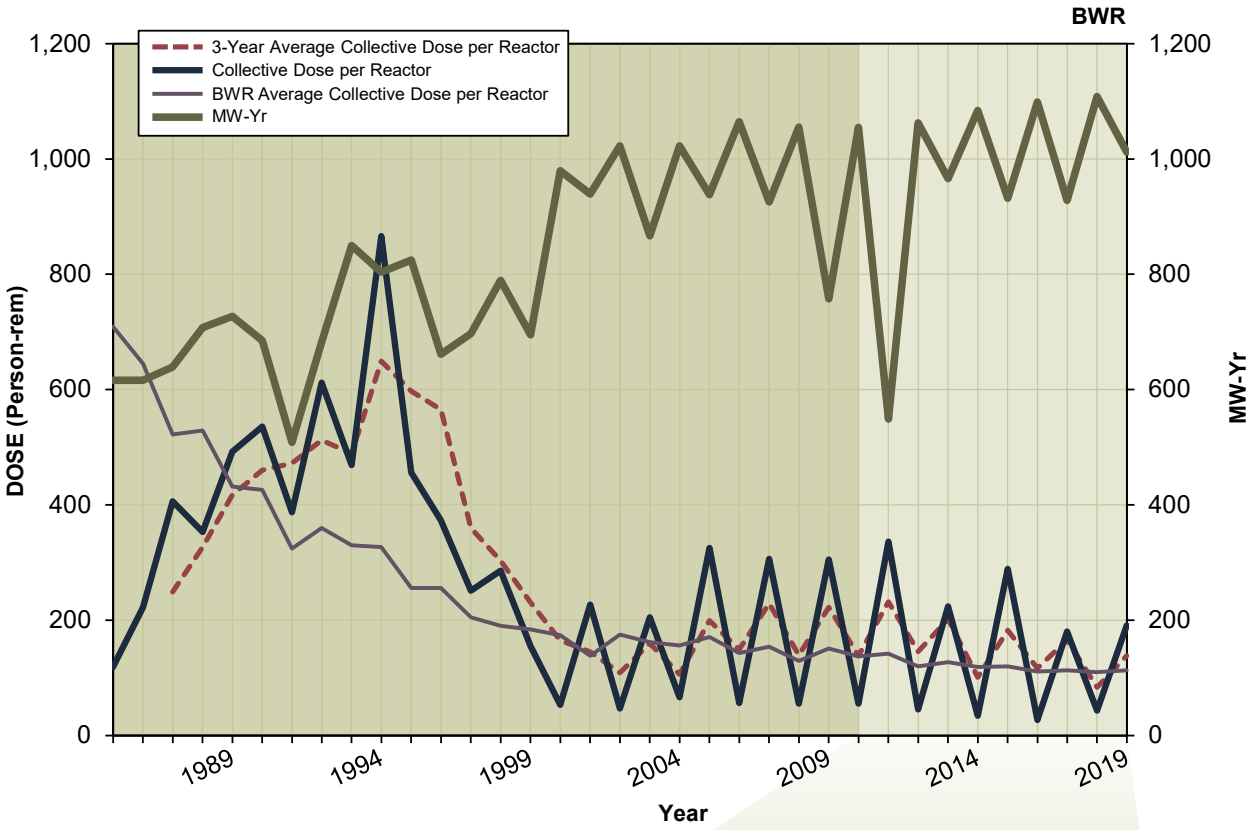
CLINTON
Dose Performance Trends



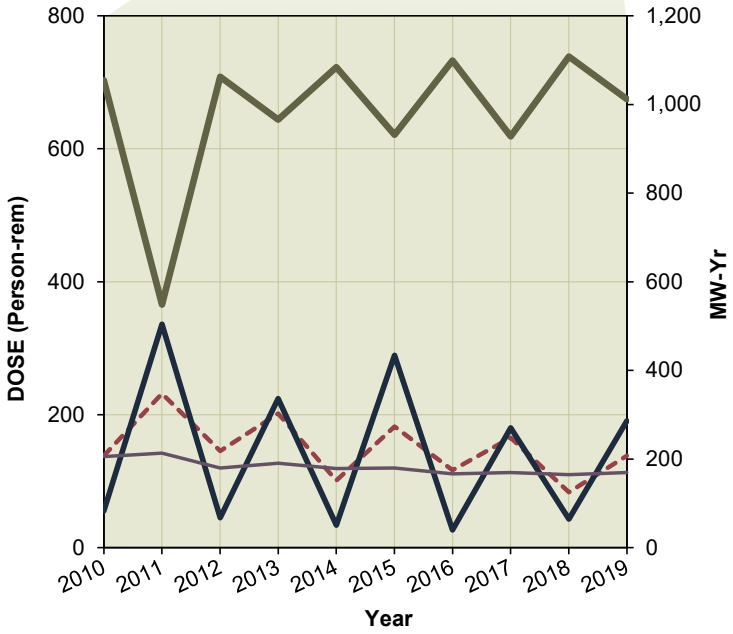
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	157.688	220.000	983.1
2011	165.470	228.000	989.9
2012	154.217	14.000	1,067.1
2013	123.826	129.000	950.2
2014	53.632	18.000	1,038.6
2015	81.427	97.634	922.9
2016	49.573	33.218	1,017.8
2017	95.144	154.579	954.1
2018	88.537	77.813	958.7
2019	130.408	158.832	957.6



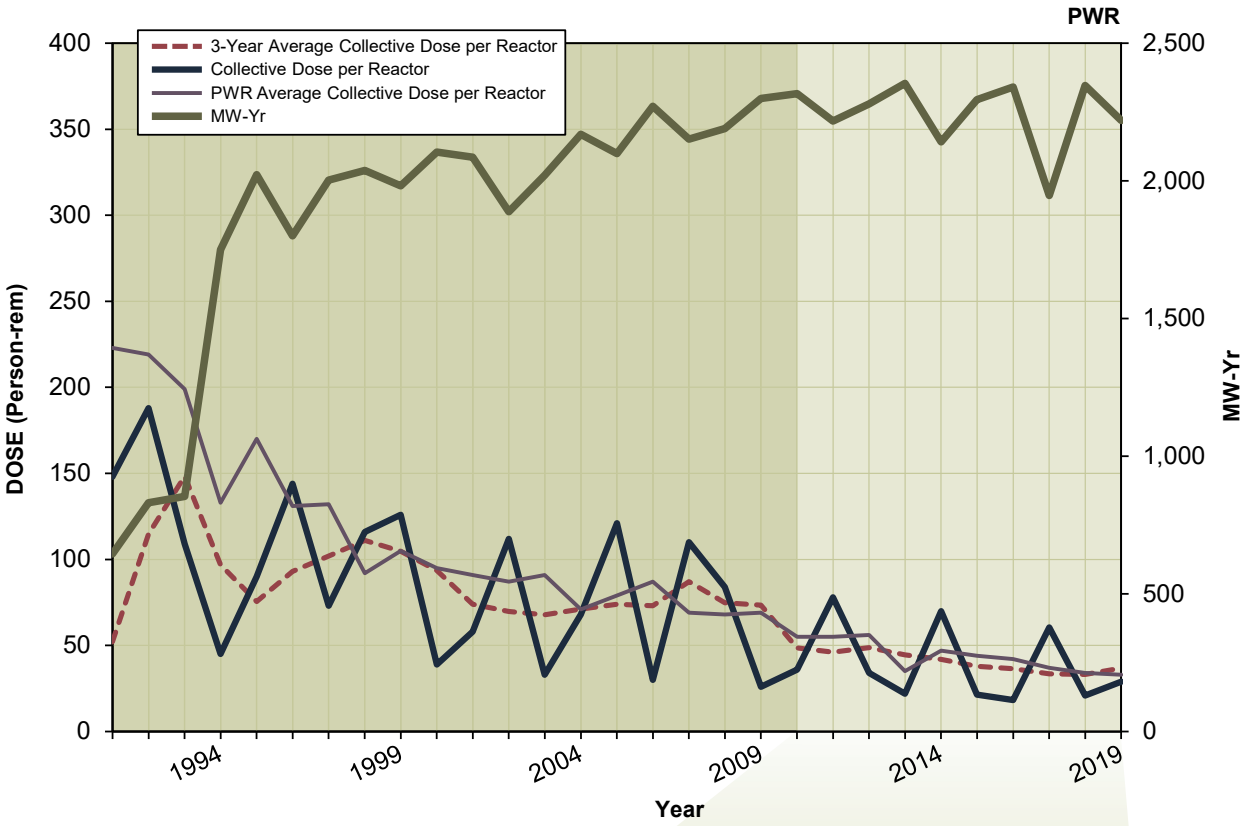
COLUMBIA GENERATING
Dose Performance Trends



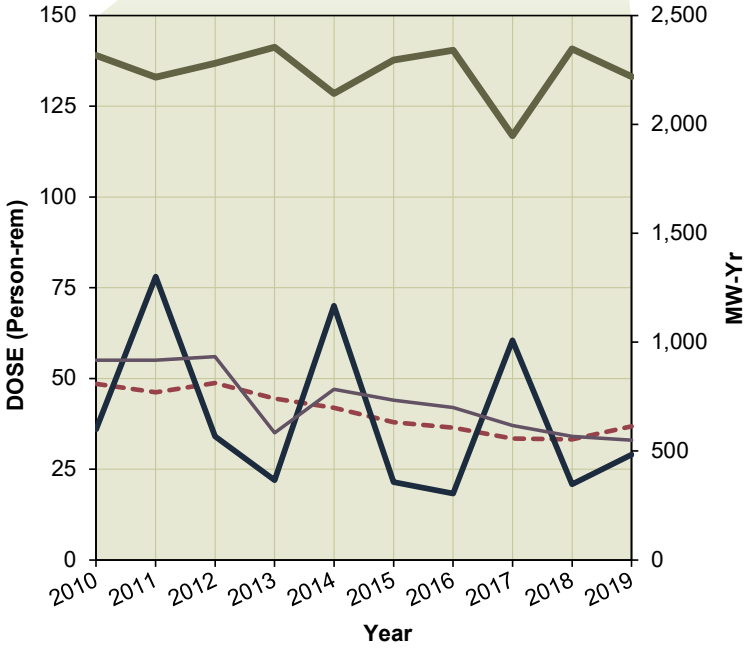
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	138.292	55.000	1,054.9
2011	231.844	336.000	548.7
2012	145.277	45.000	1,062.6
2013	201.662	224.000	965.9
2014	101.033	34.000	1,084.2
2015	182.257	289.135	931.6
2016	116.577	26.825	1,098.8
2017	165.405	180.255	927.9
2018	83.386	43.078	1,108.3
2019	138.009	190.694	1,012.2



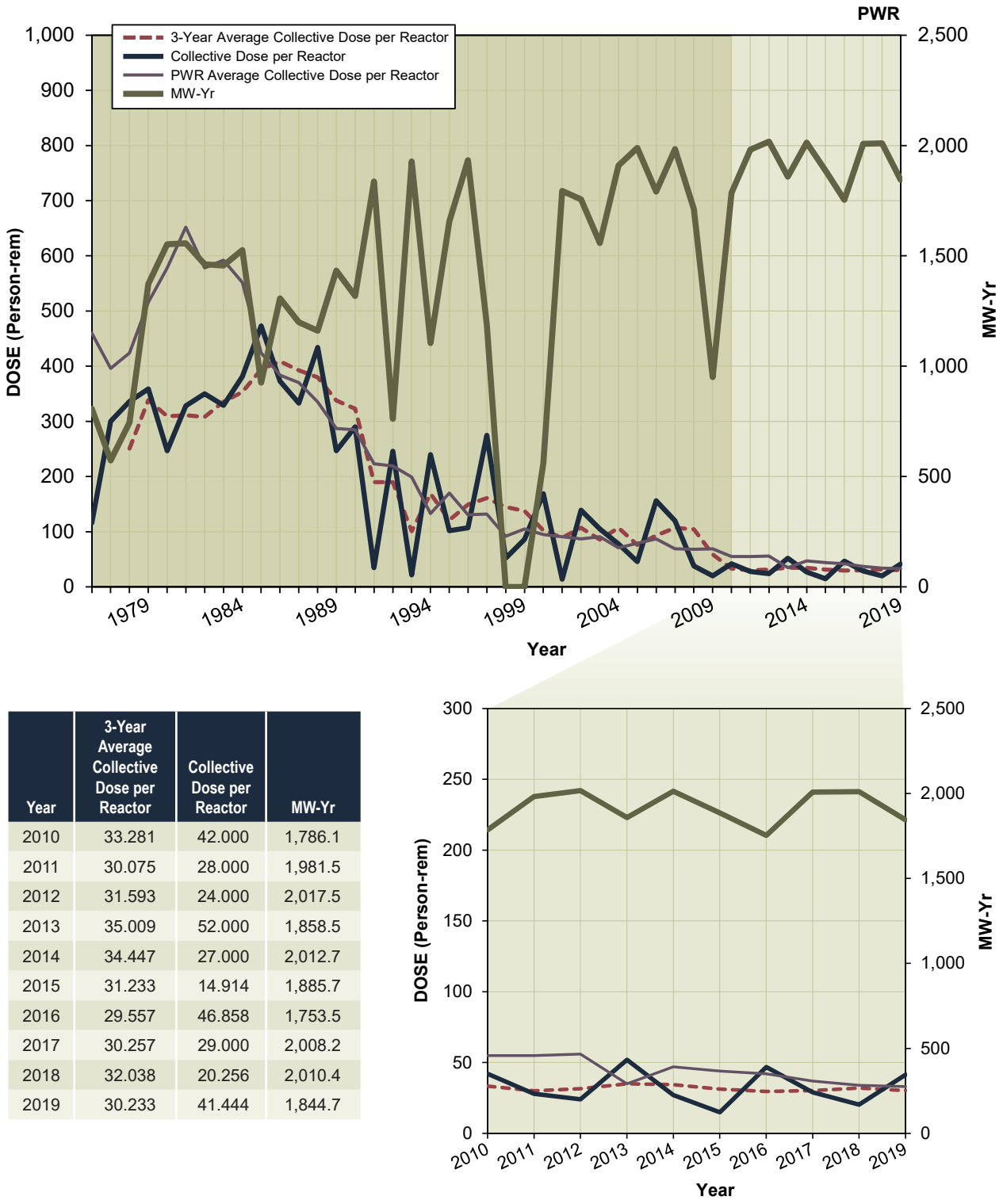
COMANCHE PEAK 1, 2
Dose Performance Trends



Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	48.505	36.000	2,316.8
2011	46.157	78.000	2,216.8
2012	48.711	34.000	2,279.9
2013	44.449	22.000	2,353.5
2014	41.871	70.000	2,141.7
2015	37.895	21.445	2,294.6
2016	36.464	18.324	2,340.7
2017	33.422	60.498	1,947.3
2018	33.220	20.839	2,346.3
2019	36.787	29.026	2,219.0

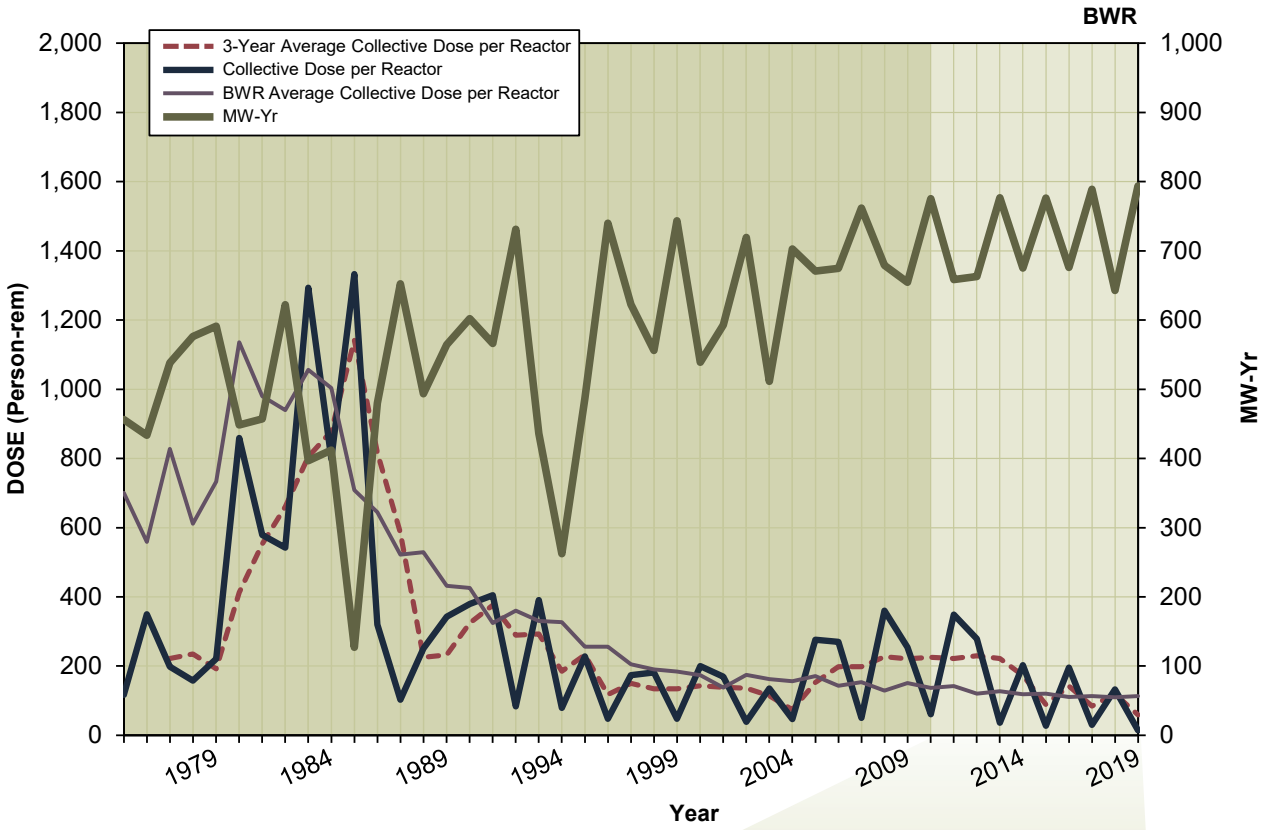


COOK 1, 2
Dose Performance Trends

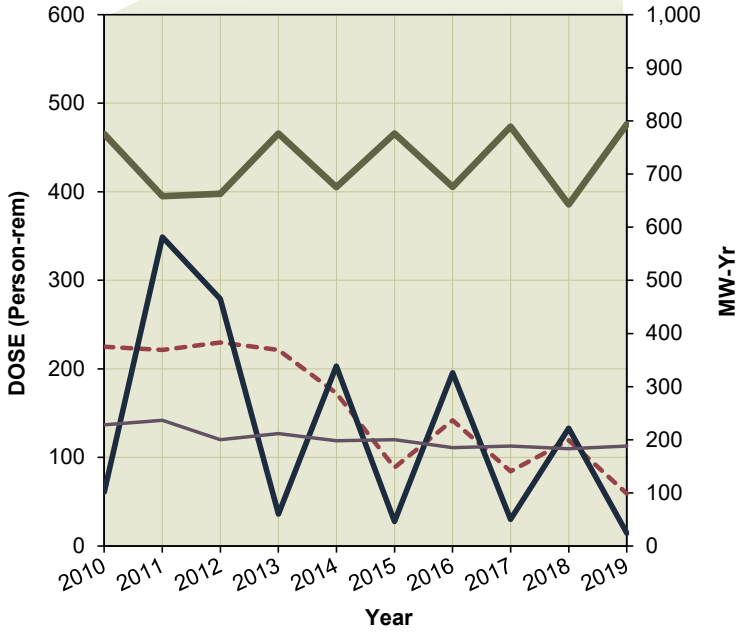


Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	33.281	42.000	1,786.1
2011	30.075	28.000	1,981.5
2012	31.593	24.000	2,017.5
2013	35.009	52.000	1,858.5
2014	34.447	27.000	2,012.7
2015	31.233	14.914	1,885.7
2016	29.557	46.858	1,753.5
2017	30.257	29.000	2,008.2
2018	32.038	20.256	2,010.4
2019	30.233	41.444	1,844.7

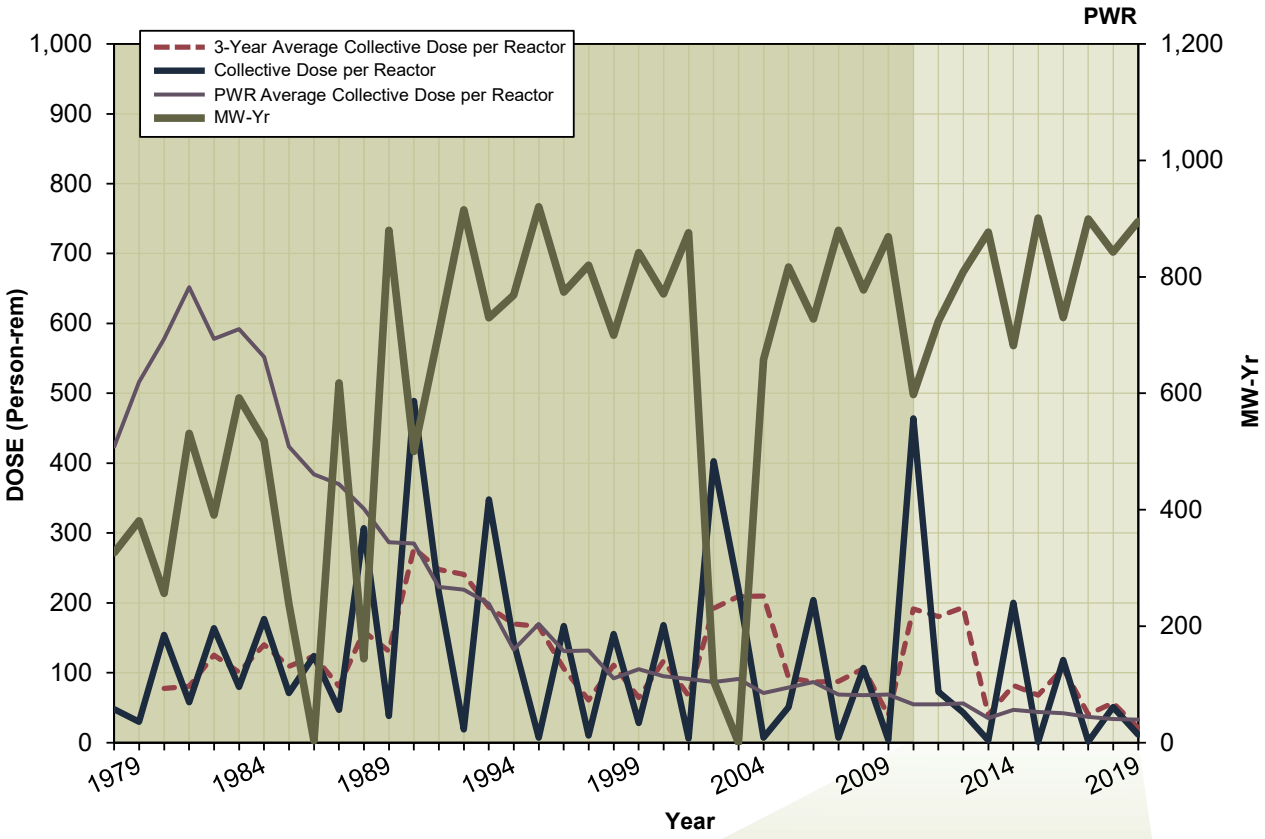
COOPER STATION
Dose Performance Trends



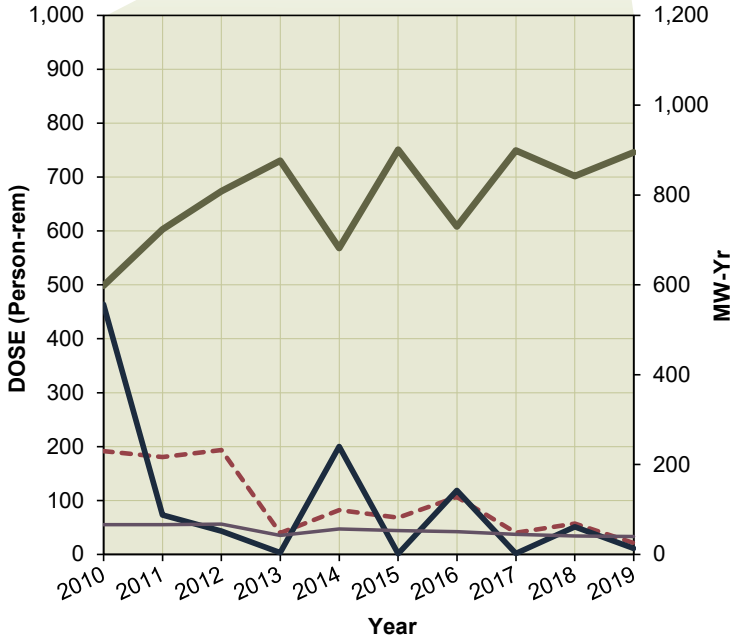
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	225.078	61.000	775.4
2011	221.527	349.000	658.5
2012	229.950	279.000	662.9
2013	221.473	36.000	776.5
2014	172.614	203.000	675.3
2015	88.725	27.634	776.1
2016	141.941	195.518	676.1
2017	84.448	30.193	789.1
2018	119.565	132.984	642.9
2019	59.213	14.463	793.6



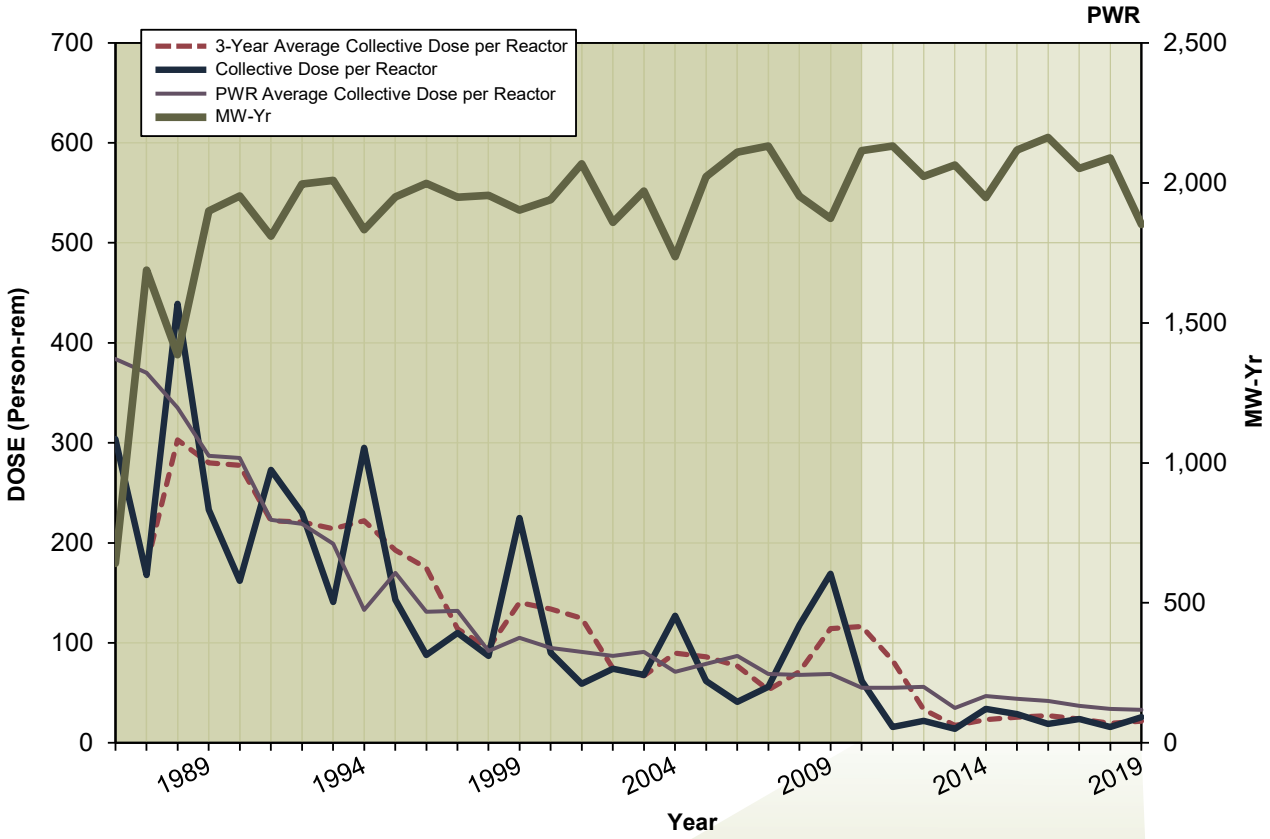
DAVIS-BESSE 1
Dose Performance Trends



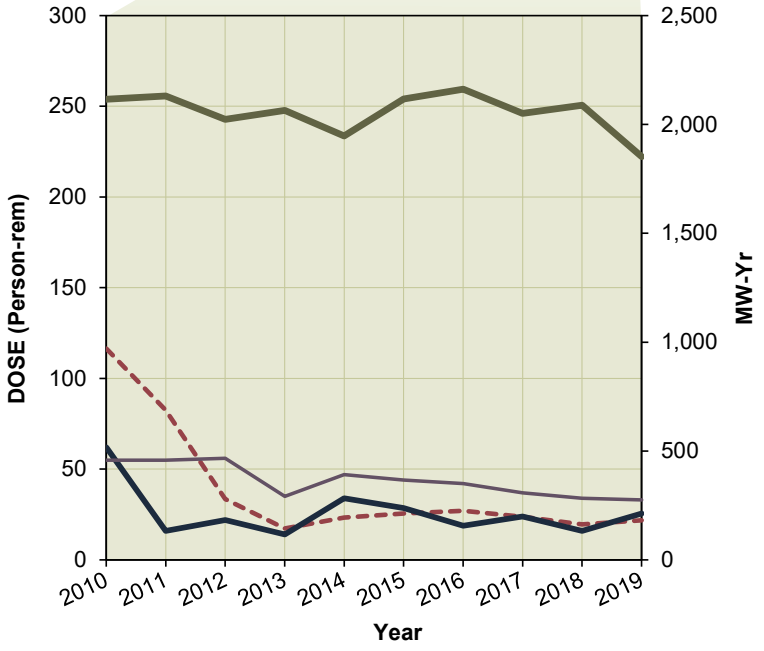
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	191.439	464.000	598.0
2011	180.359	73.000	723.7
2012	193.509	43.000	808.5
2013	39.663	3.000	876.6
2014	82.032	200.000	681.8
2015	68.006	0.995	901.1
2016	106.644	118.472	730.0
2017	40.363	1.621	899.1
2018	57.032	51.003	842.5
2019	21.343	11.405	894.9



DIABLO CANYON 1, 2
Dose Performance Trends

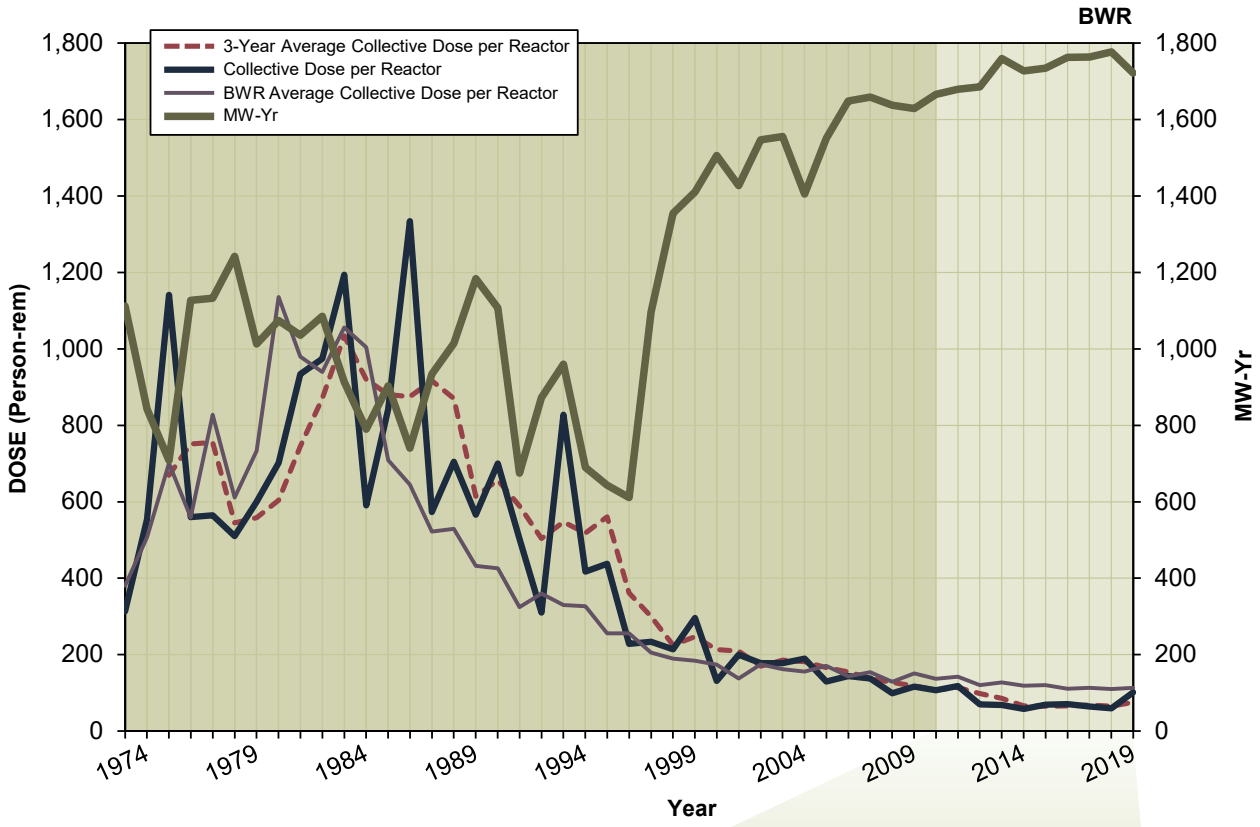


Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	116.382	62.000	2,115.2
2011	82.486	16.000	2,131.1
2012	33.436	22.000	2,023.0
2013	17.321	14.000	2,064.1
2014	23.316	34.000	1,947.1
2015	25.602	28.622	2,116.8
2016	27.096	18.867	2,162.2
2017	23.815	23.955	2,051.4
2018	19.610	16.007	2,088.4
2019	21.843	25.568	1,851.7

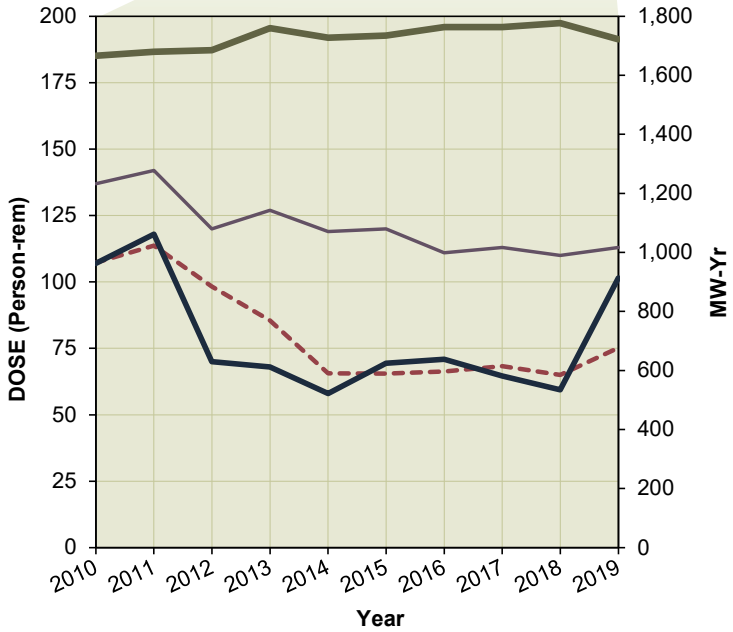


DRESDEN 2, 3

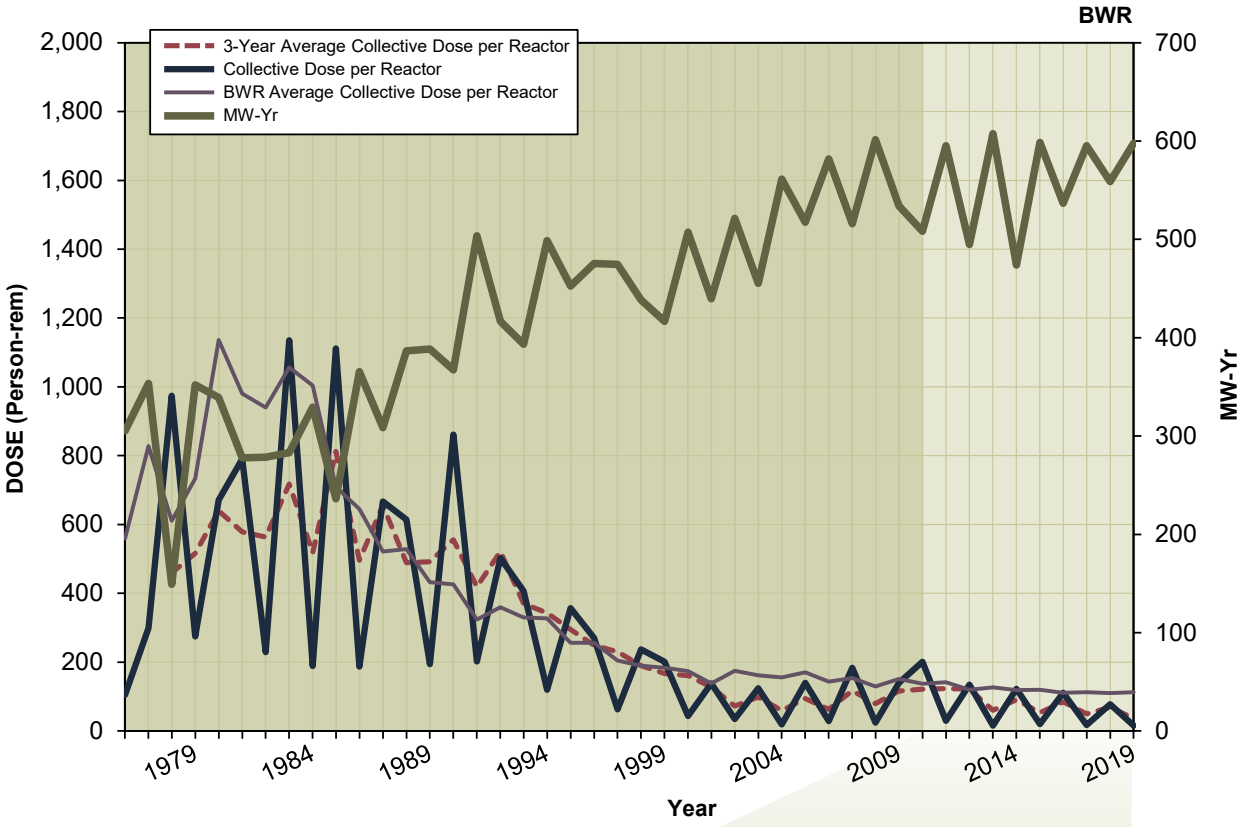
Dose Performance Trends



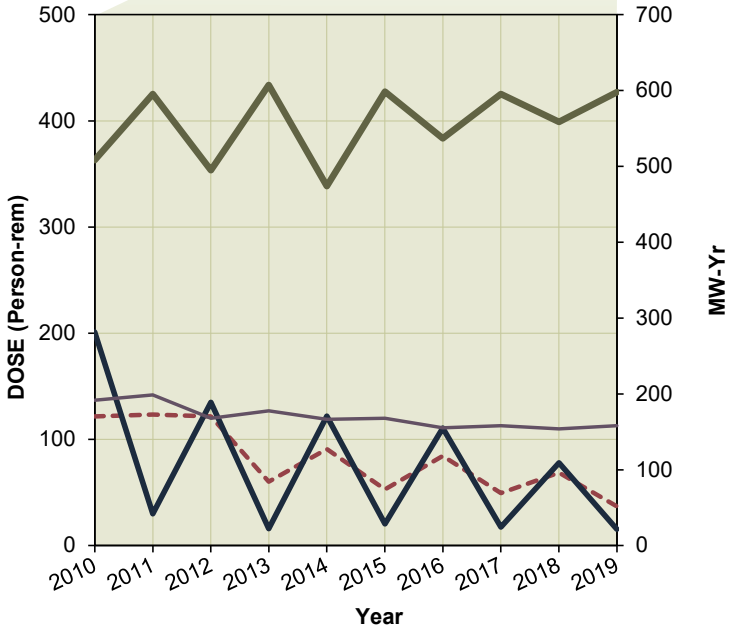
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	107.286	107.000	1,665.9
2011	113.657	118.000	1,679.7
2012	98.311	70.000	1,685.5
2013	85.497	68.000	1,759.9
2014	65.582	58.000	1,727.8
2015	65.457	69.432	1,734.4
2016	66.271	70.914	1,763.2
2017	68.326	64.633	1,763.3
2018	64.987	59.416	1,776.9
2019	75.161	101.433	1,721.7



