

# **Annual Radiological Effluent Summary Reports NUREG/CR-2907**

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Radiological Effluents and Environmental Workshop

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# Annual Licensee Effluent Reports

- Annual Radioactive Effluent Release Reports (ARERRs) and Annual Radiological Environmental Operating Reports (AREORs) are posted on the NRC website: <https://www.nrc.gov/reactors/operating/ops-experience/tritium/plant-info.html>

## Radioactive Effluent and Environmental Reports

Alphabetical List of Operating Nuclear Power Reactors		
A - G	H - P	Q - W
Arkansas Nuclear One 1 & 2 Beaver Valley 1 & 2 Braidwood 1 & 2	H.B. Robinson 2 Haddam Neck* Hope Creek 1	Quad Cities 1 & 2 River Bend 1 Salem 1 & 2

# NUREG/CR-2907 “Radioactive Effluents from Nuclear Power Plants”

- Oak Ridge Associated Universities (ORAU) extract data from the ARERRs
- ORAU prepares an annual summary report for NRC’s review
- NRC staff reviews and issues the annual summary report
- NUREG/CR-2907s are posted on the NRC website at:  
<https://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr2907/index.html>

# NUREG/CR-2907 “Radioactive Effluents from Nuclear Power Plants” (Cont’d)

- The NUREG contains:
  - Descriptions of the radioactive effluents
  - Good visual depictions of effluents via graphs and tables
  - The ability for the reader to quickly compare effluents from different nuclear power plants



## **NUREG/CR-2907 Effluent General Categories**

- Gaseous and Liquid Effluents
- Tritium
- C-14
- Fission and Activation (Noble) Gases
- Iodines
- Particulates
- Effluent Trends
- Radiation Doses from Gaseous and Liquid Effluents

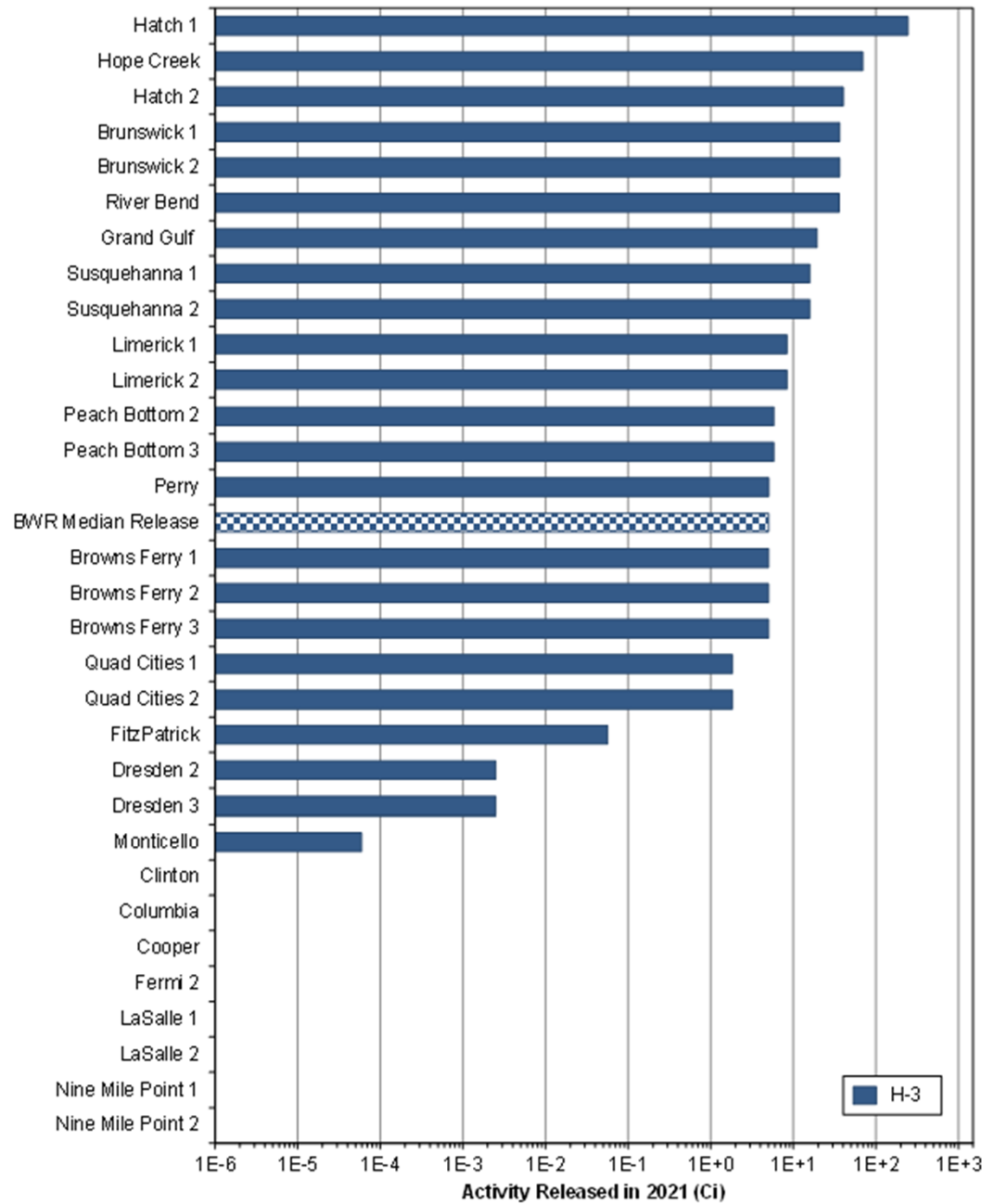
# Tritium, 2021

## Table 3.12 BWR Liquid Releases - Tritium, 2021

*Shown in Descending Order of Total Activity*

BWR Facility	H-3 (Ci)
Hatch 1	2.44E+02
Hope Creek	6.93E+01
Hatch 2	4.02E+01
Brunswick 1	3.65E+01
Brunswick 2	3.65E+01
River Bend	3.60E+01
Grand Gulf	1.94E+01
Susquehanna 1	1.58E+01
Susquehanna 2	1.58E+01
Limerick 1	8.40E+00
Limerick 2	8.40E+00
Peach Bottom 2	5.79E+00
Peach Bottom 3	5.79E+00
Perry	5.04E+00

BWR Facility	H-3 (Ci)
<b>BWR Median Release</b>	<b>5.02E+00</b>
Browns Ferry 1	5.02E+00
Browns Ferry 2	5.02E+00
Browns Ferry 3	5.02E+00
Quad Cities 1	1.83E+00
Quad Cities 2	1.83E+00
FitzPatrick	5.65E-02
Dresden 2	2.49E-03
Dresden 3	2.49E-03
Monticello	5.96E-05
Clinton	
Columbia	
Cooper	
Fermi 2	
LaSalle 1	
LaSalle 2	
Nine Mile Point 1	
Nine Mile Point 2	



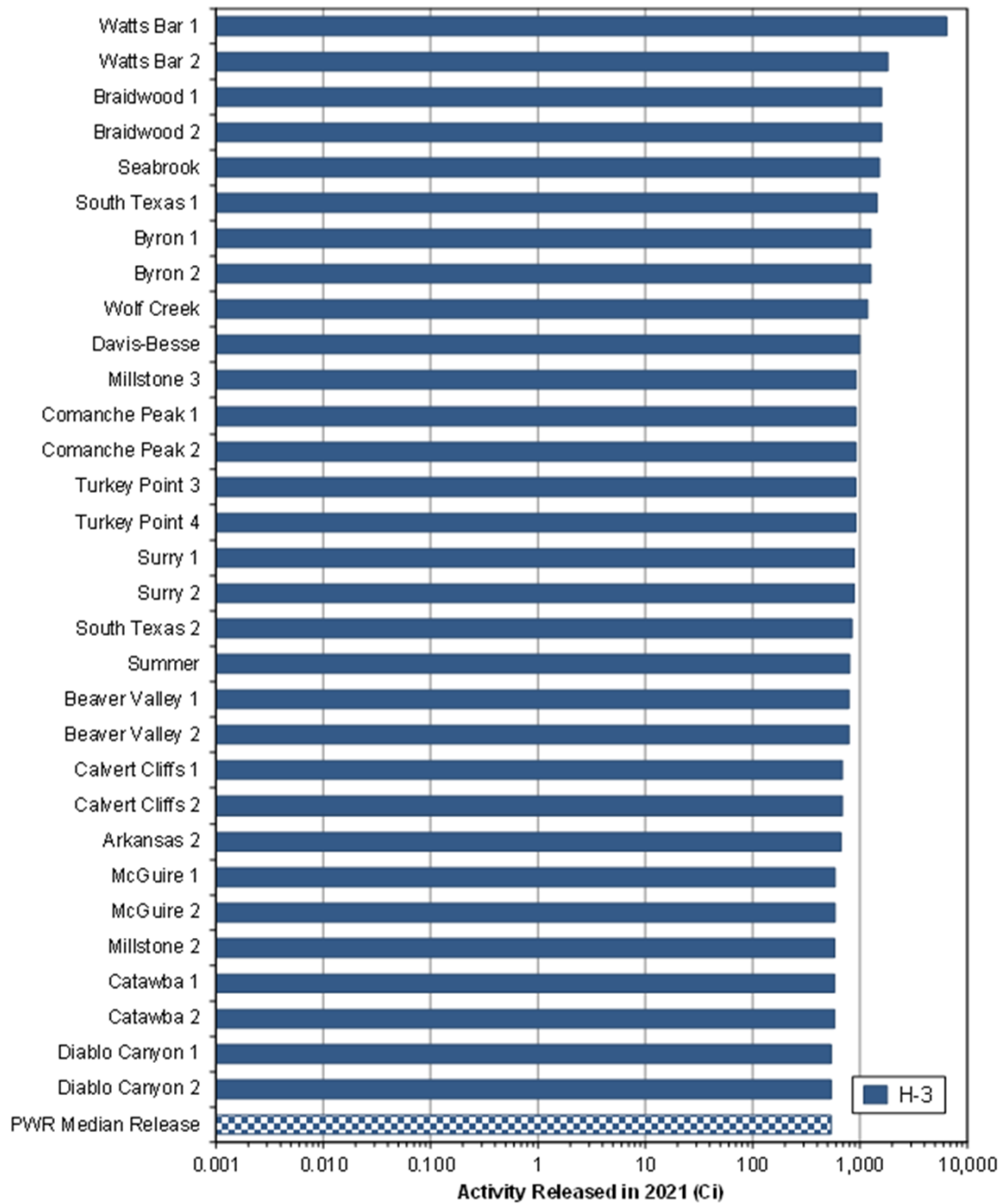
**Figure 3.12**  
**BWR**  
**Liquid**  
**Releases –**  
**Tritium**

# Table 3.14 PWR Liquid Releases - Tritium, 2021

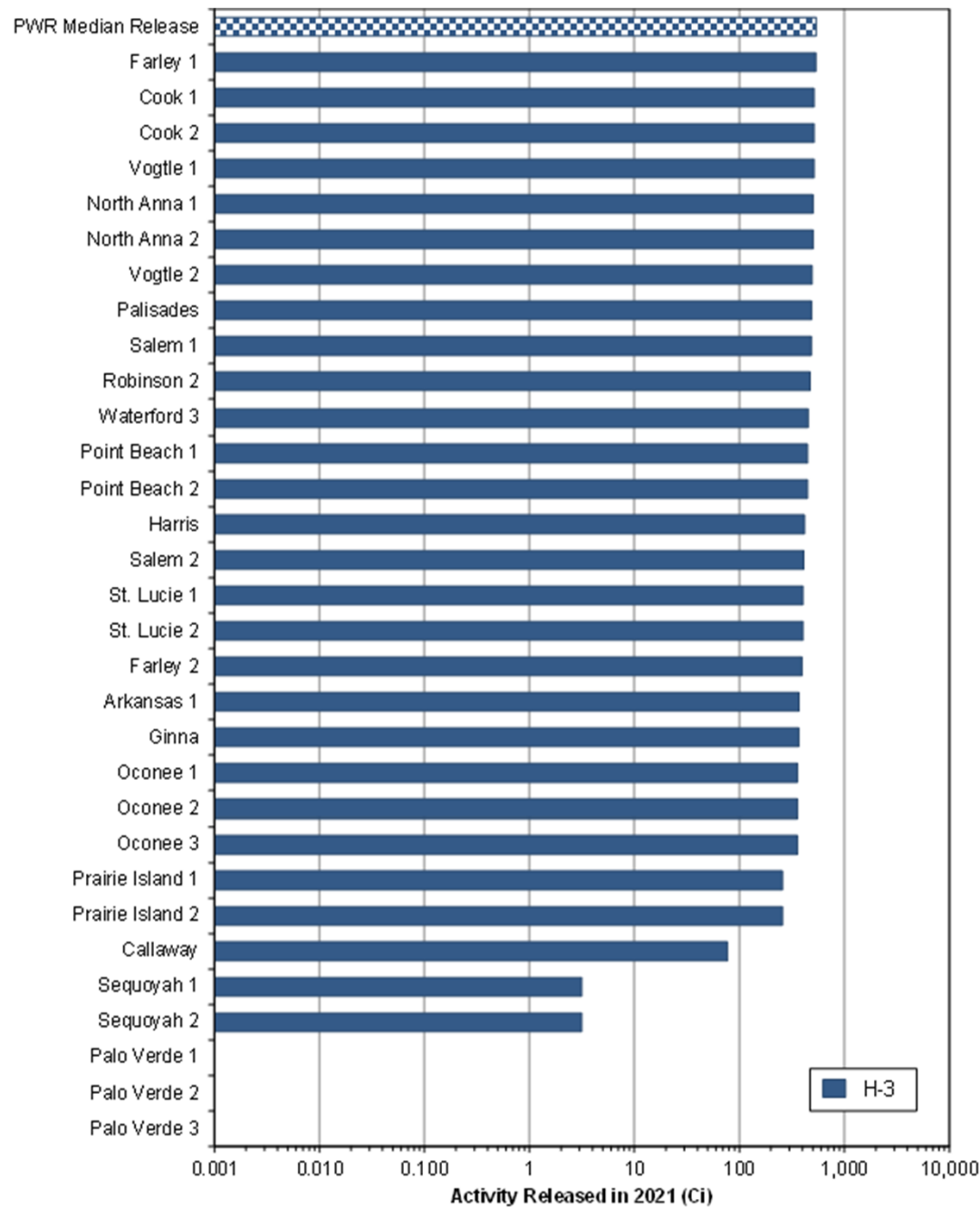
*Shown in Descending Order of Total Activity*

PWR Facility	H-3 (Ci)
Watts Bar 1	6.45E+03
Watts Bar 2	1.82E+03
Braidwood 1	1.59E+03
Braidwood 2	1.59E+03
Seabrook	1.52E+03
South Texas 1	1.45E+03
Byron 1	1.26E+03
Byron 2	1.26E+03
Wolf Creek	1.18E+03
Davis-Besse	9.93E+02
Millstone 3	9.21E+02
Comanche Peak 1	9.18E+02
Comanche Peak 2	9.18E+02
Turkey Point 3	9.17E+02
Turkey Point 4	9.17E+02
Surry 1	8.85E+02
Surry 2	8.85E+02
South Texas 2	8.40E+02
Summer	8.01E+02
Beaver Valley 1	7.91E+02
Beaver Valley 2	7.91E+02
Calvert Cliffs 1	6.84E+02
Calvert Cliffs 2	6.84E+02
Arkansas 2	6.66E+02
McGuire 1	5.87E+02
McGuire 2	5.87E+02
Millstone 2	5.82E+02
Catawba 1	5.78E+02
Catawba 2	5.78E+02
Diablo Canyon 1	5.39E+02
Diablo Canyon 2	5.39E+02