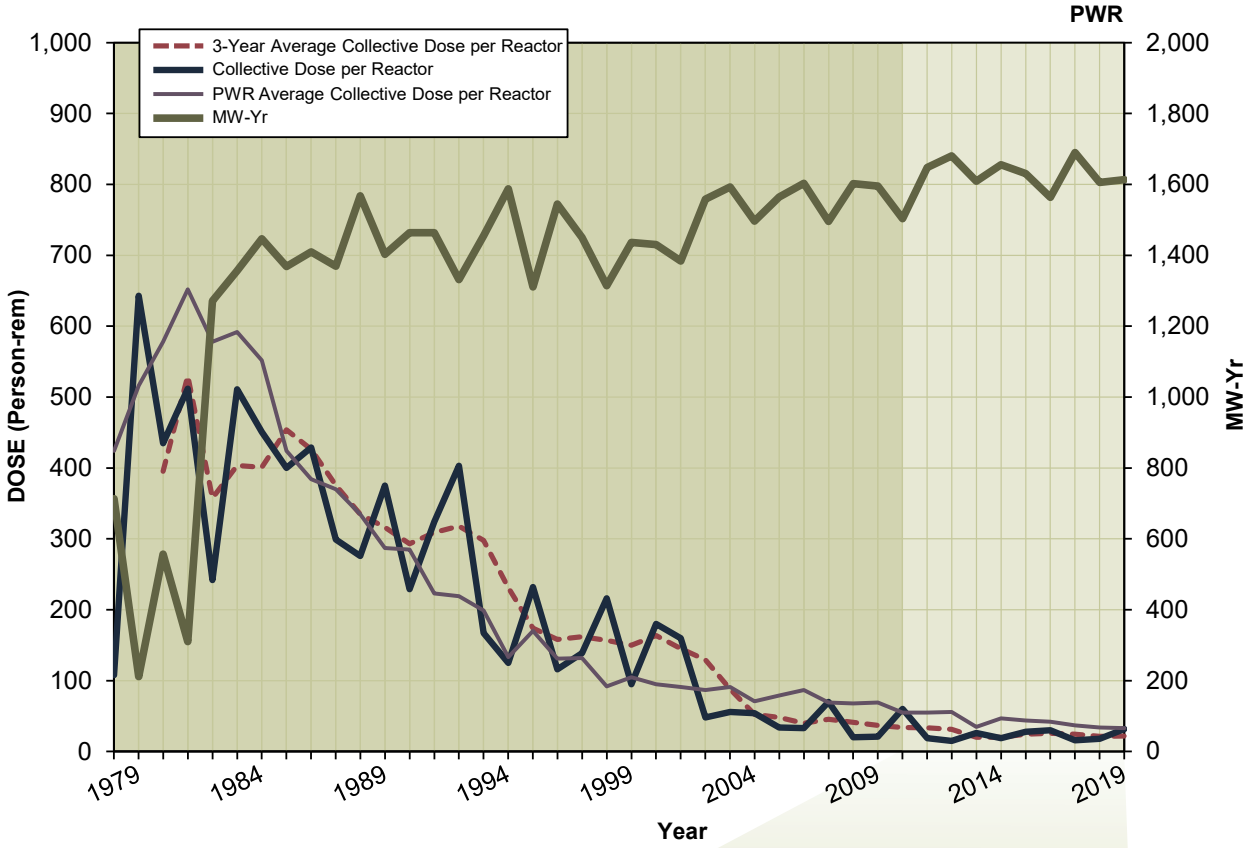
DUANE ARNOLD
Dose Performance Trends



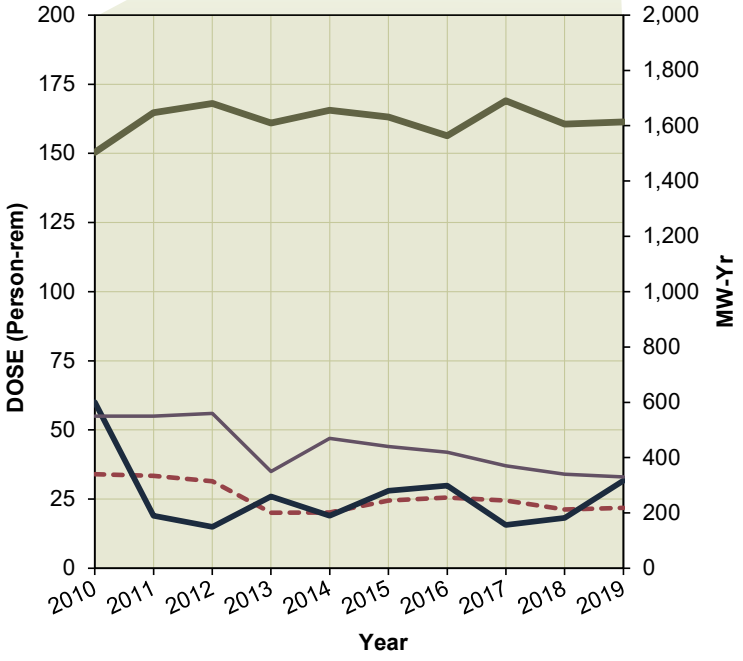
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	121.669	201.000	508.1
2011	123.460	30.000	595.3
2012	121.593	135.000	494.9
2013	60.197	16.000	607.4
2014	90.972	122.000	474.0
2015	52.947	20.441	598.6
2016	84.347	110.613	536.8
2017	49.463	17.336	595.2
2018	68.644	77.984	558.8
2019	36.963	15.569	597.7



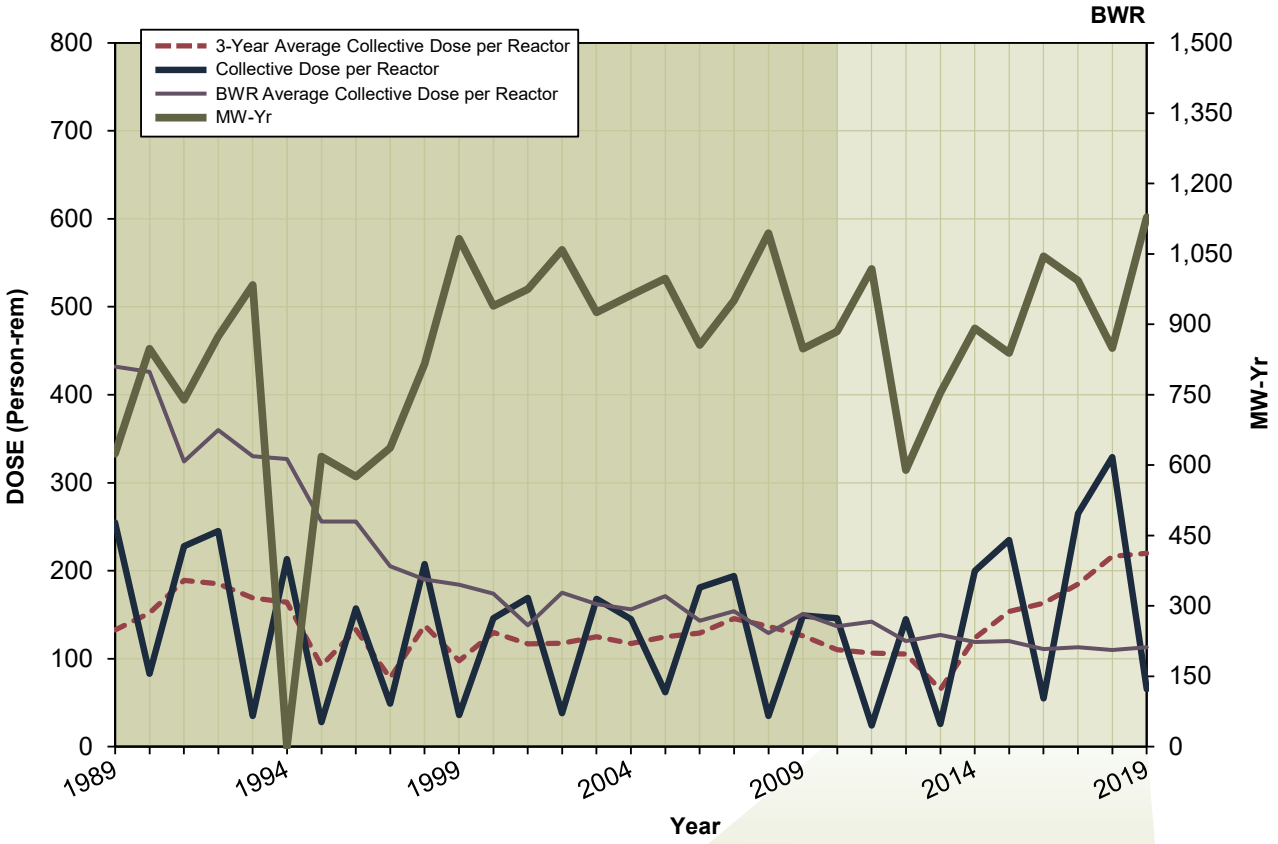
FARLEY 1, 2
Dose Performance Trends



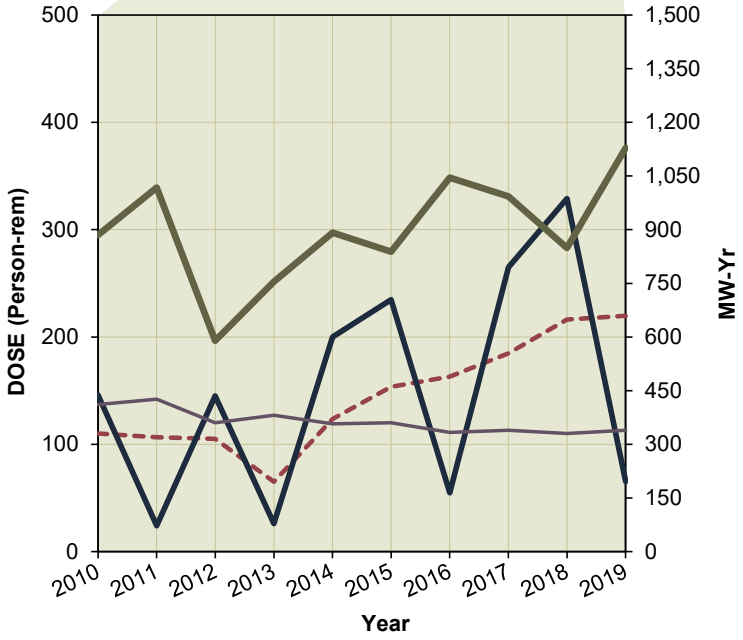
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	33.994	60.000	1,503.4
2011	33.446	19.000	1,647.4
2012	31.440	15.000	1,680.7
2013	20.090	26.000	1,609.4
2014	20.122	19.000	1,655.9
2015	24.476	27.971	1,631.0
2016	25.581	29.920	1,563.7
2017	24.522	15.676	1,690.0
2018	21.258	18.178	1,605.6
2019	21.837	31.660	1,613.8



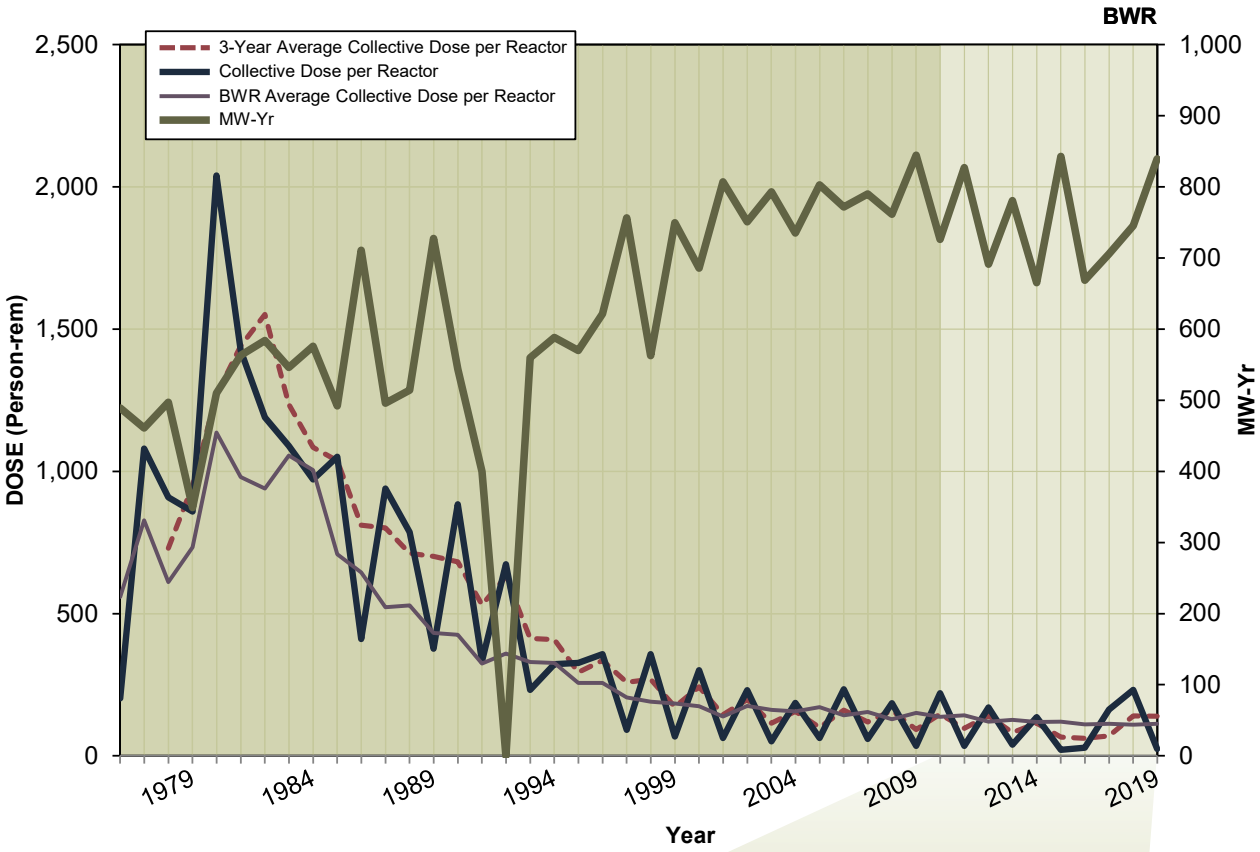
FERMI 2
Dose Performance Trends



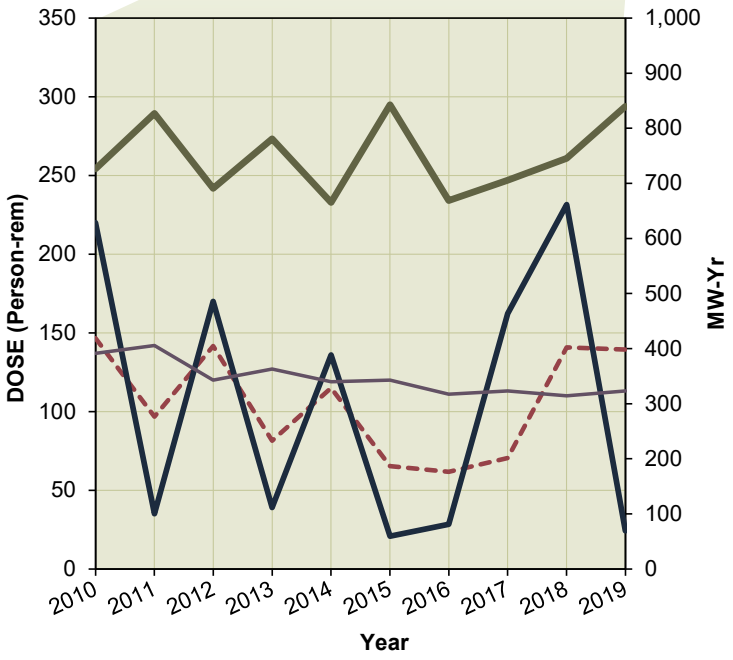
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	110.179	146.000	885.0
2011	106.472	24.000	1,017.9
2012	105.181	145.000	589.3
2013	65.077	26.000	754.5
2014	123.617	200.000	891.5
2015	153.577	234.853	838.6
2016	163.104	54.761	1,045.0
2017	184.899	265.082	993.0
2018	216.286	329.015	849.2
2019	219.793	65.282	1,128.6



FITZPATRICK
Dose Performance Trends

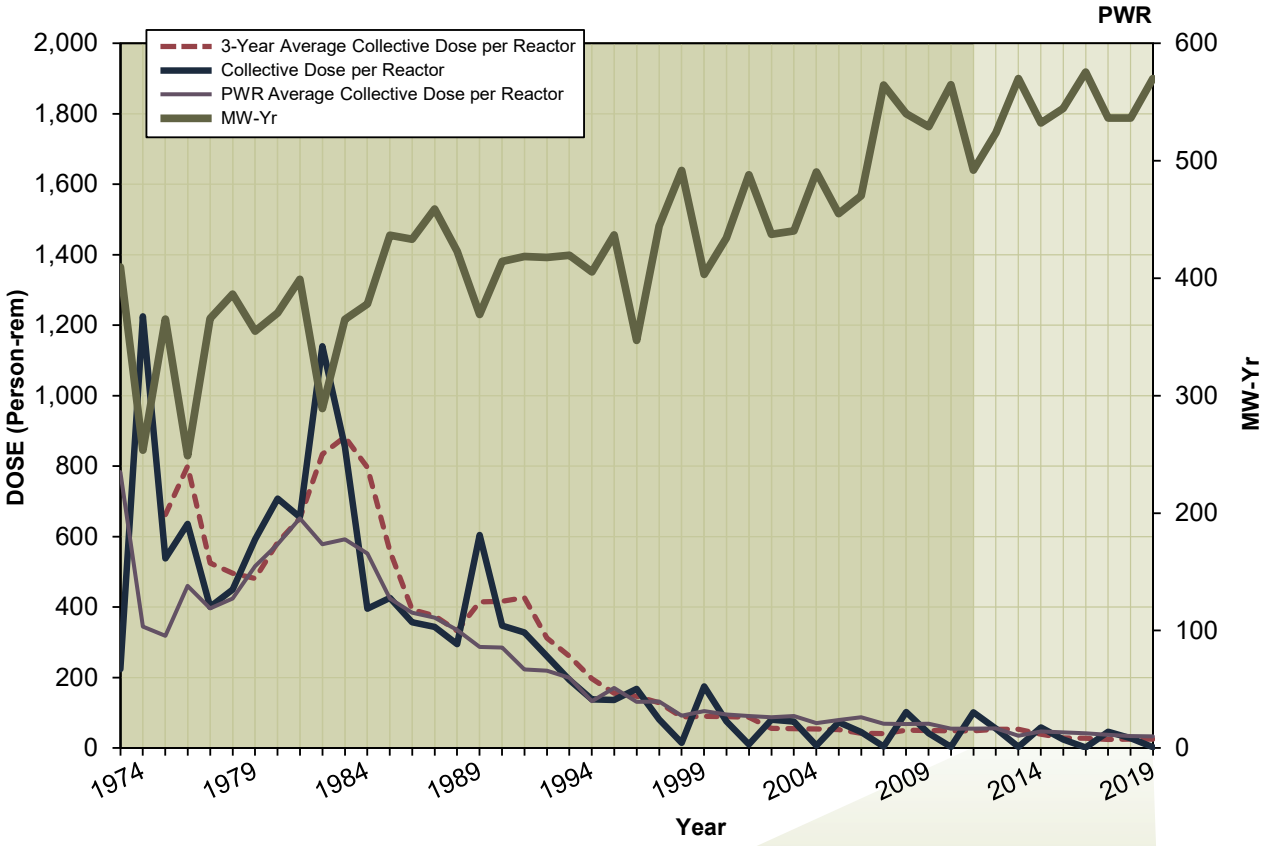


Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	146.602	220.000	726.2
2011	96.741	35.000	826.9
2012	141.663	170.000	691.1
2013	81.498	39.000	780.8
2014	115.056	136.000	665.4
2015	65.356	20.785	842.7
2016	61.660	28.304	668.7
2017	70.428	162.196	705.8
2018	140.683	231.548	745.2
2019	139.301	24.160	839.5

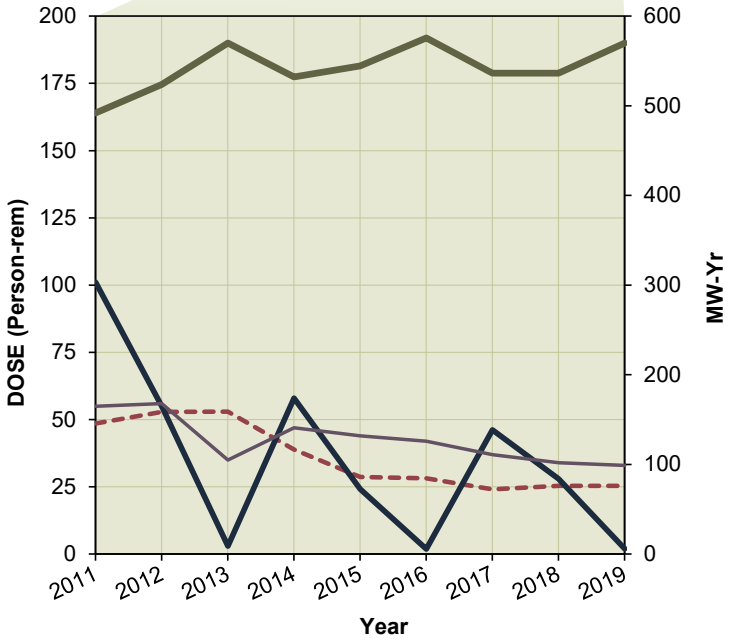


GINNA

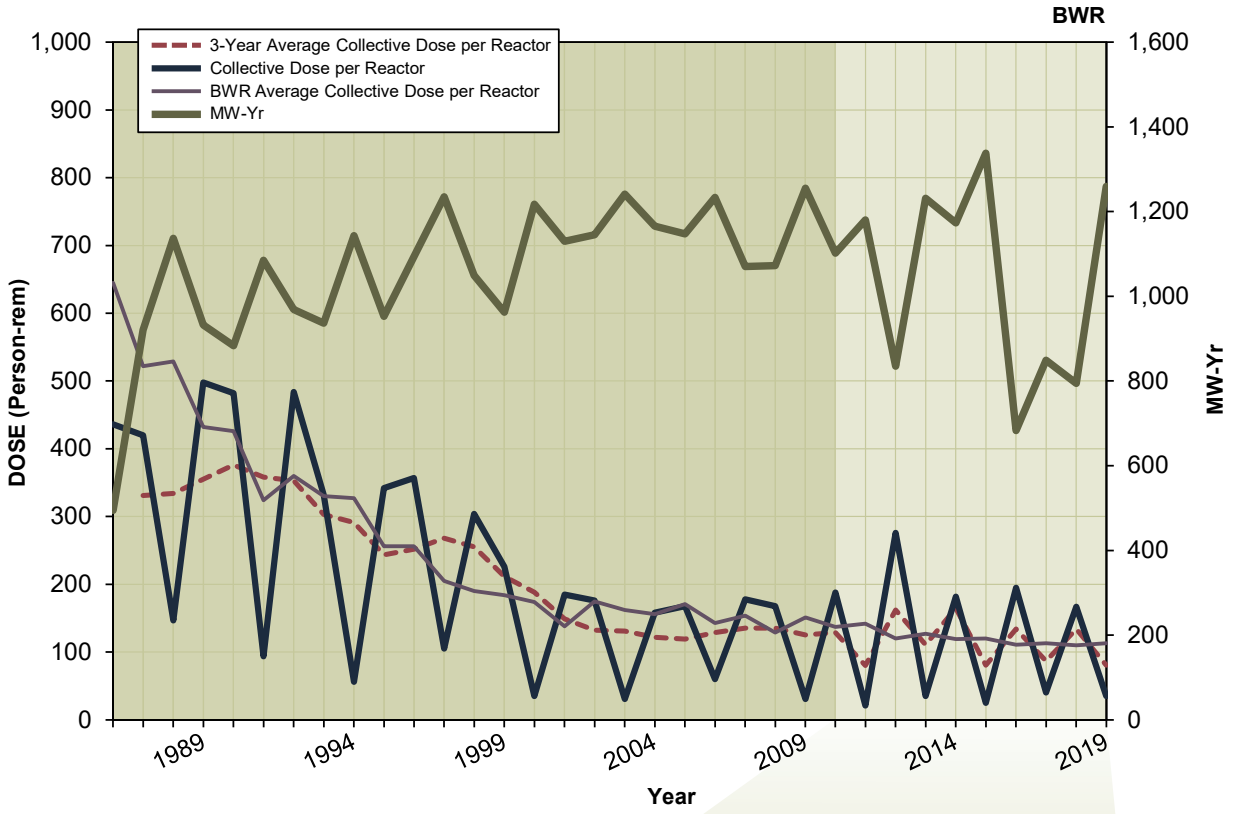
Dose Performance Trends



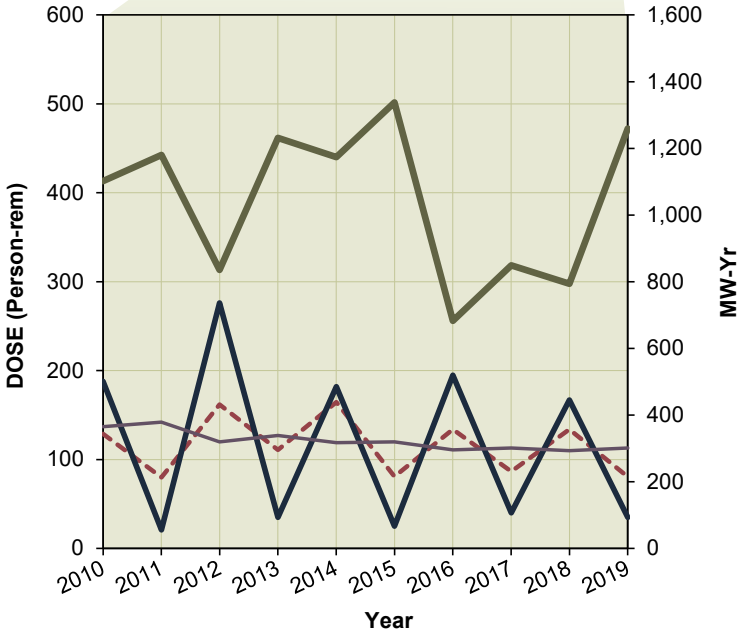
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	48.992	3.000	564.9
2011	48.563	101.000	492.1
2012	52.838	55.000	523.9
2013	52.927	3.000	570.0
2014	38.817	58.000	532.2
2015	28.659	24.163	544.5
2016	28.142	1.882	575.6
2017	24.073	46.173	536.3
2018	25.329	27.931	536.4
2019	25.376	2.023	570.1



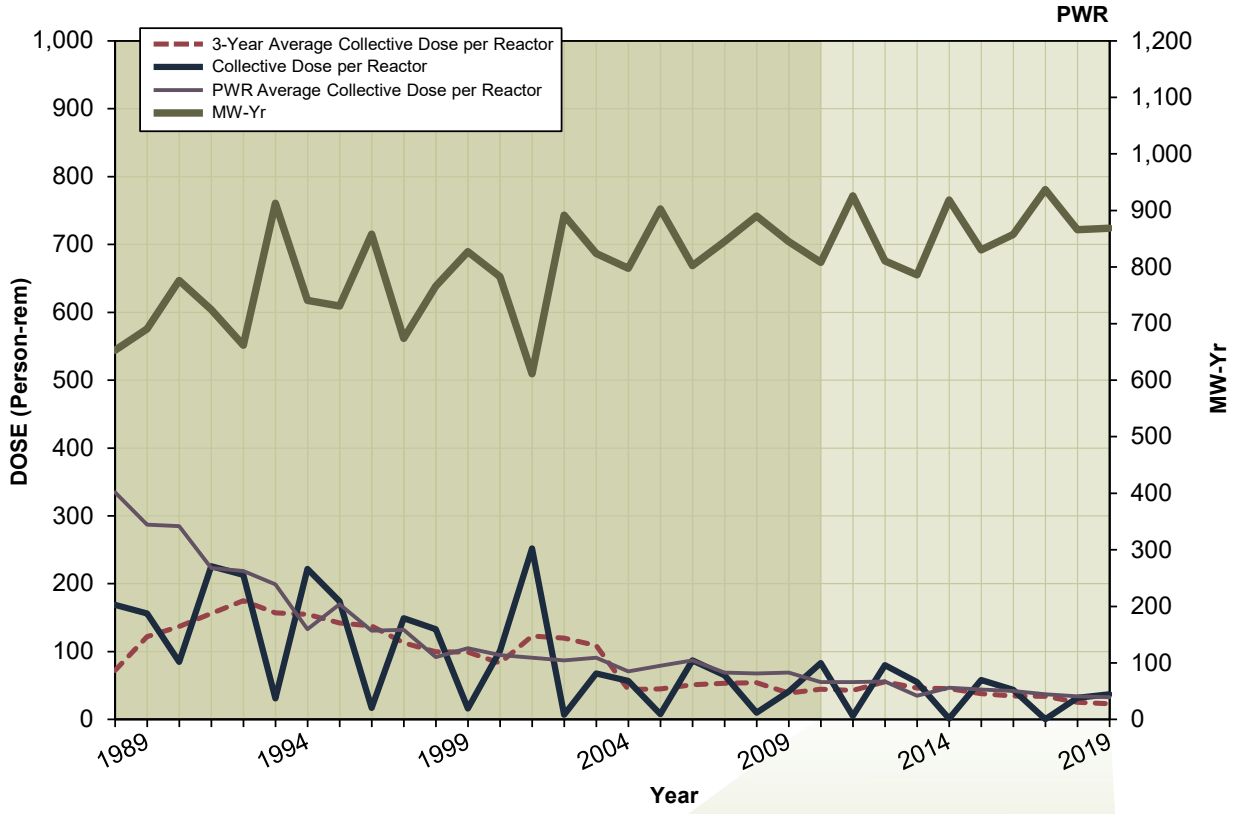
GRAND GULF
Dose Performance Trends



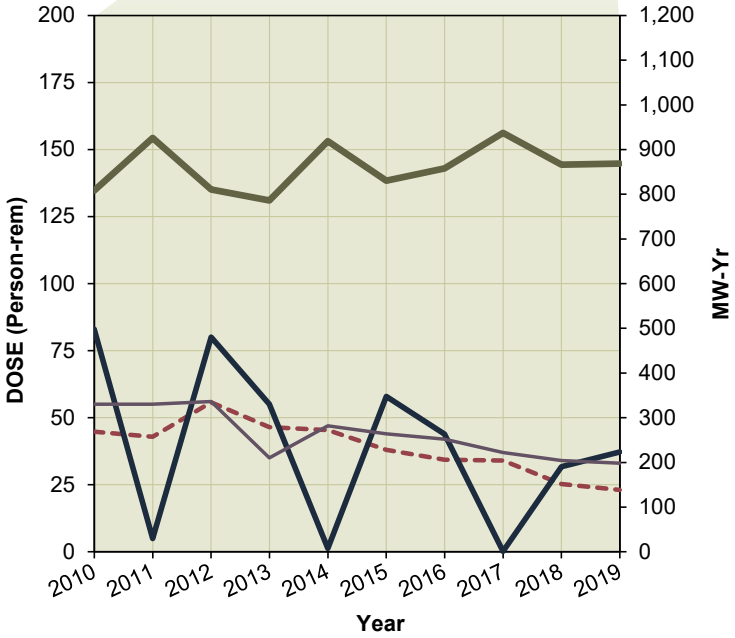
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	128.997	188.000	1,102.0
2011	80.058	21.000	1,180.0
2012	161.944	276.000	835.2
2013	110.970	35.000	1,231.1
2014	164.524	182.000	1,173.5
2015	80.812	25.241	1,337.8
2016	133.914	194.755	682.8
2017	86.749	40.251	849.1
2018	133.971	166.908	794.3
2019	80.766	35.139	1,259.4



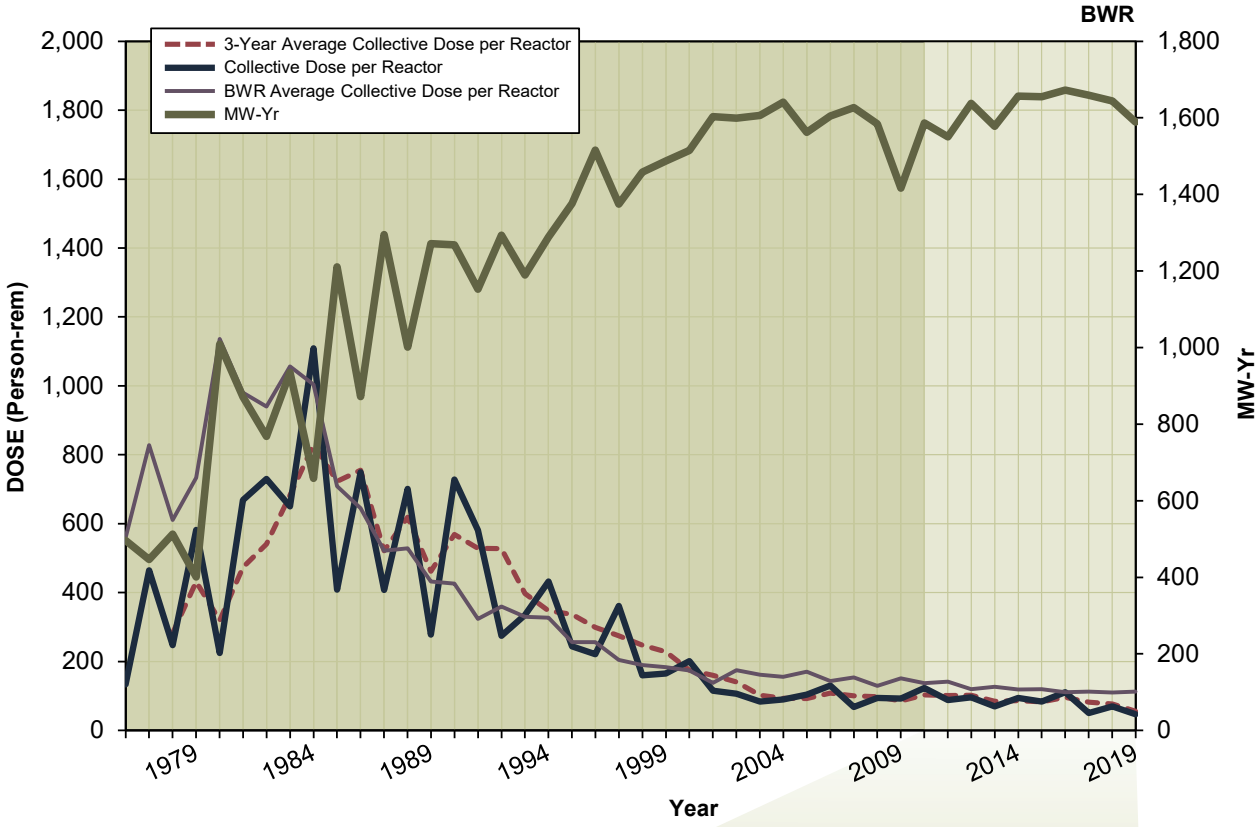
HARRIS 1
Dose Performance Trends



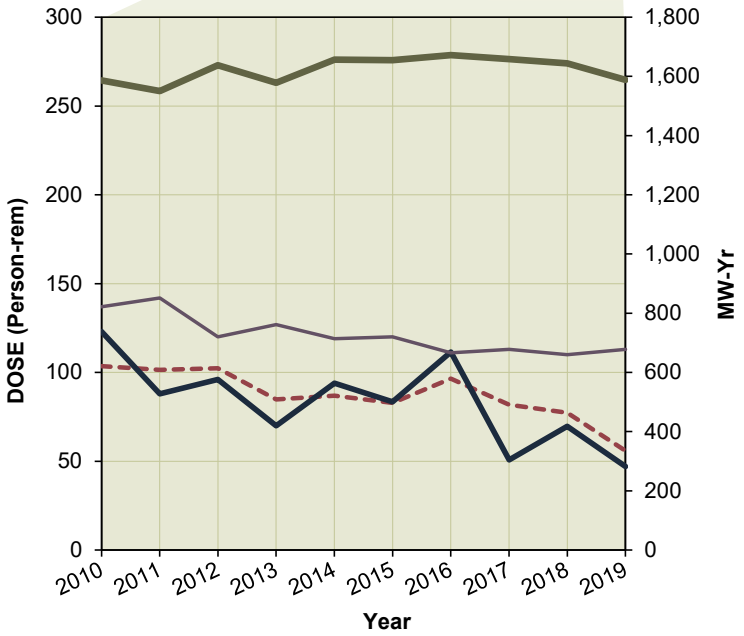
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	44.793	83.000	808.3
2011	42.901	5.000	926.0
2012	55.716	80.000	810.8
2013	46.481	55.000	786.3
2014	45.336	1.289	918.8
2015	38.047	57.978	830.2
2016	34.381	43.876	857.7
2017	34.024	0.217	937.1
2018	25.276	31.736	866.2
2019	23.059	37.223	868.8