PWR Facility	H-3 (Ci)
<b>PWR Median Release</b>	<b>5.38E+02</b>
Farley 1	5.36E+02
Cook 1	5.15E+02
Cook 2	5.15E+02
Vogtle 1	5.15E+02
North Anna 1	5.05E+02
North Anna 2	5.05E+02
Vogtle 2	4.93E+02
Palisades	4.88E+02
Salem 1	4.84E+02
Robinson 2	4.71E+02
Waterford 3	4.52E+02
Point Beach 1	4.47E+02
Point Beach 2	4.47E+02
Harris	4.18E+02
Salem 2	4.10E+02
St. Lucie 1	4.03E+02
St. Lucie 2	4.03E+02
Farley 2	3.96E+02
Arkansas 1	3.71E+02
Ginna	3.68E+02
Oconee 1	3.59E+02
Oconee 2	3.59E+02
Oconee 3	3.59E+02
Prairie Island 1	2.57E+02
Prairie Island 2	2.57E+02
Callaway	7.74E+01
Sequoyah 1	3.15E+00
Sequoyah 2	3.15E+00
Palo Verde 1	
Palo Verde 2	
Palo Verde 3	



**Figure 3.14  
 PWR Liquid  
 Releases –  
 Tritium**



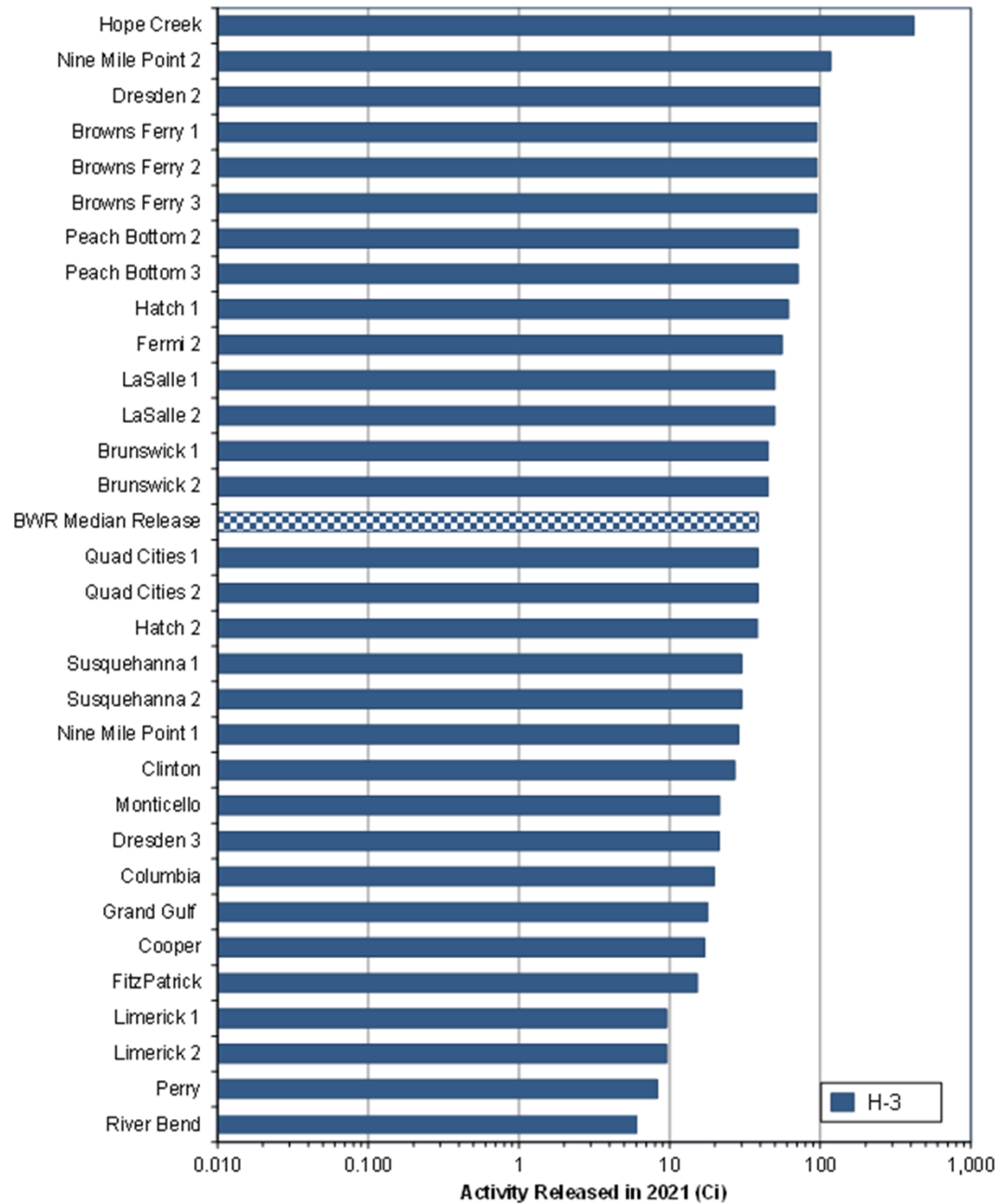
**Figure 3.14**  
**PWR Liquid**  
**Releases –**  
**Tritium, *cont.***

**Table 3.4 BWR Gaseous Releases - Tritium, 2021**  
*Shown in Descending Order of Total Activity*

BWR Facility	H-3 (Ci)
Hope Creek	4.18E+02
Nine Mile Point 2	1.17E+02
Dresden 2	9.86E+01
Browns Ferry 1	9.49E+01
Browns Ferry 2	9.49E+01
Browns Ferry 3	9.49E+01
Peach Bottom 2	7.10E+01
Peach Bottom 3	7.10E+01
Hatch 1	6.12E+01
Fermi 2	5.58E+01
LaSalle 1	4.99E+01
LaSalle 2	4.99E+01
Brunswick 1	4.51E+01
Brunswick 2	4.51E+01

BWR Facility	H-3 (Ci)
<b>BWR Median Release</b>	<b>3.86E+01</b>
Quad Cities 1	3.86E+01
Quad Cities 2	3.86E+01
Hatch 2	3.83E+01
Susquehanna 1	3.01E+01
Susquehanna 2	3.01E+01
Nine Mile Point 1	2.88E+01
Clinton	2.71E+01
Monticello	2.14E+01
Dresden 3	2.13E+01
Columbia	1.98E+01
Grand Gulf	1.78E+01
Cooper	1.71E+01
FitzPatrick	1.53E+01
Limerick 1	9.54E+00
Limerick 2	9.54E+00
Perry	8.30E+00
River Bend	6.11E+00

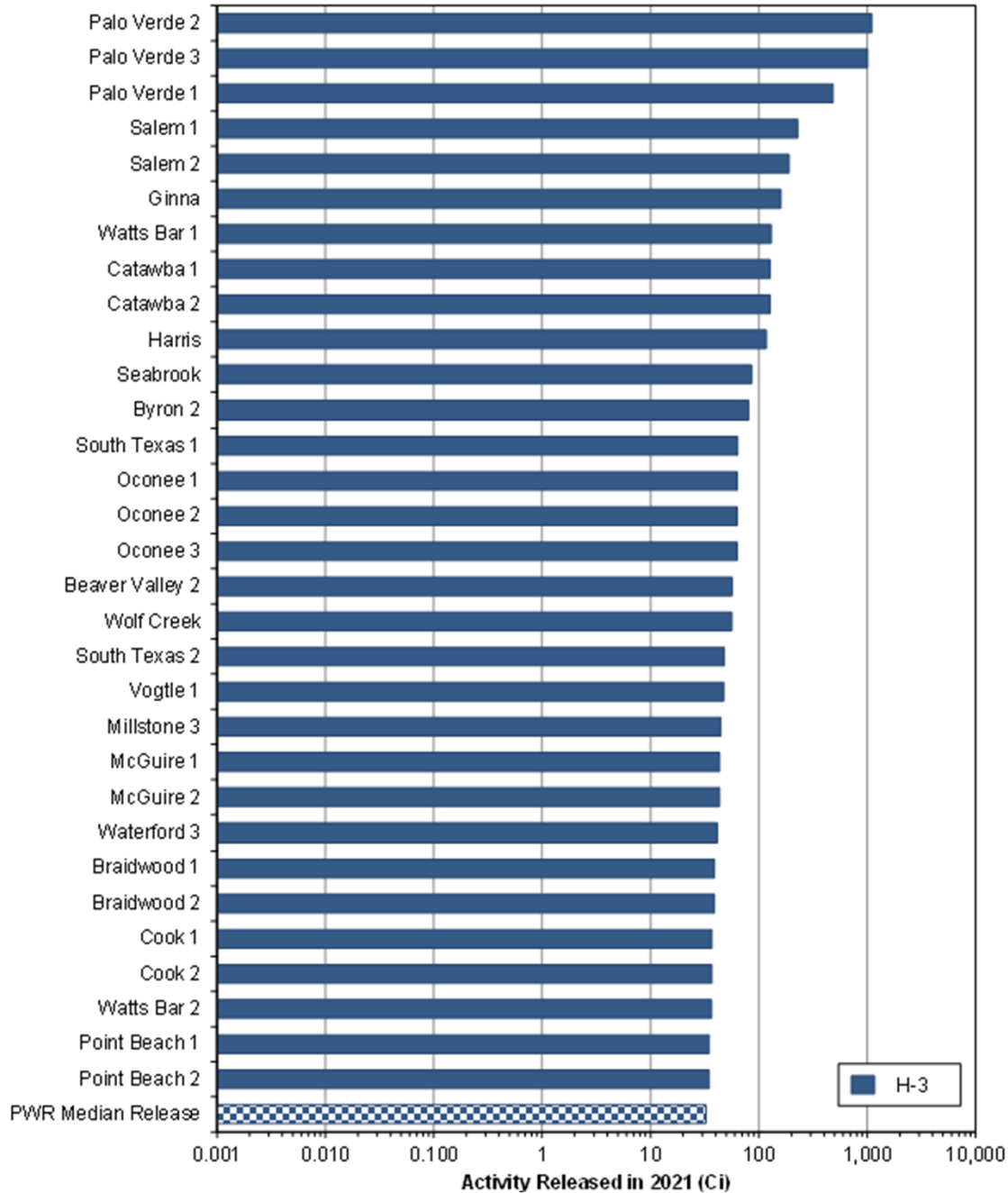




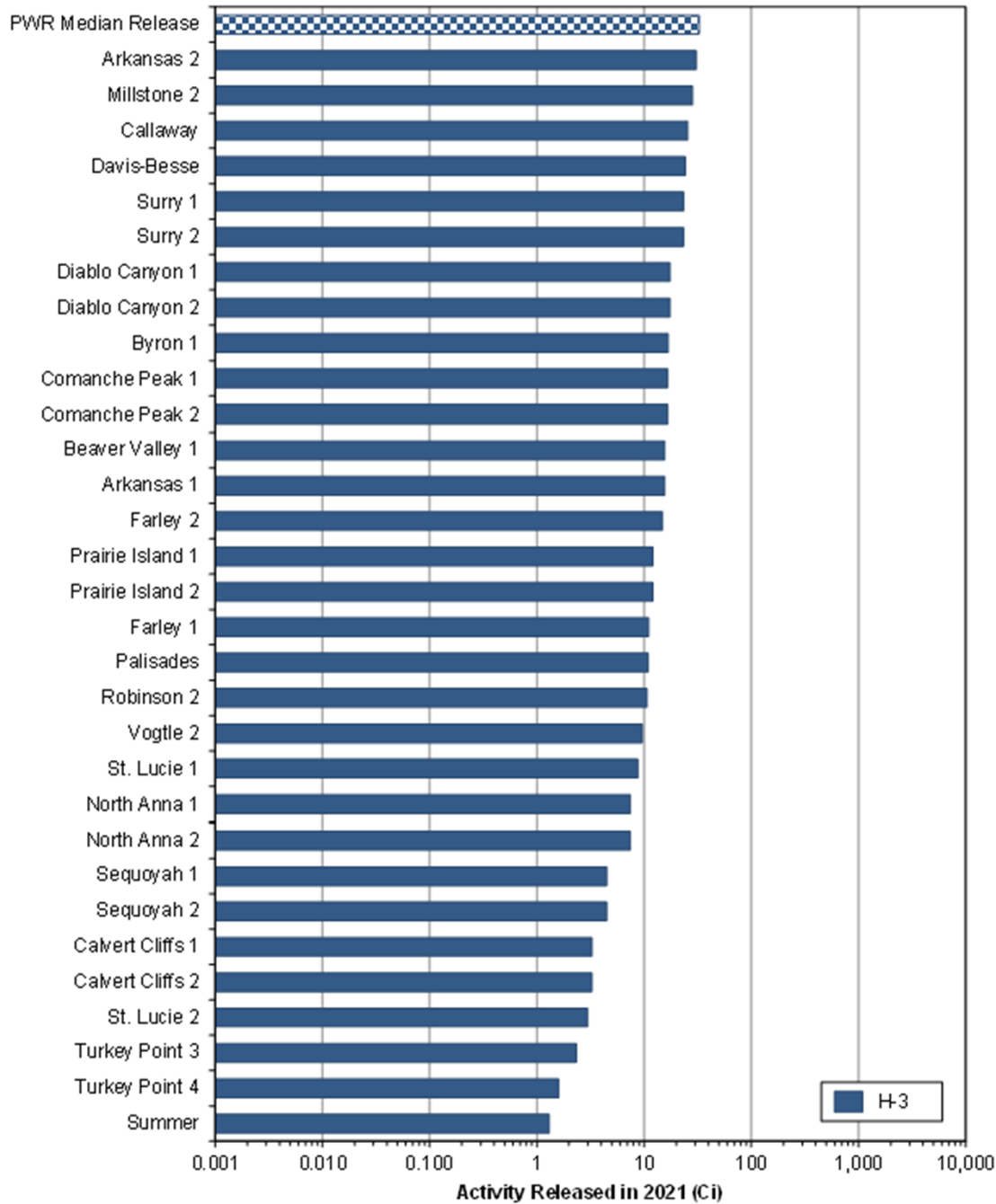
**Figure 3.4  
 BWR Gaseous  
 Releases –  
 Tritium**

**Table 3.9 PWR Gaseous Releases - Tritium, 2021**  
*Shown in Descending Order of Total Activity*

PWR Facility	H-3 (Ci)	PWR Facility	H-3 (Ci)
Palo Verde 2	1.10E+03	<b>PWR Median Release</b>	<b>3.26E+01</b>
Palo Verde 3	1.00E+03	Arkansas 2	3.06E+01
Palo Verde 1	4.84E+02	Millstone 2	2.83E+01
Salem 1	2.27E+02	Callaway	2.55E+01
Salem 2	1.90E+02	Davis-Besse	2.43E+01
Ginna	1.59E+02	Surry 1	2.34E+01
Watts Bar 1	1.30E+02	Surry 2	2.34E+01
Catawba 1	1.27E+02	Diablo Canyon 1	1.74E+01
Catawba 2	1.27E+02	Diablo Canyon 2	1.74E+01
Harris	1.17E+02	Byron 1	1.68E+01
Seabrook	8.56E+01	Comanche Peak 1	1.66E+01
Byron 2	8.04E+01	Comanche Peak 2	1.66E+01
South Texas 1	6.36E+01	Beaver Valley 1	1.56E+01
Oconee 1	6.31E+01	Arkansas 1	1.55E+01
Oconee 2	6.31E+01	Farley 2	1.48E+01
Oconee 3	6.31E+01	Prairie Island 1	1.21E+01
Beaver Valley 2	5.66E+01	Prairie Island 2	1.21E+01
Wolf Creek	5.62E+01	Farley 1	1.10E+01
South Texas 2	4.78E+01	Palisades	1.10E+01
Vogtle 1	4.74E+01	Robinson 2	1.06E+01
Millstone 3	4.43E+01	Vogtle 2	9.62E+00
McGuire 1	4.33E+01	St. Lucie 1	8.78E+00
McGuire 2	4.33E+01	North Anna 1	7.43E+00
Waterford 3	4.12E+01	North Anna 2	7.43E+00
Braidwood 1	3.88E+01	Sequoyah 1	4.49E+00
Braidwood 2	3.88E+01	Sequoyah 2	4.49E+00
Cook 1	3.68E+01	Calvert Cliffs 1	3.26E+00
Cook 2	3.68E+01	Calvert Cliffs 2	3.26E+00
Watts Bar 2	3.65E+01	St. Lucie 2	2.96E+00
Point Beach 1	3.46E+01	Turkey Point 3	2.34E+00
Point Beach 2	3.46E+01	Turkey Point 4	1.60E+00
		Summer	1.30E+00



**Figure 3.9  
 PWR Gaseous  
 Releases –  
 Tritium**



**Figure 3.9  
 PWR Gaseous  
 Releases –  
 Tritium, *cont.***

# Carbon-14, 2021

# Carbon-14

- C-14 parameters vary based on power produced and consumption rates
  - PWR activity ranges from 4-14 Ci (9.28 Ci median); dose ranges from 0-10 mrem (0.1 mrem median)
  - BWR activity range is 7-23 Ci (15.5 median); dose ranges from 0.04 to 4.7 mrem (0.15 median)

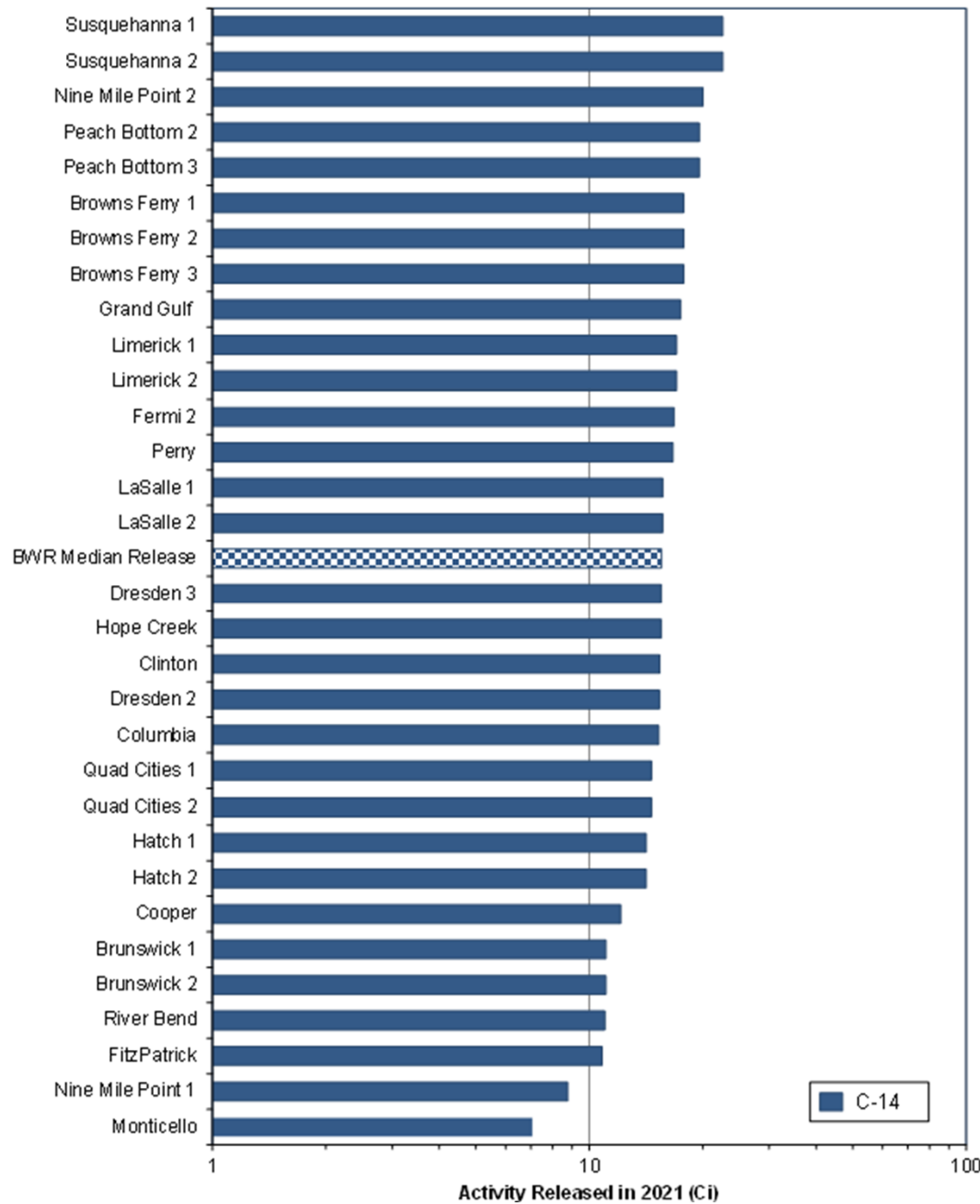
## Table 3.5 BWR Gaseous Releases - C-14, 2021

*Shown In Descending Order Of Total Activity*

BWR Facility	C-14 (Ci)
Susquehanna 1	2.26E+01
Susquehanna 2	2.26E+01
Nine Mile Point 2	2.00E+01
Peach Bottom 2	1.96E+01
Peach Bottom 3	1.96E+01
Browns Ferry 1	1.78E+01
Browns Ferry 2	1.78E+01
Browns Ferry 3	1.78E+01
Grand Gulf	1.75E+01
Limerick 1	1.70E+01
Limerick 2	1.70E+01
Fermi 2	1.68E+01
Perry	1.67E+01
LaSalle 1	1.57E+01
LaSalle 2	1.57E+01

BWR Facility	C-14 (Ci)
<b>BWR Median Release</b>	<b>1.55E+01</b>
Dresden 3	1.55E+01
Hope Creek	1.55E+01
Clinton	1.54E+01
Dresden 2	1.54E+01
Columbia	1.53E+01
Quad Cities 1	1.46E+01
Quad Cities 2	1.46E+01
Hatch 1	1.42E+01
Hatch 2	1.42E+01
Cooper	1.21E+01
Brunswick 1	1.11E+01
Brunswick 2	1.11E+01
River Bend	1.10E+01
FitzPatrick	1.08E+01
Nine Mile Point 1	8.76E+00
Monticello	7.05E+00

**Figure 3.5  
BWR  
Gaseous  
Releases -  
Carbon-14**



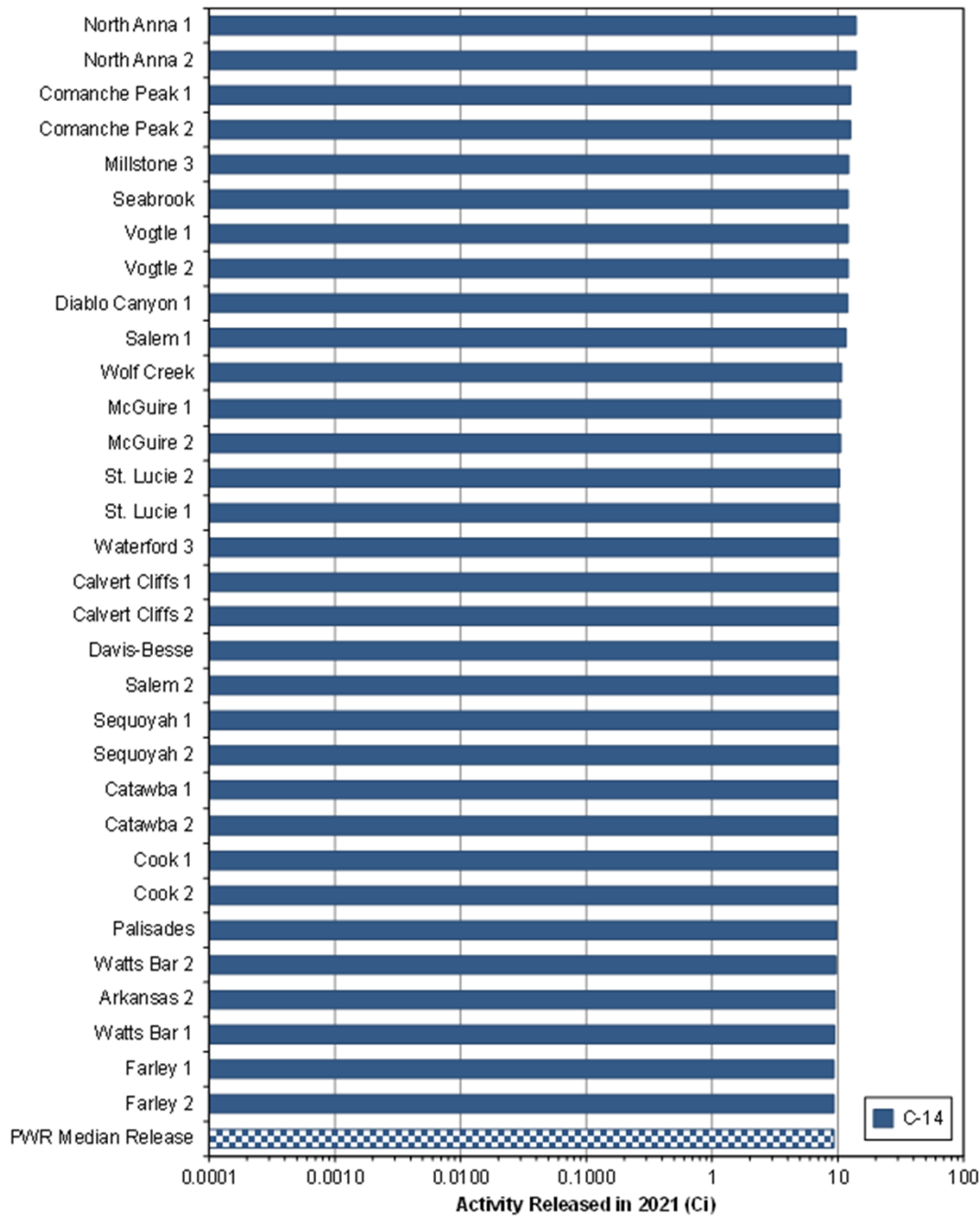


## Table 3.5 PWR Gaseous Releases - C-14, 2021

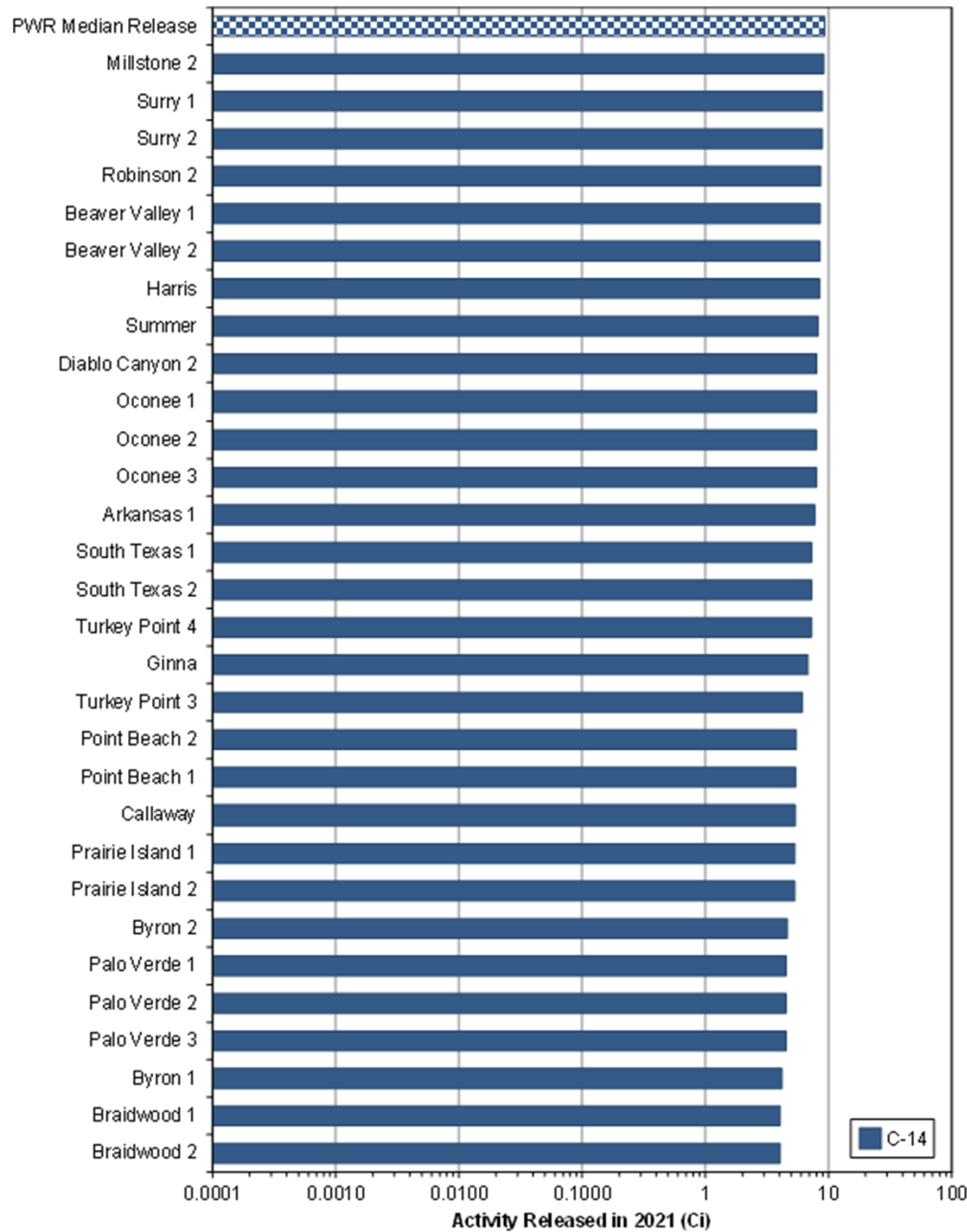
*Shown In Descending Order Of Total Activity*

PWR Facility	C-14 (Ci)	PWR Facility	C-14 (Ci)
North Anna 1	1.40E+01	<b>PWR Median Release</b>	<b>9.28E+00</b>
North Anna 2	1.40E+01	Millstone 2	9.18E+00
Comanche Peak 1	1.26E+01	Surry 1	8.92E+00
Comanche Peak 2	1.26E+01	Surry 2	8.92E+00
Millstone 3	1.22E+01	Robinson 2	8.63E+00
Seabrook	1.21E+01	Beaver Valley 1	8.60E+00
Vogtle 1	1.21E+01	Beaver Valley 2	8.55E+00
Vogtle 2	1.21E+01	Harris	8.46E+00
Diablo Canyon 1	1.20E+01	Summer	8.24E+00
Salem 1	1.16E+01	Diablo Canyon 2	8.00E+00
Wolf Creek	1.07E+01	Oconee 1	7.95E+00
McGuire 1	1.05E+01	Oconee 2	7.95E+00
McGuire 2	1.05E+01	Oconee 3	7.95E+00
St. Lucie 2	1.03E+01	Arkansas 1	7.76E+00
St. Lucie 1	1.02E+01	South Texas 1	7.31E+00
Waterford 3	1.02E+01	South Texas 2	7.29E+00
Calvert Cliffs 1	1.01E+01	Turkey Point 4	7.26E+00
Calvert Cliffs 2	1.01E+01	Ginna	6.80E+00
Davis-Besse	1.01E+01	Turkey Point 3	6.15E+00
Salem 2	1.01E+01	Point Beach 2	5.46E+00
Sequoyah 1	1.01E+01	Point Beach 1	5.40E+00
Sequoyah 2	1.01E+01	Callaway	5.35E+00
Catawba 1	9.98E+00	Prairie Island 1	5.35E+00
Catawba 2	9.98E+00	Prairie Island 2	5.35E+00
Cook 1	9.94E+00	Byron 2	4.61E+00
Cook 2	9.94E+00	Palo Verde 1	4.52E+00
Palisades	9.75E+00	Palo Verde 2	4.52E+00
Watts Bar 2	9.63E+00	Palo Verde 3	4.52E+00
Arkansas 2	9.53E+00	Byron 1	4.19E+00
Watts Bar 1	9.43E+00	Braidwood 1	4.05E+00
Farley 1	9.28E+00	Braidwood 2	4.05E+00
Farley 2	9.28E+00		