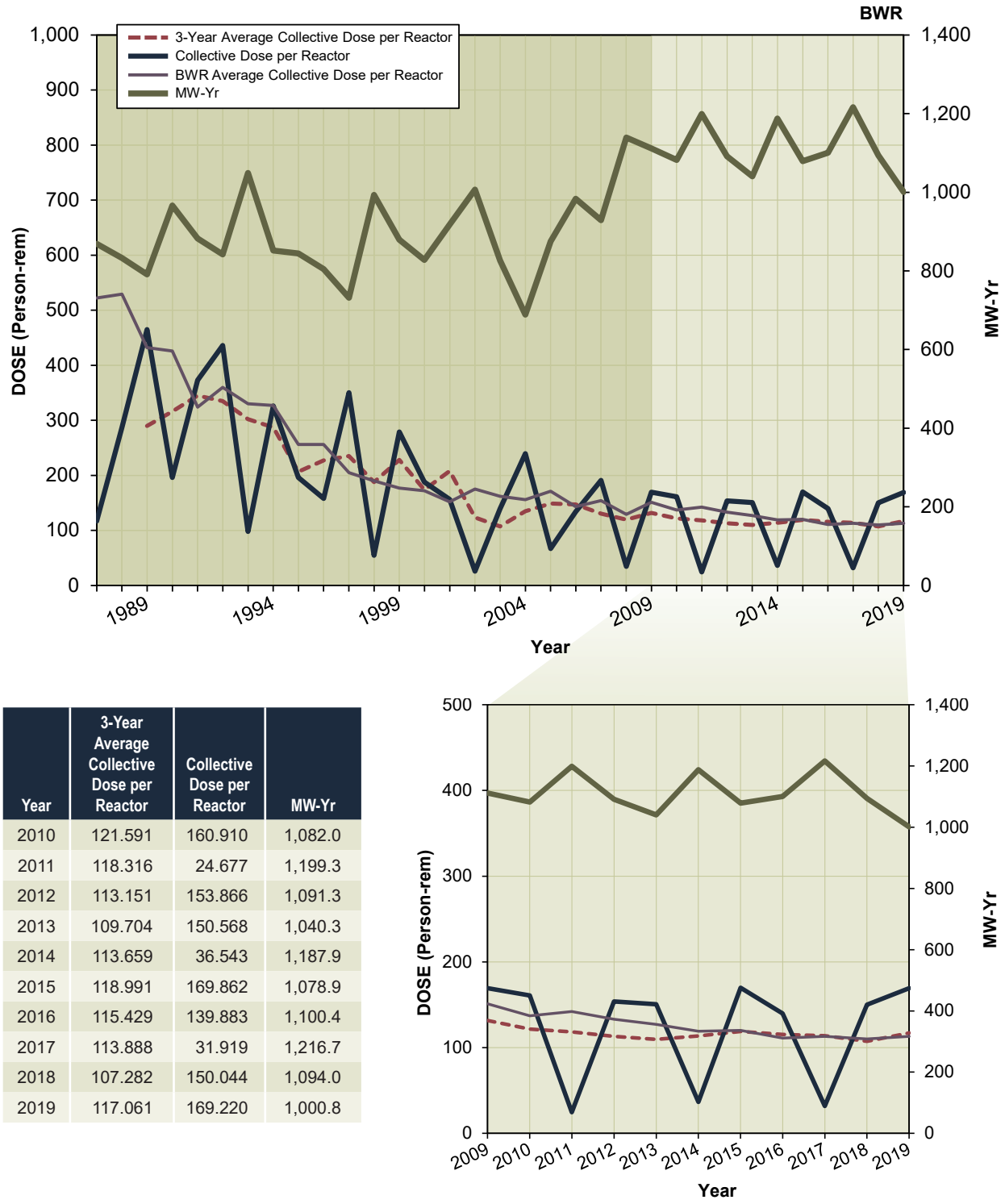
HATCH 1, 2
Dose Performance Trends



Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	103.535	123.000	1,586.9
2011	101.464	88.000	1,550.4
2012	102.327	96.000	1,637.5
2013	84.860	70.000	1,578.1
2014	86.935	94.000	1,656.4
2015	82.877	83.500	1,654.9
2016	96.522	111.433	1,672.1
2017	81.854	50.711	1,658.8
2018	77.276	69.684	1,644.2
2019	55.816	47.052	1,588.7

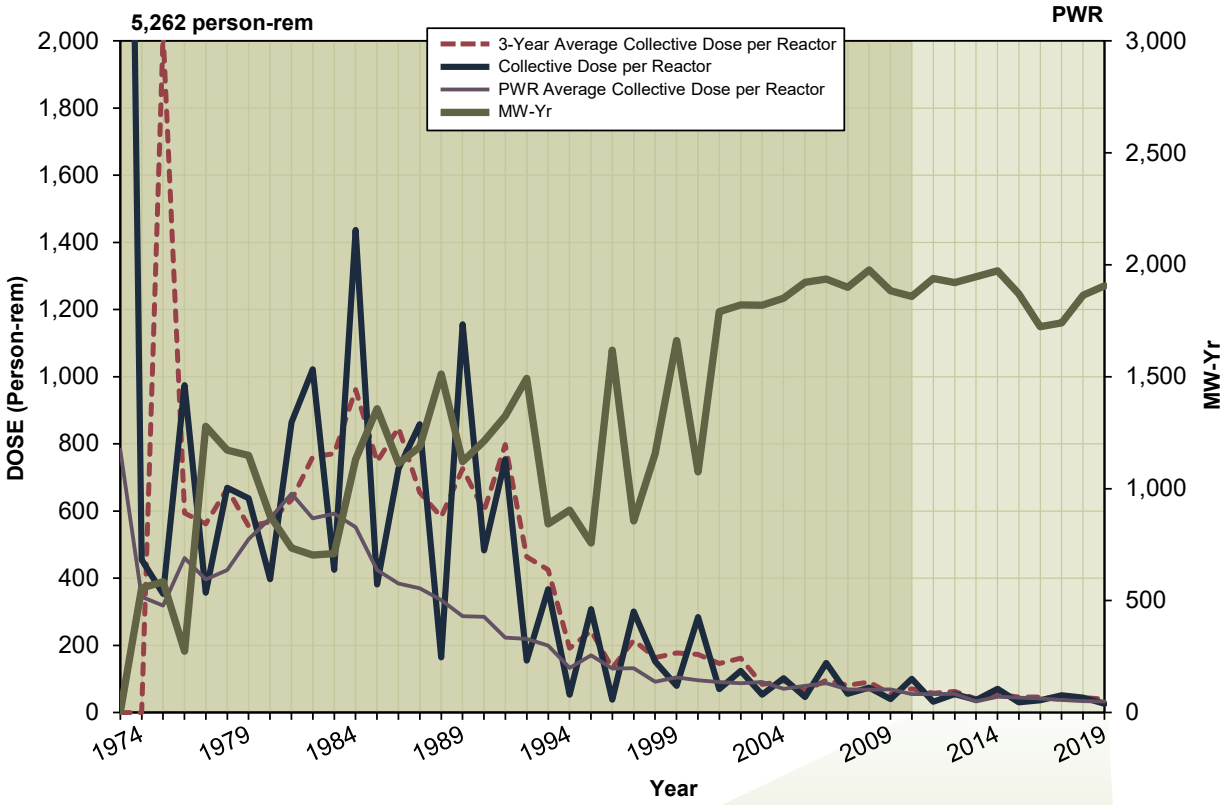


HOPE CREEK 1
Dose Performance Trends

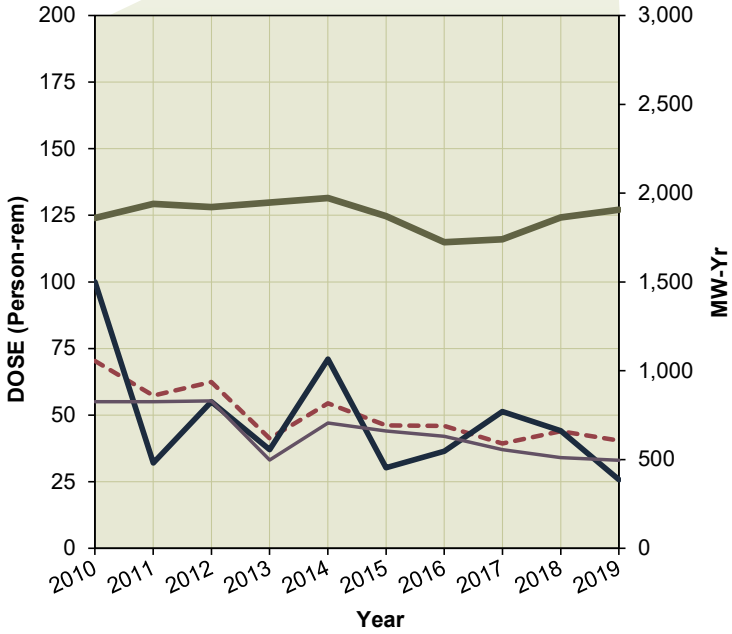


Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	121.591	160.910	1,082.0
2011	118.316	24.677	1,199.3
2012	113.151	153.866	1,091.3
2013	109.704	150.568	1,040.3
2014	113.659	36.543	1,187.9
2015	118.991	169.862	1,078.9
2016	115.429	139.883	1,100.4
2017	113.888	31.919	1,216.7
2018	107.282	150.044	1,094.0
2019	117.061	169.220	1,000.8

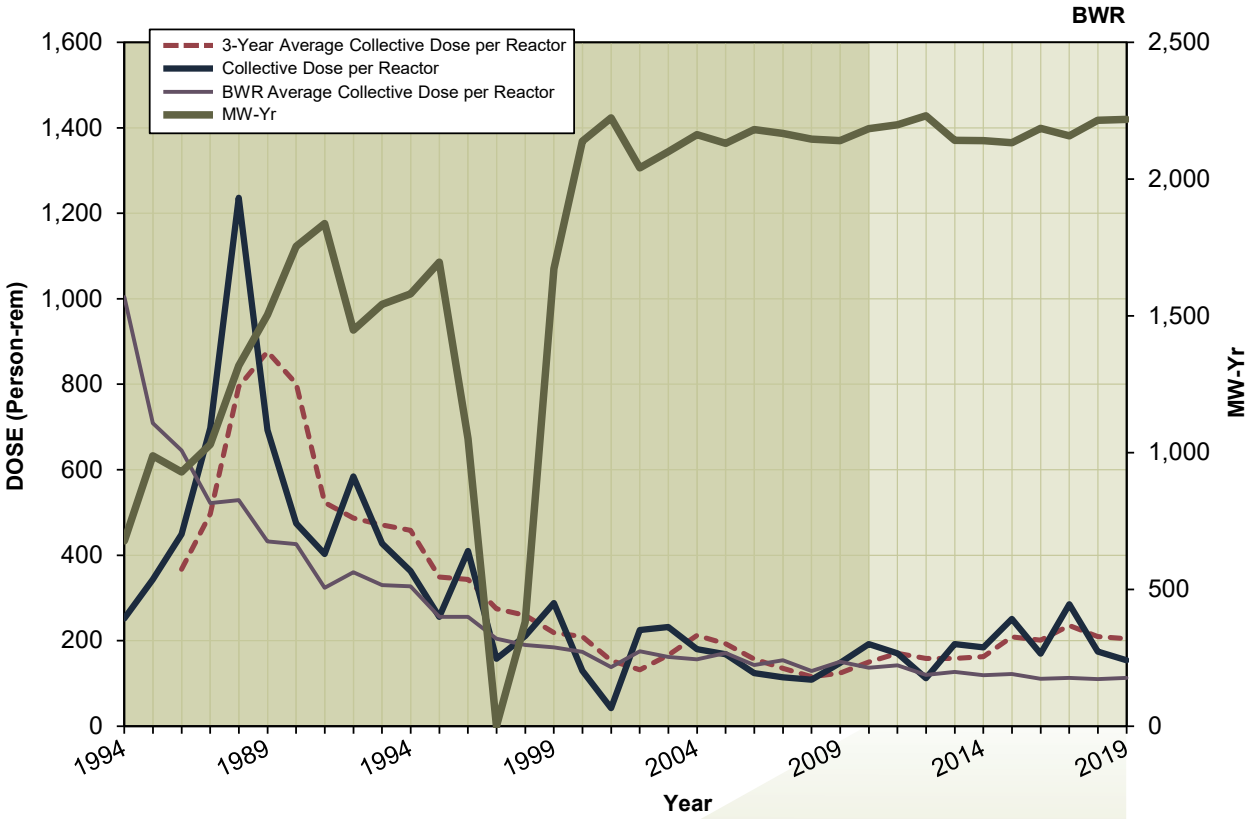
INDIAN POINT 2,3
Dose Performance Trends



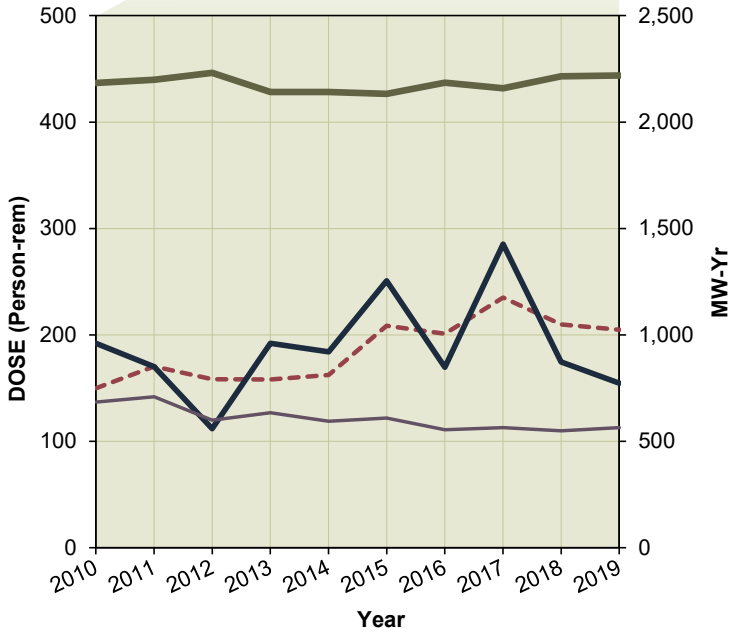
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	70.361	100.000	1,859.2
2011	57.326	32.000	1,938.8
2012	62.379	55.000	1,921.0
2013	41.230	37.000	1,946.6
2014	54.387	71.000	1,973.1
2015	46.165	30.238	1,870.1
2016	45.931	36.458	1,723.7
2017	39.354	51.368	1,740.7
2018	43.977	44.106	1,863.6
2019	40.393	25.707	1,905.9



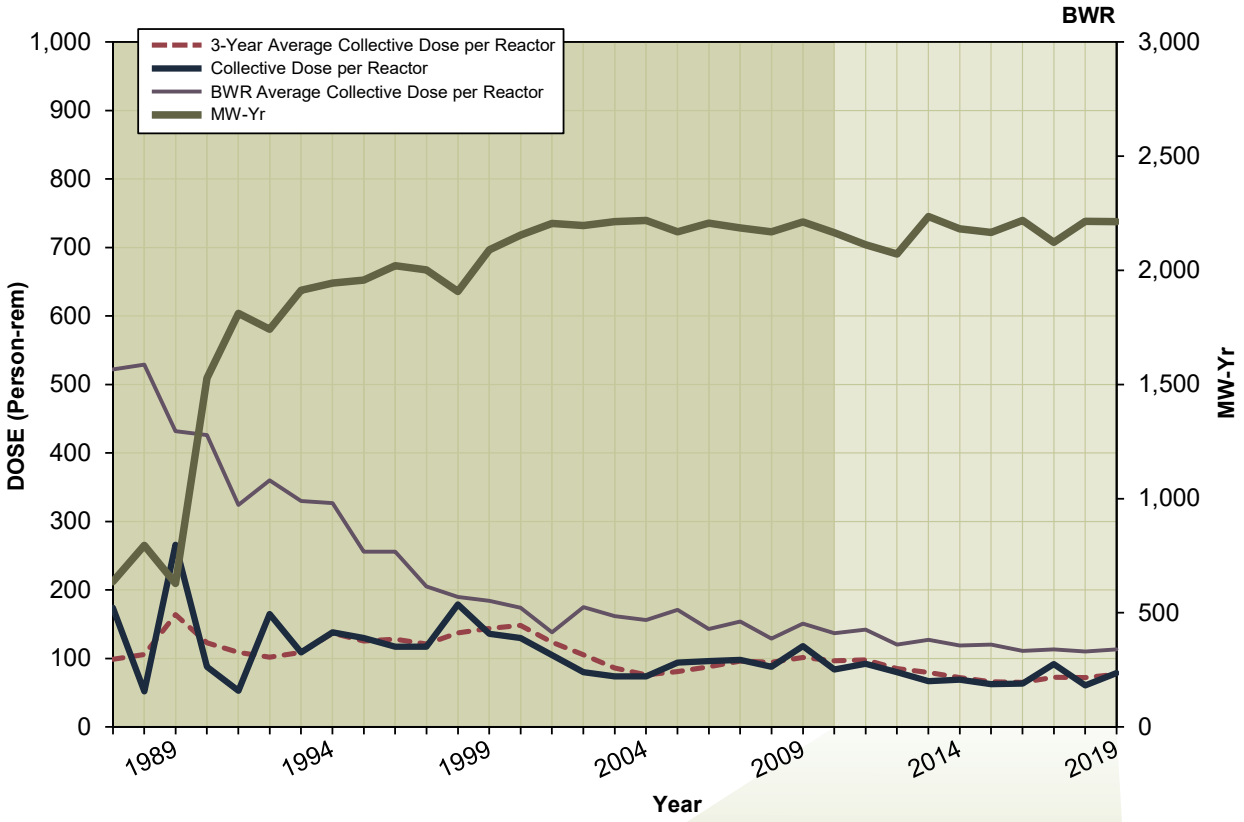
LASALLE 1, 2
Dose Performance Trends



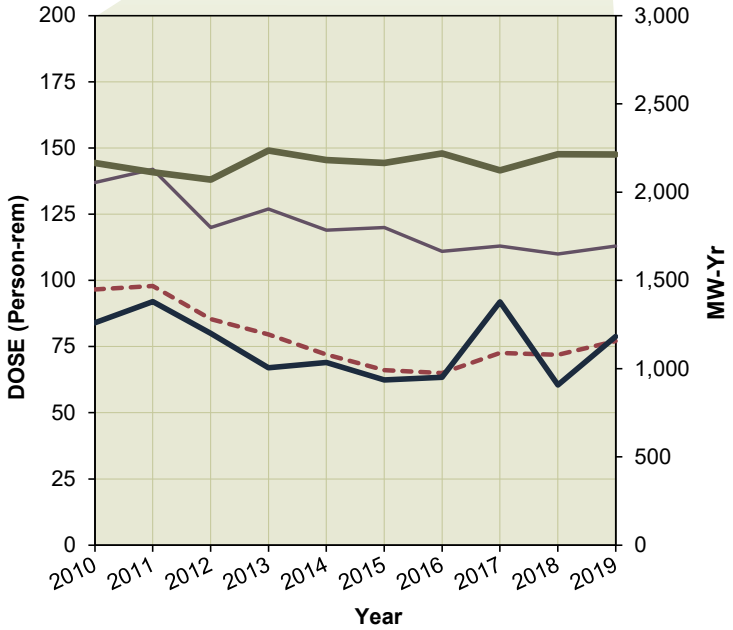
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	149.782	192.000	2,184.1
2011	170.270	170.000	2,198.2
2012	158.279	112.000	2,230.8
2013	158.144	192.000	2,141.6
2014	162.476	184.000	2,141.0
2015	208.635	250.833	2,132.9
2016	201.196	169.493	2,185.5
2017	235.173	285.195	2,158.5
2018	209.774	174.634	2,214.7
2019	204.798	154.565	2,218.6



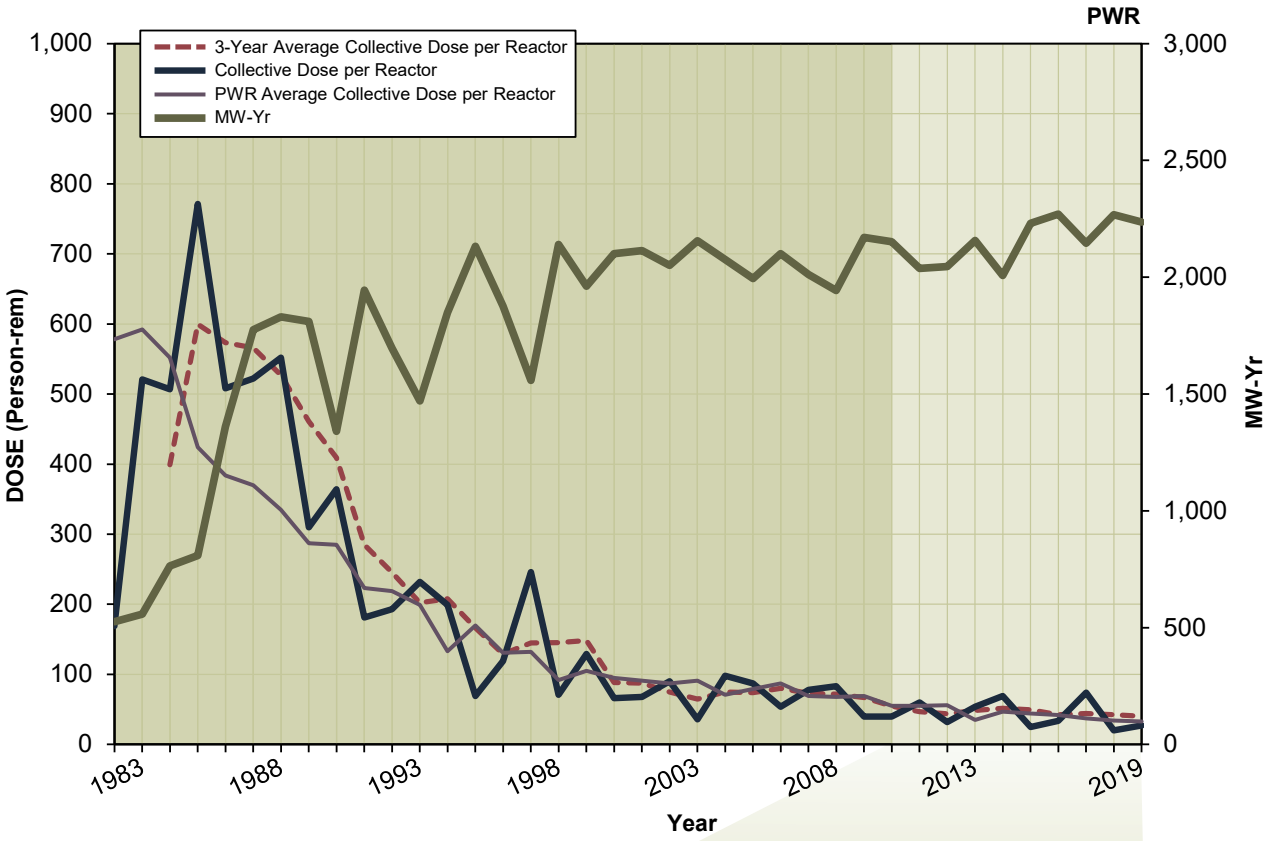
LIMERICK 1, 2
Dose Performance Trends



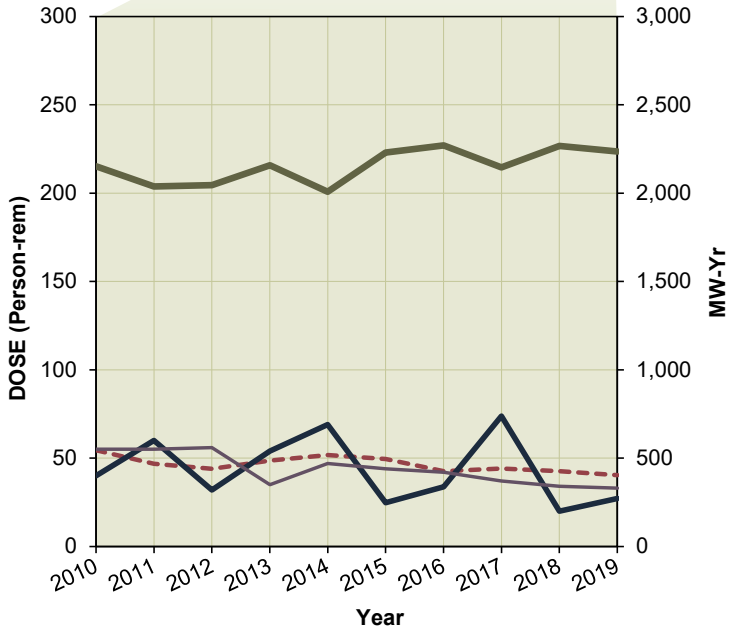
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	96.557	84.000	2,165.2
2011	97.826	92.000	2,112.7
2012	85.337	80.000	2,071.4
2013	79.626	67.000	2,235.7
2014	71.957	69.000	2,182.1
2015	66.119	62.394	2,165.6
2016	64.997	63.400	2,219.1
2017	72.554	91.868	2,123.1
2018	71.931	60.527	2,214.9
2019	77.043	78.736	2,213.1



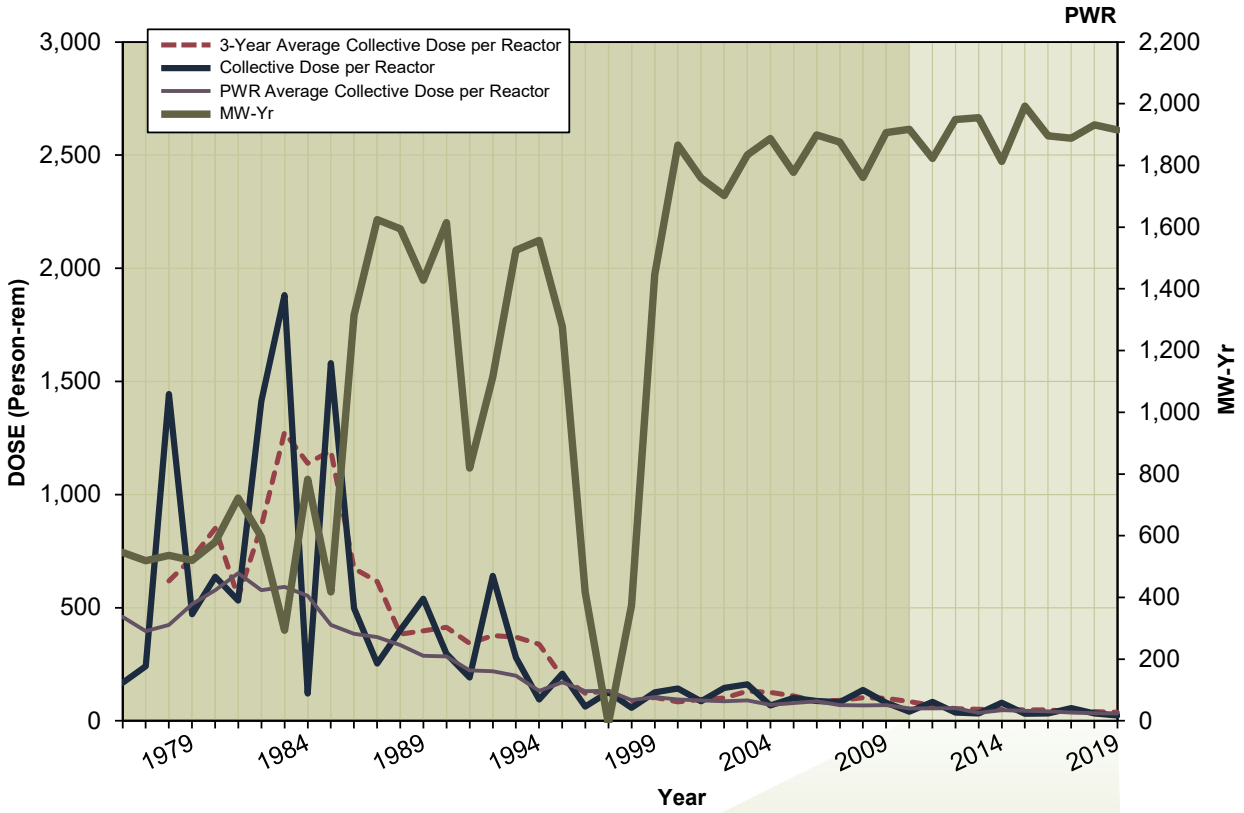
MCGUIRE 1, 2
Dose Performance Trends



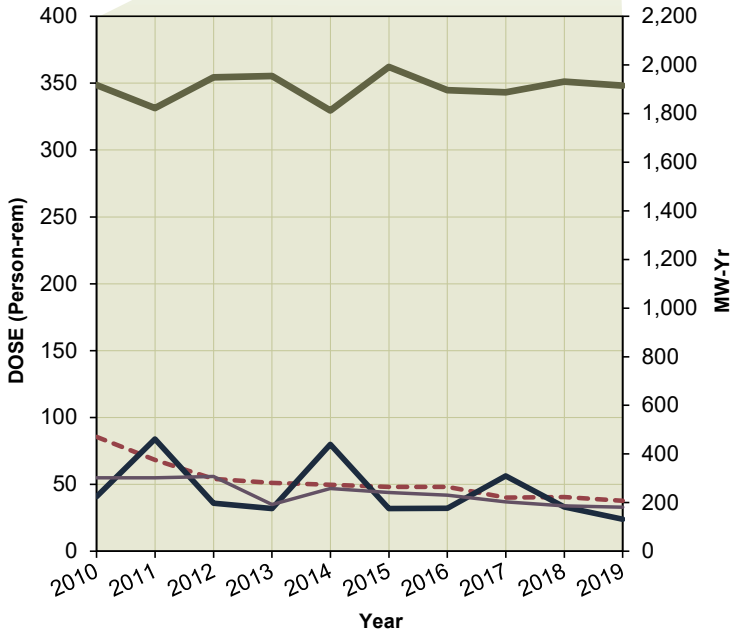
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	54.483	40.000	2,151.9
2011	46.789	60.000	2,038.3
2012	43.941	32.000	2,045.6
2013	48.625	54.000	2,157.3
2014	51.728	69.000	2,008.0
2015	49.513	24.700	2,230.1
2016	42.552	33.827	2,269.9
2017	44.107	73.795	2,145.6
2018	42.541	20.003	2,267.4
2019	40.304	27.115	2,236.1



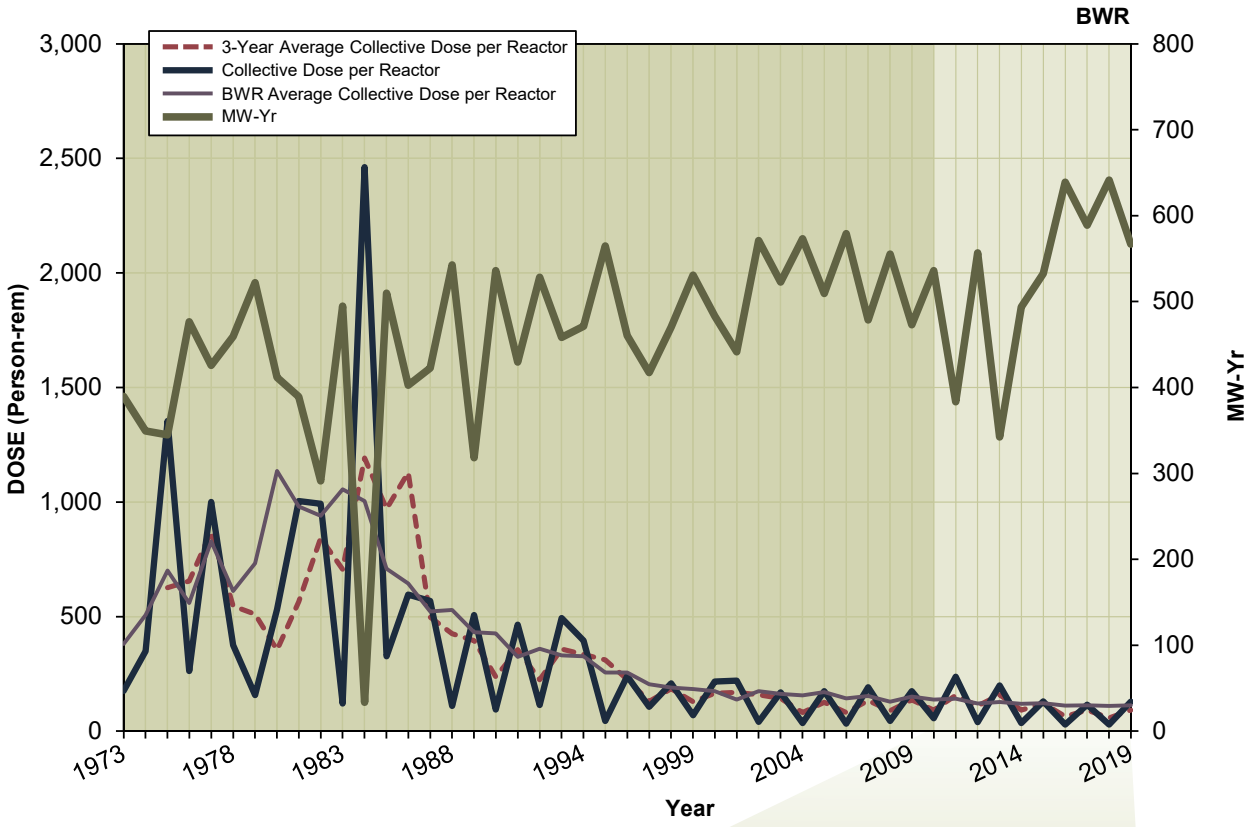
MILLSTONE 2, 3
Dose Performance Trends



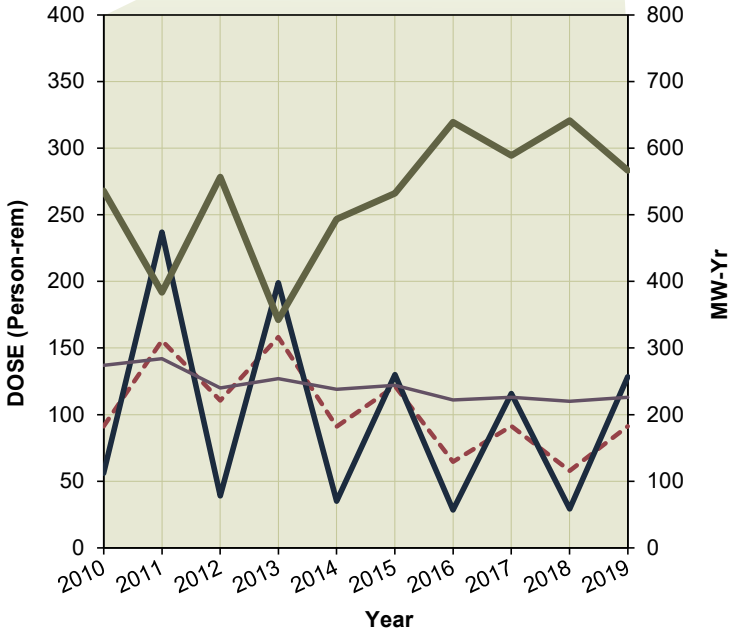
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	85.599	41.000	1,916.8
2011	68.368	84.000	1,822.7
2012	54.046	36.000	1,948.9
2013	51.153	32.000	1,954.5
2014	49.667	80.000	1,812.7
2015	48.112	31.970	1,992.4
2016	48.095	32.063	1,896.1
2017	40.111	56.299	1,888.0
2018	40.472	33.055	1,931.7
2019	37.730	23.837	1,914.9



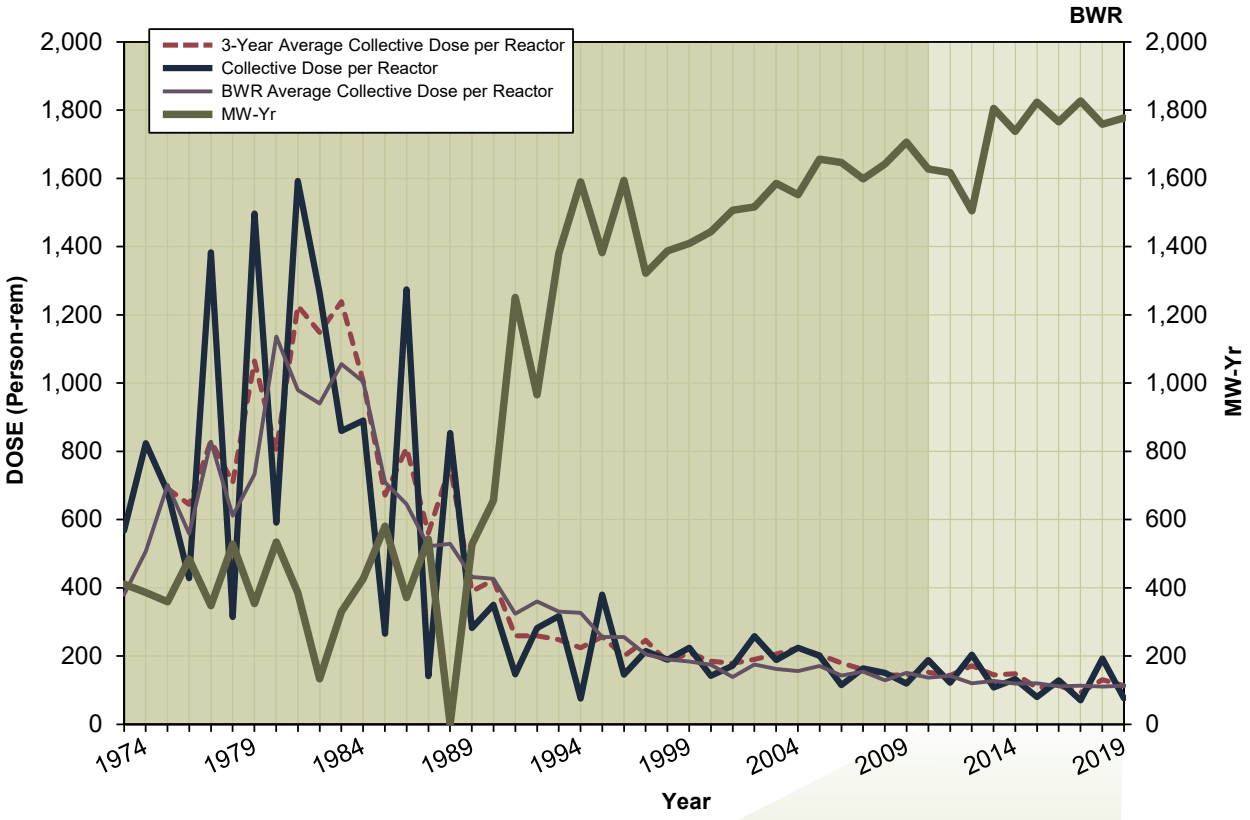
MONTICELLO
Dose Performance Trends



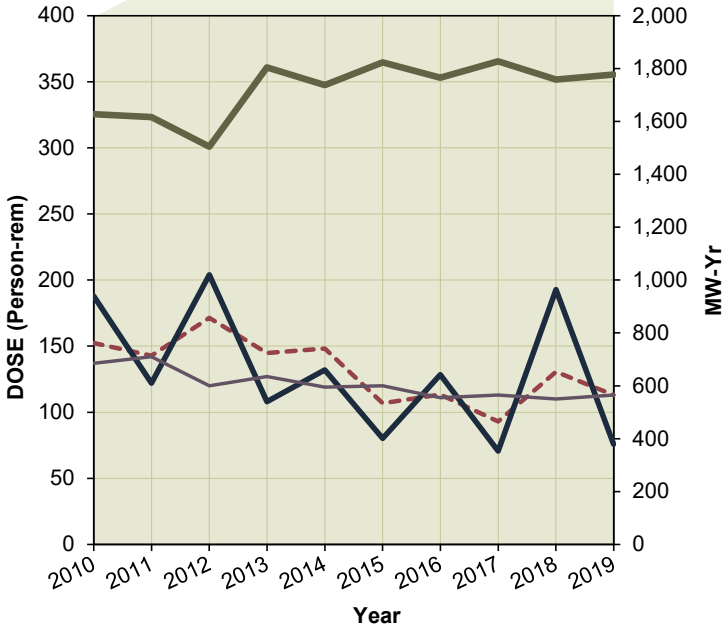
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	91.180	56.000	536.0
2011	155.579	237.000	383.4
2012	110.633	39.000	556.7
2013	158.250	199.000	342.3
2014	91.020	35.000	493.6
2015	121.444	130.057	532.4
2016	64.637	28.547	639.0
2017	91.473	115.814	589.0
2018	57.866	29.238	641.3
2019	91.159	128.425	566.7