**DRAFT**



**Figure 3.10  
 PWR Gaseous  
 Releases -  
 Carbon-14**



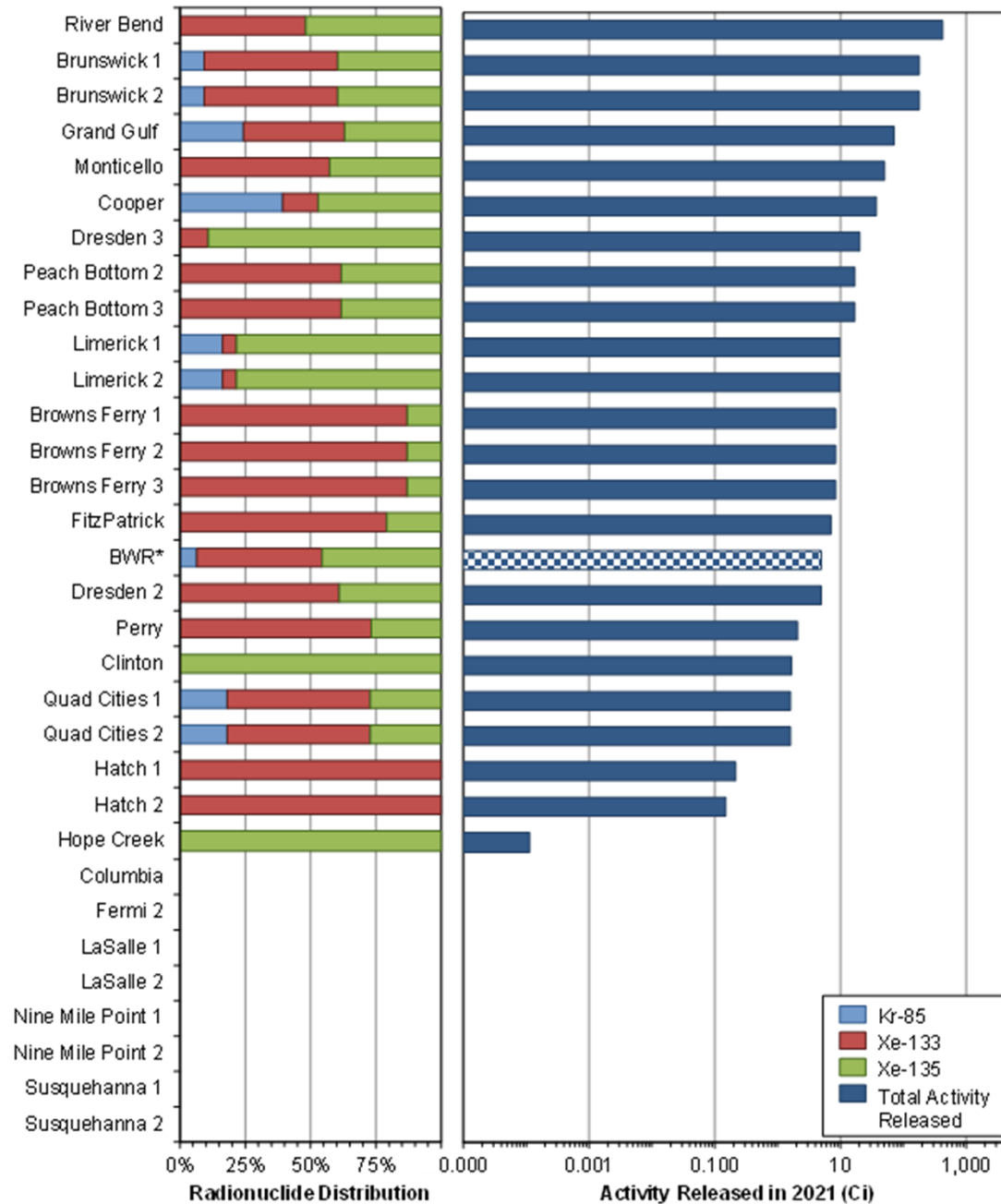
**Figure 3.10**  
**PWR Gaseous**  
**Releases -**  
**Carbon-14,**  
*cont.*

# **Fission and Activation (Noble) Gases, 2021**

# Table 3.1 BWR Fission and Activation Gases, 2021

*Shown in Descending Order of Total Activity*

BWR Facility	Kr-85 (Ci)	Xe-133 (Ci)	Xe-135 (Ci)	Total (Ci)
River Bend		2.05E+02	2.21E+02	4.26E+02
Brunswick 1	1.67E+01	9.16E+01	7.09E+01	1.79E+02
Brunswick 2	1.67E+01	9.16E+01	7.09E+01	1.79E+02
Grand Gulf	1.74E+01	2.77E+01	2.64E+01	7.16E+01
Monticello		2.88E+01	2.14E+01	5.02E+01
Cooper	1.46E+01	5.03E+00	1.75E+01	3.71E+01
Dresden 3		2.22E+00	1.81E+01	2.03E+01
Peach Bottom 2		1.05E+01	6.49E+00	1.70E+01
Peach Bottom 3		1.05E+01	6.49E+00	1.70E+01
Limerick 1	1.60E+00	5.16E-01	7.68E+00	9.79E+00
Limerick 2	1.60E+00	5.16E-01	7.68E+00	9.79E+00
Browns Ferry 1		7.23E+00	1.08E+00	8.31E+00
Browns Ferry 2		7.23E+00	1.08E+00	8.31E+00
Browns Ferry 3		7.23E+00	1.08E+00	8.31E+00
FitzPatrick		5.60E+00	1.47E+00	7.07E+00
<b>BWR Median Release</b>	<b>0.00E+00</b>	<b>8.80E-01</b>	<b>1.08E+00</b>	<b>4.94E+00</b>
Dresden 2		3.01E+00	1.93E+00	4.94E+00
Perry		1.52E+00	5.55E-01	2.08E+00
Clinton			1.66E+00	1.66E+00
Quad Cities 1	2.90E-01	8.80E-01	4.36E-01	1.61E+00
Quad Cities 2	2.90E-01	8.80E-01	4.36E-01	1.61E+00
Hatch 1		2.14E-01		2.14E-01
Hatch 2		1.50E-01		1.50E-01
Hope Creek			1.13E-04	1.13E-04
Columbia				
Fermi 2				
LaSalle 1				
LaSalle 2				
Nine Mile Point 1				
Nine Mile Point 2				
Susquehanna 1				
Susquehanna 2				



**Figure 3.1  
BWR Fission  
and  
Activation  
Gases**

\* BWR average radionuclide mix and median activity released

# Table 3.6 PWR Fission and Activation Gases, 2021

*Shown in Descending Order of Total Activity*

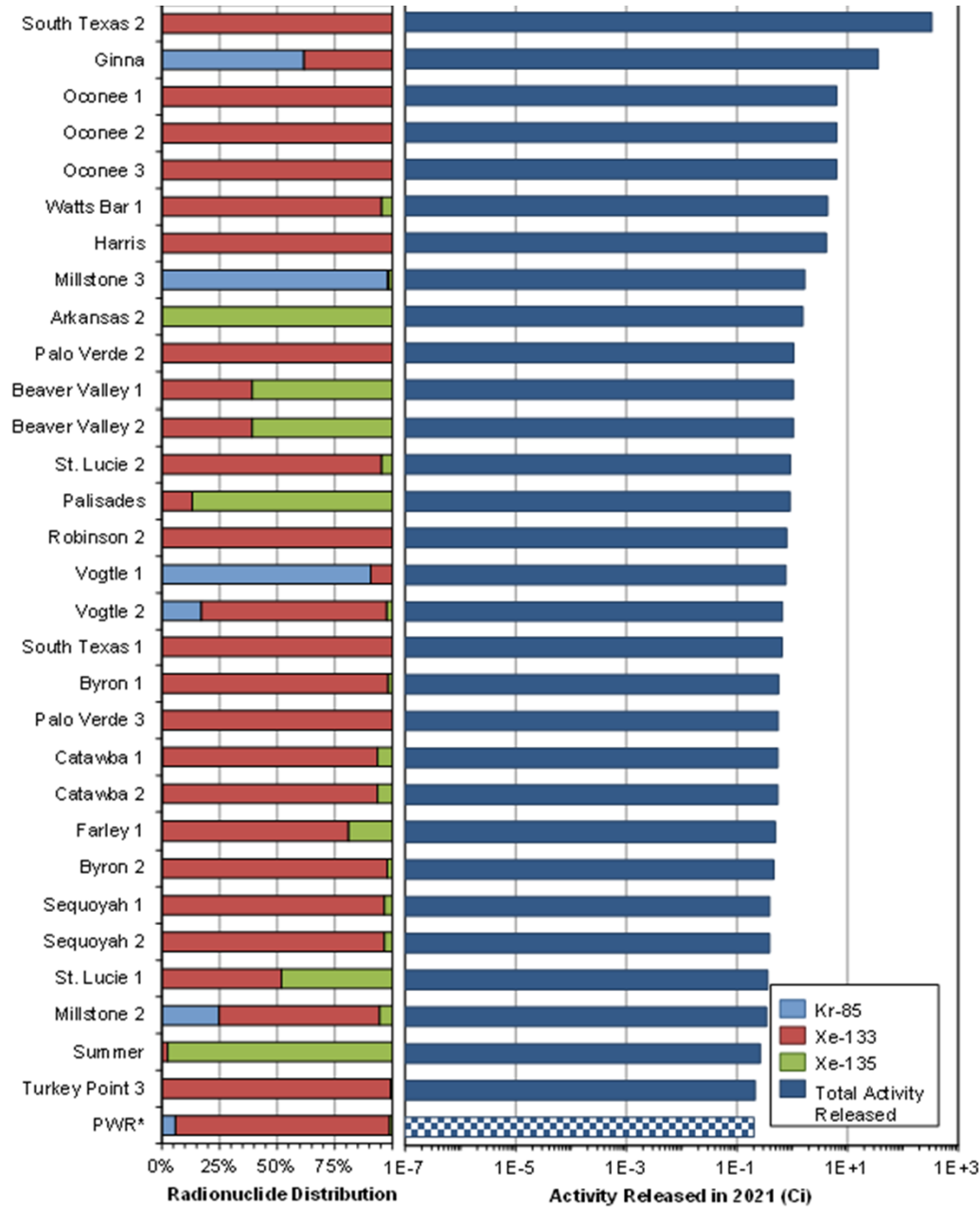
PWR Facility	Kr-85 (Ci)	Xe-133 (Ci)	Xe-135 (Ci)	Total (Ci)
South Texas 2		3.35E+02	3.46E-03	3.35E+02
Ginna	2.21E+01	1.37E+01	1.45E-02	3.58E+01
Oconee 1		6.32E+00	9.69E-04	6.32E+00
Oconee 2		6.32E+00	9.69E-04	6.32E+00
Oconee 3		6.32E+00	9.69E-04	6.32E+00
Watts Bar 1		4.15E+00	2.04E-01	4.35E+00
Harris		4.14E+00		4.14E+00
Millstone 3	1.65E+00	5.21E-03	2.66E-02	1.68E+00
Arkansas 2		1.79E-04	1.56E+00	1.56E+00
Palo Verde 2		1.07E+00	1.15E-04	1.07E+00
Beaver Valley 1		4.06E-01	6.32E-01	1.04E+00
Beaver Valley 2		4.06E-01	6.32E-01	1.04E+00
St. Lucie 2		8.82E-01	4.36E-02	9.25E-01
Palisades	1.63E-03	1.18E-01	7.91E-01	9.11E-01
Robinson 2		7.92E-01	5.91E-04	7.92E-01
Vogtle 1	6.94E-01	7.20E-02		7.66E-01
Vogtle 2	1.13E-01	5.32E-01	1.57E-02	6.61E-01
South Texas 1		6.56E-01		6.56E-01
Byron 1		5.55E-01	1.06E-02	5.65E-01
Palo Verde 3		5.54E-01		5.54E-01
Catawba 1	2.28E-03	5.11E-01	3.49E-02	5.48E-01
Catawba 2	2.28E-03	5.11E-01	3.49E-02	5.48E-01
Farley 1		4.00E-01	9.39E-02	4.94E-01
Byron 2		4.53E-01	1.06E-02	4.64E-01
Sequoyah 1		3.76E-01	1.35E-02	3.89E-01
Sequoyah 2		3.76E-01	1.35E-02	3.89E-01
St. Lucie 1		1.88E-01	1.74E-01	3.62E-01
Millstone 2	8.63E-02	2.41E-01	1.92E-02	3.46E-01
Summer		6.68E-03	2.58E-01	2.65E-01
Turkey Point 3		2.11E-01	1.71E-03	2.13E-01



**Table 3.6 PWR Fission and Activation Gases, 2021, cont.**  
*Shown in Descending Order of Total Activity*

PWR Facility	Kr-85 (Ci)	Xe-133 (Ci)	Xe-135 (Ci)	Total (Ci)
<b>PWR Median Release</b>	<b>0.00E+00</b>	<b>1.29E-01</b>	<b>3.58E-03</b>	<b>2.03E-01</b>
Braidwood 1		1.54E-01	4.88E-02	2.03E-01
Braidwood 2		1.54E-01	4.88E-02	2.03E-01
Point Beach 1		1.51E-01	1.21E-04	1.51E-01
Point Beach 2		1.51E-01	1.21E-04	1.51E-01
Diablo Canyon 1		1.39E-01	1.39E-03	1.41E-01
Diablo Canyon 2		1.39E-01	1.39E-03	1.41E-01
Surry 1		9.76E-02	2.24E-04	9.78E-02
Surry 2		9.76E-02	2.24E-04	9.78E-02
Turkey Point 4		8.70E-02	1.71E-03	8.87E-02
McGuire 1		7.90E-02	8.50E-03	8.75E-02
McGuire 2		7.90E-02	8.50E-03	8.75E-02
Calvert Cliffs 1		7.51E-02	1.02E-02	8.53E-02
Calvert Cliffs 2		7.51E-02	1.02E-02	8.53E-02
North Anna 1		6.33E-02	5.79E-03	6.91E-02
North Anna 2		6.33E-02	5.79E-03	6.91E-02
Watts Bar 2		3.01E-02	1.39E-02	4.40E-02
Wolf Creek	4.60E-10	3.50E-02	6.71E-03	4.17E-02
Salem 2		2.27E-02	3.93E-04	2.31E-02
Comanche Peak 1		8.38E-03	3.69E-03	1.21E-02
Comanche Peak 2		8.38E-03	3.69E-03	1.21E-02
Waterford 3		1.13E-02		1.13E-02
Prairie Island 1		7.94E-03	6.14E-06	7.95E-03
Prairie Island 2		7.94E-03	6.14E-06	7.95E-03
Salem 1		5.35E-03		5.35E-03
Callaway	3.60E-03			3.60E-03
Seabrook		5.24E-05	3.12E-03	3.17E-03
Arkansas 1	1.64E-03	2.45E-04		1.89E-03
Palo Verde 1		2.48E-04		2.48E-04
Cook 1				
Cook 2				
Davis-Besse				
Farley 2				

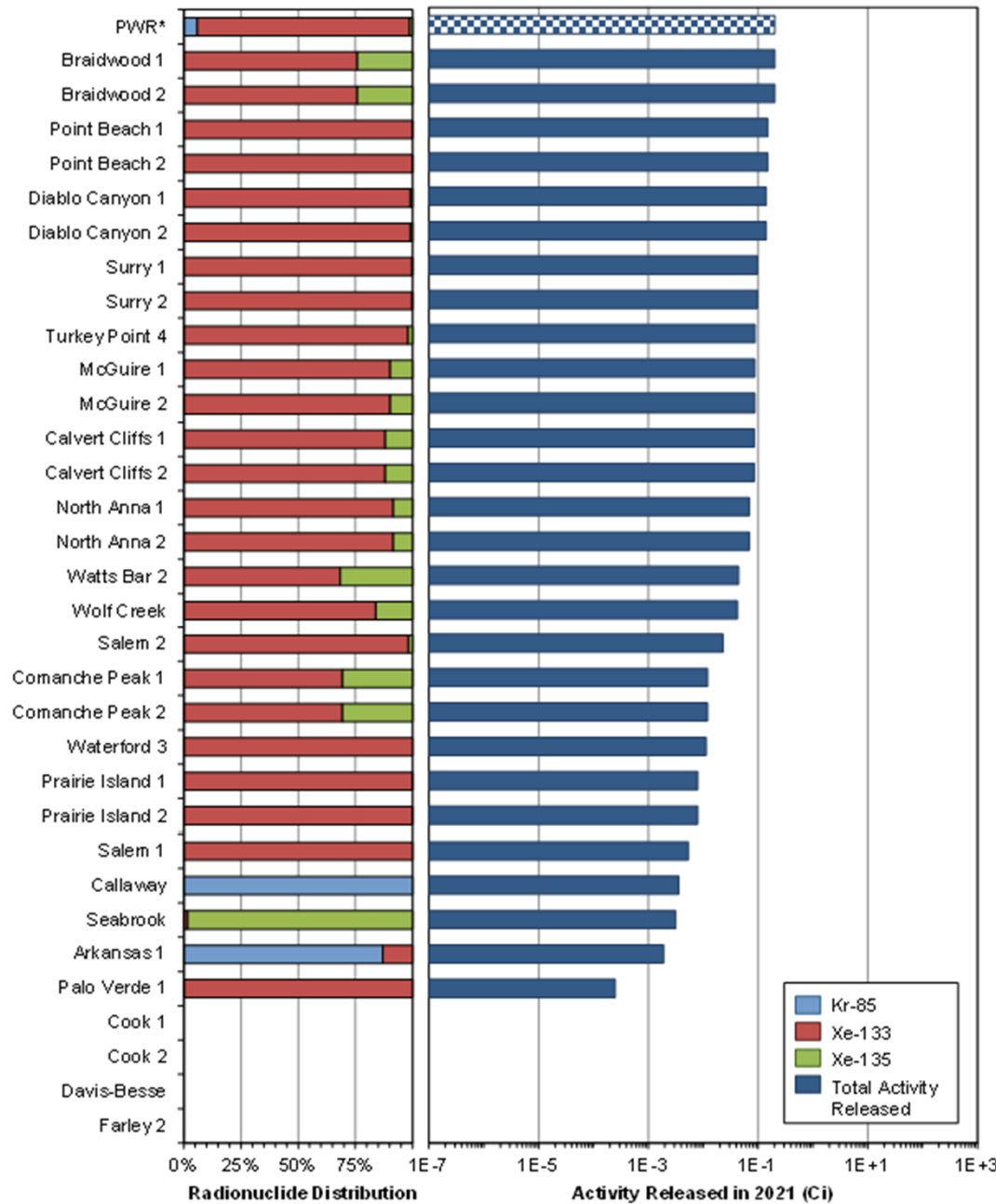




**Figure 3.6  
PWR Fission  
and  
Activation  
Gases**

\* PWR average radionuclide mix and median activity released

**Figure 3.6  
PWR Fission  
and  
Activation  
Gases, *cont.***



\* PWR average radionuclide mix and median activity released

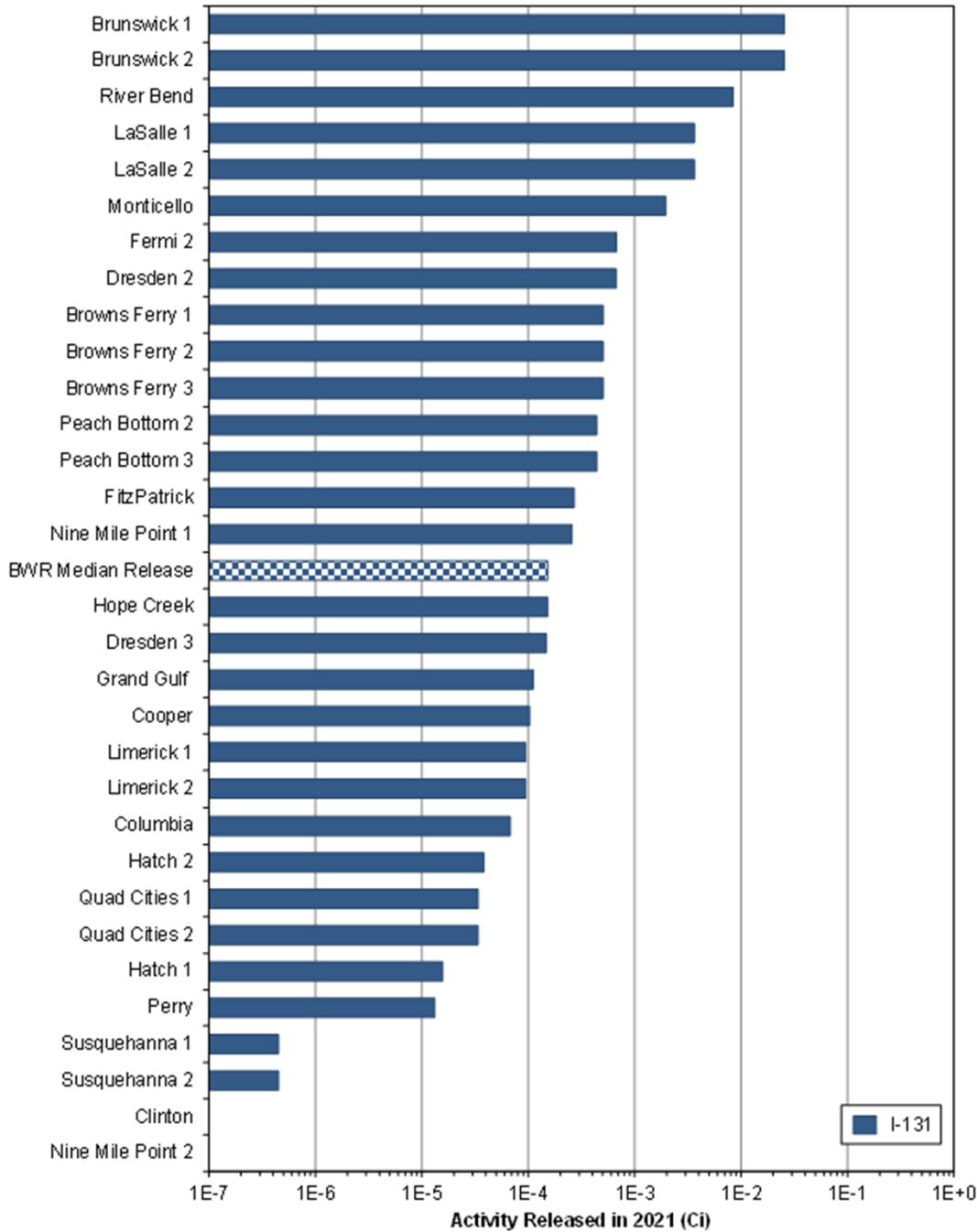
# Iodines, 2021

## Table 3.2 BWR Gaseous Releases—Iodine, 2021

*Shown in Descending Order of Total Activity*

BWR Facility	I-131 (Ci)
Brunswick 1	2.54E-02
Brunswick 2	2.54E-02
River Bend	8.41E-03
LaSalle 1	3.64E-03
LaSalle 2	3.64E-03
Monticello	1.96E-03
Fermi 2	6.75E-04
Dresden 2	6.70E-04
Browns Ferry 1	5.03E-04
Browns Ferry 2	5.03E-04
Browns Ferry 3	5.03E-04
Peach Bottom 2	4.40E-04
Peach Bottom 3	4.40E-04
FitzPatrick	2.70E-04
Nine Mile Point 1	2.57E-04

BWR Facility	I-131 (Ci)
<b>BWR Median Release</b>	<b>1.51E-04</b>
Hope Creek	1.51E-04
Dresden 3	1.48E-04
Grand Gulf	1.11E-04
Cooper	1.03E-04
Limerick 1	9.42E-05
Limerick 2	9.42E-05
Columbia	6.77E-05
Hatch 2	3.82E-05
Quad Cities 1	3.38E-05
Quad Cities 2	3.38E-05
Hatch 1	1.57E-05
Perry	1.32E-05
Susquehanna 1	4.50E-07
Susquehanna 2	4.50E-07
Clinton	
Nine Mile Point 2	

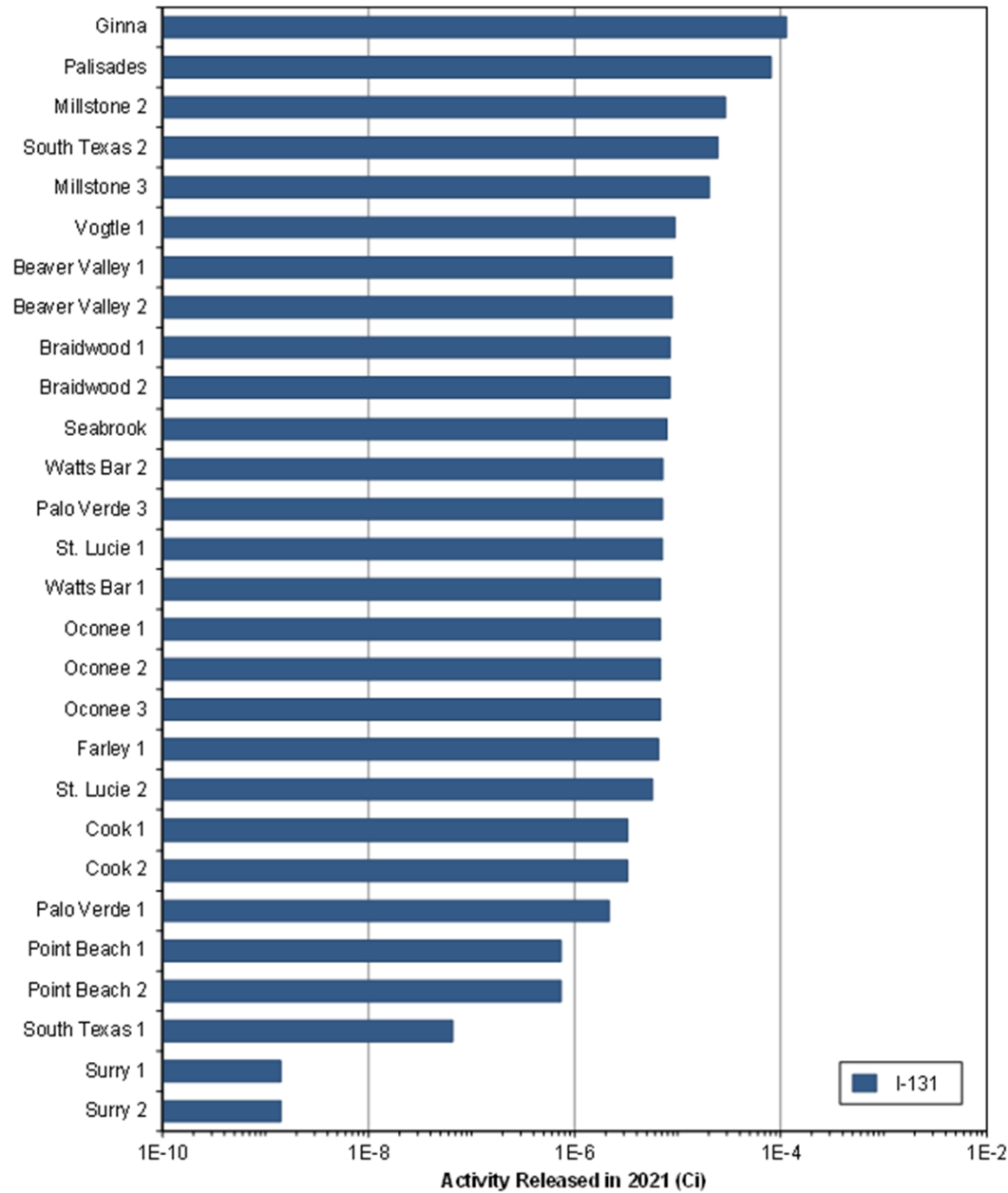


**Figure 3.2**  
**BWR**  
**Gaseous**  
**Releases -**  
**Iodine**

# Table 3.7 PWR Gaseous Releases—Iodine, 2021

*Shown in Descending Order of Total Activity*

PWR Facility	I-131 (Ci)	PWR Facility	I-131 (Ci)
Ginna	1.13E-04	<b>PWR Median Release</b>	<b>0.00E+00</b>
Palisades	8.07E-05	Arkansas 1	
Millstone 2	2.90E-05	Arkansas 2	
South Texas 2	2.45E-05	Beaver Valley 1	
Millstone 3	2.02E-05	Beaver Valley 2	
Vogtle 1	9.38E-06	Byron 1	
Beaver Valley 1	8.87E-06	Callaway	
Beaver Valley 2	8.87E-06	Calvert Cliffs 1	
Braidwood 1	8.40E-06	Calvert Cliffs 2	
Braidwood 2	8.40E-06	Catawba 1	
Seabrook	7.84E-06	Catawba 2	
Watts Bar 2	7.17E-06	Comanche Peak 1	
Palo Verde 3	7.14E-06	Comanche Peak 2	
St. Lucie 1	7.10E-06	Diablo Canyon 1	
Watts Bar 1	6.83E-06	Diablo Canyon 2	
Oconee 1	6.81E-06	Farley 2	
Oconee 2	6.81E-06	Harris	
Oconee 3	6.81E-06	Indian Point 3	
Farley 1	6.50E-06	McGuire 1	
St. Lucie 2	5.73E-06	McGuire 2	
Cook 1	3.27E-06	Millstone 3	
Cook 2	3.27E-06	Palo Verde 3	
Palo Verde 1	2.15E-06	Prairie Island 1	
Point Beach 1	7.37E-07	Prairie Island 2	
Point Beach 2	7.37E-07	Salem 1	
South Texas 1	6.57E-08	Salem 2	
Surry 1	1.41E-09	Sequoyah 1	
Surry 2	1.41E-09	Sequoyah 2	
		South Texas 2	
		Surry 1	
		Surry 2	
		Turkey Point 3	
		Turkey Point 4	
		Waterford 3	
		Wolf Creek	



**Figure 3.7**  
**PWR**  
**Gaseous**  
**Releases -**  
**Iodine**

Note: See Table 3.7 for list of nuclear power plants with no releases of iodine reported.