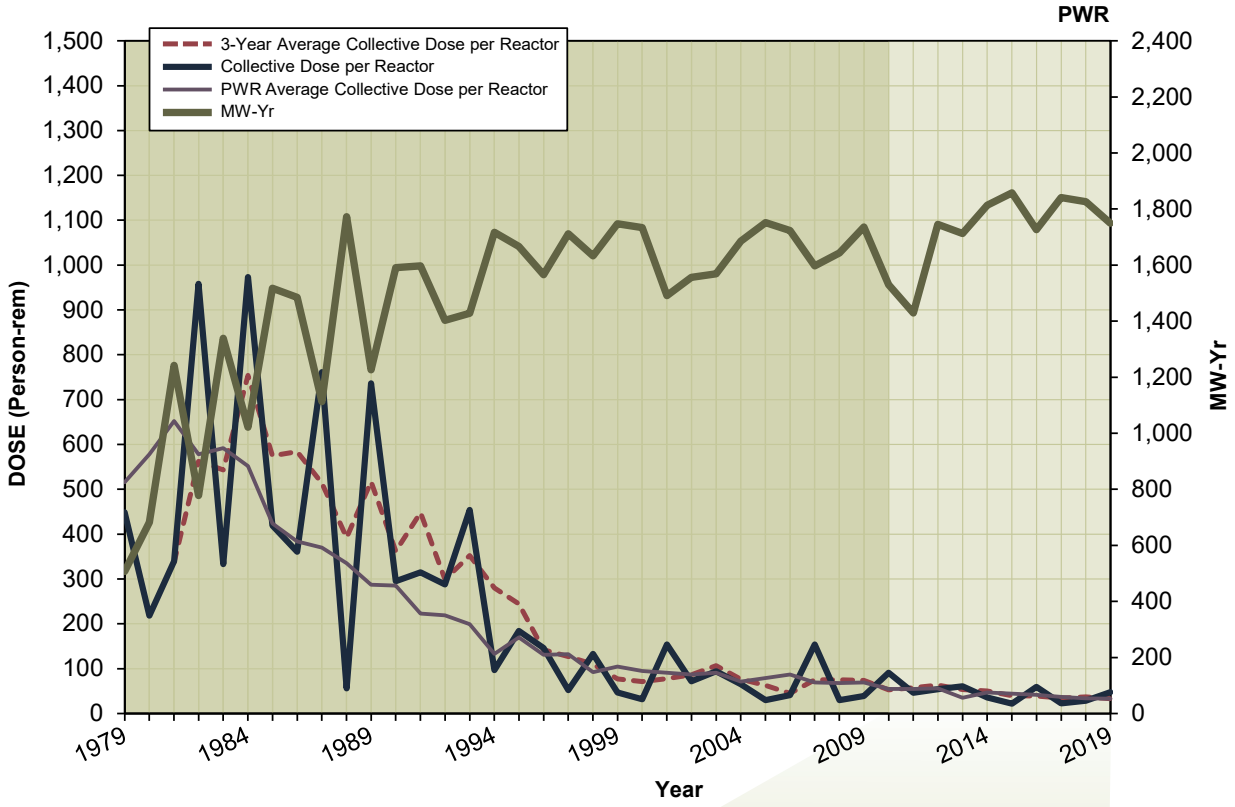
NINE MILE POINT 1, 2
Dose Performance Trends



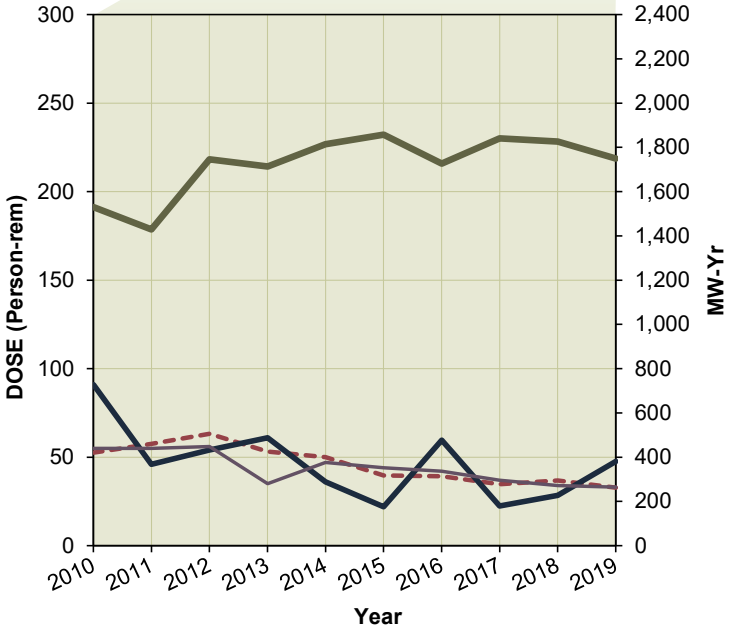
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	152.463	188.000	1,627.1
2011	142.895	122.000	1,616.8
2012	171.287	204.000	1,504.6
2013	144.892	108.000	1,804.9
2014	148.111	132.000	1,737.8
2015	106.858	80.190	1,823.7
2016	113.481	128.397	1,765.5
2017	93.054	70.575	1,827.3
2018	130.573	192.746	1,758.9
2019	113.060	75.860	1,777.2



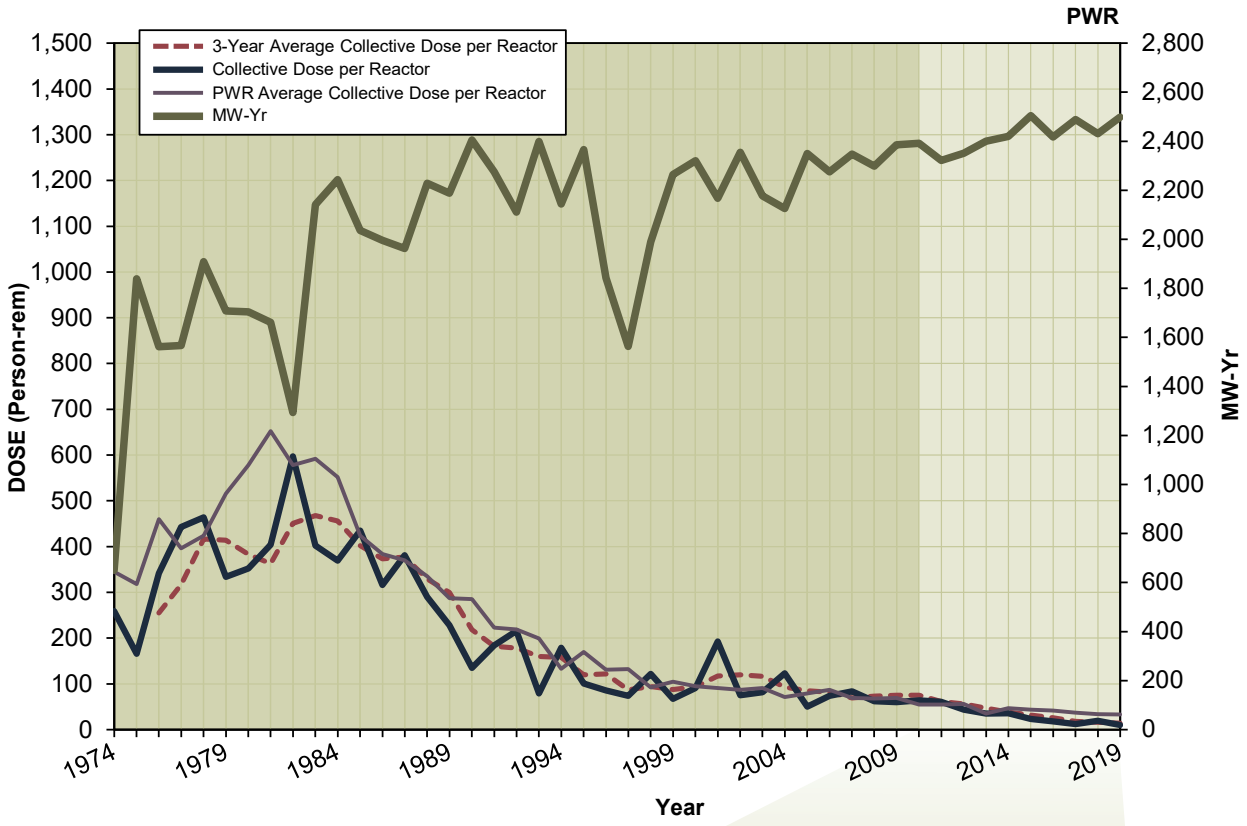
NORTH ANNA 1, 2
Dose Performance Trends



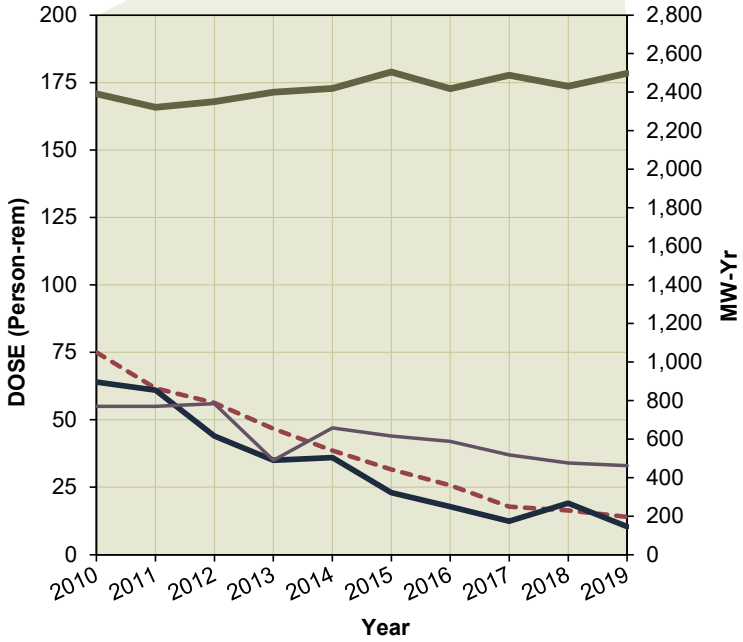
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	52.569	91.000	1,529.6
2011	57.530	46.000	1,429.1
2012	63.262	54.000	1,745.6
2013	53.181	61.000	1,712.9
2014	50.039	36.000	1,813.8
2015	39.593	21.919	1,857.4
2016	39.182	59.670	1,726.2
2017	34.677	22.442	1,840.9
2018	36.845	28.423	1,826.2
2019	32.836	47.644	1,749.4



OCONEE 1, 2, 3
Dose Performance Trends

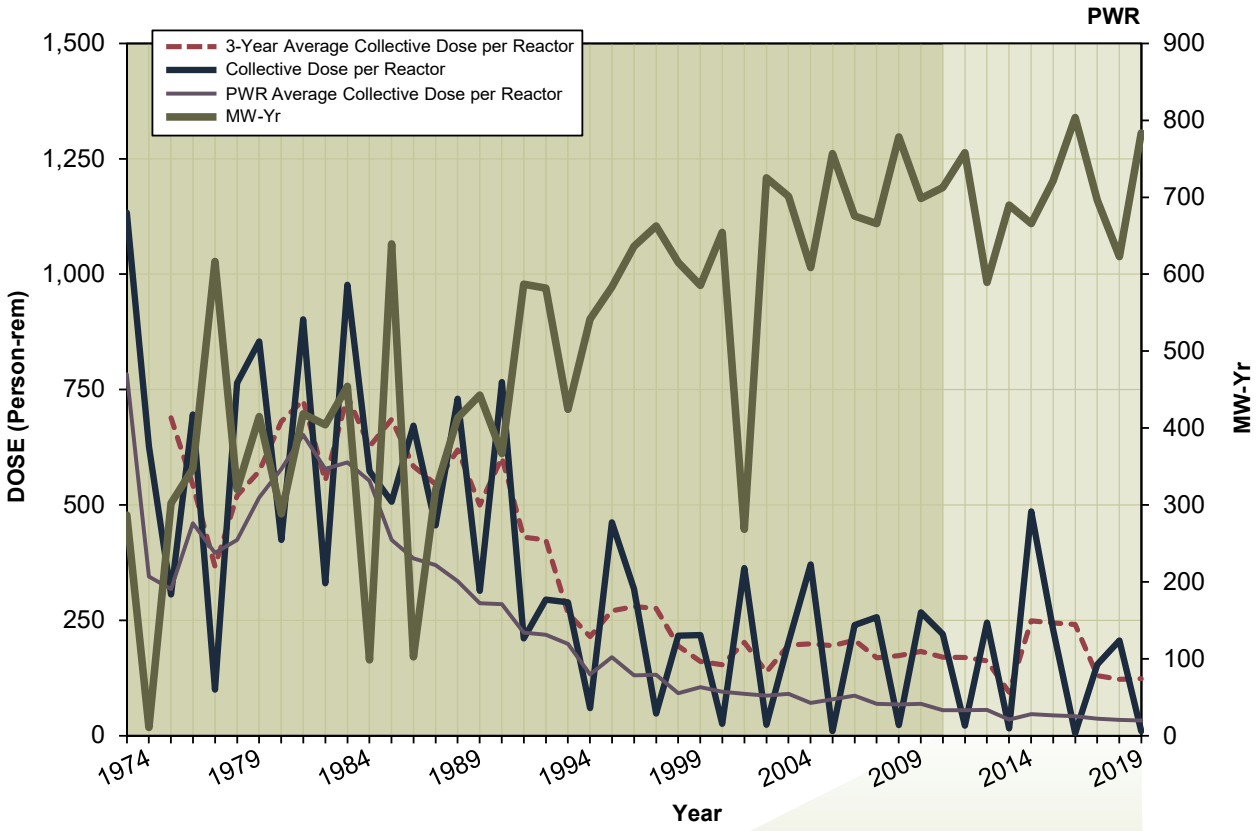


Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	74.979	64.000	2,391.1
2011	61.667	61.000	2,321.6
2012	56.310	44.000	2,351.0
2013	46.680	35.000	2,400.1
2014	38.541	36.000	2,419.3
2015	31.608	23.017	2,504.5
2016	25.718	17.799	2,417.5
2017	17.750	12.434	2,488.4
2018	16.433	19.067	2,430.8
2019	13.960	10.379	2,498.3

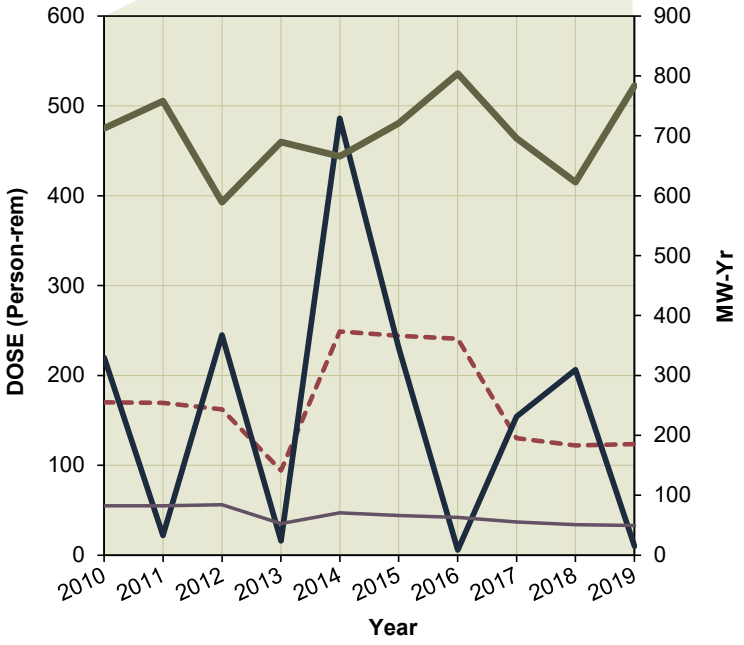


PALISADES

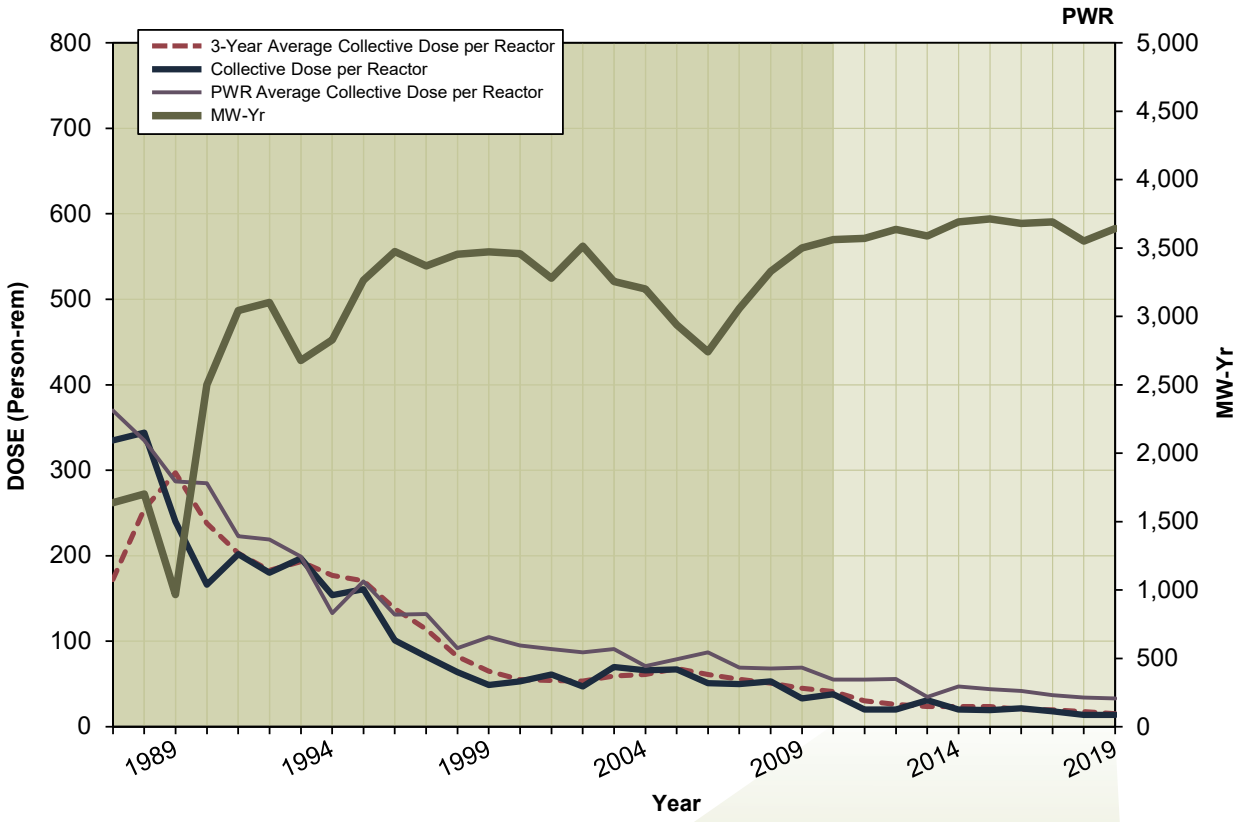
Dose Performance Trends



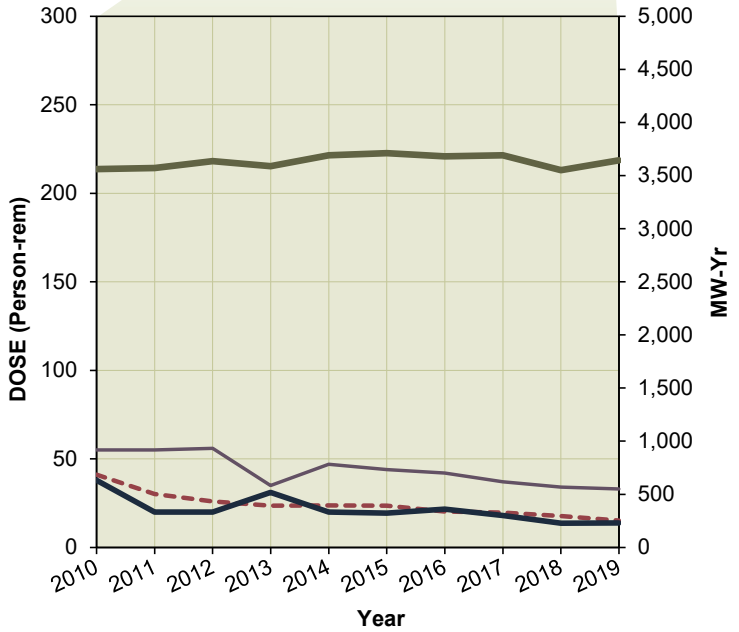
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	170.223	220.000	712.5
2011	169.607	22.000	758.1
2012	162.219	245.000	589.5
2013	94.204	16.000	689.7
2014	249.007	486.000	665.6
2015	244.193	230.687	721.3
2016	240.805	5.667	803.8
2017	130.165	154.142	696.1
2018	122.031	206.284	622.8
2019	123.492	10.051	783.6



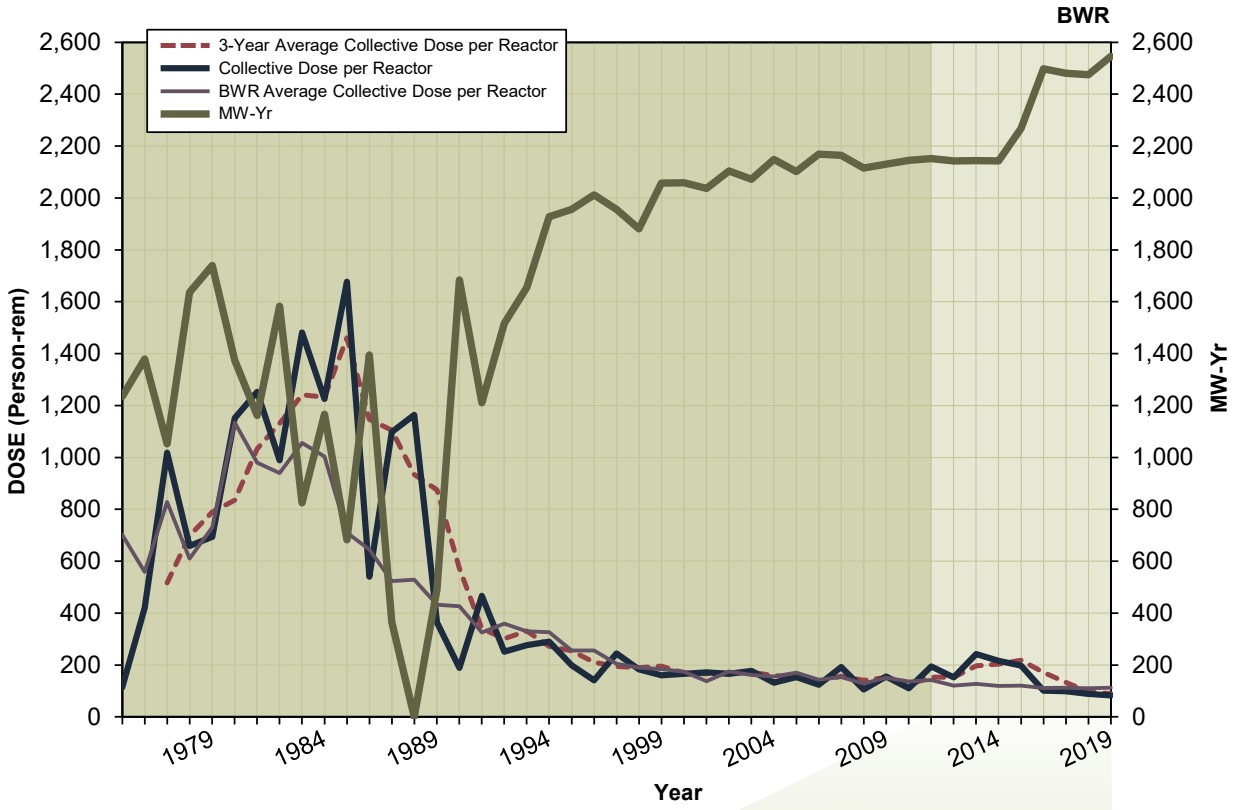
PALO VERDE 1, 2, 3
Dose Performance Trends



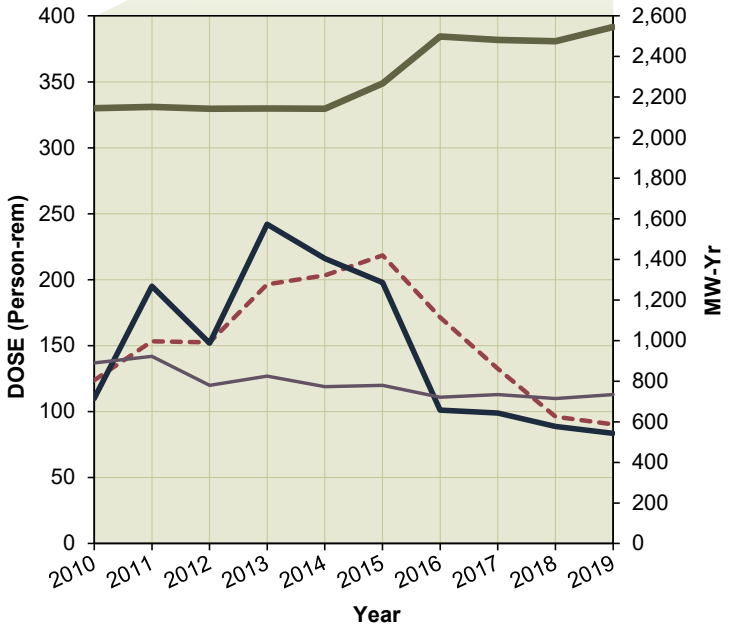
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	41.157	38.000	3,561.6
2011	30.210	20.000	3,570.5
2012	25.953	20.000	3,635.5
2013	23.583	31.000	3,588.0
2014	23.701	20.000	3,689.9
2015	23.523	19.332	3,711.7
2016	20.310	21.599	3,680.7
2017	19.631	17.963	3,691.8
2018	17.754	13.701	3,551.0
2019	15.139	13.754	3,643.8



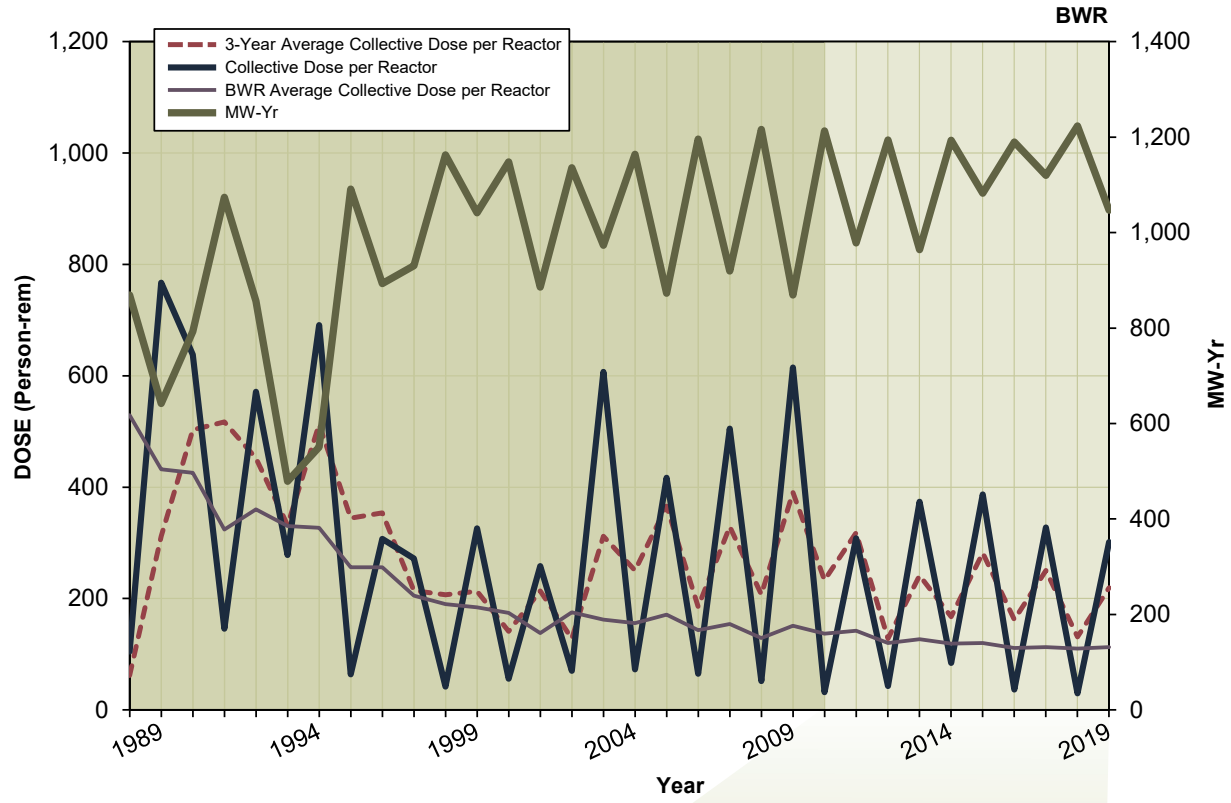
PEACH BOTTOM 2, 3
Dose Performance Trends



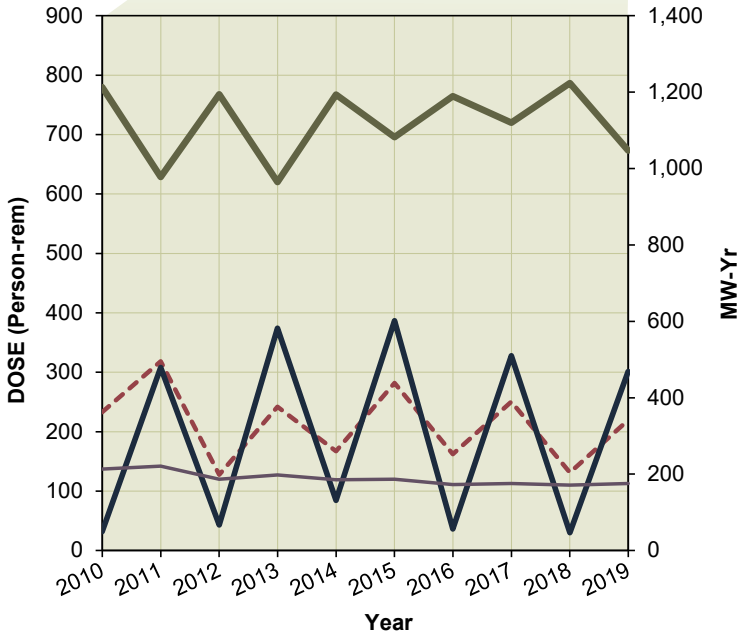
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	123.782	110.000	2,145.3
2011	153.284	195.000	2,152.0
2012	152.436	152.000	2,142.5
2013	196.530	242.000	2,143.5
2014	203.385	216.000	2,142.3
2015	218.412	197.799	2,267.6
2016	171.460	101.111	2,498.1
2017	132.605	98.907	2,481.1
2018	96.229	88.669	2,474.9
2019	90.372	83.542	2,545.2



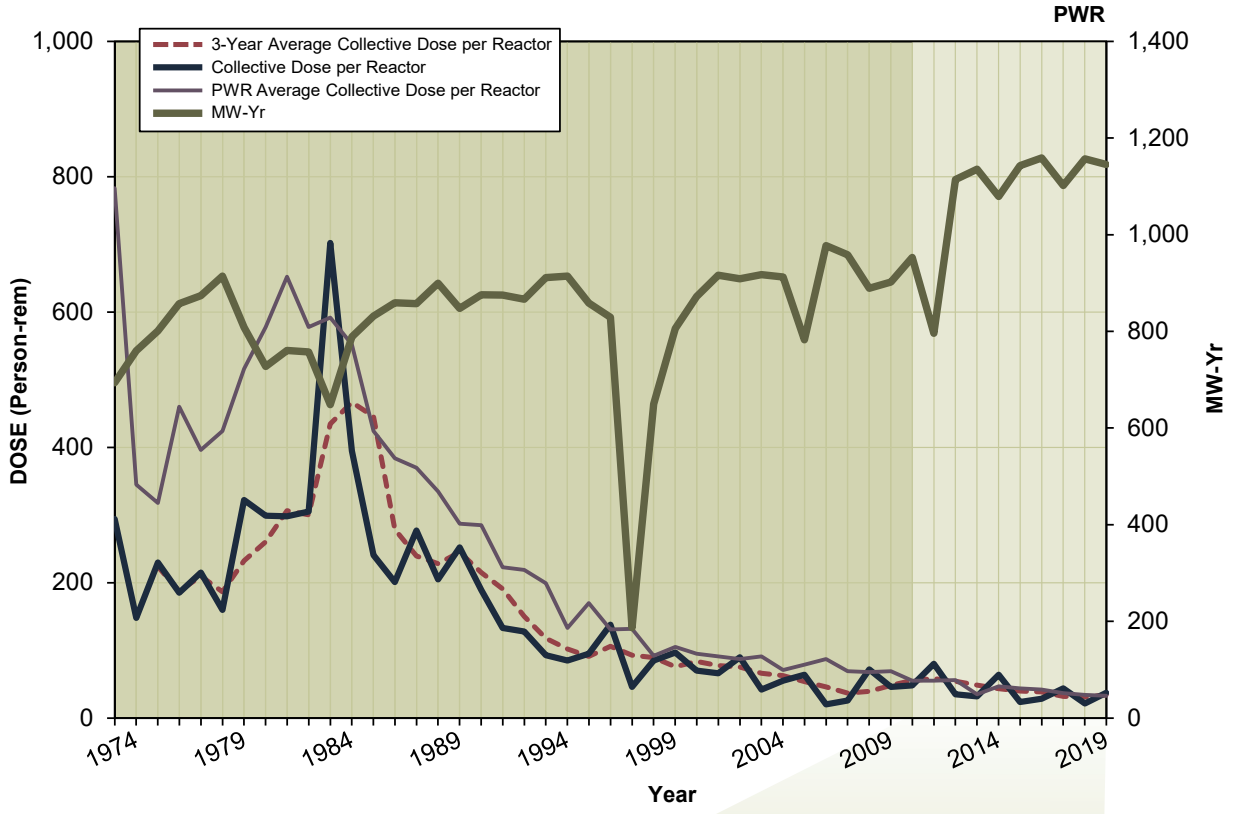
PERRY
Dose Performance Trends



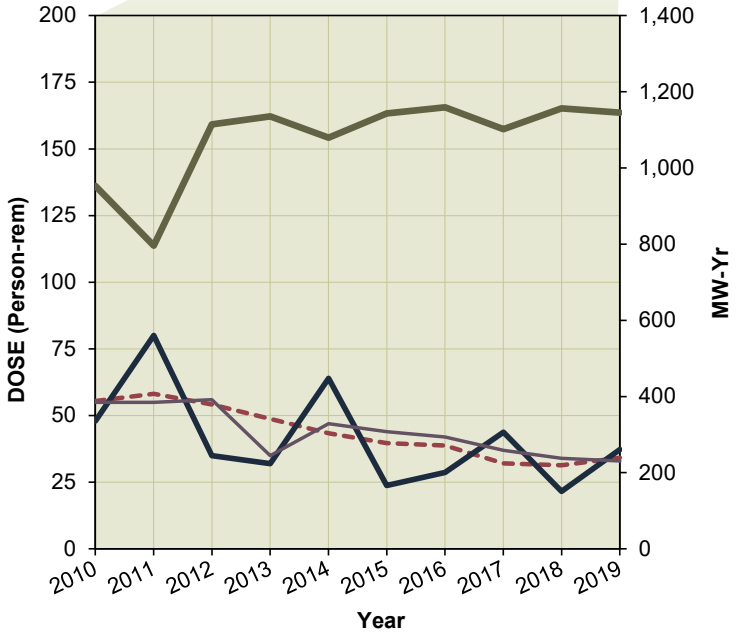
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	233.082	32.000	1,213.3
2011	318.350	308.000	978.2
2012	127.822	43.000	1,194.3
2013	241.675	374.000	964.5
2014	167.246	84.617	1,193.5
2015	281.714	386.778	1,082.5
2016	162.261	36.389	1,189.5
2017	250.295	327.717	1,120.1
2018	131.318	29.848	1,223.6
2019	219.544	301.067	1,047.2



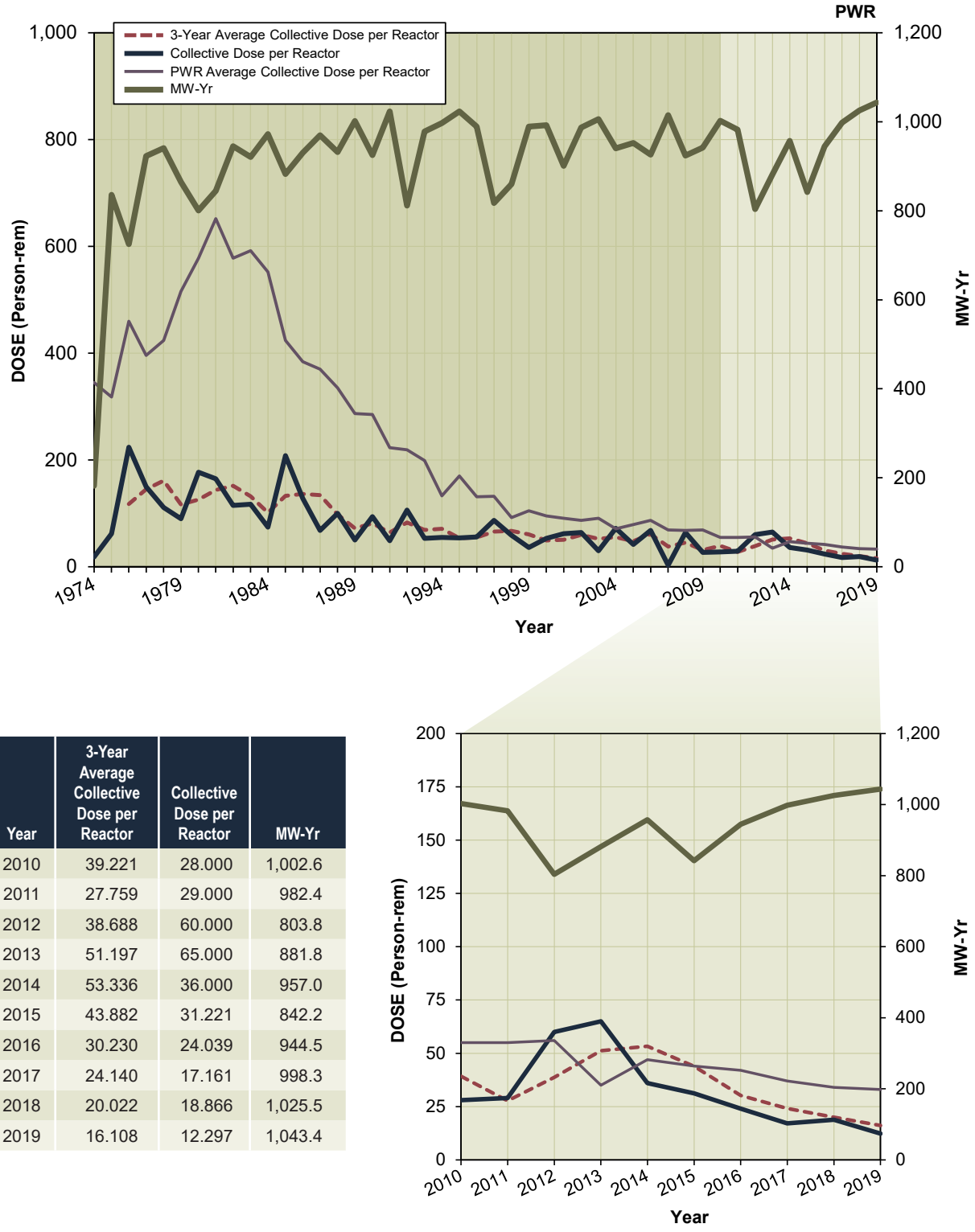
POINT BEACH 1, 2
Dose Performance Trends



Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	55.494	48.000	952.8
2011	58.108	80.000	796.2
2012	54.189	35.000	1,114.3
2013	48.764	32.000	1,135.3
2014	43.404	64.000	1,079.4
2015	39.690	23.737	1,142.9
2016	38.715	28.647	1,159.0
2017	32.041	43.740	1,102.0
2018	31.334	21.614	1,156.7
2019	34.199	37.243	1,145.3

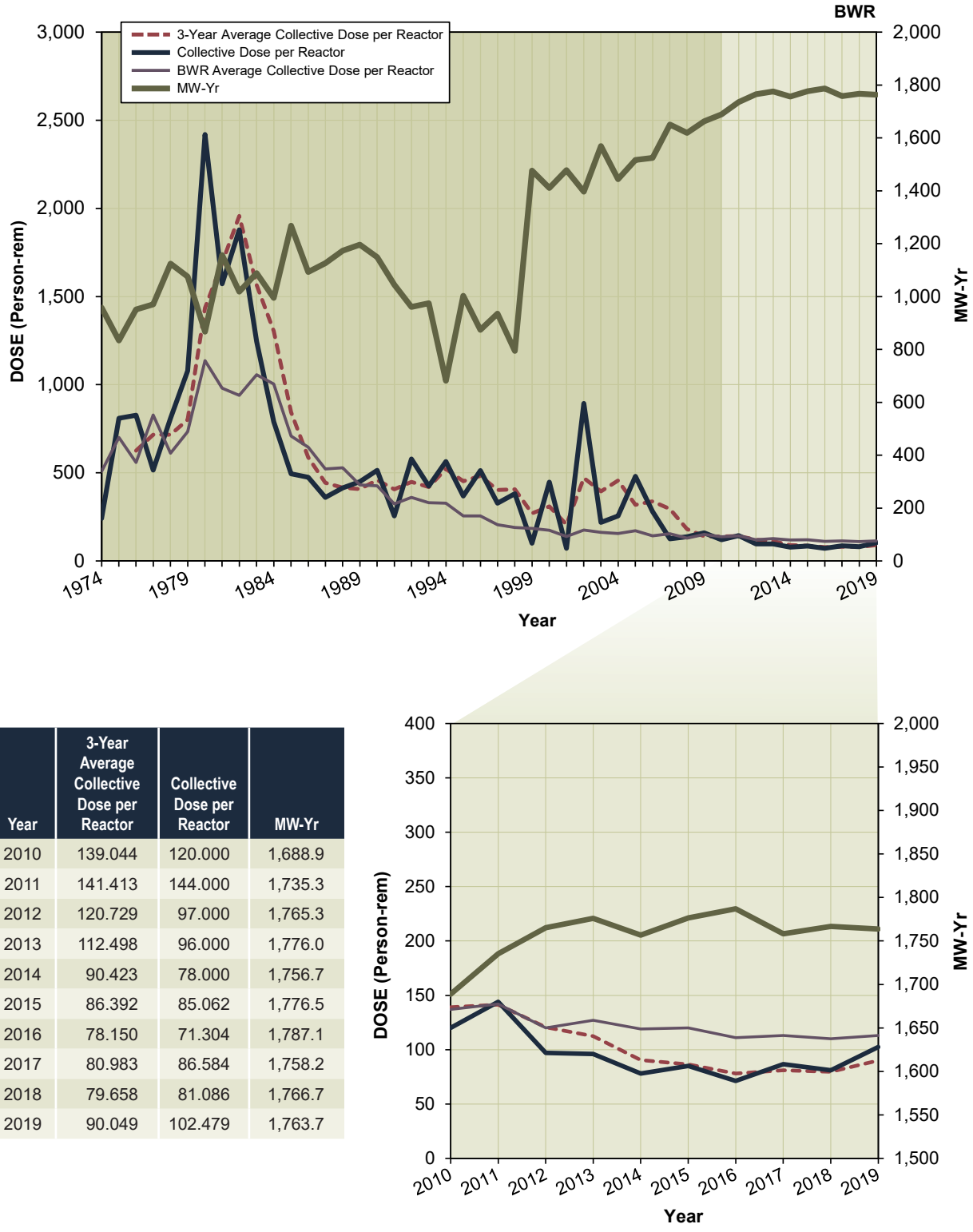


PRAIRIE ISLAND 1, 2
Dose Performance Trends



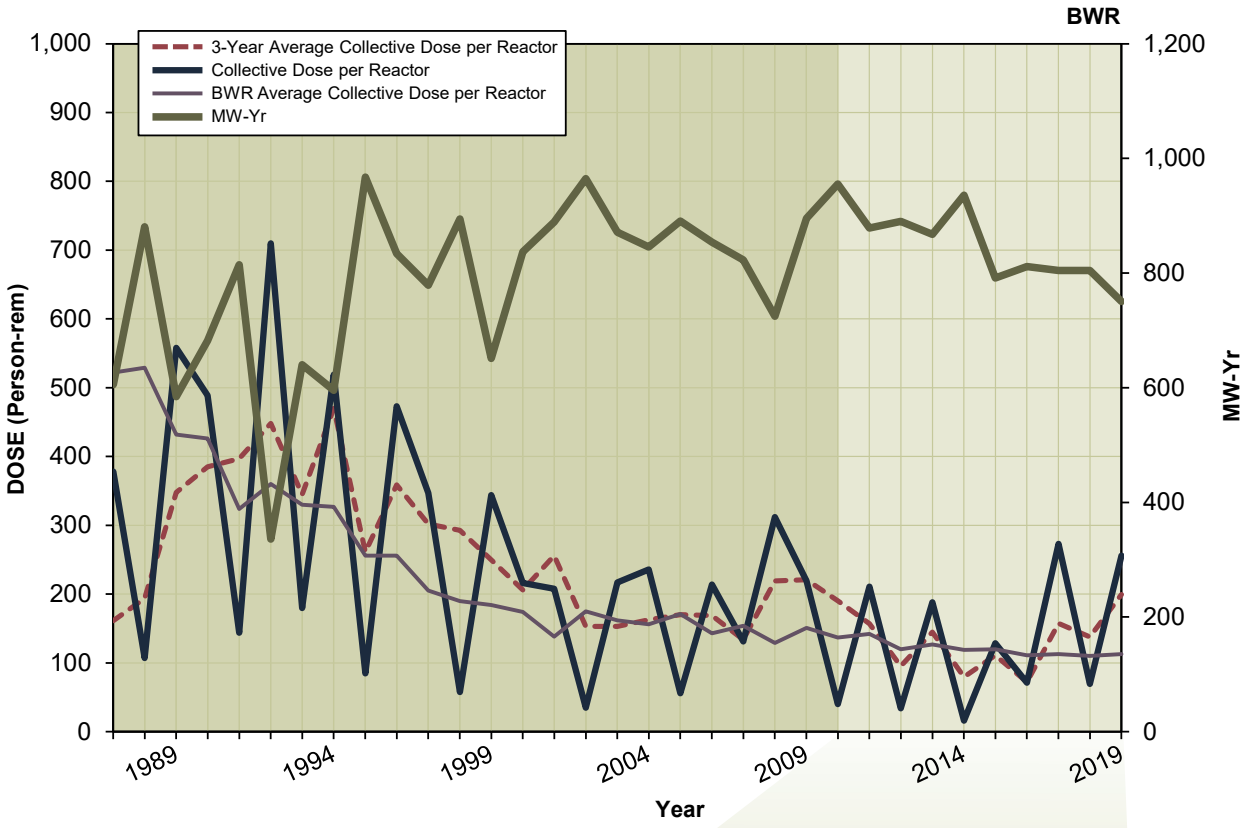
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	39.221	28.000	1,002.6
2011	27.759	29.000	982.4
2012	38.688	60.000	803.8
2013	51.197	65.000	881.8
2014	53.336	36.000	957.0
2015	43.882	31.221	842.2
2016	30.230	24.039	944.5
2017	24.140	17.161	998.3
2018	20.022	18.866	1,025.5
2019	16.108	12.297	1,043.4

QUAD CITIES 1, 2
Dose Performance Trends

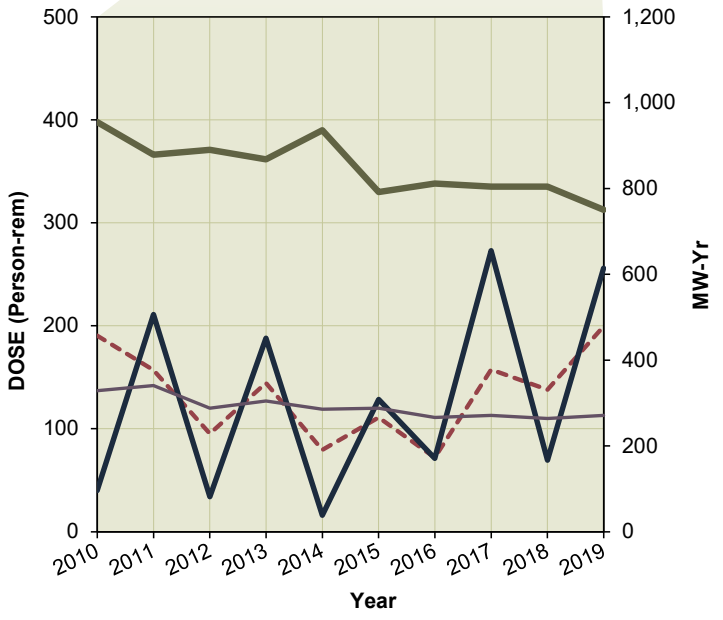


Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	139.044	120.000	1,688.9
2011	141.413	144.000	1,735.3
2012	120.729	97.000	1,765.3
2013	112.498	96.000	1,776.0
2014	90.423	78.000	1,756.7
2015	86.392	85.062	1,776.5
2016	78.150	71.304	1,787.1
2017	80.983	86.584	1,758.2
2018	79.658	81.086	1,766.7
2019	90.049	102.479	1,763.7

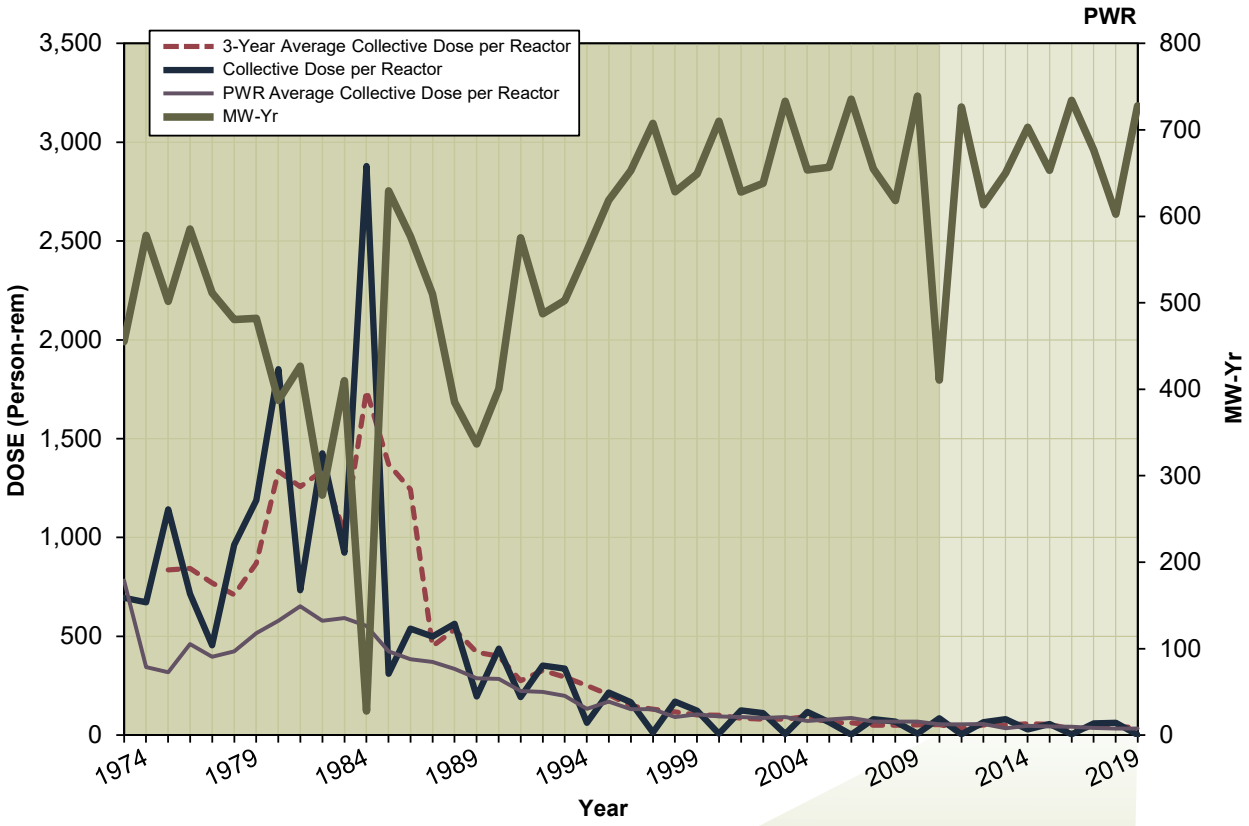
RIVER BEND 1
Dose Performance Trends



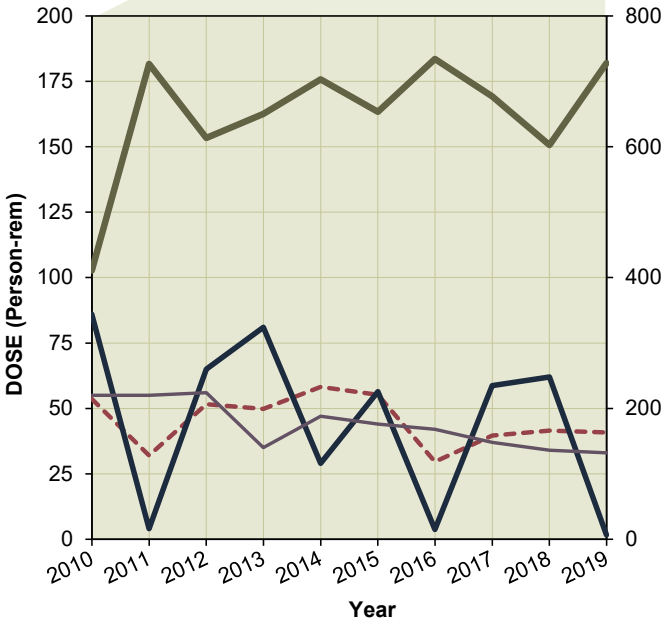
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	190.501	40.000	955.1
2011	157.005	211.000	878.6
2012	95.249	34.000	890.2
2013	144.574	188.000	867.6
2014	79.549	16.000	935.8
2015	110.99	128.492	791.6
2016	71.924	71.142	811.5
2017	157.546	273.004	804.5
2018	137.909	69.580	804.3
2019	199.501	255.918	750.5



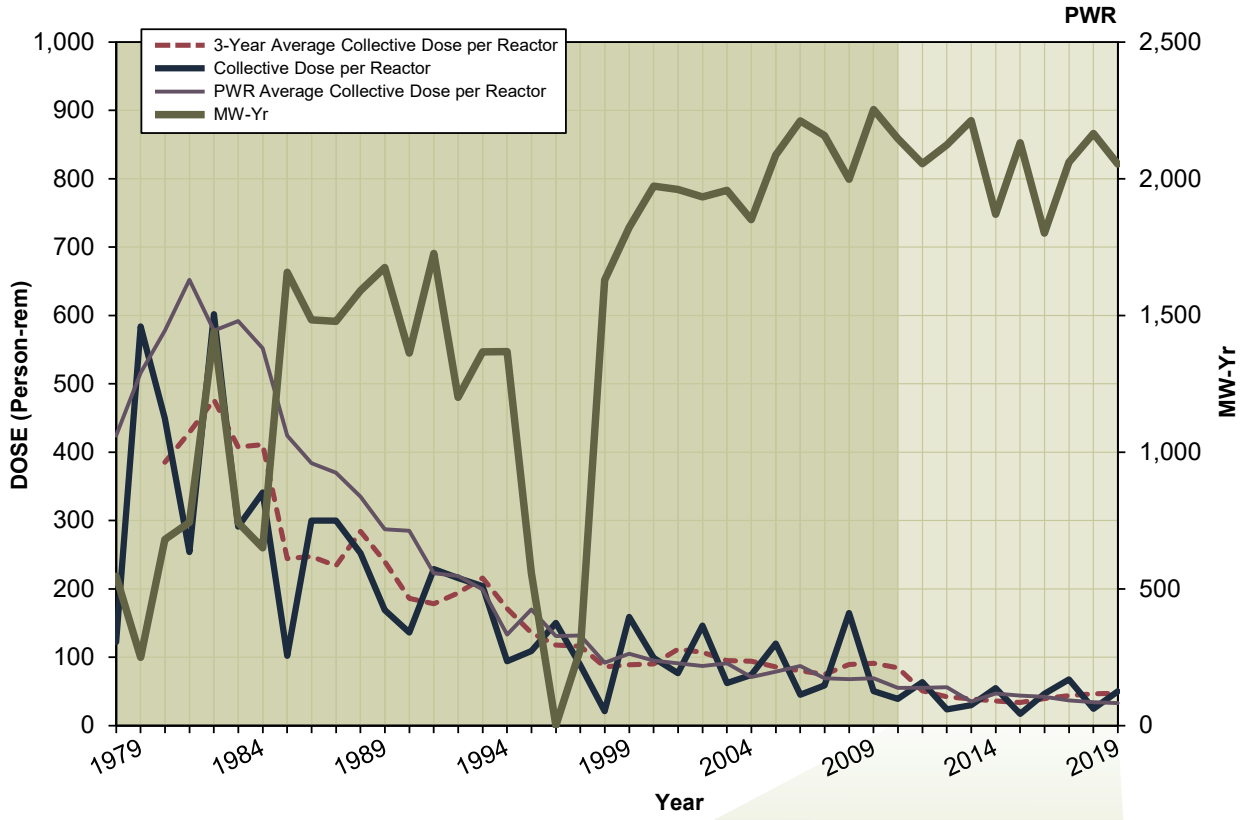
ROBINSON 2
Dose Performance Trends



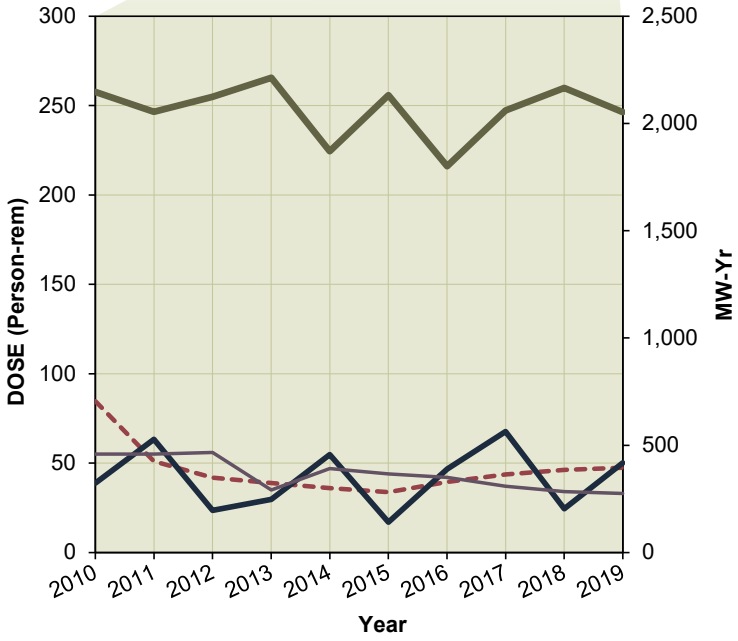
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	53.653	86.000	410.8
2011	32.063	4.000	726.5
2012	51.602	65.000	613.4
2013	49.828	81.000	650.3
2014	58.173	29.000	703.1
2015	55.211	56.373	653.4
2016	29.581	3.704	734.3
2017	39.605	58.739	676.9
2018	41.480	61.998	602.5
2019	40.802	1.668	727.9



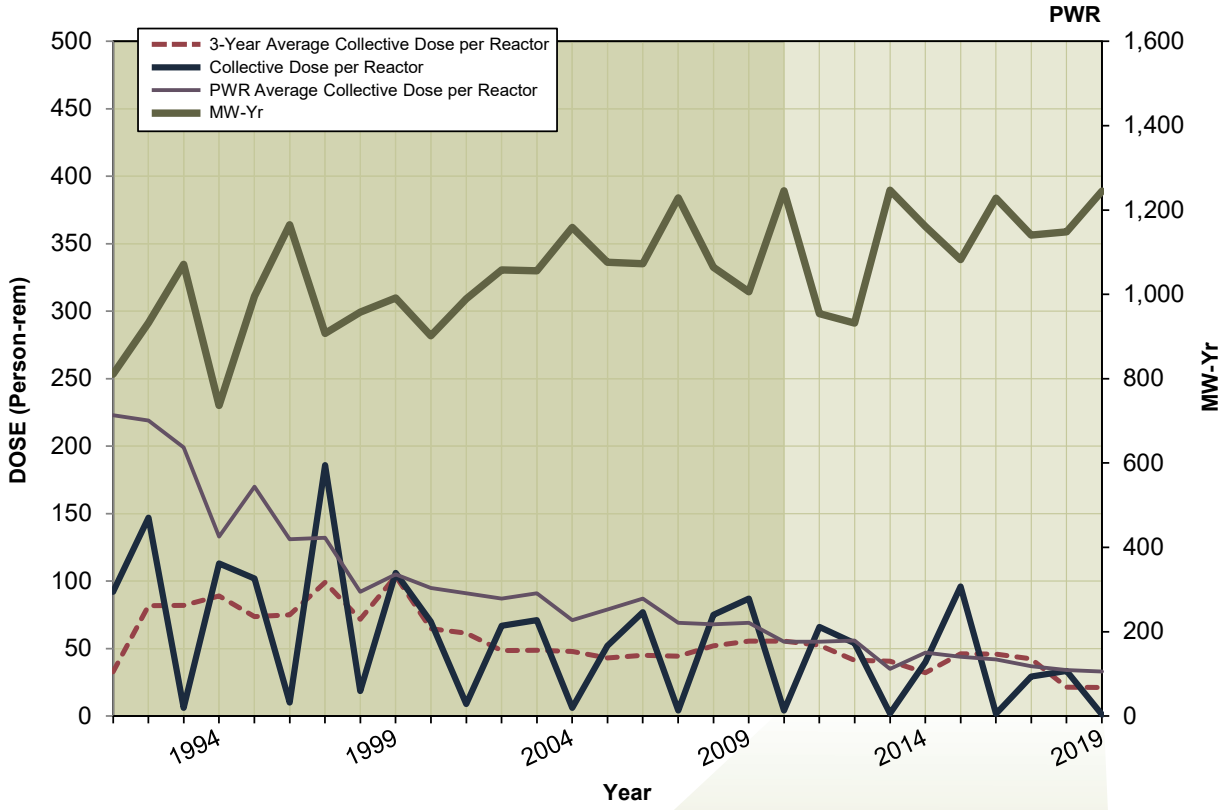
SALEM 1, 2
Dose Performance Trends



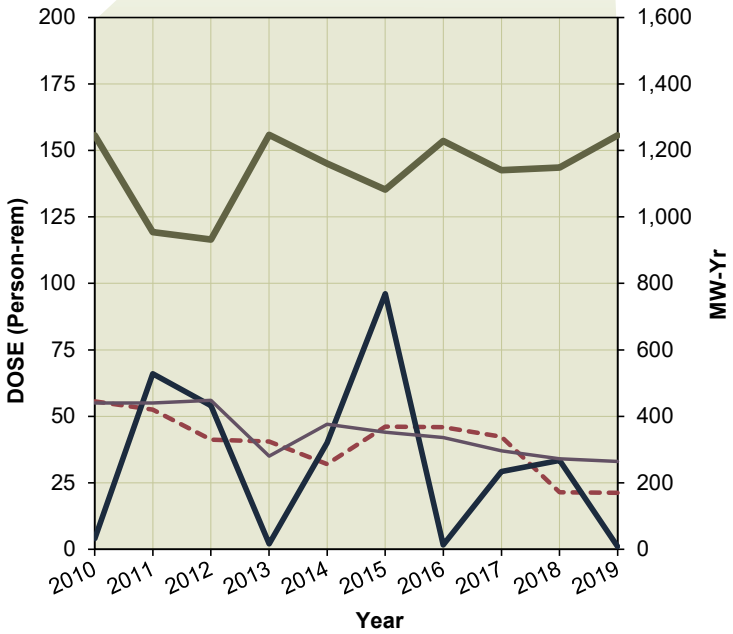
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	84.636	38.914	2,147.3
2011	50.955	63.358	2,054.6
2012	41.925	23.502	2,123.8
2013	38.858	29.715	2,213.1
2014	36.011	54.817	1,870.1
2015	33.812	16.905	2,131.3
2016	39.450	46.628	1,800.9
2017	43.710	67.599	2,060.5
2018	46.256	24.543	2,165.1
2019	47.399	50.055	2,053.6



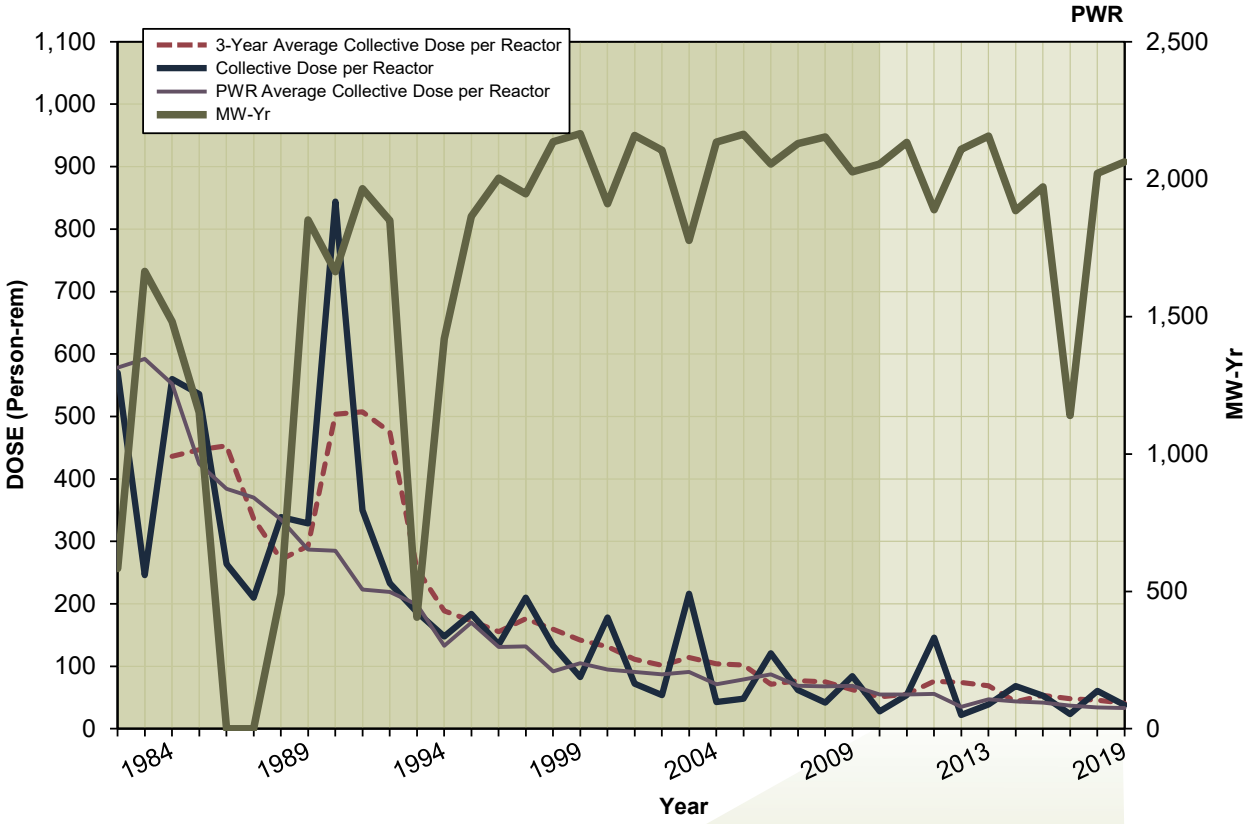
SEABROOK
Dose Performance Trends



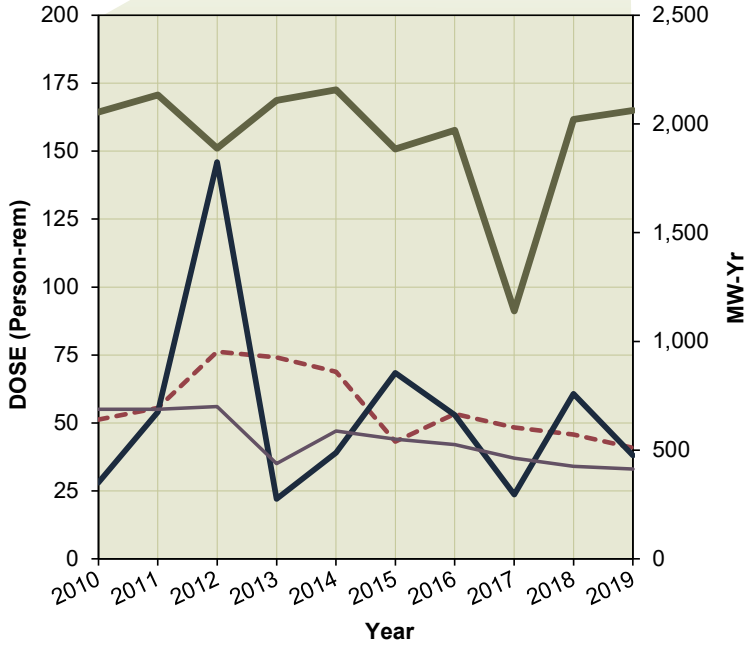
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	55.620	4.000	1,245.4
2011	52.484	66.000	954.5
2012	41.239	54.000	932.2
2013	40.557	2.000	1,247.3
2014	32.020	40.000	1,160.7
2015	46.159	96.053	1,082.6
2016	45.903	1.672	1,228.4
2017	42.305	29.191	1,140.4
2018	21.427	33.418	1,148.5
2019	21.231	1.084	1,245.0



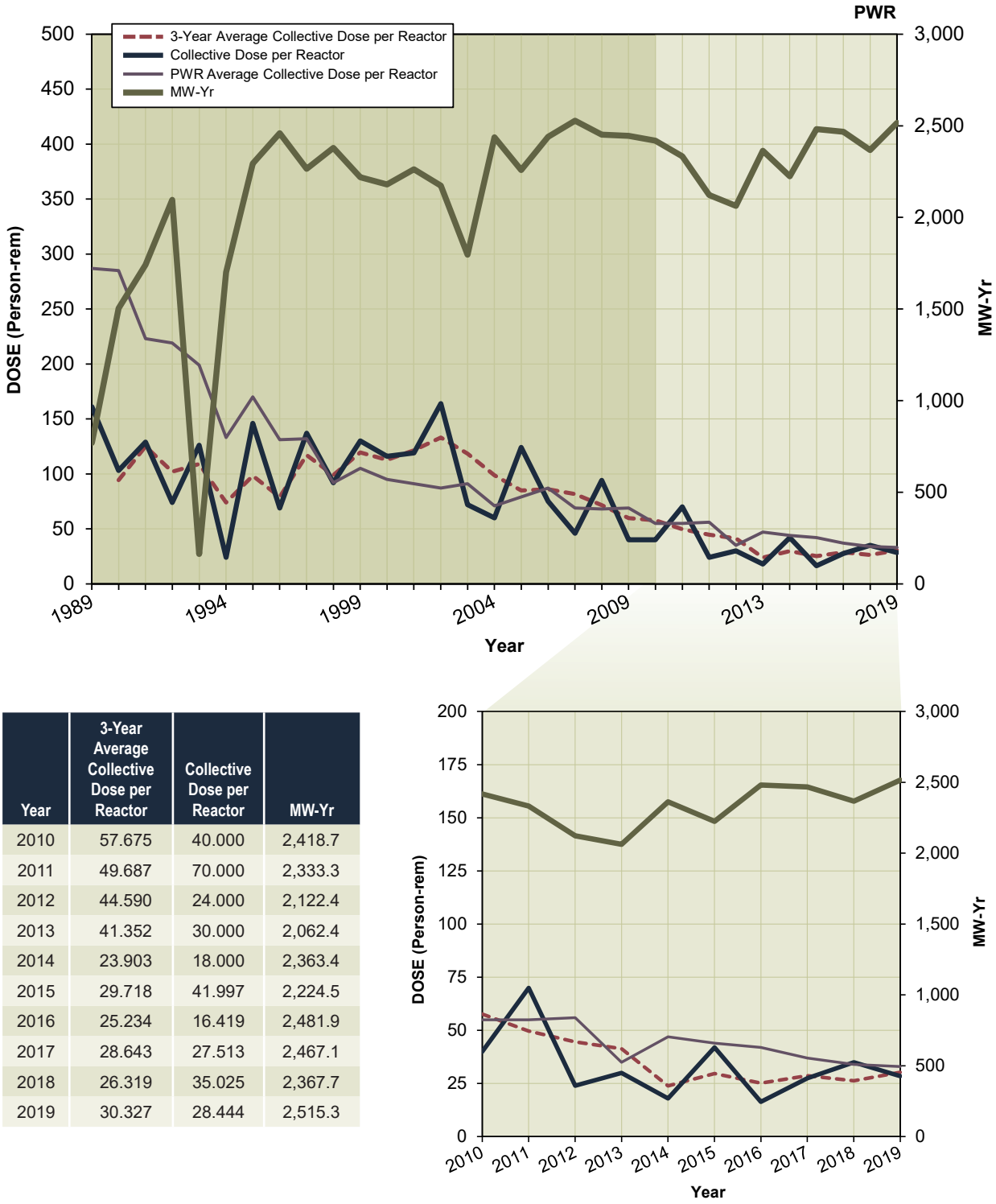
SEQUOYAH 1, 2
Dose Performance Trends



Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	51.255	28.000	2,054.9
2011	55.525	54.000	2,133.3
2012	76.202	146.000	1,888.2
2013	74.123	22.000	2,108.1
2014	68.817	39.000	2,156.7
2015	43.148	68.413	1,884.9
2016	53.360	52.882	1,971.4
2017	48.298	23.600	1,140.4
2018	45.732	60.713	2,021.0
2019	40.785	38.043	2,062.2

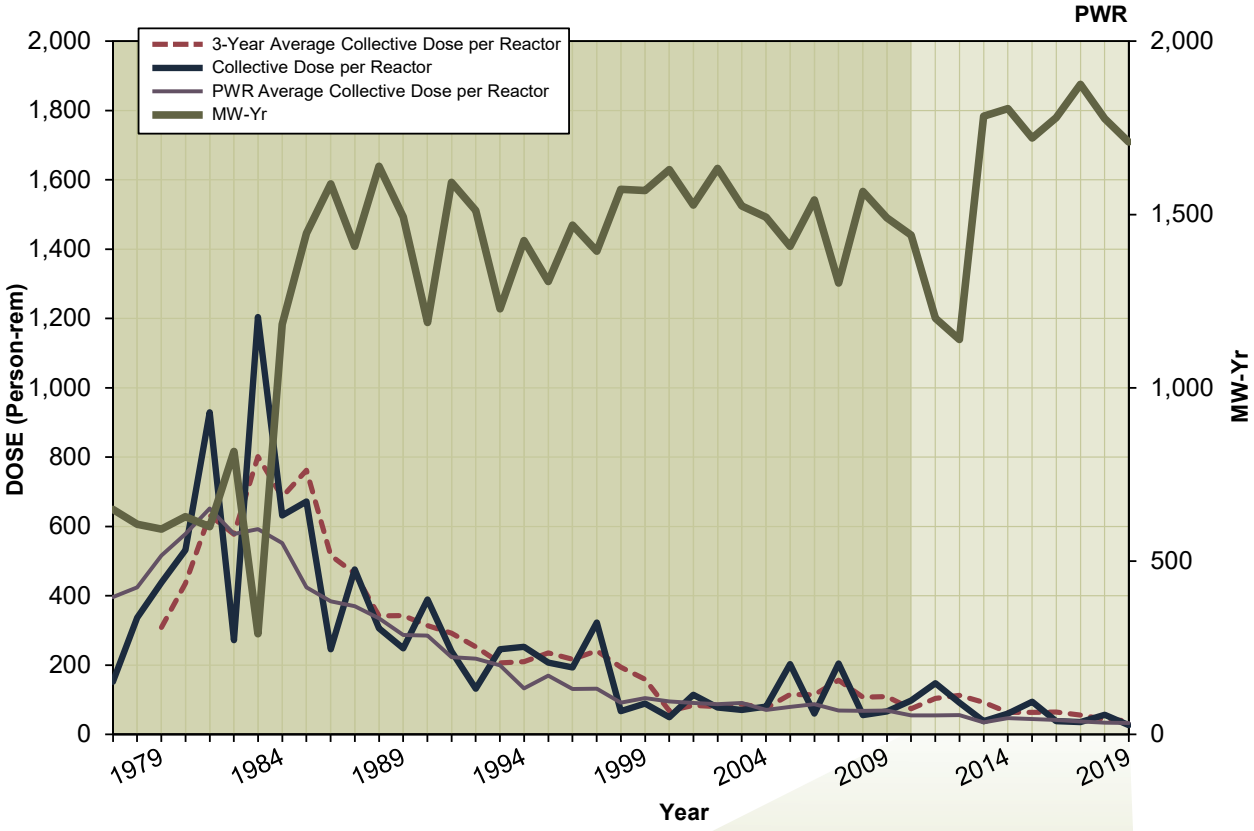


SOUTH TEXAS 1, 2
Dose Performance Trends

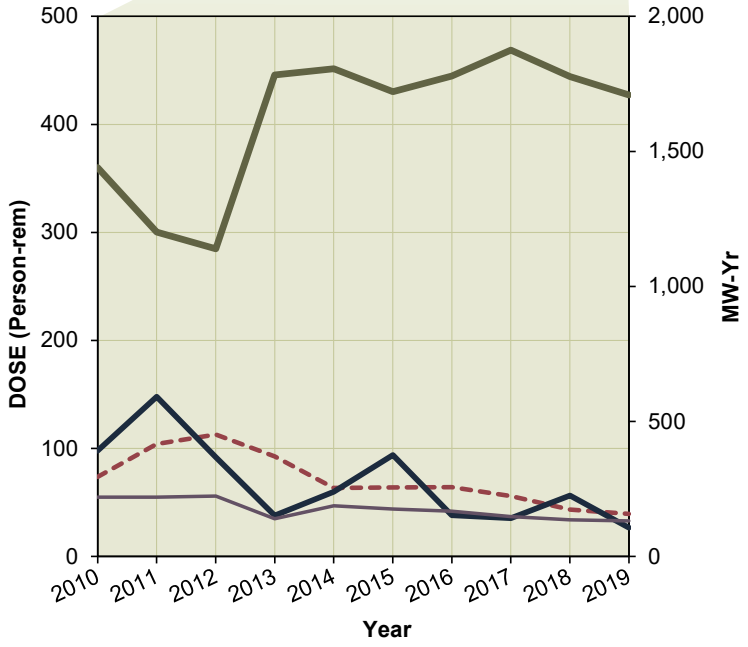


Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	57.675	40.000	2,418.7
2011	49.687	70.000	2,333.3
2012	44.590	24.000	2,122.4
2013	41.352	30.000	2,062.4
2014	23.903	18.000	2,363.4
2015	29.718	41.997	2,224.5
2016	25.234	16.419	2,481.9
2017	28.643	27.513	2,467.1
2018	26.319	35.025	2,367.7
2019	30.327	28.444	2,515.3