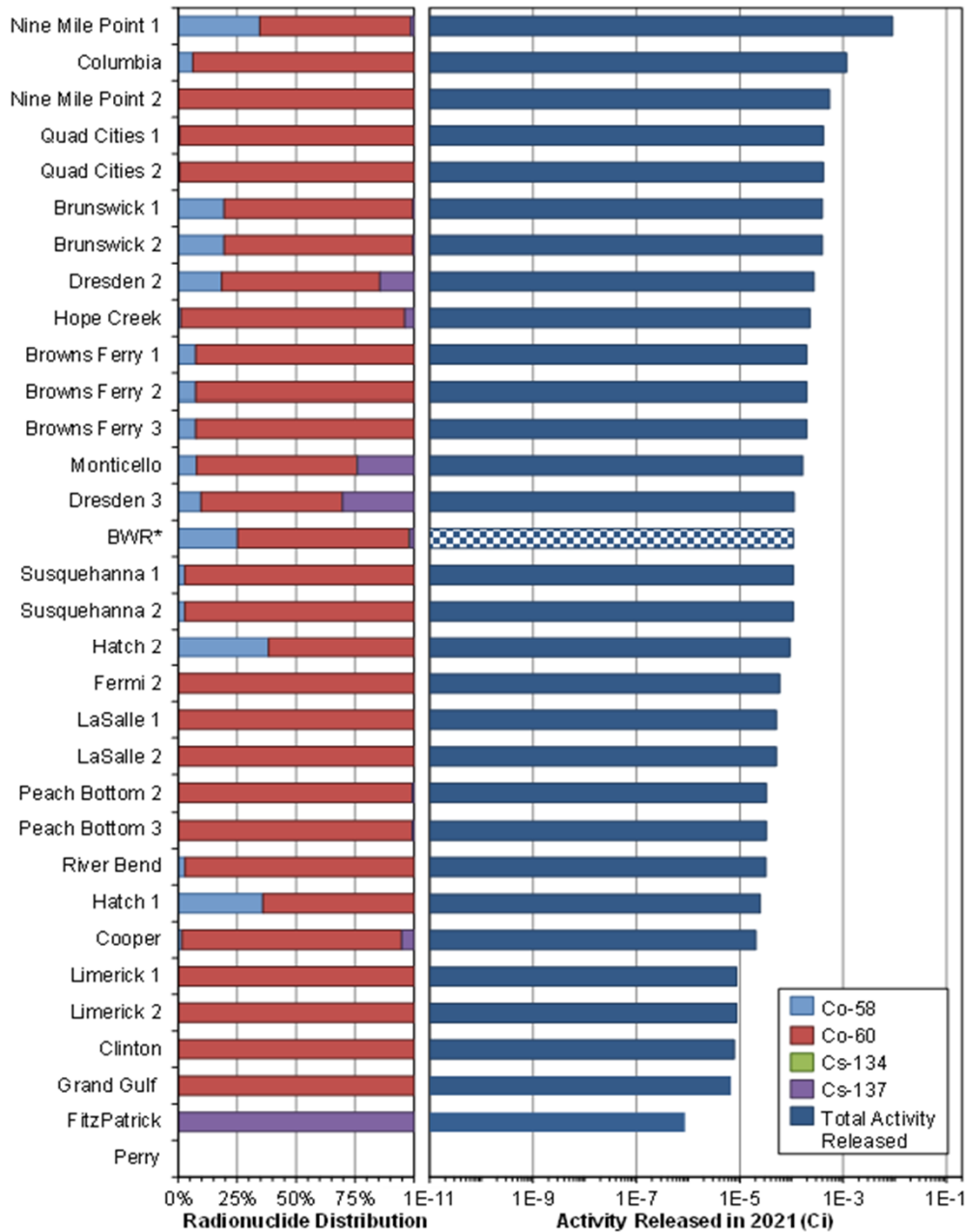
# Particulates, 2021



## Table 3.3 BWR Gaseous Releases - Particulates, 2021

*Shown in Descending Order of Total Activity*

BWR Facility	Co-58 (Ci)	Co-60 (Ci)	Cs-134 (Ci)	Cs-137 (Ci)	Total (Ci)
Nine Mile Point 1	3.13E-03	5.80E-03		1.17E-04	9.05E-03
Columbia	7.21E-05	1.09E-03			1.16E-03
Nine Mile Point 2		5.42E-04			5.42E-04
Quad Cities 1	2.98E-06	4.07E-04			4.10E-04
Quad Cities 2	2.98E-06	4.07E-04			4.10E-04
Brunswick 1	7.65E-05	3.13E-04		1.77E-06	3.91E-04
Brunswick 2	7.65E-05	3.13E-04		1.77E-06	3.91E-04
Dresden 2	5.04E-05	1.82E-04		3.92E-05	2.72E-04
Hope Creek	2.55E-06	2.17E-04		8.64E-06	2.28E-04
Browns Ferry 1	1.46E-05	1.82E-04			1.96E-04
Browns Ferry 2	1.46E-05	1.82E-04			1.96E-04
Browns Ferry 3	1.46E-05	1.82E-04			1.96E-04
Monticello	1.29E-05	1.13E-04	5.29E-08	3.96E-05	1.65E-04
Dresden 3	1.09E-05	6.79E-05		3.41E-05	1.13E-04
<b>BWR Median Release</b>	<b>2.98E-06</b>	<b>6.79E-05</b>	<b>0.00E+00</b>	<b>0.00E+00</b>	<b>1.09E-04</b>
Susquehanna 1	3.16E-06	1.06E-04			1.09E-04
Susquehanna 2	3.16E-06	1.06E-04			1.09E-04
Hatch 2	3.56E-05	5.72E-05			9.28E-05
Fermi 2		5.95E-05			5.95E-05
LaSalle 1		5.07E-05			5.07E-05
LaSalle 2		5.07E-05			5.07E-05
Peach Bottom 2		3.22E-05		2.28E-07	3.25E-05
Peach Bottom 3		3.22E-05		2.28E-07	3.25E-05
River Bend	9.52E-07	3.09E-05			3.18E-05
Hatch 1	8.97E-06	1.60E-05			2.49E-05
Cooper	3.19E-07	1.91E-05		1.06E-06	2.05E-05
Limerick 1		8.75E-06			8.75E-06
Limerick 2		8.75E-06			8.75E-06
Clinton		7.85E-06			7.85E-06
Grand Gulf		6.80E-06			6.80E-06
FitzPatrick				8.70E-07	8.70E-07
Perry					



**Figure 3.3**  
**BWR**  
**Gaseous**  
**Releases -**  
**Particulates**

\* BWR average radionuclide mix and median activity released

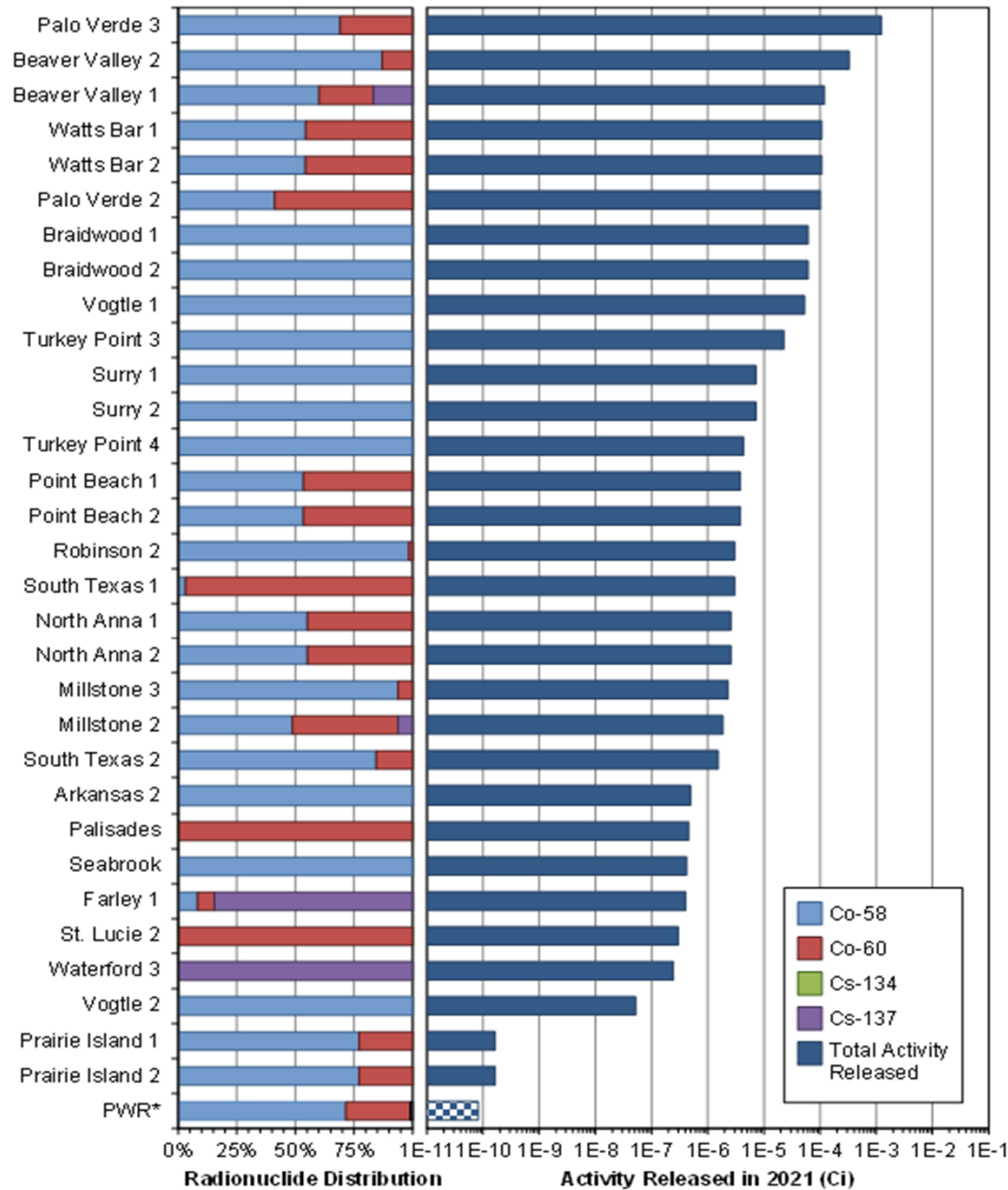
**Table 3.8 PWR Gaseous Releases - Particulates, 2021**  
*Shown in Descending Order of Total Activity*

PWR Facility	Co-58 (Ci)	Co-60 (Ci)	Cs-134 (Ci)	Cs-137 (Ci)	Total (Ci)
Palo Verde 3	8.48E-04	3.79E-04			1.23E-03
Beaver Valley 2	2.85E-04	4.25E-05			3.28E-04
Beaver Valley 1	7.11E-05	2.72E-05		1.98E-05	1.18E-04
Watts Bar 1	5.79E-05	4.85E-05			1.06E-04
Watts Bar 2	5.77E-05	4.85E-05			1.06E-04
Palo Verde 2	4.15E-05	5.93E-05			1.01E-04
Braidwood 1	6.10E-05				6.10E-05
Braidwood 2	6.10E-05				6.10E-05
Vogtle 1	5.26E-05				5.26E-05
Turkey Point 3	2.26E-05				2.26E-05
Surry 1	7.17E-06				7.17E-06
Surry 2	7.17E-06				7.17E-06
Turkey Point 4	4.34E-06				4.34E-06
Point Beach 1	2.03E-06	1.77E-06			3.79E-06
Point Beach 2	2.03E-06	1.77E-06			3.79E-06
Robinson 2	2.95E-06	4.63E-08			3.00E-06
South Texas 1	9.42E-08	2.88E-06			2.97E-06
North Anna 1	1.42E-06	1.16E-06			2.58E-06
North Anna 2	1.42E-06	1.16E-06			2.58E-06
Millstone 3	2.14E-06	1.39E-07			2.28E-06
Millstone 2	9.06E-07	8.38E-07		1.14E-07	1.86E-06
South Texas 2	1.30E-06	2.38E-07			1.54E-06
Arkansas 2	4.91E-07				4.91E-07
Palisades		4.54E-07			4.54E-07
Seabrook	4.18E-07				4.18E-07
Farley 1	3.37E-08	2.87E-08		3.42E-07	4.04E-07
St. Lucie 2		2.95E-07			2.95E-07
Waterford 3				2.43E-07	2.43E-07
Vogtle 2	5.20E-08				5.20E-08
Prairie Island 1	1.27E-10	3.76E-11			1.65E-10
Prairie Island 2	1.27E-10	3.76E-11			1.65E-10

## Table 3.8 PWR Gaseous Releases - Particulates, 2021, cont.

*Shown in Descending Order of Total Activity*

PWR Facility	Co-58 (Ci)	Co-60 (Ci)	Cs-134 (Ci)	Cs-137 (Ci)	Total (Ci)
<b>PWR Median Release</b>	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.23E-11
Arkansas 1					
Byron 1					
Byron 2					
Callaway					
Calvert Cliffs 1					
Calvert Cliffs 2					
Catawba 1					
Catawba 2					
Comanche Peak 1					
Comanche Peak 2					
Cook 1					
Cook 2					
Davis-Besse					
Diablo Canyon 1					
Diablo Canyon 2					
Farley 2					
Ginna					
Harris					
McGuire 1					
McGuire 2					
Oconee 1					
Oconee 2					
Oconee 3					
Palo Verde 1					
Salem 1					
Salem 2					
Sequoyah 1					
Sequoyah 2					
St. Lucie 1					
Summer					
Wolf Creek					