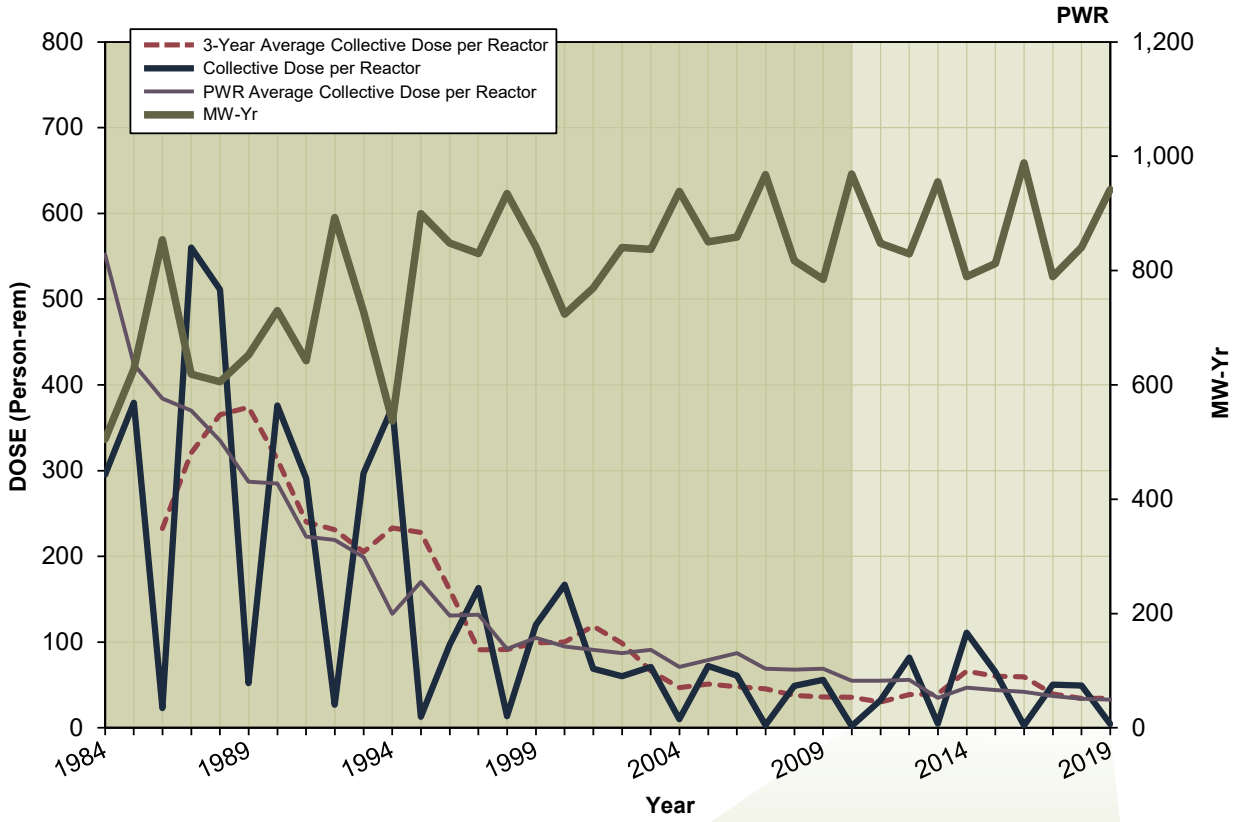
ST. LUCIE 1, 2
Dose Performance Trends



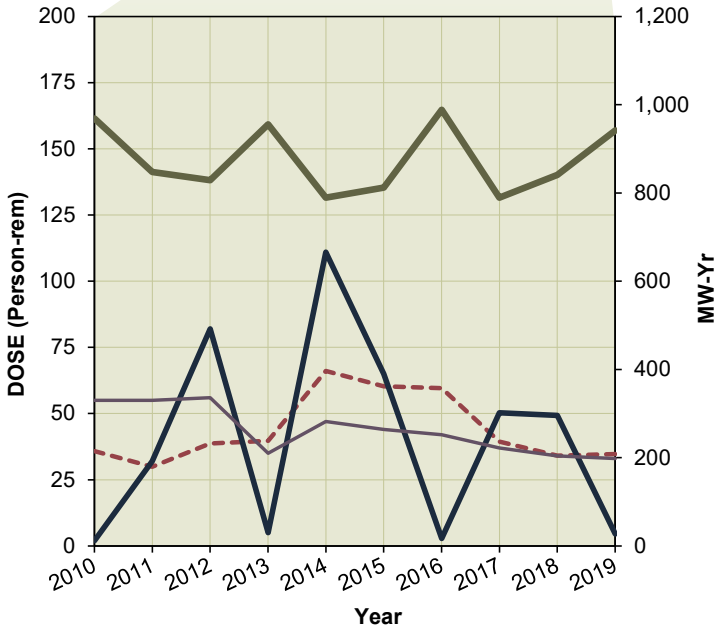
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	73.737	98.000	1,440.2
2011	104.242	148.000	1,200.9
2012	113.002	92.000	1,139.5
2013	92.597	38.000	1,783.4
2014	63.574	60.000	1,805.7
2015	64.018	94.044	1,720.9
2016	64.301	38.314	1,779.5
2017	55.973	35.562	1,875.3
2018	43.445	56.460	1,777.1
2019	39.563	26.668	1,709.5



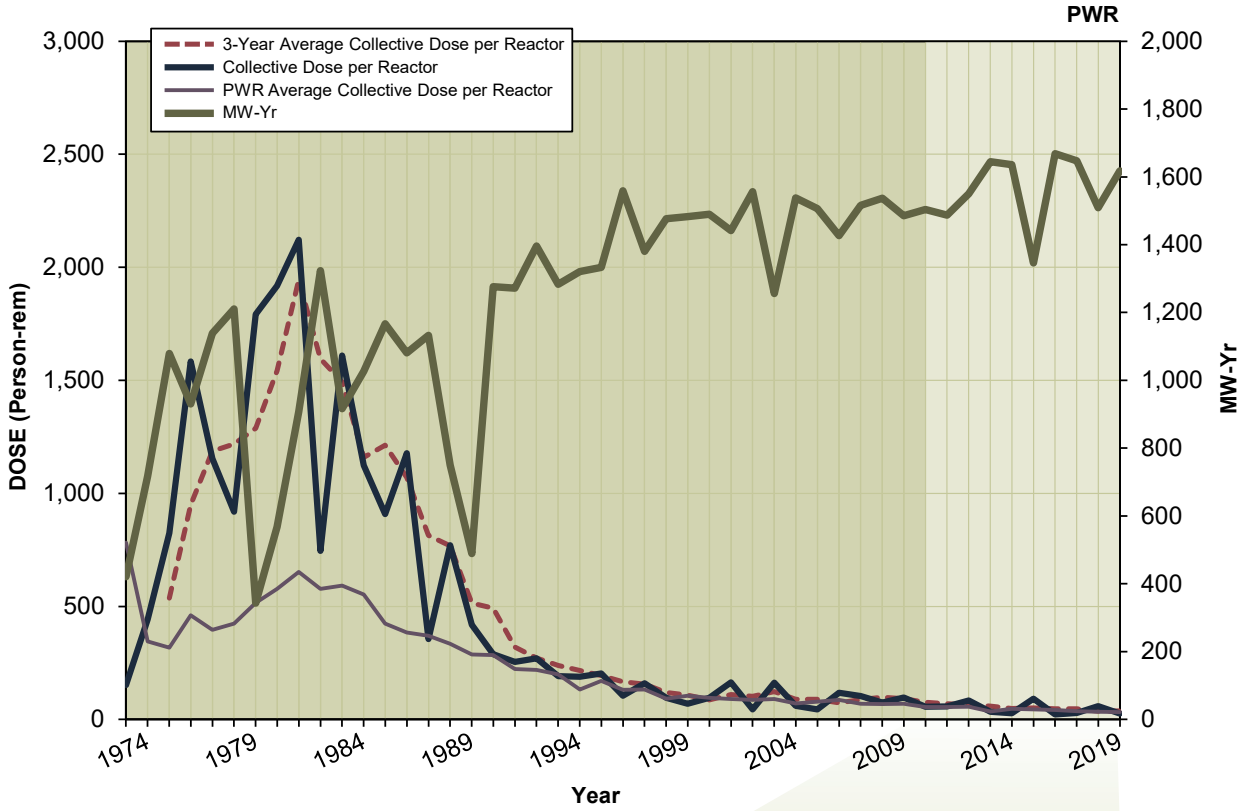
SUMMER 1
Dose Performance Trends



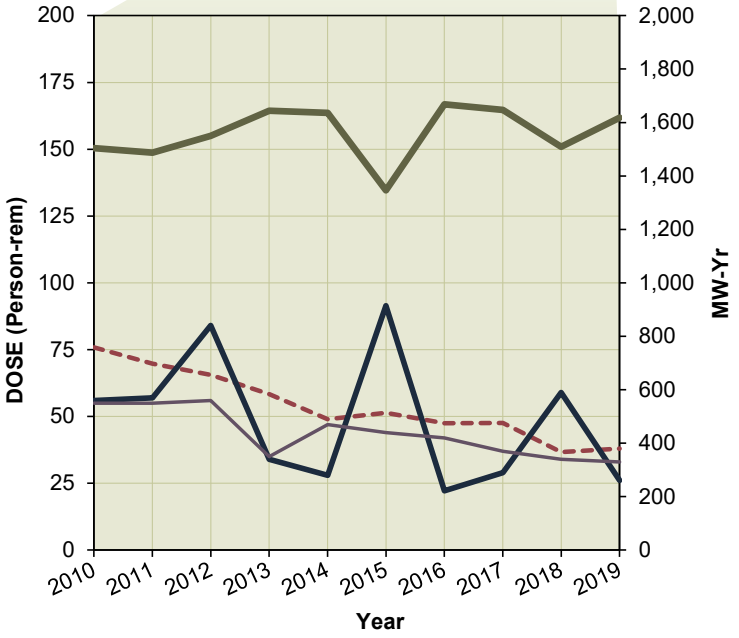
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	35.760	2.000	968.8
2011	29.920	32.000	847.7
2012	38.657	82.000	829.0
2013	39.651	5.000	955.5
2014	66.101	111.000	789.4
2015	60.333	64.958	812.3
2016	59.583	2.862	988.4
2017	39.376	50.308	789.2
2018	34.140	49.251	840.9
2019	34.705	4.557	941.6



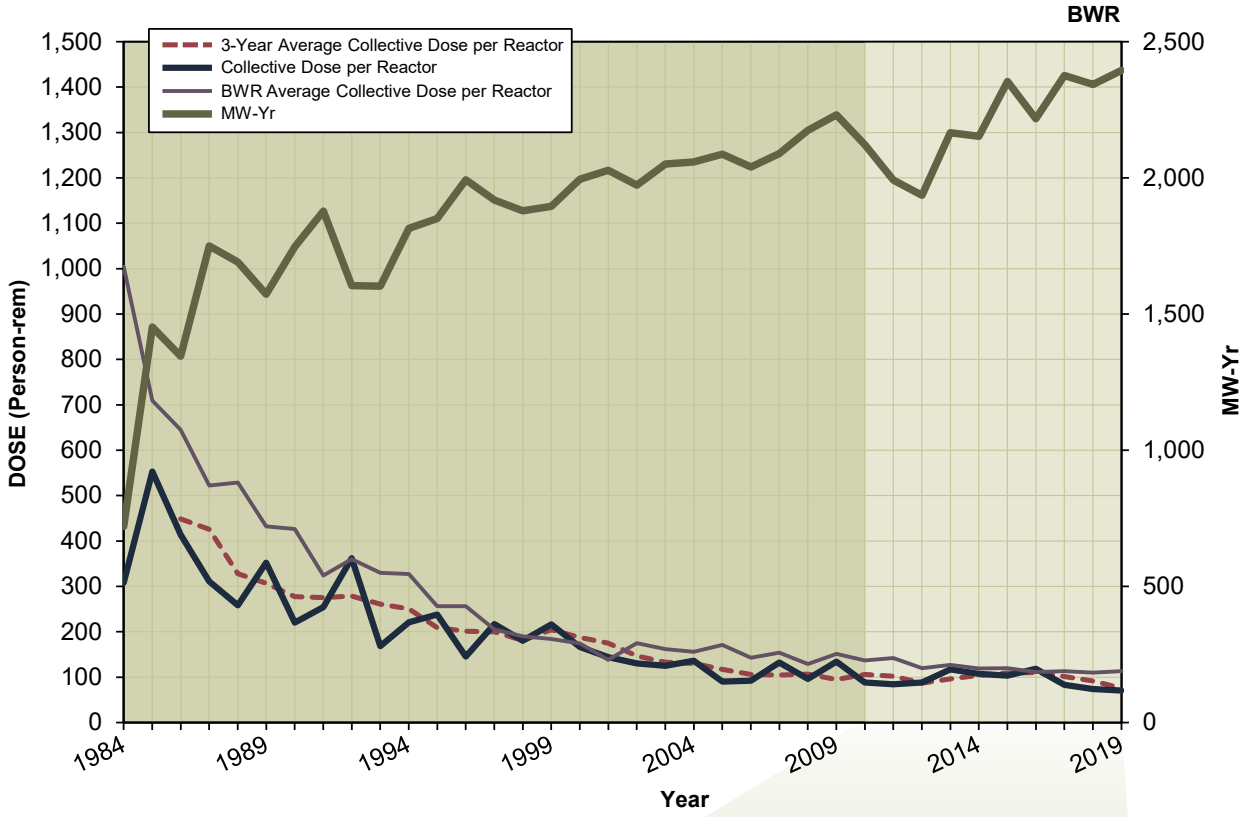
SURRY 1, 2
Dose Performance Trends



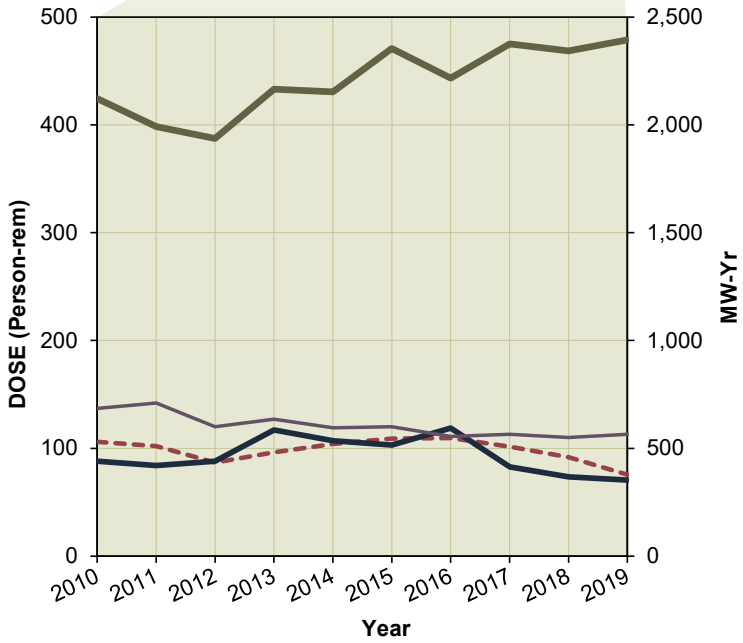
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	75.839	56.000	1,503.7
2011	69.759	57.000	1,487.4
2012	65.600	84.000	1,549.9
2013	58.334	34.000	1,644.4
2014	48.962	28.000	1,636.1
2015	51.333	91.490	1,345.9
2016	47.484	22.216	1,667.9
2017	47.571	29.006	1,647.0
2018	36.714	58.919	1,509.0
2019	37.992	26.051	1,617.9



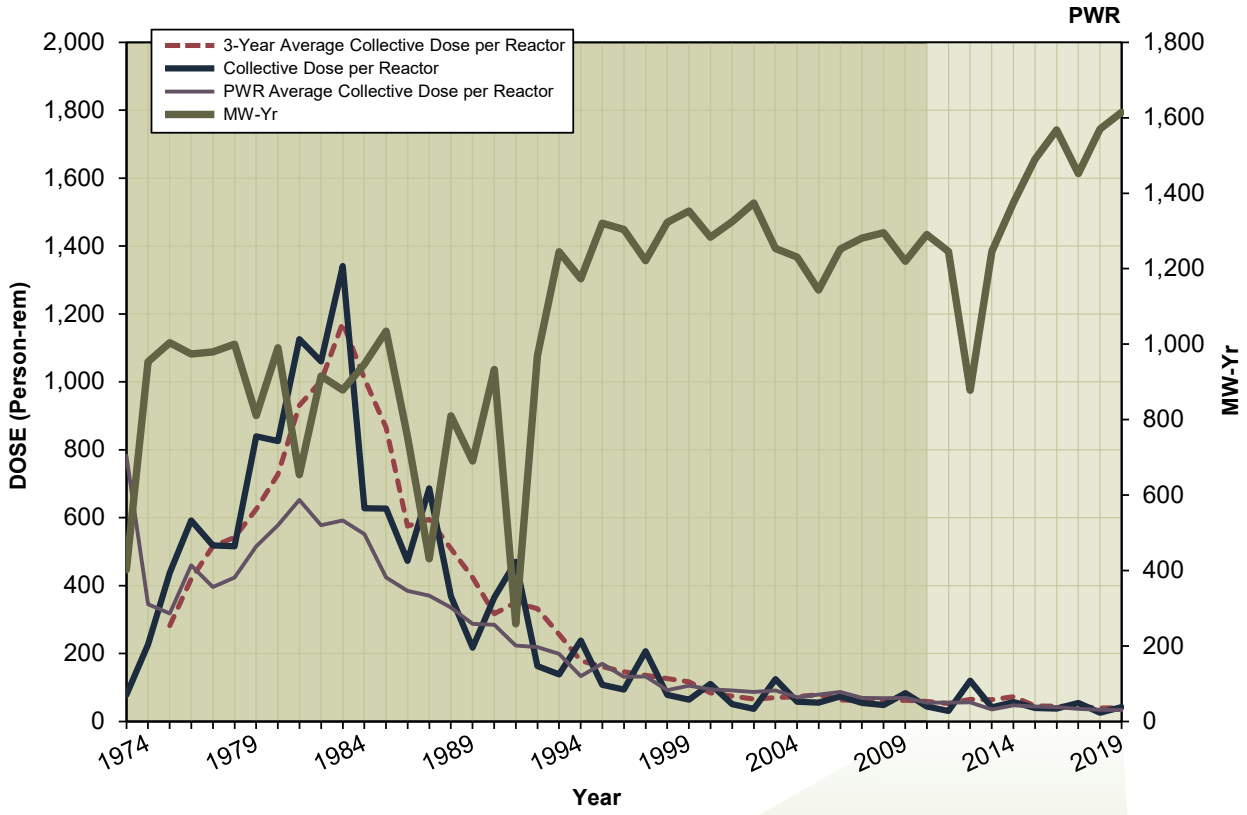
SUSQUEHANNA 1, 2
Dose Performance Trends



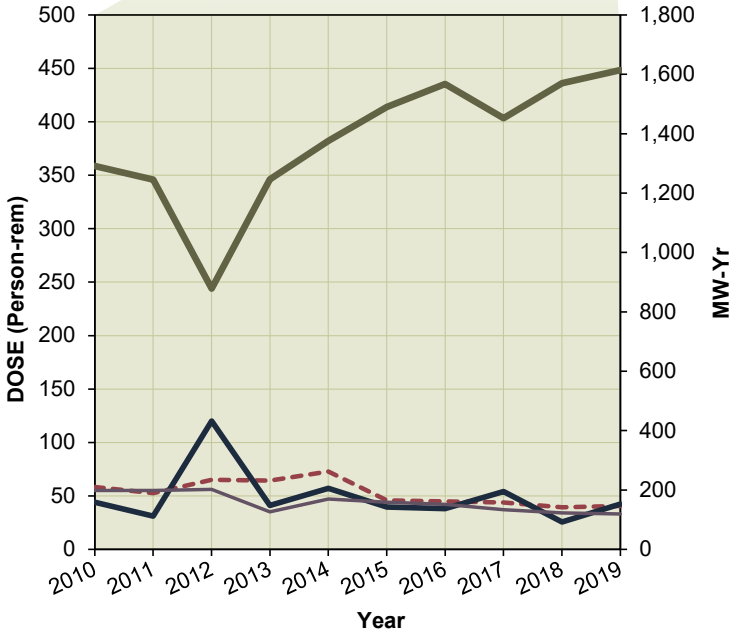
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	105.927	88.000	2,121.6
2011	101.954	84.000	1,992.0
2012	86.835	88.000	1,936.5
2013	96.397	117.000	2,166.2
2014	103.980	107.000	2,153.1
2015	109.026	103.077	2,354.3
2016	109.660	118.668	2,217.2
2017	101.493	82.734	2,375.6
2018	91.689	73.664	2,343.4
2019	75.646	70.539	2,394.1



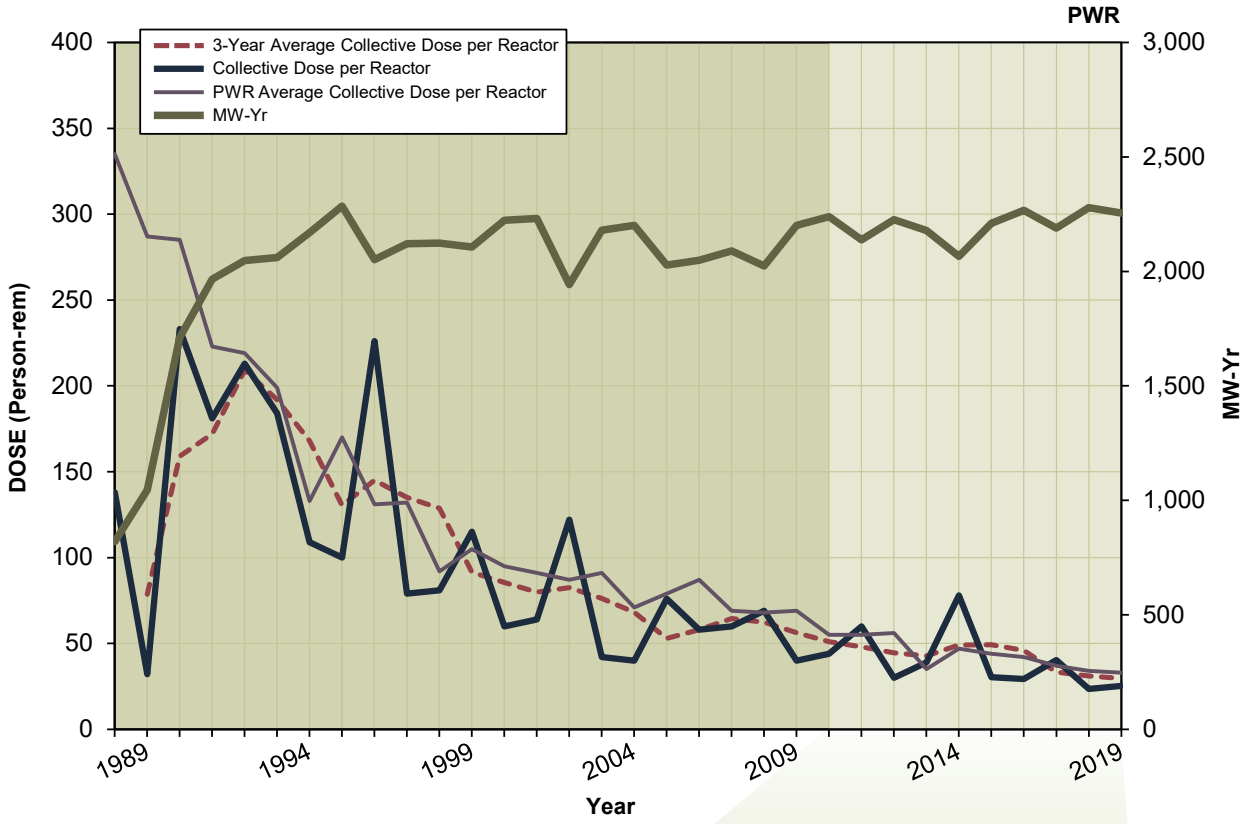
TURKEY POINT 3, 4
Dose Performance Trends



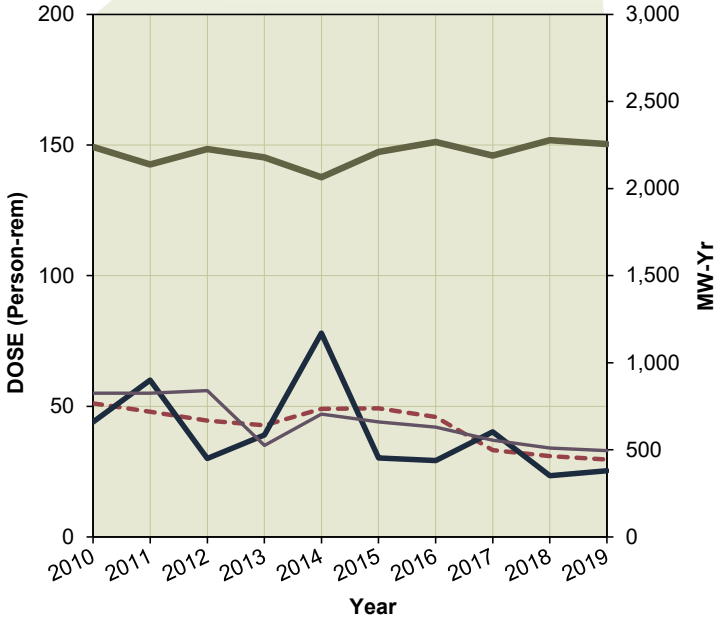
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	58.395	44.000	1,290.9
2011	52.549	31.000	1,245.7
2012	65.038	120.000	878.0
2013	64.282	41.000	1,245.9
2014	72.949	57.000	1,375.7
2015	45.944	39.562	1,489.7
2016	44.953	38.135	1,567.7
2017	43.932	54.100	1,451.9
2018	39.260	25.544	1,570.2
2019	40.650	42.305	1,614.4



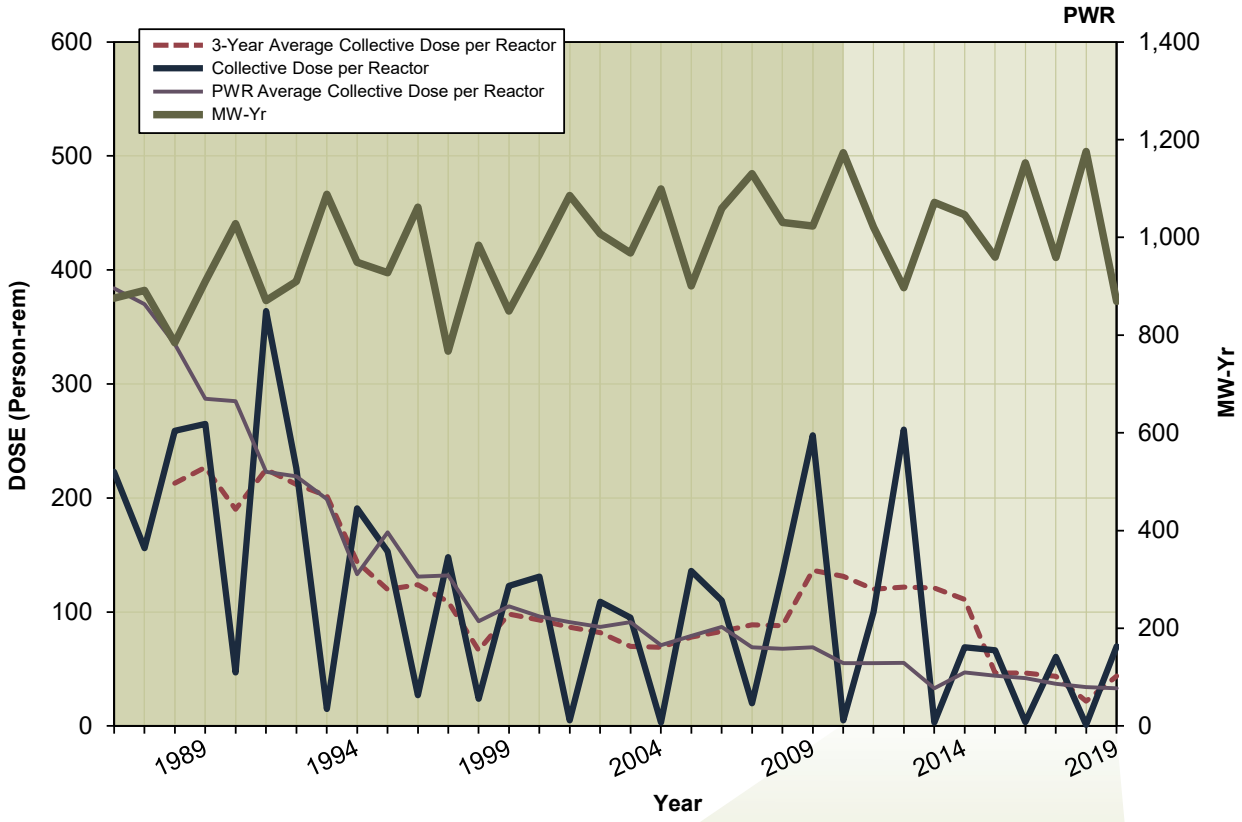
VOGTLE 1, 2
Dose Performance Trends



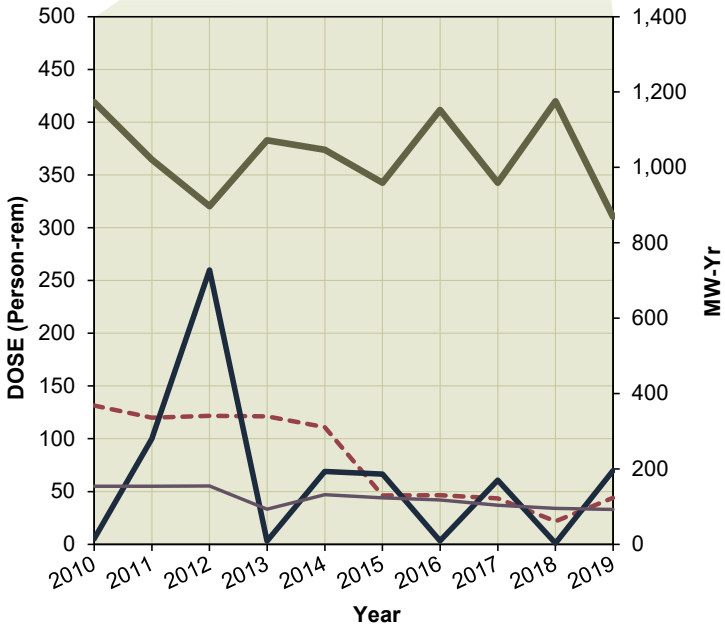
Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	51.077	44.000	2,238.6
2011	47.966	60.000	2,138.0
2012	44.572	30.000	2,226.6
2013	42.758	39.000	2,178.4
2014	49.060	78.000	2,065.8
2015	49.268	30.283	2,210.0
2016	45.964	29.236	2,267.1
2017	33.266	40.278	2,189.0
2018	30.981	23.428	2,278.4
2019	29.680	25.334	2,255.0



WATERFORD 3
Dose Performance Trends

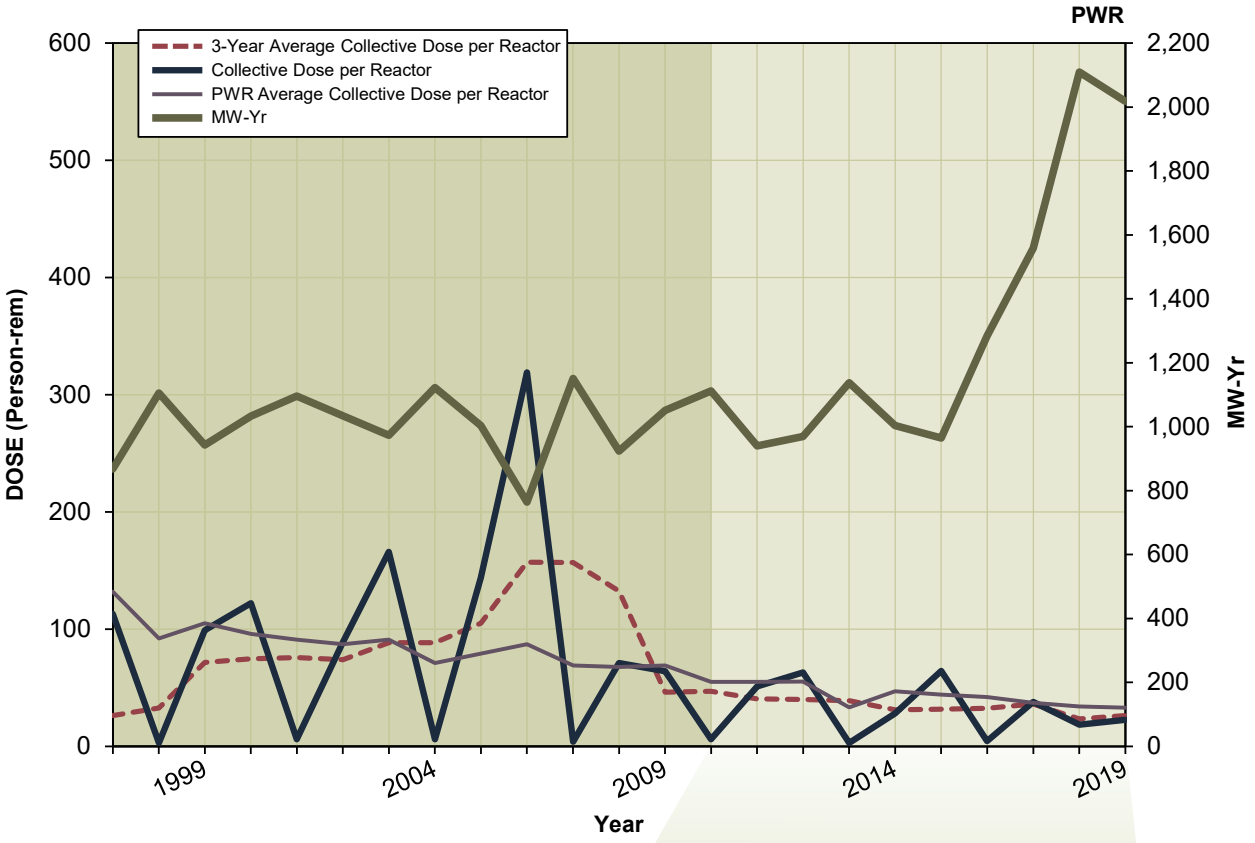


Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	131.400	5.000	1,173.1
2011	120.018	100.000	1,020.8
2012	121.723	260.000	897.1
2013	121.128	3.000	1,071.6
2014	110.931	69.000	1,046.4
2015	46.330	66.399	959.5
2016	46.418	3.392	1,152.5
2017	43.506	60.728	959.1
2018	21.750	1.130	1,175.6
2019	43.879	69.780	869.0

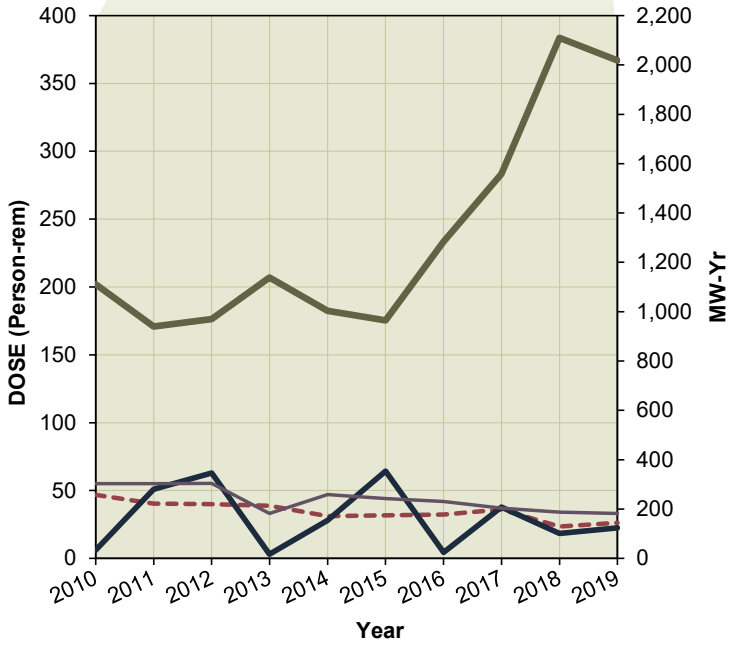


WATTS BAR 1, 2

Dose Performance Trends

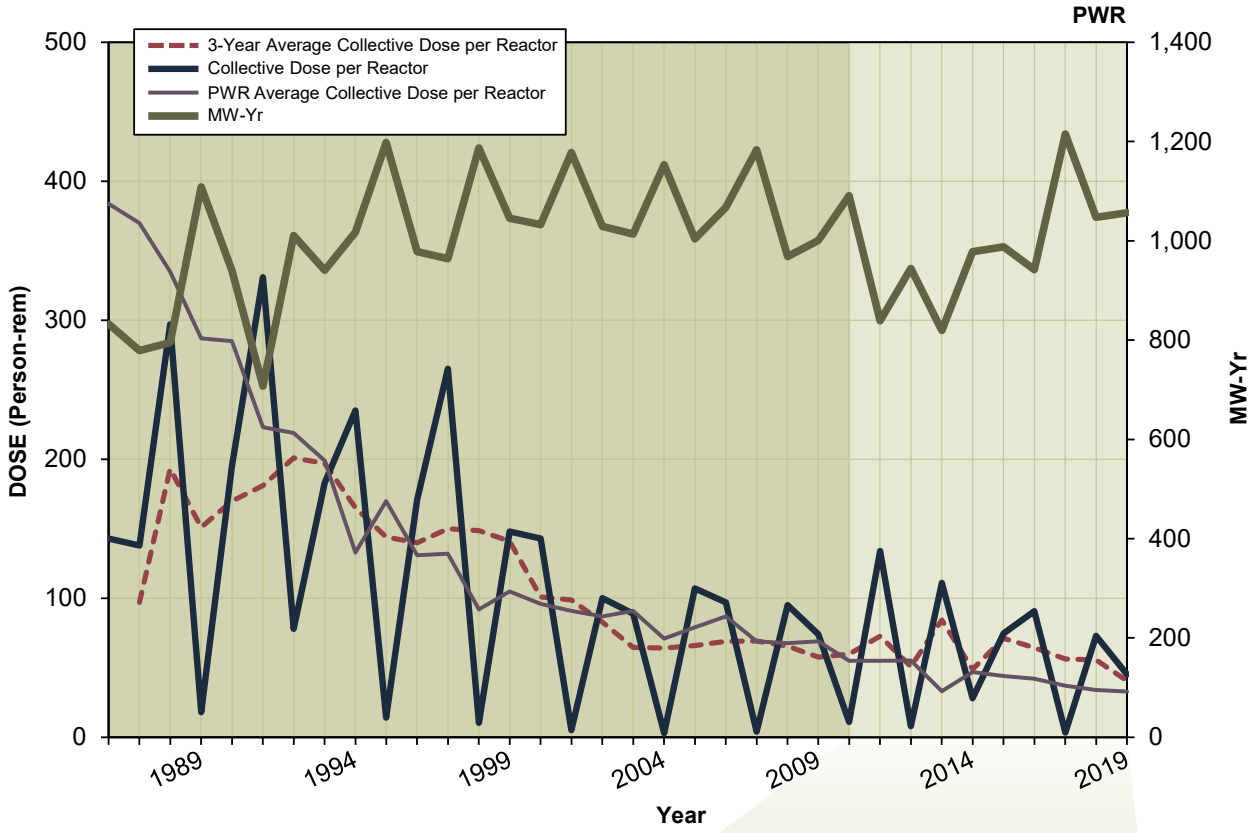


Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	46.880	6.000	1,111.7
2011	40.353	51.000	939.6
2012	39.998	63.000	969.5
2013	38.805	3.000	1,137.9
2014	31.221	28.000	1,003.4
2015	31.735	64.320	964.5
2016	32.359	4.489	1,284.1
2017	36.120	37.836	1,558.2
2018	23.416	18.460	2,110.1
2019	26.268	22.509	2,018.4

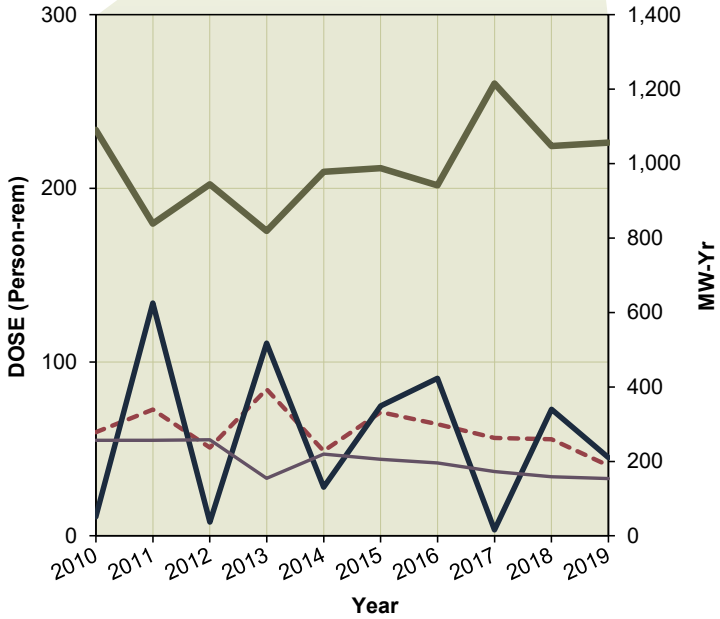


WOLF CREEK 1

Dose Performance Trends



Year	3-Year Average Collective Dose per Reactor	Collective Dose per Reactor	MW-Yr
2010	59.718	11.000	1,090.8
2011	72.704	134.000	839.1
2012	50.788	8.000	944.4
2013	84.368	111.000	819.2
2014	48.882	28.000	978.2
2015	71.187	74.804	987.9
2016	64.312	90.631	942.0
2017	56.291	3.437	1,215.5
2018	55.650	72.882	1,047.5
2019	40.501	45.183	1,056.6



APPENDIX E

PLANTS NO LONGER IN OPERATION

2019

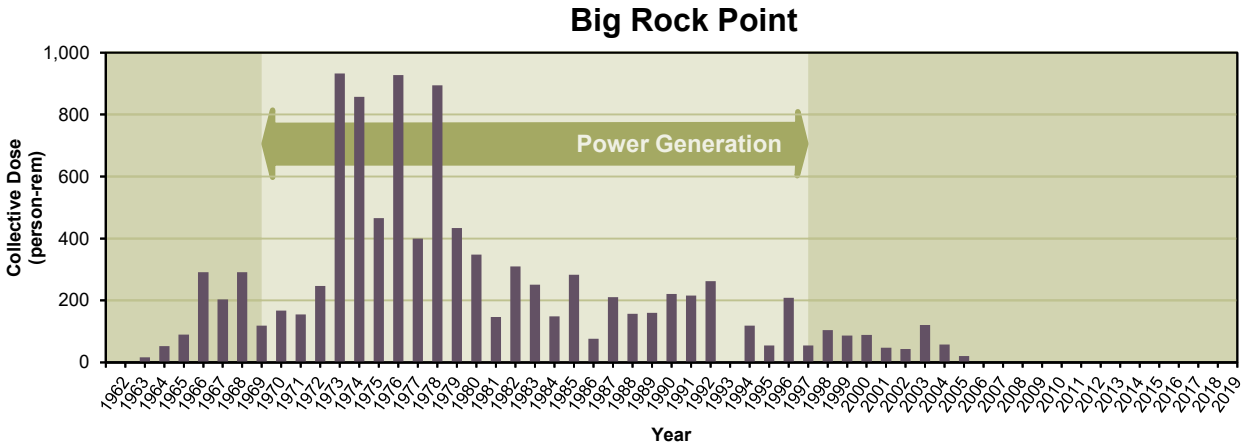
Information in this appendix was obtained from References 19, 20, and 21.

PLANTS NO LONGER IN OPERATION 2019

Big Rock Point

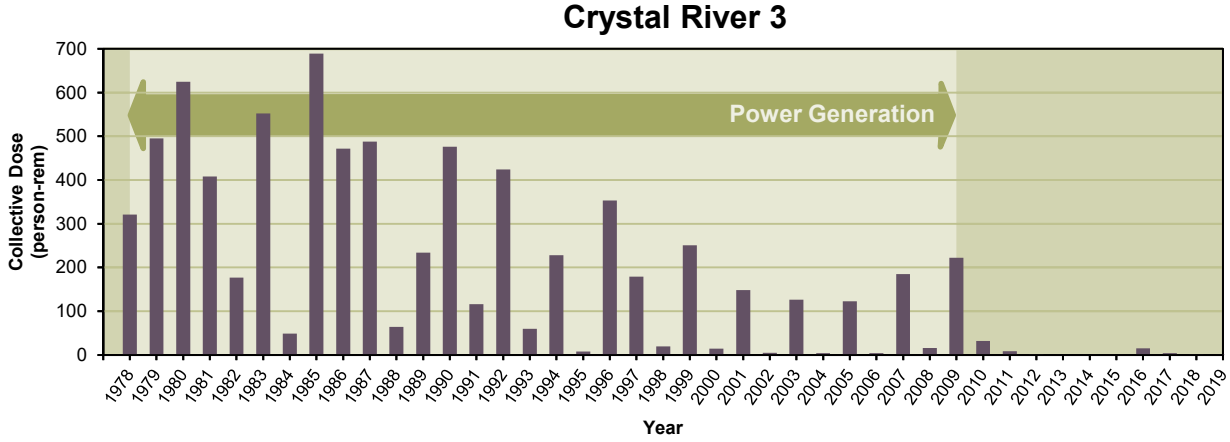
Big Rock Point (BRP) was a boiling-water reactor rated at 75 megawatt (MW) electric (MWe), designed by General Electric Company, and owned by Consumers Energy Company (CE). BRP was permanently shut down on August 29, 1997, and fuel was transferred to the spent fuel pool by September 20, 1997. The site completed decommissioning to a “green field” status. Big Rock Point will retain its 10 CFR Part 50 license until the fuel is removed from the ISFSI.

All fuel was transferred to the independent spent fuel storage installation (ISFSI) by March 2003. After fuel is removed from the site to a U.S. Department of Energy (DOE) facility, the ISFSI will be decommissioned and the 10 CFR Part 50 license terminated.



Crystal River 3

Crystal River Nuclear Generating Plant Unit 3 (CR-3) was a 2,609 MW thermal (MWt), pressurized-water reactor that was licensed to operate from December 1976 to February 20, 2013, and is located on approximately 4,700 acres in Crystal River, FL. During a refueling outage that started on September 26, 2009, CR-3 replaced the steam generators (SGs), requiring a large hole to be made in the containment building structure. When attempting to restore the containment structure following the SG replacement, damage to the containment structure was observed. The licensee attempted to repair the damage, but later decided to decommission the reactor.



The facility is currently in SAFSTOR condition although they are still considering beginning active decommissioning. The licensee submitted the CR-3 post-shutdown decommissioning activities report, including the site-specific cost estimate, on December 2, 2013. The plant began construction of an ISFSI in 2016, and begin loading fuel in summer 2017. Fuel transfer to the ISFSI was completed in January 2018.

Dresden Unit 1

Dresden Unit 1 (Dresden 1) produced power commercially from August 1, 1960, to October 31, 1978, and is now designated a Nuclear Historic Landmark by the American Nuclear Society. Dresden 1 was shut down on October 31, 1978, and is currently in SAFSTOR. The NRC approved the Decommissioning Plan in September 1993.

During the SAFSTOR period, through 2027, the Dresden 1 facility will be subjected to periodic inspection and monitoring. The licensee plans that decontamination and dismantlement of Dresden 1 will take place from 2029 through 2031. A 4-year site restoration delay will follow the major decontamination and dismantlement of Dresden 1 to allow for the decontamination and dismantlement of Units 2 and 3, with completion of these activities tentatively planned for 2035. Site restoration will be conducted in 2035 and 2036, concluding with a final site survey in late 2036. The licensee will monitor the Dresden ISFSI complex with site security and periodic inspections until final transfer of the spent fuel to DOE.

Fermi Unit 1

The Enrico Fermi Atomic Power Plant Unit 1 (Fermi 1) was a fast breeder reactor power plant cooled by sodium and operated at essentially atmospheric pressure. The reactor plant was designed for a maximum capacity of 430 MW; however, the maximum reactor power was 200 MW. The primary system was filled with sodium in December 1960 and criticality was achieved in August 1963. The reactor was tested at low power in the first couple of years of operation. Power ascension testing above 1 MW began in December 1965, immediately following receipt of the high-power operating license. In October 1966, during power ascension, a zirconium plate at the bottom of the reactor vessel became loose and blocked sodium coolant flow to some fuel subassemblies. Two subassemblies started to melt. Radiation monitors alarmed and the operators manually shut down the reactor. No abnormal releases to the environment occurred. Three years and nine months later, the cause had been determined, cleanup was completed, and fuel was replaced; Fermi 1 was restarted. In 1972, the core was approaching the burnup limit. In November 1972, the Power Reactor Development Company made the decision to decommission Fermi 1.

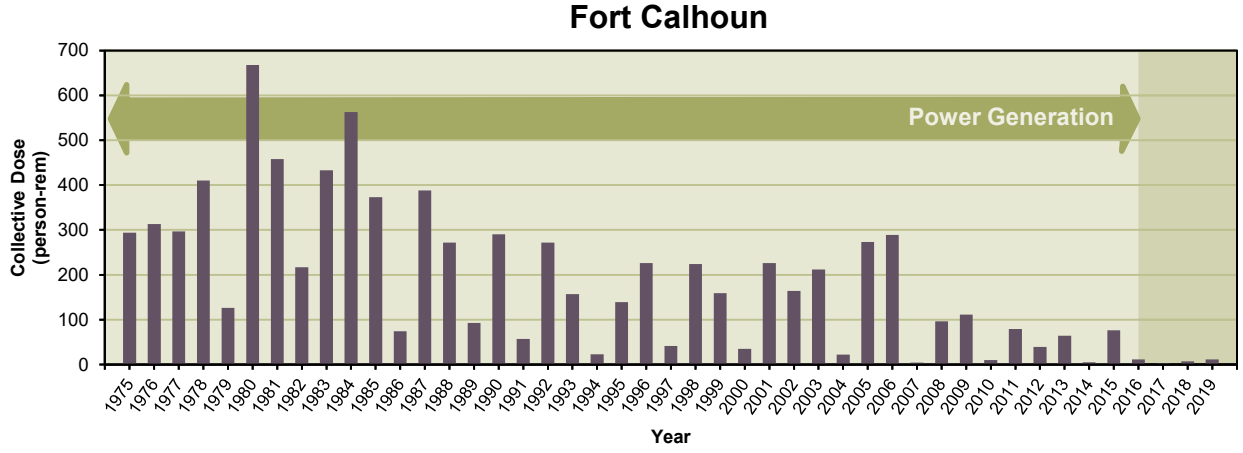
The fuel and blanket subassemblies were shipped off site in 1973. The nonradioactive secondary sodium system was drained and the sodium was sent to Fike Chemical Company. The radioactive primary sodium was stored in storage tanks and in 55-gallon drums until the sodium was shipped off site in 1984. Decommissioning of the Fermi 1 plant was originally completed in December 1975. The license for Fermi 1 expires in 2025. The licensee submitted a revised license termination plan (LTP) in March 2010, and the NRC staff completed an expanded acceptance review of the revised LTP for Fermi Unit 1. The NRC LTP review was deferred at the request of the licensee in 2012.The license expires in 2025 and the estimated date for closure is 2032.

Fort Calhoun

Fort Calhoun Station (FCS) was a 1,500 Mwt, pressurized-water reactor that began operation in 1973 and is owned by the Omaha Public Power District (OPPD). The reactor was permanently shut down on October 24, 2016. By letter dated November 13, 2016, OPPD certified that all fuel had been removed from the reactor.

OPPD submitted the FCS Post-Shutdown Decommissioning Activities Report (PSDAR) to the NRC on March 30, 2017. In the PSDAR, OPPD stated its intention to move all of the spent nuclear fuel into dry cask storage by the end of 2022 and put the plant into SAFSTOR until it is ready to fully decommission the facility starting in 2060. License termination is scheduled to take place by 2065.

Major regulatory activity to adapt the operating plant license to the needs of the post-shutdown functions of the facility has been completed. The activity focused on adapting the application of the regulations to post-shutdown requirements related to security, emergency planning, finance and insurance. As the licensee moves to place all spent fuel remaining in the spent fuel pool into onsite dry storage, licensing activities will begin for adapting the regulations to the dry storage only condition. In June 2018 the licensee requested to release a non-impacted part of their site from their 10 CFR Part 50 license for unrestricted use. The request was approved in April 2019.



GE Vallecitos Boiling-Water Reactor (VBWR)

The VBWR was shut down in 1963 and NRC issued a possession only license in 1965. The license was renewed in 1973 and the license has remained effective under the provisions of 10 CFR 50.51(b). The facility has been maintained in SAFSTOR condition with a limit of 60 years under 10 CFR 50.82(a)(3). The licensee has requested to maintain the facility in SAFSTOR past 60 years until other ongoing nuclear activities are terminated so that the entire site can be decommissioned in an integrated fashion. The spent fuel has been removed from the site.

In 2015, the licensee, GE Hitachi, began a licensing process to exempt the VBWR from the 60-year decommissioning schedule limit of 10 CFR 50.82(a)(3). The request is currently under NRC review and if the exemption request is approved, the estimated date for closure would be 2041.

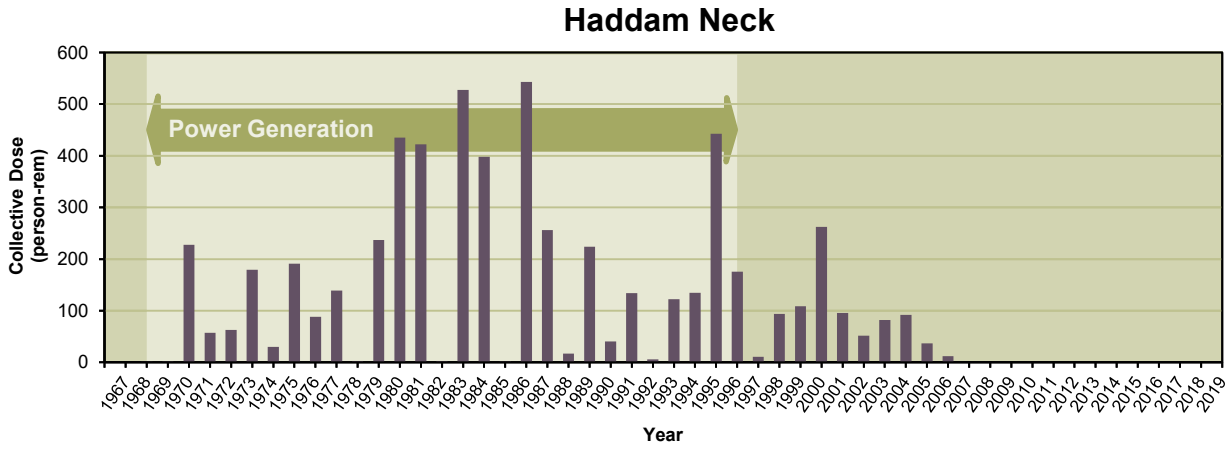
GE ESADA Vallecitos Experimental Superheat Reactor (EVESR)

On April 15, 1970, NRC authorized the licensee to possess, but not operate the reactor. The license was renewed on June 11, 1976, and remains in effect under the provisions of 10 CFR 50.51(b). The facility has been maintained in SAFSTOR condition. The facility is next to the Vallecitos Boiling-Water Reactor which is also in SAFSTOR. The licensee plans to maintain the facility in SAFSTOR until other ongoing nuclear and radioactive activities are also to be decommissioned to provide an integrated site decommissioning. In 2015, the licensee began the process of requesting an exemption to the 60-year decommissioning schedule limit of 10 CFR 50.82(a)(3) so that the entire site can be decommissioned in an integrated fashion. If the exemption request is approved, the date for closure would move from 2025 to 2041.

Haddam Neck – Connecticut Yankee

Haddam Neck was a 619 MWe (1,825 MWt) pressurized-water reactor that began commercial operation in January 1968, and ceased power operations in 1996. Decommissioning activities began in May 1998. Steam generators, reactor coolant pumps, the pressurizer, the reactor vessel, and shield wall blocks from the reactor building were disposed of off site and demolition of the administration and turbine buildings began in spring 2004. As of March 30, 2005, all spent fuel and greater-than-Class-C waste had been transferred to the ISFSI, which is currently operational.

Decommissioning at Haddam Neck was completed in 2007 and the applicable NRC reactor license under Title 10 of the Code of Federal Regulations (10 CFR) was terminated.

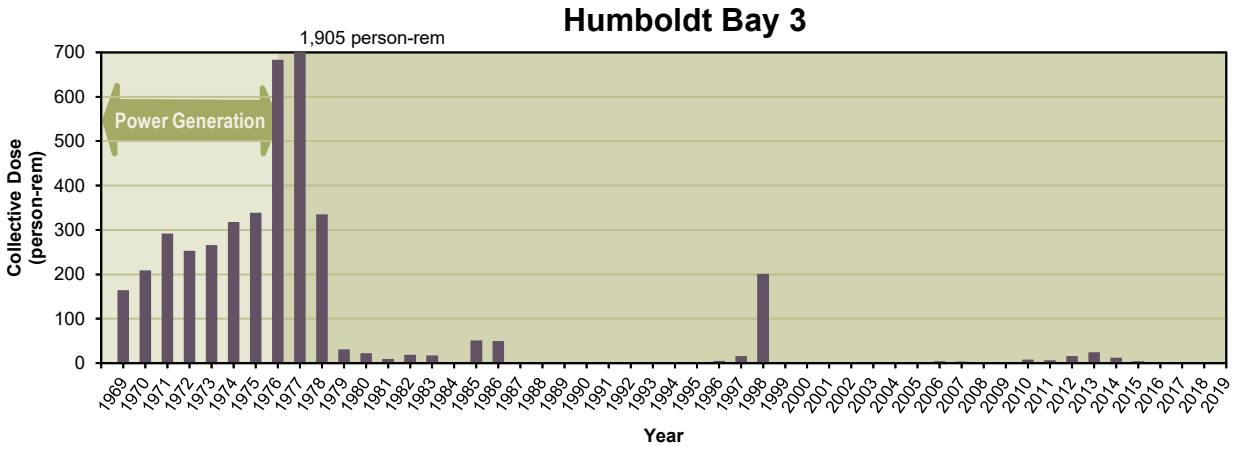


Humboldt Bay Unit 3

Humboldt Bay Power Plant (HBPP) Unit 3 produced power commercially from August 1, 1963, to July 1976. In July 1976, Unit 3 was shut down for annual refueling and to conduct seismic modifications. In 1983, with the plant still shut down, Pacific Gas & Electric, the owner of the facility, determined that required seismic modifications and the requirements imposed as a result of the accident at Three Mile Island made continued operations no longer economically feasible and decided to decommission the plant. The NRC approved the licensee's Decommissioning Plan in July 1988.

The licensee submitted a PSDAR in February 1998 and has begun incremental decommissioning activities. In December 2003, the licensee submitted an ISFSI application to the NRC. Humboldt Bay was to have unique dry cask storage because of the short length of its

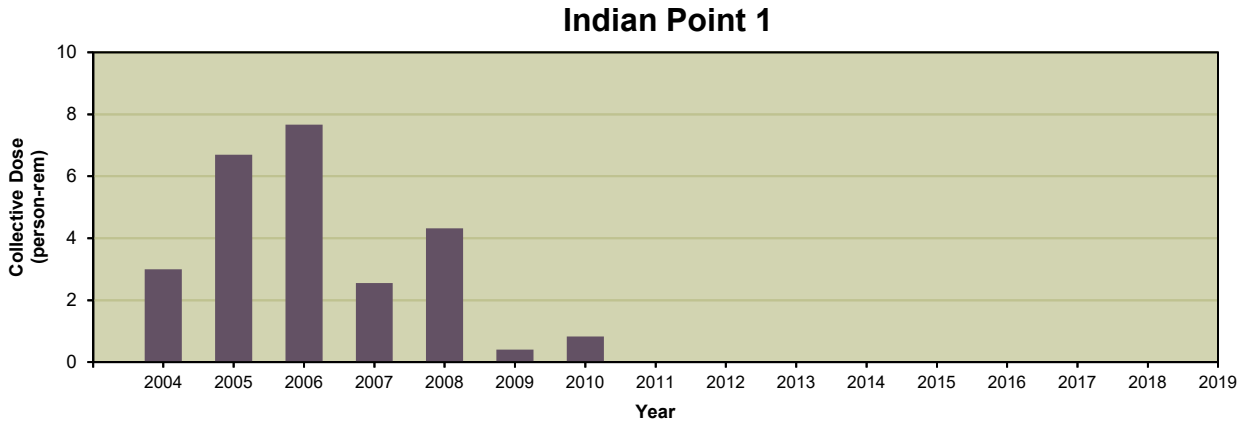
fuel assemblies. Moreover, the casks were to be stored below-grade to accommodate regional seismicity issues, security concerns, and site boundary dose limits. The NRC issued the ISFSI license on November 18, 2005, and the licensee began constructing the ISFSI in 2007. Following fuel loading into the ISFSI in 2008, the licensee began constructing new combustion units in 2008 and 2009 to replace the old Humboldt Bay fossil Units 1 and 2. Decommissioning activities at the old fossil Units 1 and 2 were completed in 2013. During this period, decommissioning of Unit 3 commenced and HBPP successfully completed removal of the reactor vessel internals in September 2013. The Humboldt Bay Unit 3 decommissioning status is DECON. The only remaining activities are radiological final status surveys. It is estimated that all decommissioning activities will be completed by September 30, 2020. The ISFSI remains under a separate NRC license.



Indian Point Unit 1

Indian Point Unit 1 (IP-1) produced power commercially from August 1962 to October 1974. IP-1 was shut down on October 31, 1974, because the emergency core cooling system did not meet regulatory requirements. Some decommissioning work associated with spent fuel storage was performed from 1974 through 1978. By January 1976, all spent fuel had been removed from the reactor vessel. The NRC order approving SAFSTOR was issued in January 1996.

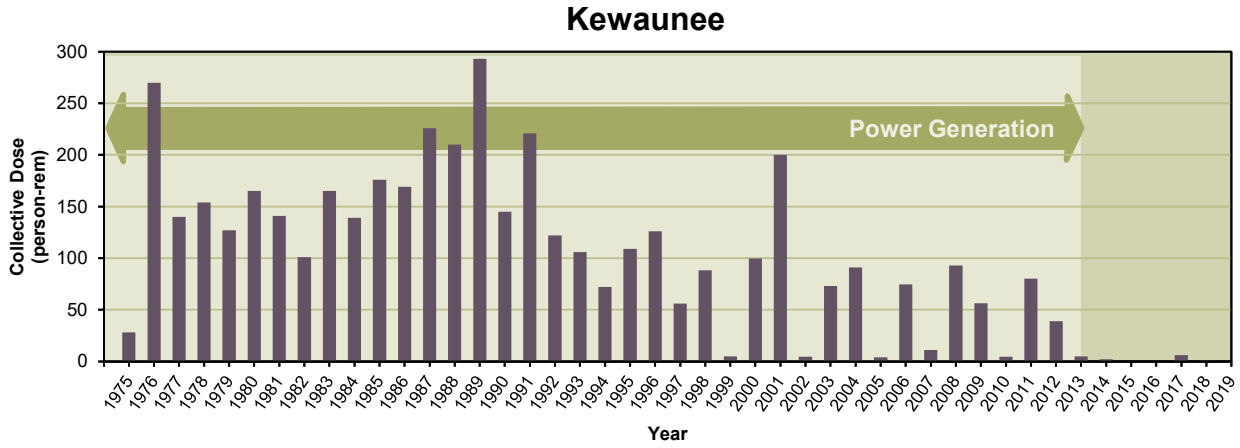
A PSDAR public meeting was held on January 20, 1999. The licensee plans to decommission IP-1 with Indian Point Unit 2 (IP-2), which is currently in operation. The licensee does not plan to begin active decontamination and decommissioning of IP-1 until IP-2 ceases operation.



Kewaunee

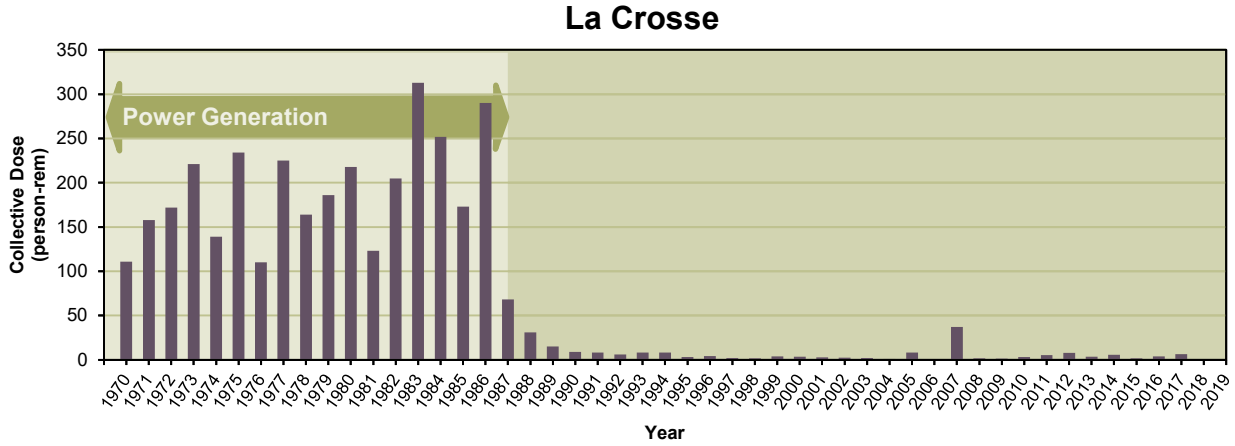
Kewaunee Power Station was a 1,772 MWt, pressurized-water reactor that was licensed to operate from December 1973 to May 2013. Kewaunee is located in Carlton, WI, on Lake Michigan about 35 miles southeast of Green Bay.

At present, the facility has transitioned to a SAFSTOR condition. Kewaunee submitted a PSDAR and conducted a public meeting near the site in April 2013. The facility retains its Part 50 license but is no longer authorized to operate or emplace fuel in the reactor vessel. The transfer of spent fuel from the spent fuel pool to the ISFSI was completed in June 2017. Major decommissioning and dismantlement activities are scheduled to begin in 2069 with license termination following in 2073.



La Crosse

The La Crosse Boiling-Water Reactor (LACBWR) produced power commercially starting on November 1, 1969. The plant was one of a series of demonstration plants funded, in part, by the U.S. Atomic Energy Commission (AEC). The nuclear steam supply system and its auxiliaries were funded by the AEC, and the balance-of-plant equipment was funded by the Allis-Chalmers Company. The AEC later sold the plant to Dairyland Power Cooperative (DPC) and provided it with a provisional operating license. LACBWR was shut down on April 30, 1987, and the NRC approved its Decommissioning Plan on August 7, 1991.



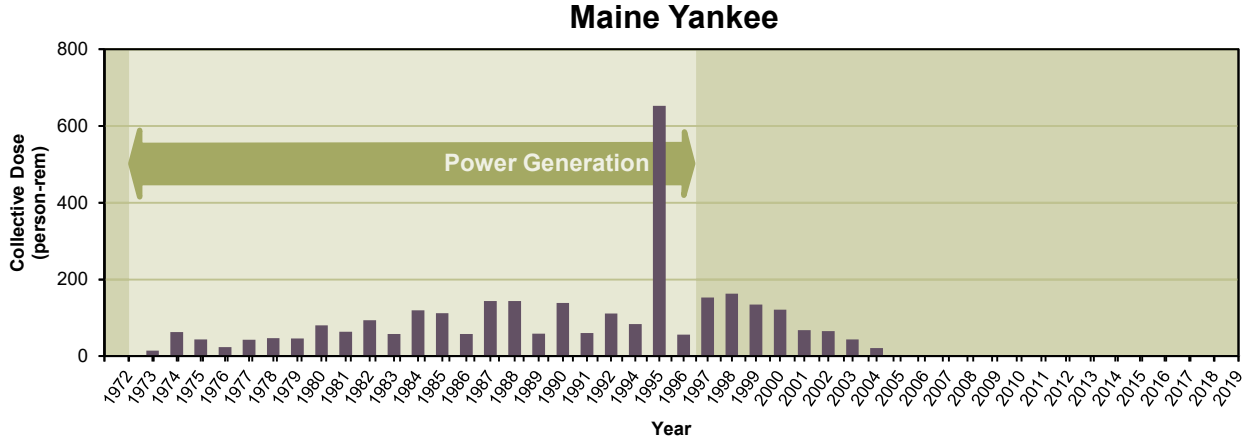
Because the NRC approved DPC's Decommissioning Plan (DP) before August 28, 1996 (the effective date of an NRC final rule concerning reactor decommissioning (61 FR 39278; July 29, 1996)), the DP is considered the Post Shutdown Decommissioning Activities Report (PSDAR) for LACBWR (see 10 CFR 50.82). The PSDAR public meeting was held on May 13, 1998, and subsequent updates to the LACBWR decommissioning report have combined the DP and PSDAR into the "LACBWR Decommissioning Plan and Post-Shutdown Decommissioning Activities Report" (D Plan/PSDAR). DPC constructed an onsite ISFSI and completed the movement of all 333 spent nuclear fuel elements from the Fuel Element Storage Well to dry cask storage at the ISFSI by September 19, 2012.

By order dated May 20, 2016, the NRC approved the direct transfer of Possession Only License No. DPR-45 for LACBWR from DPC to LaCrosse Solutions, LLC (LS), a wholly owned subsidiary of EnergySolutions, LLC. The order was published in the Federal Register on June 2, 2016 (81 FR 35383). The transfer assigns DPC's licensed possession, maintenance, and decommissioning authorities for LACBWR to LS in order to implement expedited decommissioning at the LACBWR site. On September 24, 2019, the NRC approved an order that allows the LACBWR license to be transferred back to DPC upon completion of decommissioning at the site and termination of the Part 50 license outside of the ISFSI. Final decommissioning activities at LACBWR are currently underway and are scheduled to be completed in 2020, with the license transfer to DPC to be executed soon after.

The license termination plan (LTP) for LACBWR was submitted on June 27, 2016. The staff issued the LTP amendment, safety evaluation, and environmental assessment on May 21, 2019.

Maine Yankee

Maine Yankee was an 860 MWe pressurized-water reactor located on Bailey Point in Wiscasset, ME, that started commercial power operations in 1972. The Maine Yankee plant was shut down on December 6, 1996. Certification of permanent cessation of operations was submitted on August 7, 1997. The PSDAR was submitted on August 27, 1997, and the NRC approved the LTP on February 28, 2003.

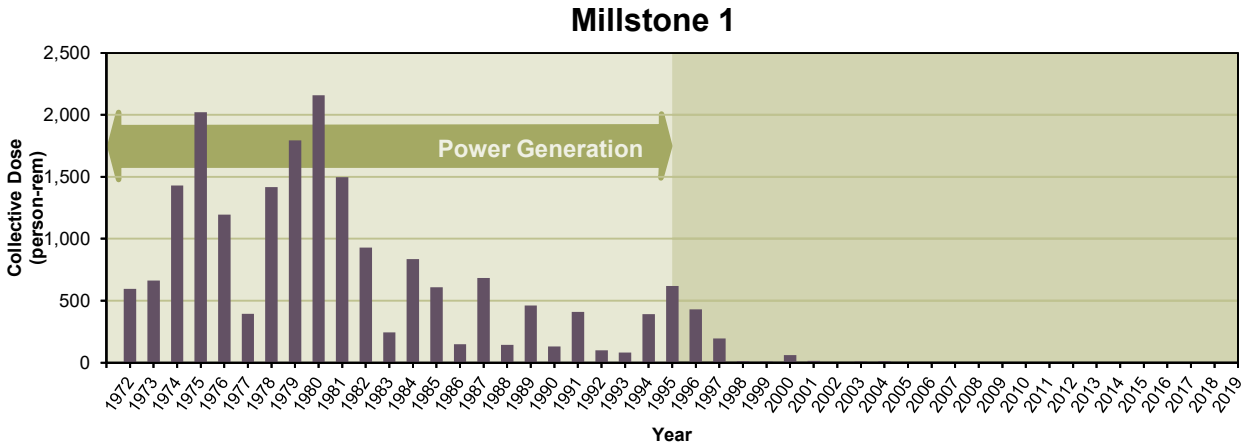


In 2003, the reactor pressure vessel was shipped to Barnwell, SC via barge. Spent nuclear fuel and greater-than-Class-C waste were transferred to the onsite ISFSI between August 2002 and February 2004. Decommissioning was completed in June 2005, and Maine Yankee will retain its 10 CFR Part 50 license until the fuel is removed from the ISFSI. The NRC LTP approval date is to be determined.

Millstone Unit 1

Millstone Unit 1 produced power commercially from December 28, 1970, to November 4, 1995. Millstone Unit 1 was a single-cycle, boiling-water reactor with a reactor thermal output of 2,011 MW and a net electrical output of 652.1 MW. The unit was shut down on November 4, 1995. On July 21, 1998, pursuant to 10 CFR 50.82(a)(1)(i) and 10 CFR 50.82(a)(1)(ii), the licensee certified to the NRC that, as of July 17, 1998, Millstone Unit 1 had permanently ceased operations and that fuel had been permanently removed from the reactor vessel. The owner of the facility submitted its PSDAR to the NRC on June 14, 1999, which included a combination of DECON and SAFSTOR options. After a formal assessment of spent fuel storage options in 2007, the licensee concluded that they would keep the Millstone Unit 1 fuel in the spent fuel pool, in a SAFSTOR status, until 2048 rather than move the fuel to an ISFSI.

Safety-related structures, systems, and components and those important to safety remaining at Millstone Unit 1 are associated with the spent fuel pool island where the spent fuel is stored. Besides nonessential systems that support the balance-of-plant facilities, the remaining plant equipment has been de-energized, disabled, or removed from the unit and can no longer be used for power generation. Irradiated reactor vessel components have been removed. The reactor cavity and vessel have been drained, and a radiation shield has been installed to limit occupational radiation doses to workers. Currently, the licensee has estimated 2056 for completion of all decommissioning activities and the estimated closure date of this site.



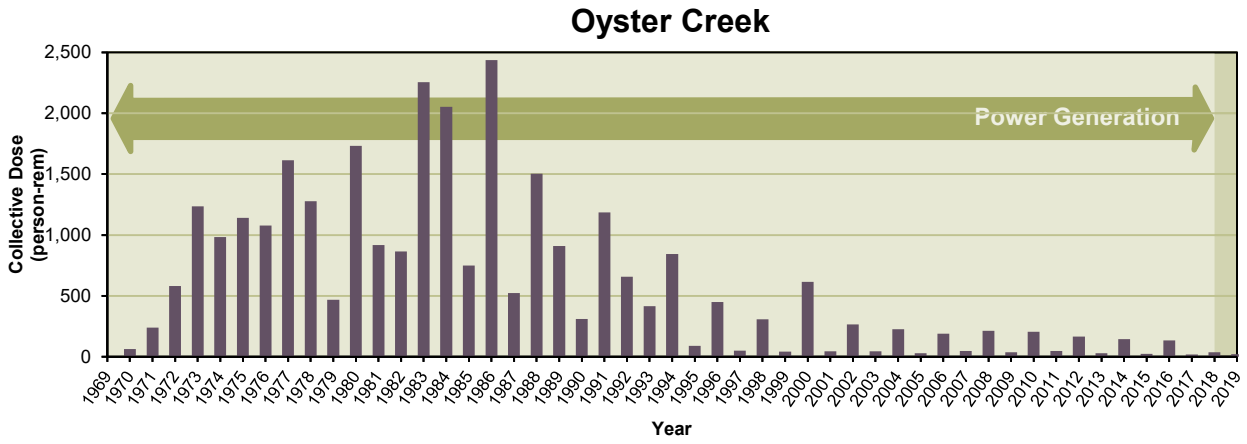
Oyster Creek

Oyster Creek produced power commercially from December 1969, to September 17, 2018. Oyster Creek was a 1,930 MWt single-cycle, boiling-water reactor with a net electrical output of 619 MW. The unit was shut down on September 17, 2018. By letter dated September 25, 2018, Exelon Generation Company (Exelon), prior owner of the facility, certified that all fuel had been removed from the reactor. In the PSDAR that was submitted to the NRC on May 21, 2018, Exelon stated its intention to move all of the spent nuclear fuel into dry cask storage by the

end of 2024 and put the plant into SAFSTOR until it is ready to fully decommission the facility starting in 2075. License termination is scheduled to take place by 2078 and site restoration by 2080.

On August 31, 2018, Exelon Generation and Holtec submitted a License Transfer Application (LTA) requesting NRC approval to transfer the Oyster Creek Renewed Facility Operating License and the General License for the Oyster Creek ISFSI to Oyster Creek Environmental Protection, LLC (OCEP), as the licensed owner and to Holtec Decommissioning International (HDI), as the licensed operator. The NRC staff is currently reviewing the revised PSDAR submitted by HDI on September 28, 2018, which includes a revised Site-Specific Decommissioning Cost Estimate and notifies the NRC of changes to accelerate the schedule for the prompt decommissioning of Oyster Creek. License termination would take place by 2035.

There are no major technical issues at this time.