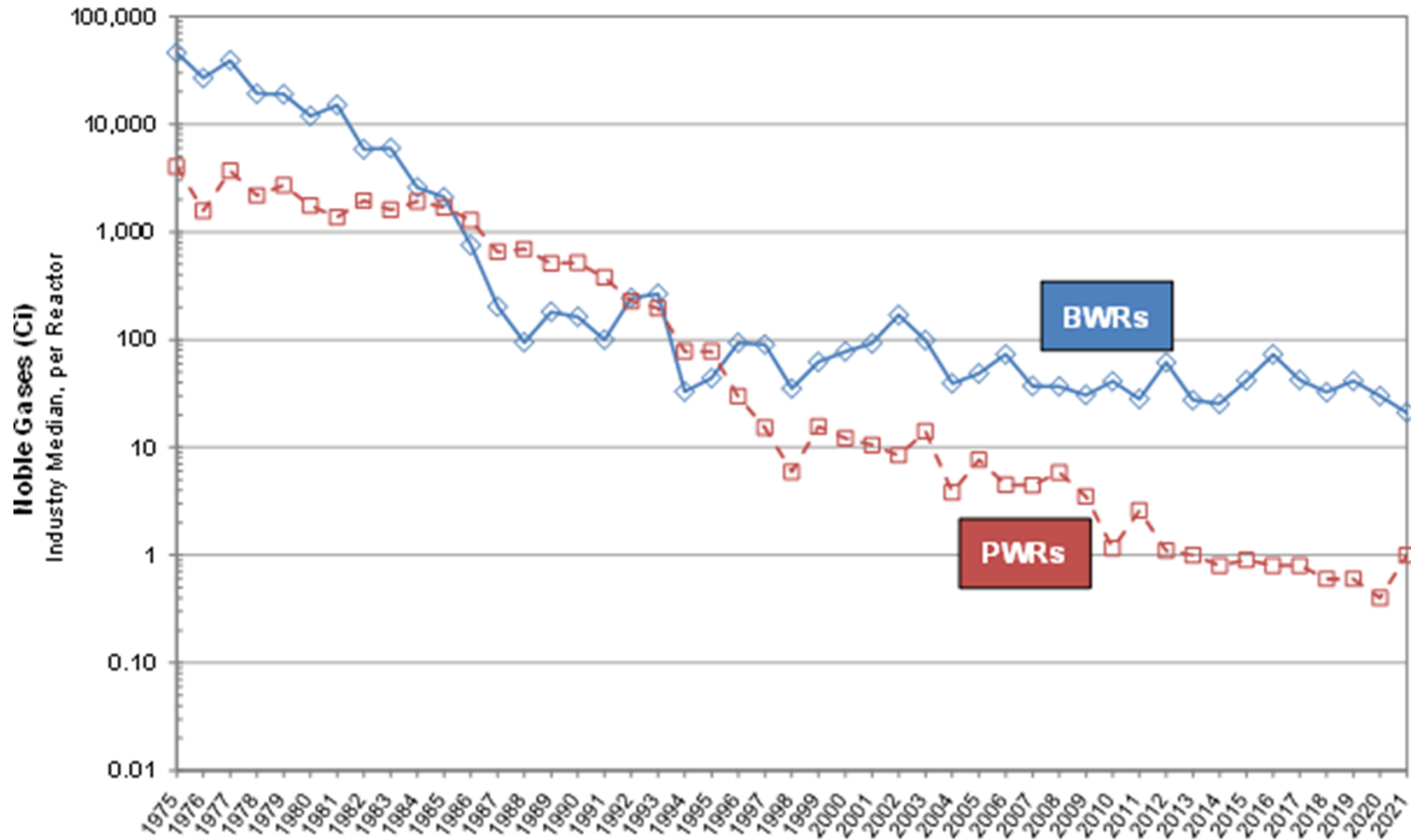


**Figure 3.8**  
**PWR**  
**Gaseous**  
**Releases -**  
**Particulates**

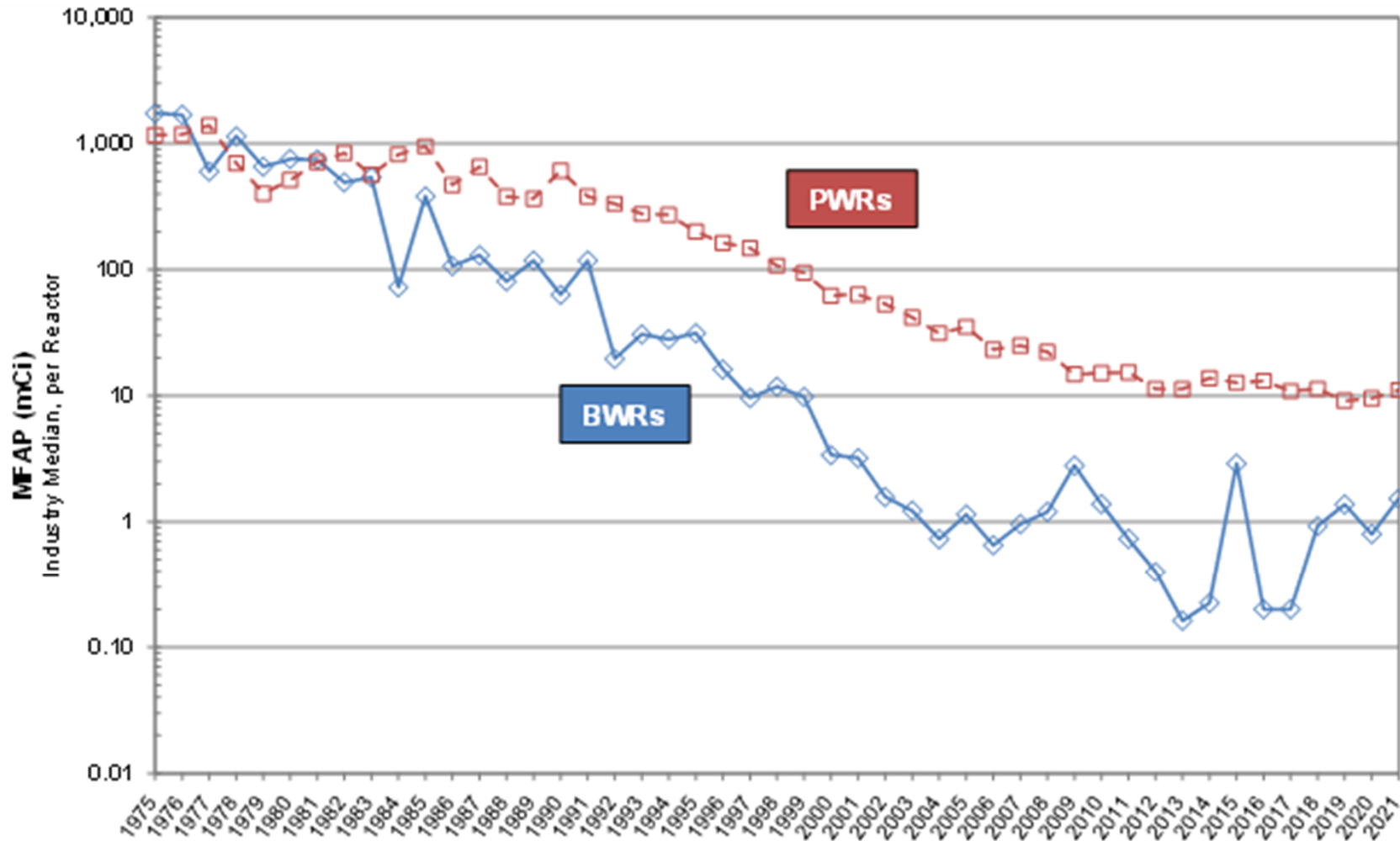
Note: See Table 3.8 for list of nuclear power plants with no releases of selected particulates reported.  
\* PWR average radionuclide mix and median activity released

# Effluent Trends, 2021

# Long-Term Trend in Noble Gases in Gaseous Effluents (~99.9% reduction)



# Long-Term Trend in Particulates in Liquid Effluents (~99% reduction or more)



**DRAFT**

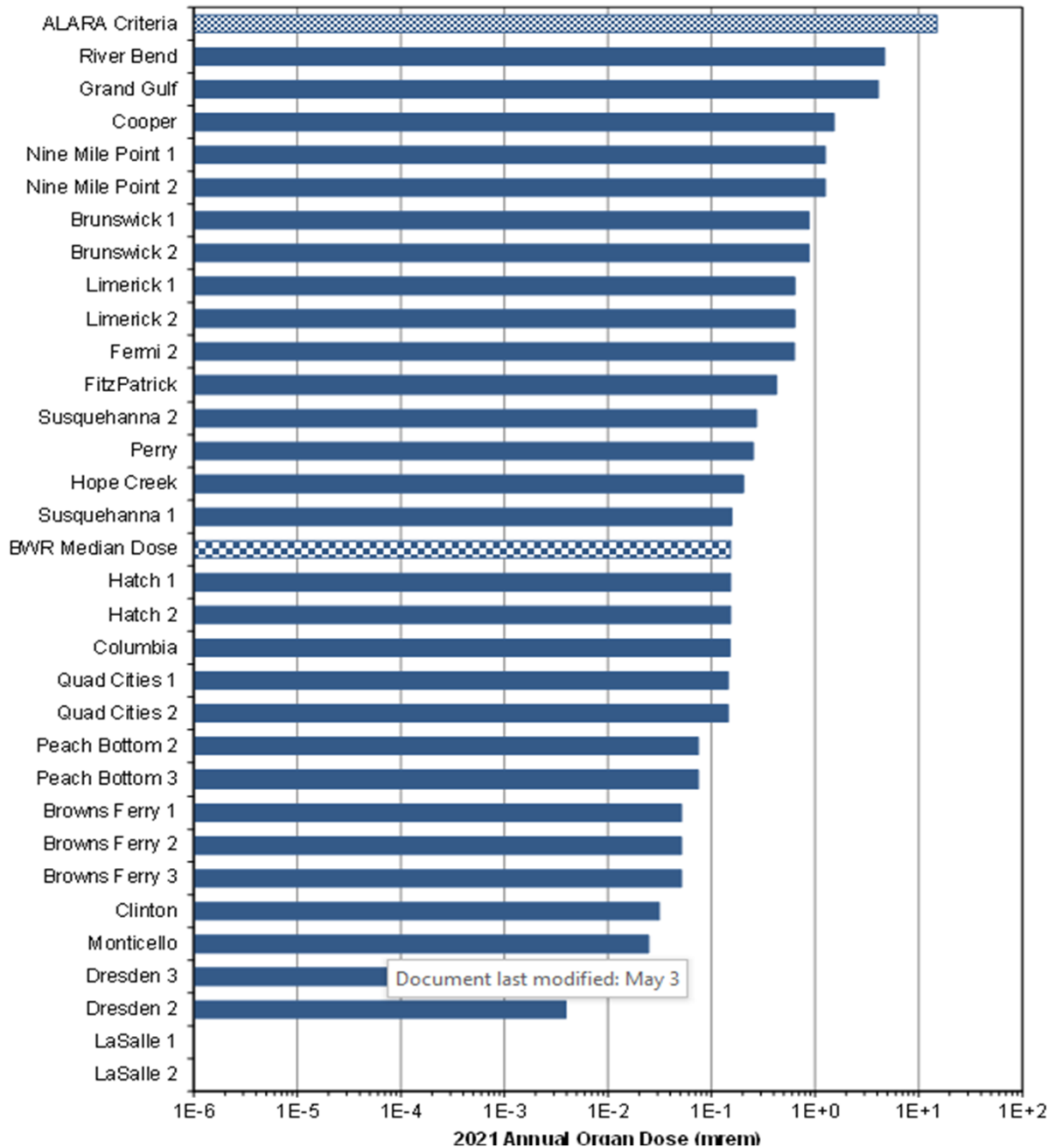


# **Radiation Doses from Gaseous and Liquid Effluents, 2021**

BWR Facility	Annual Organ Dose (mrem)
River Bend	4.70E+00
Grand Gulf	4.06E+00
Cooper	1.52E+00
Nine Mile Point 1	1.25E+00
Nine Mile Point 2	1.25E+00
Brunswick 1	8.77E-01
Brunswick 2	8.77E-01
Limerick 1	6.37E-01
Limerick 2	6.37E-01
Fermi 2	6.27E-01
FitzPatrick	4.25E-01
Susquehanna 2	2.70E-01
Perry	2.52E-01
Hope Creek	2.03E-01
Susquehanna 1	1.57E-01
<b>BWR Median Dose</b>	<b>1.53E-01</b>
Hatch 1	1.53E-01
Hatch 2	1.53E-01
Columbia	1.50E-01
Quad Cities 1	1.44E-01
Quad Cities 2	1.44E-01
Peach Bottom 2	7.45E-02
Peach Bottom 3	7.45E-02
Browns Ferry 1	5.11E-02
Browns Ferry 2	5.11E-02
Browns Ferry 3	5.11E-02
Clinton	3.11E-02
Monticello	2.46E-02
Dresden 3	8.95E-03
Dresden 2	3.93E-03
LaSalle 1	
LaSalle 2	
<b>ALARA Criteria</b>	<b>15</b>

**Table 3.19 BWR Gaseous Effluents - Maximum Annual Organ Dose, 2021**

*Shown in Descending Order of Organ Dose*



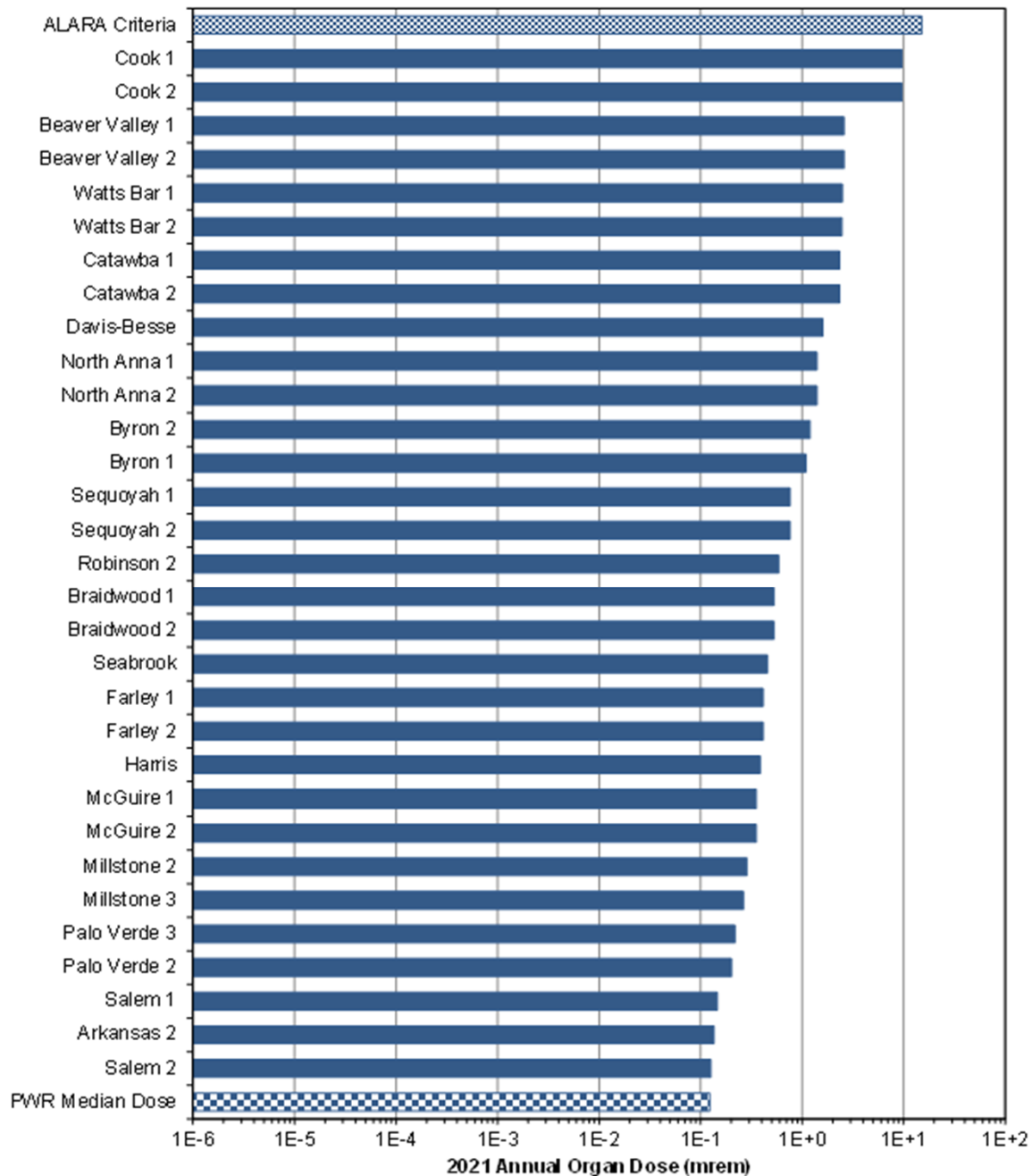
**Figure 3.17**  
**BWR**  
**Gaseous**  
**Effluents -**  
**Maximum**  
**Annual**  
**Organ Dose**

PWR Facility	Annual Organ Dose (mrem)
Cook 1	9.60E+00
Cook 2	9.60E+00
Beaver Valley 1	2.58E+00
Beaver Valley 2	2.58E+00
Watts Bar 1	2.48E+00
Watts Bar 2	2.47E+00
Catawba 1	2.34E+00
Catawba 2	2.34E+00
Davis-Besse	1.60E+00
North Anna 1	1.40E+00
North Anna 2	1.40E+00
Byron 2	1.20E+00
Byron 1	1.09E+00
Sequoyah 1	7.58E-01
Sequoyah 2	7.58E-01
Robinson 2	5.88E-01
Braidwood 1	5.25E-01
Braidwood 2	5.25E-01
Seabrook	4.55E-01
Farley 1	4.11E-01
Farley 2	4.11E-01
Harris	3.85E-01
McGuire 1	3.54E-01
McGuire 2	3.54E-01
Millstone 2	2.86E-01
Millstone 3	2.63E-01
Palo Verde 3	2.19E-01
Palo Verde 2	2.01E-01
Salem 1	1.46E-01
Arkansas 2	1.35E-01
Salem 2	1.26E-01