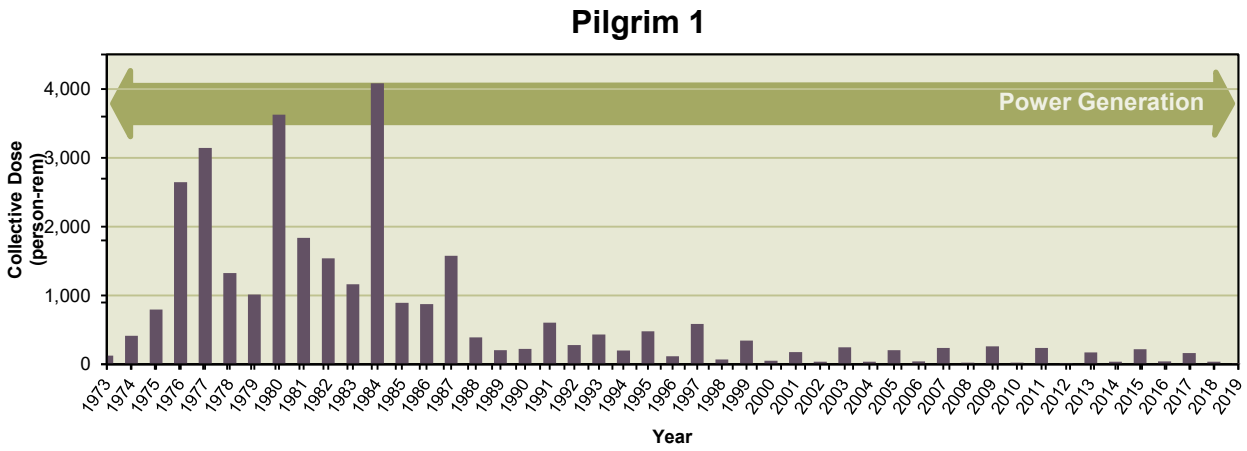


Peach Bottom 1

Peach Bottom Atomic Power Station Unit 1 was a 200 MWt, high temperature, gas cooled reactor that was operated from June of 1967 to its final shutdown on October 31, 1974. All spent fuel has been removed from the site, and the spent fuel pool is drained and decontaminated. The reactor vessel, primary system piping, and steam generators remain in place. The facility is currently in a SAFSTOR condition. Final decommissioning is not expected until 2034 when Units 2 and 3 are scheduled to shut down.

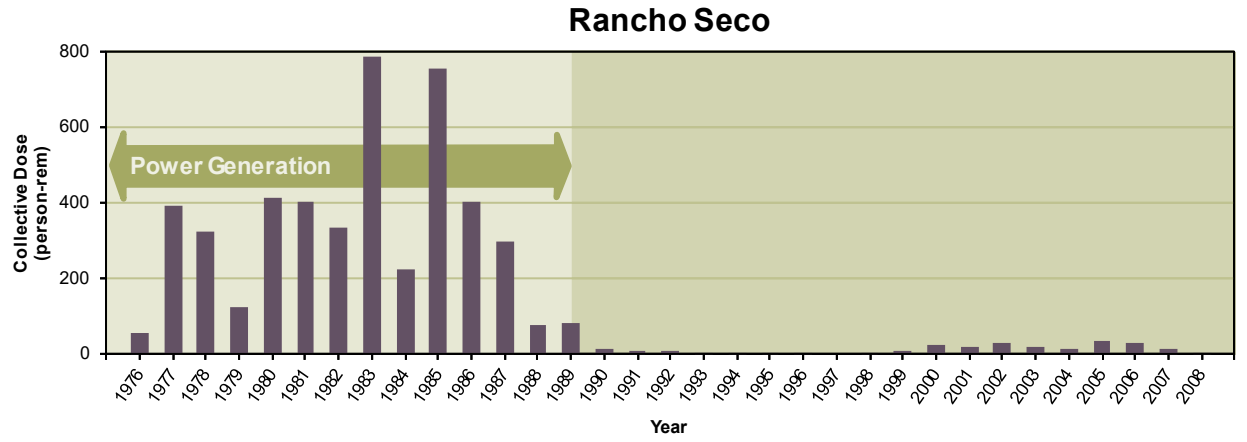
Pilgrim 1

Pilgrim Nuclear Power Station was a 670 MWe three-cycle, boiling-water reactor with a reactor thermal output of 2,028 MWt. The unit was shut down permanently by Entergy on May 31, 2019, after providing electricity safely to the region for more than 46 years. In August of 2019, Pilgrim Nuclear Power Station was purchased by Holtec International in a deal that allowed the site to enter immediate decommissioning. The deal enables decommissioning and site release for alternate uses decades sooner than previously anticipated. As Pilgrim enters into this new chapter, its commitment to safety, the community and the environment remains unchanged.



Rancho Seco

Rancho Seco Nuclear Generating Station was a 913 MW pressurized-water reactor owned by the Sacramento Municipal Utility District (SMUD). Rancho Seco permanently shut down in June 1989, after approximately 15 years of operation. The licensee was granted a site-specific 10 CFR Part 72 license for an onsite ISFSI on June 30, 2000. SMUD completed transfer of all the spent nuclear fuel to the Rancho Seco ISFSI in August 2002. Rancho Seco completed decommissioning of the former reactor site in 2009 and the site was released with the exception of a 6-acre ISFSI site and a class B and C waste storage building. The B/C waste building was decommissioned in 2017, and the 10 CFR Part 50 license was terminated on August 31, 2018. The ISFSI is still in operation.



San Onofre Unit 1

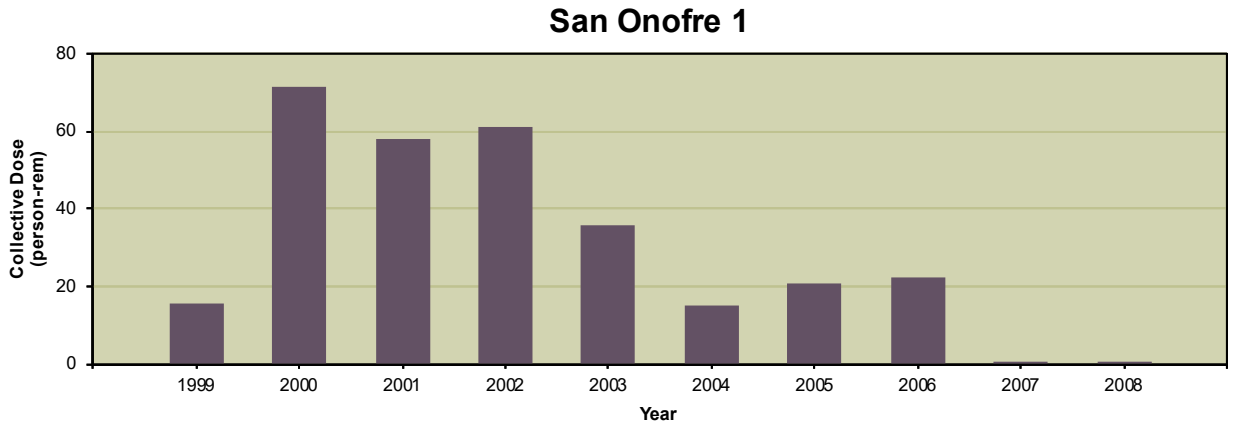
The San Onofre Nuclear Generating Station Unit 1 (SONGS-1), operated by Southern California Edison (SCE), produced power commercially from January 1, 1968, to November 30, 1992.

Unit 1 was a Westinghouse three-loop pressurized-water reactor with a reactor thermal output of 1,347 MW.

Defueling of SONGS-1 was completed on March 6, 1993, and the NRC approved the Permanently Defueled Technical Specifications on December 28, 1993. On November 3, 1994, SCE submitted a Proposed Decommissioning Plan to place SONGS-1 in SAFSTOR until the shutdown of SONGS-2 and SONGS-3. However, on December 15, 1998, SCE submitted the

PSDAR for SONGS-1 to begin decontamination in 2000. Since that time, SCE has been actively decommissioning the facility, which has been almost entirely dismantled. SCE has removed and disposed of most of the structures and equipment. The SONGS-1 turbine building was removed and the licensee completed internal segmentation and cutup of the reactor pressure vessel. The licensee plans to store the reactor vessel on site for the foreseeable future, as long as licensed activities are ongoing. In addition, the licensee transferred SONGS-1 spent fuel to an onsite generally licensed ISFSI. Starting in 2015, the ISFSI began expanding into the area previously occupied by SONGS-1 to store the spent fuel from SONGS-2 and SONGS-3.

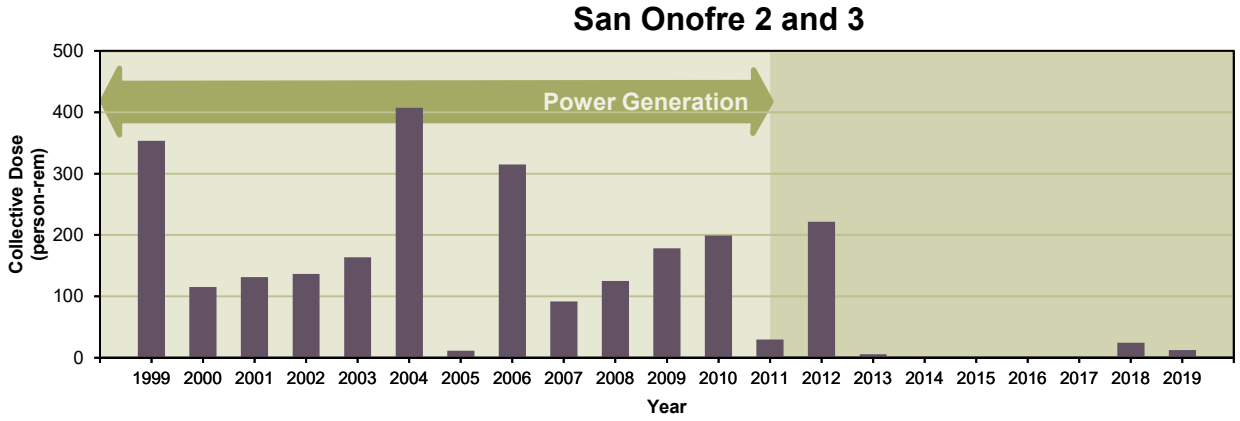
In February 2010, the NRC staff issued a license amendment to release offshore portions of the SONGS-1 cooling intake and outlet pipes for unrestricted use. It is estimated that all decommissioning activities for SONGS-1 will be completed in 2032.



San Onofre Units 2 and 3

The San Onofre Nuclear Generating Station, Units 2 and 3 (SONGS), operated by the Southern California Edison Company (SCE) is located approximately 4 miles south of San Clemente, California. SONGS, Units 2 and 3, are Combustion Engineering 1,127 MWe pressurized-water reactors, which were granted Facility Operating Licenses NPF 10 on February 16, 1982, and NPF-15 on November 15, 1982, respectively. SONGS 2 and 3 generated power commercially from 1984 to 2012. In June 2013, pursuant to 10 CFR 50.82(a)(1)(i), the licensee certified to the NRC that as of June 7, 2013, operations had ceased at SONGS, Units 2 and 3. The licensee subsequently certified, pursuant to 10 CFR 50.82(a)(1)(ii), that all fuel had been removed from the reactor vessels of both units, and committed to maintaining the units in a permanently defueled status. Therefore, pursuant to 10 CFR 50.82(a)(2), SCE's 10 CFR Part 50 licenses no longer authorize operation of SONGS or emplacement or retention of fuel into the reactor vessels. The licensee is still authorized to possess and store irradiated nuclear fuel. Irradiated fuel is currently being stored onsite in spent fuel pools and in dry casks at an ISFSI.

The PSDAR for SONGS, Units 2 and 3, was submitted on September 23, 2014, and the associated public meeting was held on October 27, 2014, in Carlsbad, California. The NRC confirmed its review of the SONGS, Units 2 and 3, PSDAR and addressed public comments in a letter dated August 20, 2015. On July 17, 2015, the NRC approved the Permanently Defueled Technical Specifications for SONGS, Units 2 and 3. It is estimated that all decommissioning activities for SONGS, Units 2 and 3, will be completed in 2032. San Onofre Units 2 and 3 will retain its 10 CFR Part 50 license until the fuel is removed from the ISFSI.

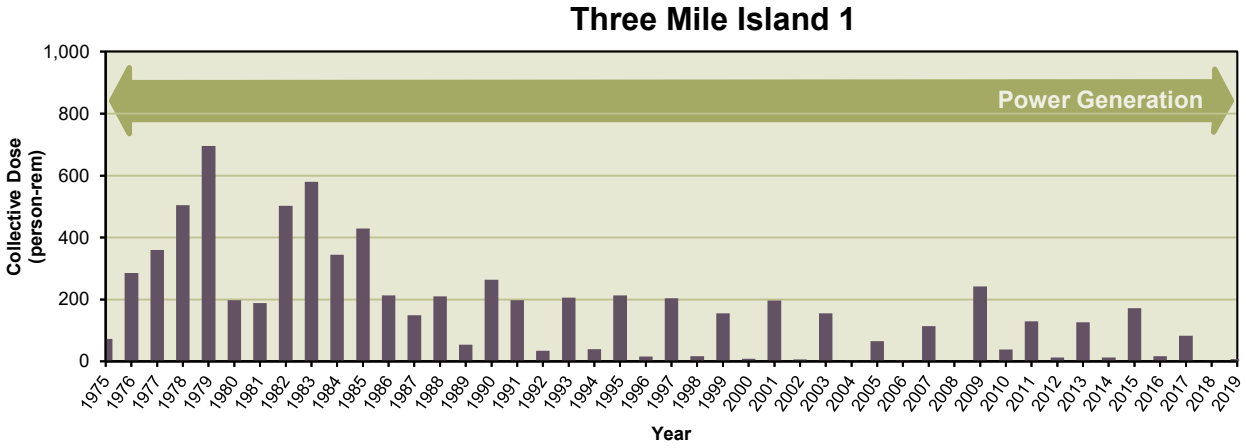


Savannah, Nuclear Ship

The Nuclear Ship (NS) Savannah was removed from service in 1970 and the fuel was removed from the ship in October 1971. The ship has been designated a national historic landmark by the American Nuclear Society. The Savannah is berthed in Baltimore, Maryland and is transitioning from SAFSTOR to DECON.

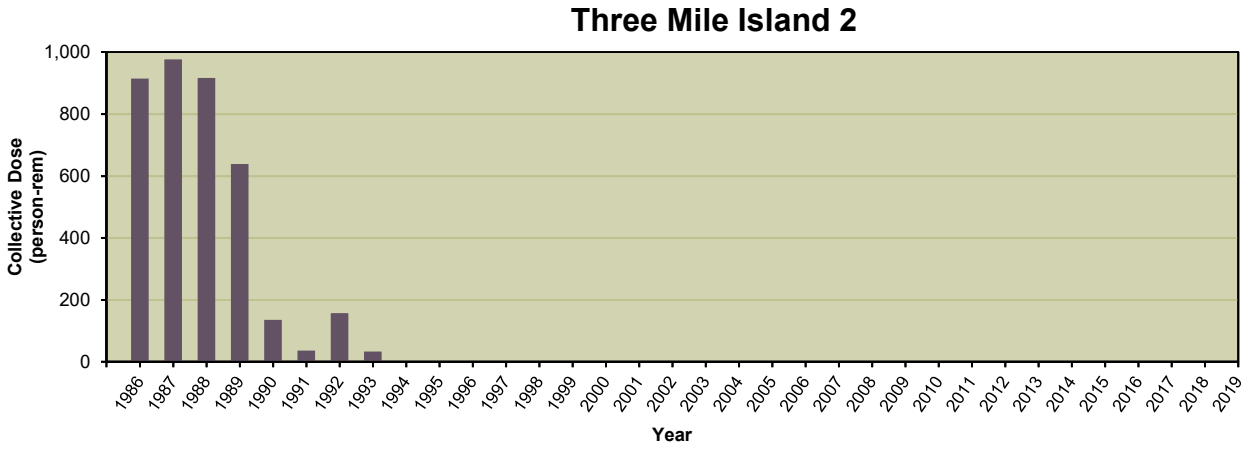
Three Mile Island Unit 1

Three Mile Island Generating Station Unit 1 (TMI Unit 1) was a 776 MWe three-loop pressurized-water reactor with a reactor thermal output of 2,568 MWt. TMI Unit 1 permanently shut down on September 20, 2019, leaving a 45-year legacy of safe, reliable, carbon-free electricity generation and service to the community. It now enters a new era—the safe decommissioning and dismantlement of its components, systems and buildings.



Three Mile Island Unit 2

Three Mile Island Unit 2 (TMI-2) produced power commercially from December 30, 1978, to March 28, 1979. On March 28, 1979, the unit experienced an accident that resulted in severe damage to the reactor core. TMI-2 has been in a non-operating status since that time. The licensee conducted a substantial program to defuel the reactor vessel and decontaminate the facility. The plant defueling was completed in April 1990. All spent fuel has been removed except for some debris in the reactor coolant system. The removed fuel is currently in storage at Idaho National Laboratory, and the DOE has taken title and possession of the fuel.

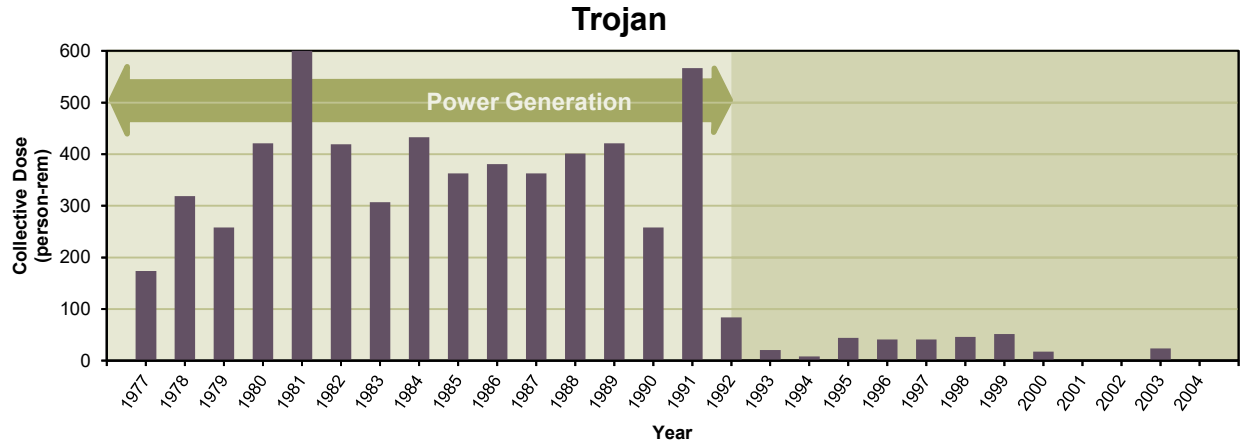


TMI-2 has been defueled and decontaminated to the extent the plant is in a safe, inherently stable condition suitable for long-term management. This long-term management condition is termed post-defueling monitored storage, which was approved in 1993. It is estimated that decommissioning activities for TMI-2 will be completed in 2036. The NRC LTP approval date is to be determined. There is no significant dismantlement underway. The plant shares equipment with the operating Three Mile Island Unit 1 (TMI-1). TMI-1 was sold to AmerGen (now Exelon) in 1999. GPU Nuclear retains the license for TMI-2 and is owned by FirstEnergy Corp. GPU Nuclear contracts with Exelon for maintenance and surveillance activities. The licensee plans to decommission TMI-2 independently of TMI-1, but may coordinate some TMI-2 decommissioning activities to support TMI-1 decommissioning. TMI-2 will retain its 10 CFR Part 50 license until the fuel is removed from the ISFSI.

Trojan

The Trojan plant was shut down in November 1992, and the SGs and reactor vessel were shipped to the Hanford site. The licensee was granted a site-specific 10 CFR Part 72 license for an onsite ISFSI in March 1999 that is still in operation. The licensee began spent fuel transfer to the ISFSI in December 2002 and finished fuel transfer in August 2003.

In December 2004, the Trojan Nuclear Plant completed decommissioning activities. The NRC terminated Trojan's 10 CFR Part 50 operating license on May 23, 2005.

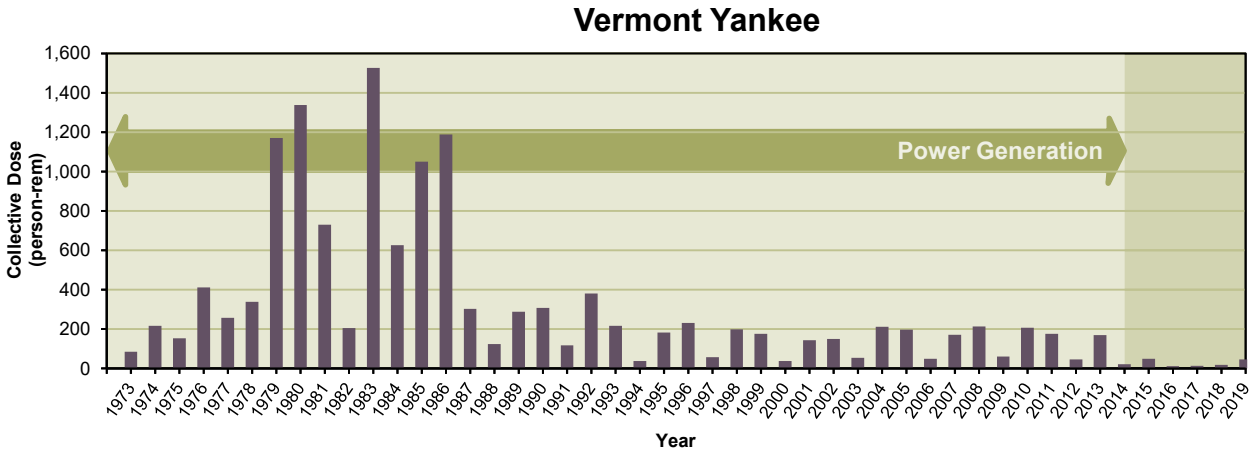


Vermont Yankee

Vermont Yankee Nuclear Power Station was a 1,912 Mwt, boiling-water reactor that began operation in 1972. The reactor was permanently shut down on December 29, 2014, and the fuel was removed from the reactor on January 12, 2015.

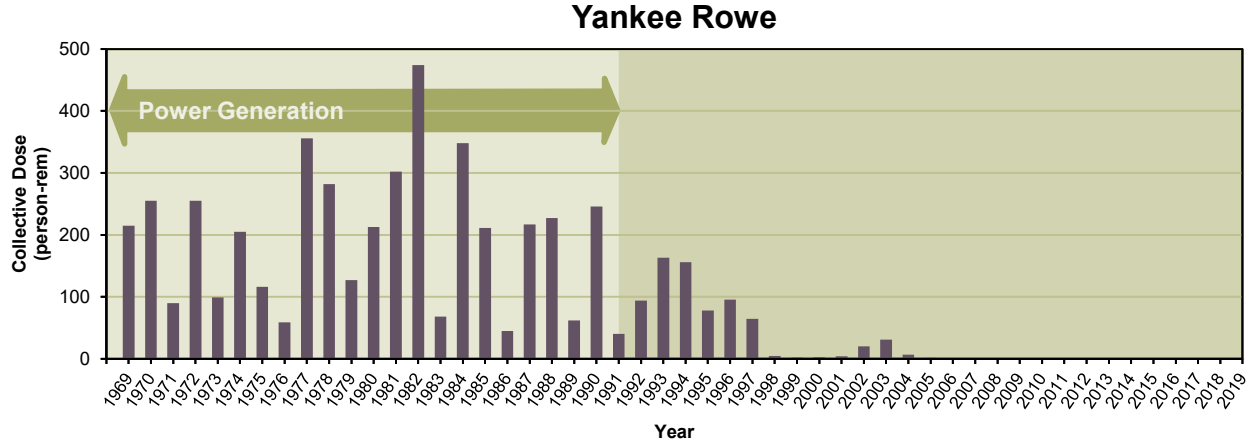
Entergy, which owns the facility, submitted the Vermont Yankee PSDAR to the NRC on Dec. 19, 2014. In the report, Entergy stated its intention to keep the plant in SAFSTOR until it is ready to fully decommission the facility in 2073. Entergy completed movement of the spent nuclear fuel to dry cask storage in August 2018.

On February 9, 2017, Entergy and NorthStar Group Services, Inc. (NorthStar) submitted a request to transfer the Vermont Yankee Nuclear Power Station license from Entergy to NorthStar. On October 12, 2018, NRC issued a first-of-a-kind order approving the permanent transfer of the Vermont Yankee Operating license and associated spent fuel in onsite storage from Entergy to Northstar for the purpose of decommissioning the reactor. With the completion of the transfer to Entergy on January 11, 2019, the new estimated date for closure is 2030.



Yankee Rowe

The Yankee Rowe plant was permanently shut down on October 1, 1991, and the SGs were shipped to the Barnwell Low-Level Radioactive Waste Disposal Facility in North Carolina, in November 1993. The reactor vessel was shipped to Barnwell in April 1997.



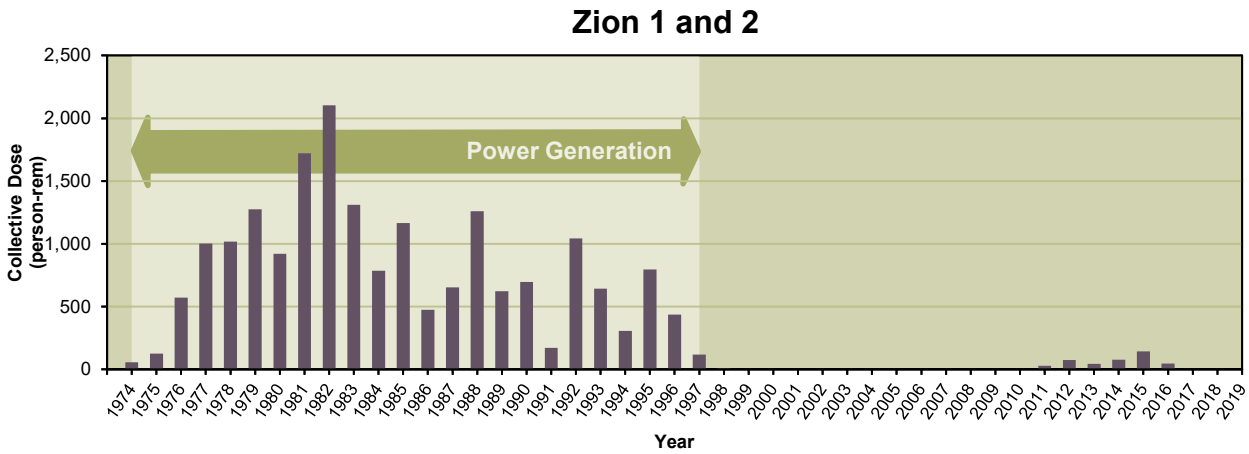
The owner completed construction of an onsite ISFSI and all the fuel from the spent fuel pool was transferred to it.

Yankee Rowe completed decommissioning in 2007. The license for the site was reduced to the two acres surrounding the ISFSI, which is still in operation.

Zion Units 1 and 2

Zion Nuclear Power Station (ZNPS) received a construction permit in December 1968 to begin building two nuclear power reactors. Unit 1 produced power commercially from December 31, 1973, to February 21, 1997, and Unit 2 produced power commercially from September 17, 1974, to September 19, 1996. On April 27, 1997, all fuel from Unit 1 was removed and on February 25, 1998, all fuel from Unit 2 was removed and placed in the spent fuel pool. On January 14, 1998, the Unicom Corporation and ComEd Boards of Directors, the joint owners of the facility, authorized the permanent cessation of operations at ZNPS for economic reasons. ComEd certified, in a letter dated February 13, 1998, to the NRC that operations had ceased at ZNPS. On March 9, 1998, ComEd informed the NRC that all fuel had been removed from the ZNPS reactor vessels and committed to maintain them permanently defueled.

The NRC acknowledged the certification of permanent cessation of power operation and permanent removal of fuel from the reactor vessels in a letter dated May 4, 1998, and ZNPS was placed in SAFSTOR. The owner submitted the PSDAR, site-specific cost estimate, and fuel management plan on February 14, 2000. The SAFSTOR approach is the intended decommissioning method to be used for ZNPS, which involves removal of all radioactive material from the site following a period of dormancy. In 2010, the NRC staff finalized the transfer of the possession license for Zion Units 1 and 2 from Exelon Generating Company, LLC to Zion Solutions, LLC to facilitate decommissioning. At Zion Units 1 and 2, decommissioning planning activities for the removal of large components were performed during 2011. The NRC staff held a public meeting in April 2015 regarding the LTP for Zion Units 1 and 2, which was submitted in December 2014. All of the above-grade plant structures have been removed. Final site survey and license reduction to the ISFSI is currently planned for -2020. It is estimated that license termination will occur in September 2020.



APPENDIX F

GLOSSARY

2019

Information in this appendix was obtained from Reference 22.

GLOSSARY 2019

Agreement State: as defined in Title 10 of the *Code of Federal Regulations* (10 CFR) 30.4, means any State with which the Atomic Energy Commission or the U.S. Nuclear Regulatory Commission has entered into an effective agreement under subsection 274b. of the [Atomic Energy] Act [of 1954, including any amendments thereto]. To simplify subsection 274b., an Agreement State is a State that has signed an agreement with the NRC under which the State regulates the use of certain byproduct, source, and small quantities of special nuclear material in that State.

As low as is reasonably achievable (ALARA): as defined in 10 CFR 20.1003, means making every reasonable effort to maintain exposures to radiation as far below the dose limits in 10 CFR Part 20 as is practical, consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to the state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

Average measurable dose: the dose obtained by dividing the collective dose by the number of individuals who received a measurable dose. This is the average most commonly used in this and other reports when examining trends and comparing doses received by workers, because it excludes those individuals receiving a less-than-measurable dose.

Boiling-water reactor (BWR): a reactor in which the water, used as both coolant and moderator, is allowed to boil in the core. The resulting steam can be used directly to drive a turbine and electrical generator, thereby producing electricity.

Byproduct material: as partially defined in 10 CFR 20.1003, means any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or using special nuclear material; and the tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content.

Breeder: a reactor that produces more nuclear fuel than it consumes. A fertile material, such as uranium-238, when bombarded by neutrons, is transformed into a fissile material, such as plutonium-239, which can be used as fuel. [Ref. 23]

Ceased operations: the date of plant shutdown notification to the NRC.

Ceased power generation: the date the plant ceased to generate electricity.

Class (or lung class or inhalation class): as defined in 10 CFR 20.1003, means a classification scheme for inhaled material according to its rate of clearance from the pulmonary region of the lung. Materials are classified as D, W, or Y, which applies to a range of clearance half-times: for Class D (Days) of less than 10 days, for Class W (Weeks) from 10 to 100 days, and for Y (Years) of greater than 100 days.

Collective dose: as defined in 10 CFR 20.1003, is the sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation.

Committed dose equivalent ($H_{T,50}$): as defined in 10 CFR 20.1003, means the dose equivalent to organs or tissues of reference that will be received from an intake of radioactive material by an individual during the 50-year period following the intake (CDE [$H_{T,50}$]). The acronym CDE is an NRC acronym used for this term.

Committed effective dose equivalent ($H_{E,50}$): as defined in 10 CFR 20.1003, is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues (CEDE [$H_{E,50}$] = $\Sigma W_T H_{T.50}$). The acronym CEDE is an NRC acronym used for this term.

Criticality: the normal operating condition of a reactor, in which nuclear fuel sustains a fission chain reaction. A reactor achieves criticality (and is said to be critical) when each fission event releases a sufficient number of neutrons to sustain an ongoing series of reactions. [Ref. 21]

DECON (immediate dismantlement): soon after the nuclear facility closes, equipment, structures, and portions of the facility containing radioactive contaminants are removed or decontaminated to a level that permits release of the property and termination of the NRC license.

Deep-dose equivalent (H_d): as defined in 10 CFR 20.1003, which applies to external whole-body exposure, is the dose equivalent at a tissue depth of 1 cm (1000 mg/cm^2). The acronym DDE is an NRC acronym used for this term.

Effective dose equivalent (H_E): as defined in 10 CFR 20.1003, is the sum of the products of the dose equivalent to the organ or tissue (H_T) and the weighting factors (W_T) applicable to each of the body organs or tissues that are irradiated (EDE [H_E] = $\Sigma W_T H_T$). The acronym EDE is an NRC acronym used for this term.

ENTOMB: radioactive contaminants that are permanently encased on site in a structurally sound material such as concrete and appropriately maintained and monitored until the radioactivity decays to a level permitting restr icted release of the property.

Exposure: as defined in 10 CFR 20.1003, means being exposed to ionizing radiation or to radioactive material.

FBR: a fast breeder reactor is a nuclear reactor that generates more fissile material than it consumes. These devices achieve this because their neutron economy is high enough to breed more fissile fuel than they use from fertile material, such as uranium-238 or thorium-232.

Independent Spent Fuel Storage Installation (ISFSI): as defined in 10 CFR 72.3, means a complex designed and constructed for the interim storage of spent nuclear fuel, solid reactor-related greater-than-Class-C (GTCC) waste, and other radioactive materials associated with spent

fuel and reactor-related GTCC waste storage. An ISFSI which is located on the site of another facility licensed under 10 CFR Part 72 or a facility licensed under 10 CFR Part 50 of [Title 10 of the *Code of Federal Regulations*] and which shares common utilities and services with that facility or is physically connected with that other facility may still be considered independent.

Lens dose equivalent (LDE): as defined in 10 CFR 20.1003, applies to the external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 centimeters (300 mg/cm2).

License: as defined in 10 CFR 20.1003, means a license issued under the regulations in 10 CFR Parts 30 through 36, 39, 40, 50, 60, 61, 63, 70, or 72 of [Title 10 of the *Code of Federal Regulations*].

Licensee: as defined in 10 CFR 20.1003, means the holder of the NRC license.

Licensed material: as defined in 10 CFR 20.1003, means source material, special nuclear material, or byproduct material received, possessed, used, transferred, or disposed of under a general or specific license issued by the [Nuclear Regulatory] Commission.

Light-water reactor (LWR): the term used in this report to describe commercial nuclear reactors that use ordinary water as a coolant and are operated for the purposes of generating electricity. Light water reactors include boiling-water reactors (BWRs) and pressurized-water reactors (PWRs).

Measurable dose: a dose greater than zero rem (not including doses reported as "not detectable").

Megawatt-year: unit of electric energy, equal to the energy from a power of 1,000,000 watts over a period of 1 year.

Mode of Intake: the manner of intake into the body: inhalation (H), absorption through the skin (B), oral ingestion (G), and injection (J).

Monitoring year: interval during which the radiation exposure monitoring was performed.

Nonreactor licensees: NRC licensees that are not commercial nuclear power reactors. These licensees are industrial radiographers, fuel processors, fabricators, and reprocessors; manufacturers and distributors of byproduct material; ISFSIs; facilities for land disposal of low-level waste; and geologic repositories for high-level waste.

Number of individuals with measurable dose: the count of unique individuals who received a measurable dose during the monitoring year. In some instances in this report, the number of individuals with a measurable dose may include individuals who are counted more than once,

since they may be monitored at more than one licensee during the year. (See Section 5 on the effect of transient individuals.) Tables that have been adjusted for transient workers are noted in the appropriate footnotes to the tables.

Occupational dose: as defined in 10 CFR 20.1003, means the dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to radiation or to radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released under [10 CFR] 35.75, from voluntary participation in medical research programs, or as a member of the public.

Pressurized-water reactor (PWR): a power reactor in which heat is transferred from the core to an exchanger by high-temperature water kept under high pressure in the primary system. Steam used to turn a turbine and electrical generator is generated in a secondary circuit. The majority of reactors producing electric power in the United States are pressurized-water reactors.

Radiation Safety Officer (RSO): as defined in 10 CFR 33, a person appointed who is qualified by training and experience in radiation protection, and who is available for advice and assistance on radiological safety matters.

Radionuclide: a radioisotope. A radioisotope is an unstable isotope that undergoes spontaneous transformation, emitting radiation. [Ref. 20]

REM: as defined in 10 CFR 20.1004, is the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (1 rem = 0.01 sievert).

SAFSTOR (often considered 'delayed DECON'): a nuclear facility that is maintained and monitored in a condition that allows the radioactivity to decay; afterwards, it is dismantled.

Shallow-dose equivalent for both maximum extremity (SDE-ME) and whole body (SDE-WB): the external exposure of an extremity, taken as the dose equivalent at a tissue depth of 0.007 centimeters.

Sievert: as defined in 10 CFR 20.1004, is the International System of Units (SI) of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv = 100 rem).

Special nuclear material: as defined in 10 CFR 20.1003, means plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235, and any other material that the [Nuclear Regulatory] Commission, pursuant to the provisions of section 51 of the [Atomic Energy] Act [of 1954, as amended], determines to be special nuclear material, but does not include source material, or any material artificially enriched by any of the foregoing.

Statistical comparisons: For statistical comparisons of averages, a two-sided one-sample t test with a 0.05 significance level (i.e., 95 percent confidence) is used to determine whether the difference between the two averages is significantly different. For values that are not averages, such as total collective dose, a 5-year average from the previous five years (not including the current year under consideration) is calculated with 95 percent confidence interval based on the normal distribution. If the value for the current year falls within the 5-year 95 percent confidence interval, then it is not significantly different; whereas, if the value falls outside (i.e., below the lower limit or above the upper limit), there is an indication of a statistical significant change.

Two-sided one-sample t test formula:

$$t = \frac{\bar{X} - \mu}{\frac{s}{\sqrt{n}}}$$

Where:

t = calculated t statistic
$\bar{X}$ = sample mean
μ = population mean
S = sample standard deviation
n = sample number

Example:

We wish to determine if the average measurable dose for a type of nuclear reactor differs from the previous five years. The five year mean for the average measurable dose is 0.080. The population mean is the current year's average measurable dose, 0.060. The sample standard deviation is 0.01, and the sample number is 5. Using the formula,

$$t = \frac{0.080 - 0.060}{\frac{0.01}{2.236}} = 4.472$$

The two-tailed probability value (as obtained from a Student's t distribution table) given a t-value of 4.472 is 0.006 which is statistically significant at a 0.05 significance level.

Total effective dose equivalent (TEDE): as defined in 10 CFR 20.1003, means the sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures) (TEDE = DDE + CEDE).

Total organ dose equivalent (TODE): as defined in the NRC Regulatory Guide 8.7, the sum of the deep dose equivalent and the committed dose equivalent to the organ receiving the highest dose as described in 10 CFR 20.2106(a)(6).

Transient individual: one who is monitored at more than one licensed site during the calendar year.

Unit availability factor: the unit available hours (the total clock hours in the report period during which the unit operated on line or was capable of such operation) times 100 divided by the period hours.

Weighting factor (W_T): as defined in 10 CFR 20.1003, the weighting factor for an organ or tissue (T) is the proportion of the risk of stochastic effects resulting from irradiation of that organ or tissue to the total risk of stochastic effects when the whole body is irradiated uniformly.

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Fifty-Second Annual Report

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10. SUPPLEMENTARY NOTES

11. ABSTRACT (200 words or less)

This report summarizes the occupational exposure data that are maintained in the U.S. Nuclear Regulatory Commission (NRC) Radiation Exposure Information and Reporting System (REIRS) database. The bulk of the information contained in this report was compiled from the 2019 annual reports submitted by five of the seven categories of NRC licensees subject to the reporting requirements of Title 10 of the Code of Federal Regulations (10 CFR) 20.2206, “Reports of Individual Monitoring.” Because there are no geologic repositories for high-level waste currently licensed and no NRC-licensed low-level waste disposal facilities currently in operation, only five categories are considered in this report. The annual reports submitted by these licensees consist of radiation exposure records for each monitored individual. These records are analyzed for trends and presented in this report in terms of collective dose and the distribution of dose among the monitored individuals. Annual reports for 2019 were received from a total of 181 NRC licensees from the five categories included in this report. The summation of reports submitted by the 181 licensees indicated that 144,243 individuals were monitored, 60,289 of whom received a measurable dose.

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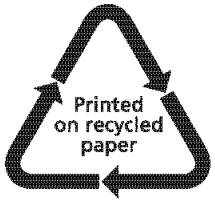

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