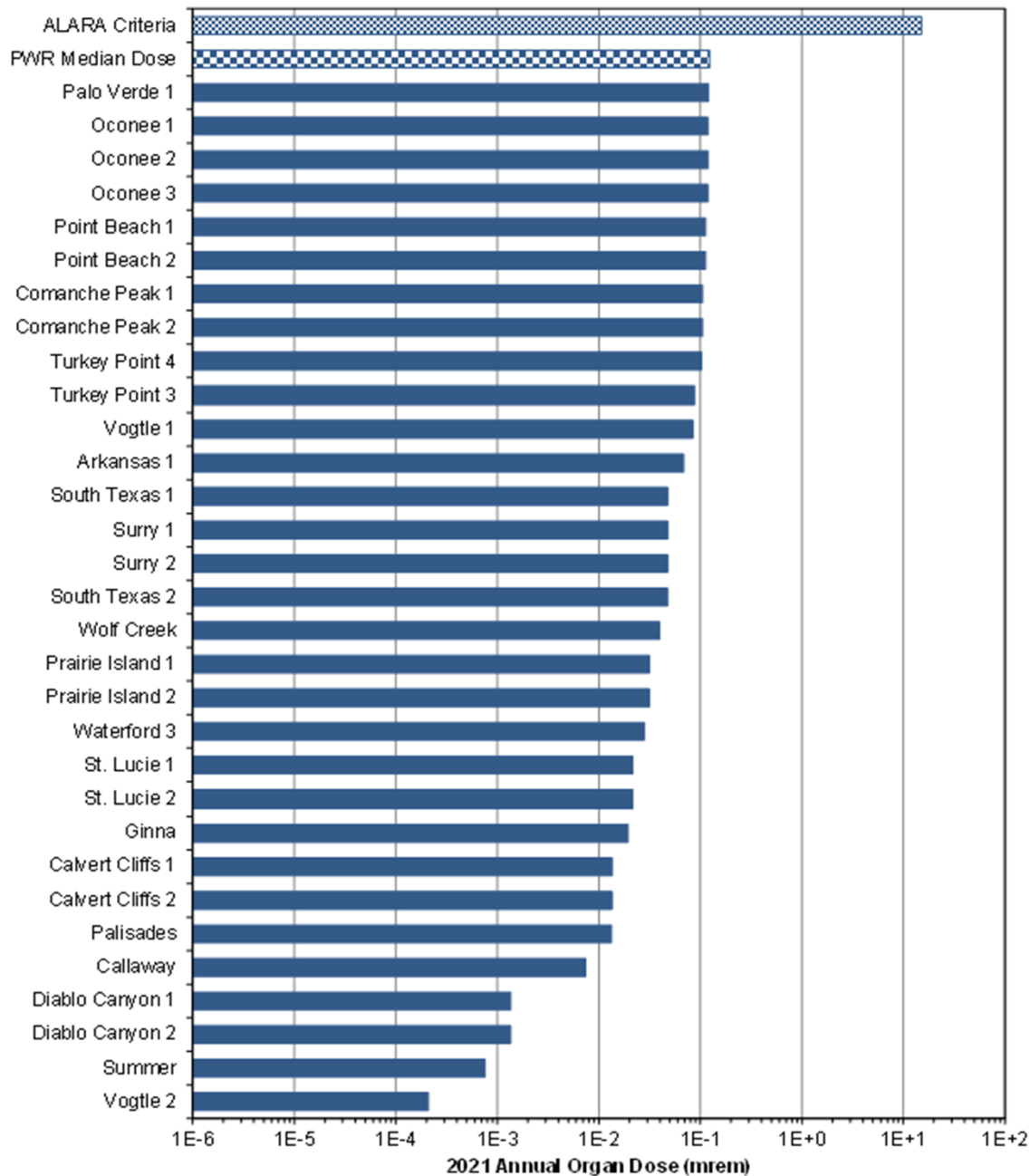
PWR Facility	Annual Organ Dose (mrem)
<b>PWR Median Dose</b>	<b>1.23E-01</b>
Palo Verde 1	1.20E-01
Oconee 1	1.18E-01
Oconee 2	1.18E-01
Oconee 3	1.18E-01
Point Beach 1	1.13E-01
Point Beach 2	1.13E-01
Comanche Peak 1	1.05E-01
Comanche Peak 2	1.05E-01
Turkey Point 4	1.03E-01
Turkey Point 3	8.73E-02
Vogtle 1	8.46E-02
Arkansas 1	6.84E-02
South Texas 1	4.77E-02
Surry 1	4.75E-02
Surry 2	4.75E-02
South Texas 2	4.73E-02
Wolf Creek	3.97E-02
Prairie Island 1	3.15E-02
Prairie Island 2	3.15E-02
Waterford 3	2.79E-02
St. Lucie 1	2.16E-02
St. Lucie 2	2.16E-02
Ginna	1.94E-02
Calvert Cliffs 1	1.35E-02
Calvert Cliffs 2	1.35E-02
Palisades	1.33E-02
Callaway	7.41E-03
Diablo Canyon 1	1.36E-03
Diablo Canyon 2	1.36E-03
Summer	7.57E-04
Vogtle 2	2.09E-04
<b>ALARA Criteria</b>	<b>15</b>

**Table 3.20 PWR Gaseous Effluents - Maximum Annual Organ Dose, 2021**

*Shown in Descending Order of Organ Dose*



**Figure 3.18**  
**PWR**  
**Gaseous**  
**Effluents -**  
**Maximum**  
**Annual**  
**Organ Dose**



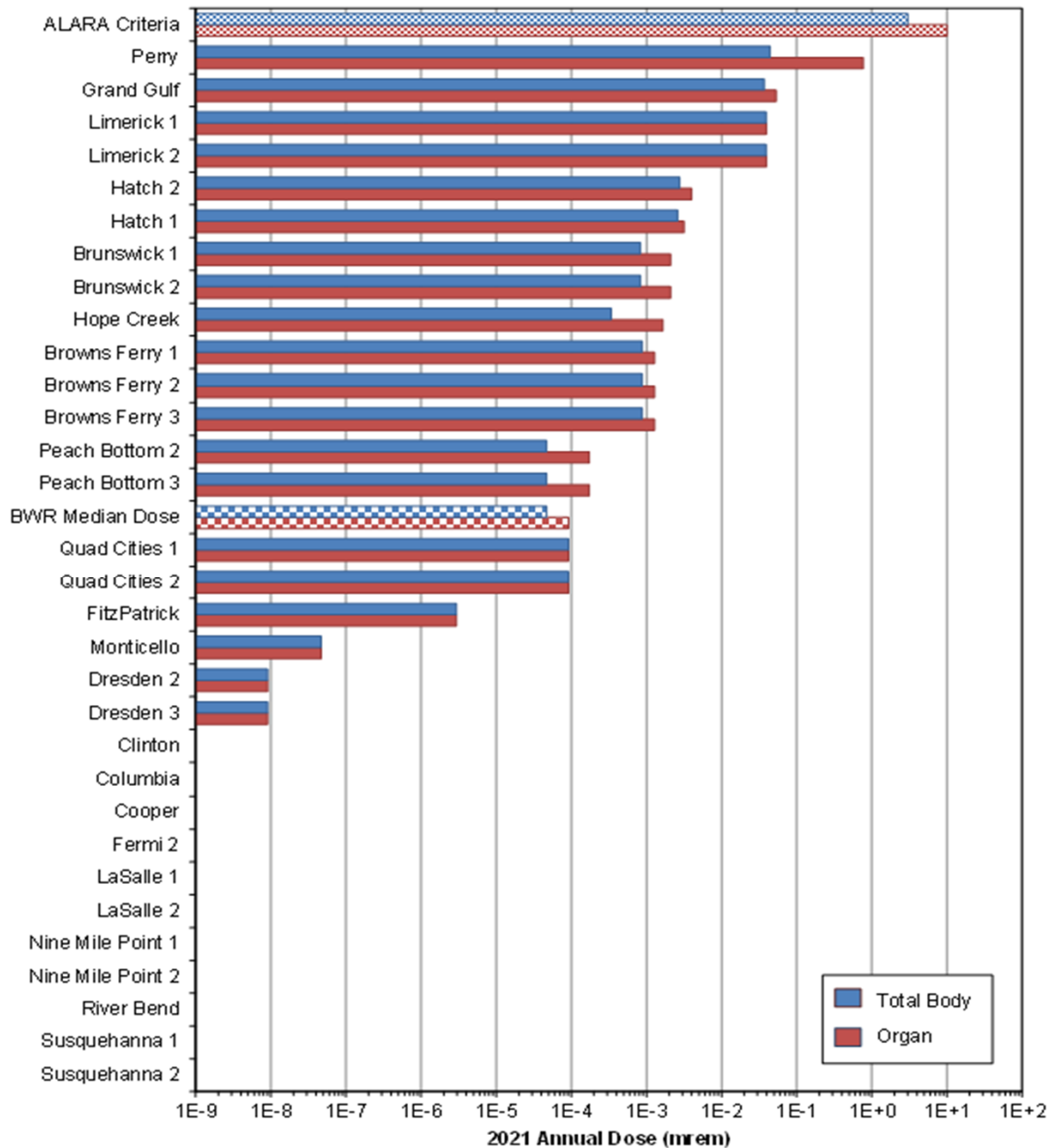
**Figure 3.18**  
**PWR**  
**Gaseous**  
**Effluents -**  
**Maximum**  
**Annual**  
**Organ**  
**Dose, *cont.***

BWR Facility	Total Body Dose (mrem)	Organ Dose (mrem)
Perry	4.43E-02	7.61E-01
Grand Gulf	3.70E-02	5.30E-02
Limerick 1	3.92E-02	3.95E-02
Limerick 2	3.92E-02	3.95E-02
Hatch 2	2.77E-03	3.98E-03
Hatch 1	2.60E-03	3.15E-03
Brunswick 1	8.35E-04	2.09E-03
Brunswick 2	8.35E-04	2.09E-03
Hope Creek	3.40E-04	1.65E-03
Browns Ferry 1	8.78E-04	1.28E-03
Browns Ferry 2	8.78E-04	1.28E-03
Browns Ferry 3	8.78E-04	1.28E-03
Peach Bottom 2	4.70E-05	1.74E-04
Peach Bottom 3	4.70E-05	1.74E-04
<b>BWR Median Dose</b>	<b>4.70E-05</b>	<b>9.20E-05</b>
Quad Cities 1	9.20E-05	9.20E-05
Quad Cities 2	9.20E-05	9.20E-05
FitzPatrick	2.96E-06	2.96E-06
Monticello	4.69E-08	4.69E-08
Dresden 2	9.09E-09	9.09E-09
Dresden 3	9.09E-09	9.09E-09
Clinton		
Columbia		
Cooper		
Fermi 2		
LaSalle 1		
LaSalle 2		
Nine Mile Point 1		
Nine Mile Point 2		
River Bend		
Susquehanna 1		
Susquehanna 2		
<b>ALARA Criteria</b>	<b>3</b>	<b>10</b>

**Table 3.21 BWR  
Liquid Effluents -  
Maximum Annual  
Total Body and Organ  
Dose, 2021**

*Shown in Descending Order of  
Organ Dose*





**Figure 3.19  
BWR Liquid  
Effluents -  
Maximum  
Annual  
Total Body  
and Organ  
Dose**

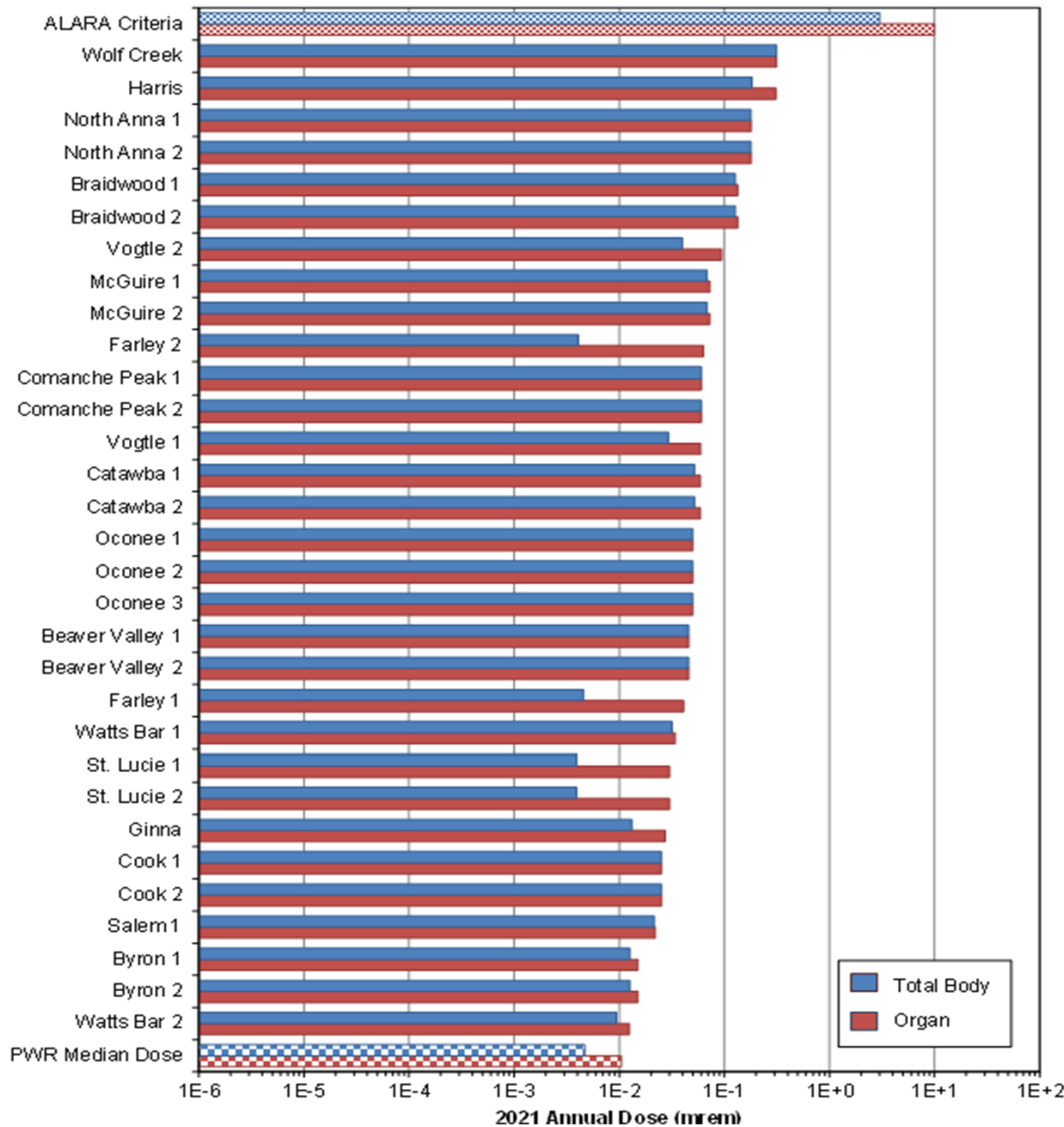


PWR Facility	Total Body Dose (mrem)	Organ Dose (mrem)
Wolf Creek	3.13E-01	3.13E-01
Harris	1.82E-01	3.08E-01
North Anna 1	1.78E-01	1.79E-01
North Anna 2	1.78E-01	1.79E-01
Braidwood 1	1.27E-01	1.34E-01
Braidwood 2	1.27E-01	1.34E-01
Vogtle 2	3.99E-02	9.41E-02
McGuire 1	6.85E-02	7.24E-02
McGuire 2	6.85E-02	7.24E-02
Farley 2	4.07E-03	6.30E-02
Comanche Peak 1	6.01E-02	6.01E-02
Comanche Peak 2	6.01E-02	6.01E-02
Vogtle 1	2.94E-02	5.95E-02
Catawba 1	5.18E-02	5.90E-02
Catawba 2	5.18E-02	5.90E-02
Oconee 1	4.97E-02	4.97E-02
Oconee 2	4.97E-02	4.97E-02
Oconee 3	4.97E-02	4.97E-02
Beaver Valley 1	4.55E-02	4.55E-02
Beaver Valley 2	4.55E-02	4.55E-02
Farley 1	4.55E-03	4.10E-02
Watts Bar 1	3.18E-02	3.38E-02
St. Lucie 1	3.92E-03	3.00E-02
St. Lucie 2	3.92E-03	3.00E-02
Ginna	1.31E-02	2.73E-02
Cook 1	2.51E-02	2.51E-02
Cook 2	2.51E-02	2.51E-02
Salem 1	2.15E-02	2.20E-02
Byron 1	1.26E-02	1.50E-02
Byron 2	1.26E-02	1.50E-02
Watts Bar 2	9.46E-03	1.25E-02

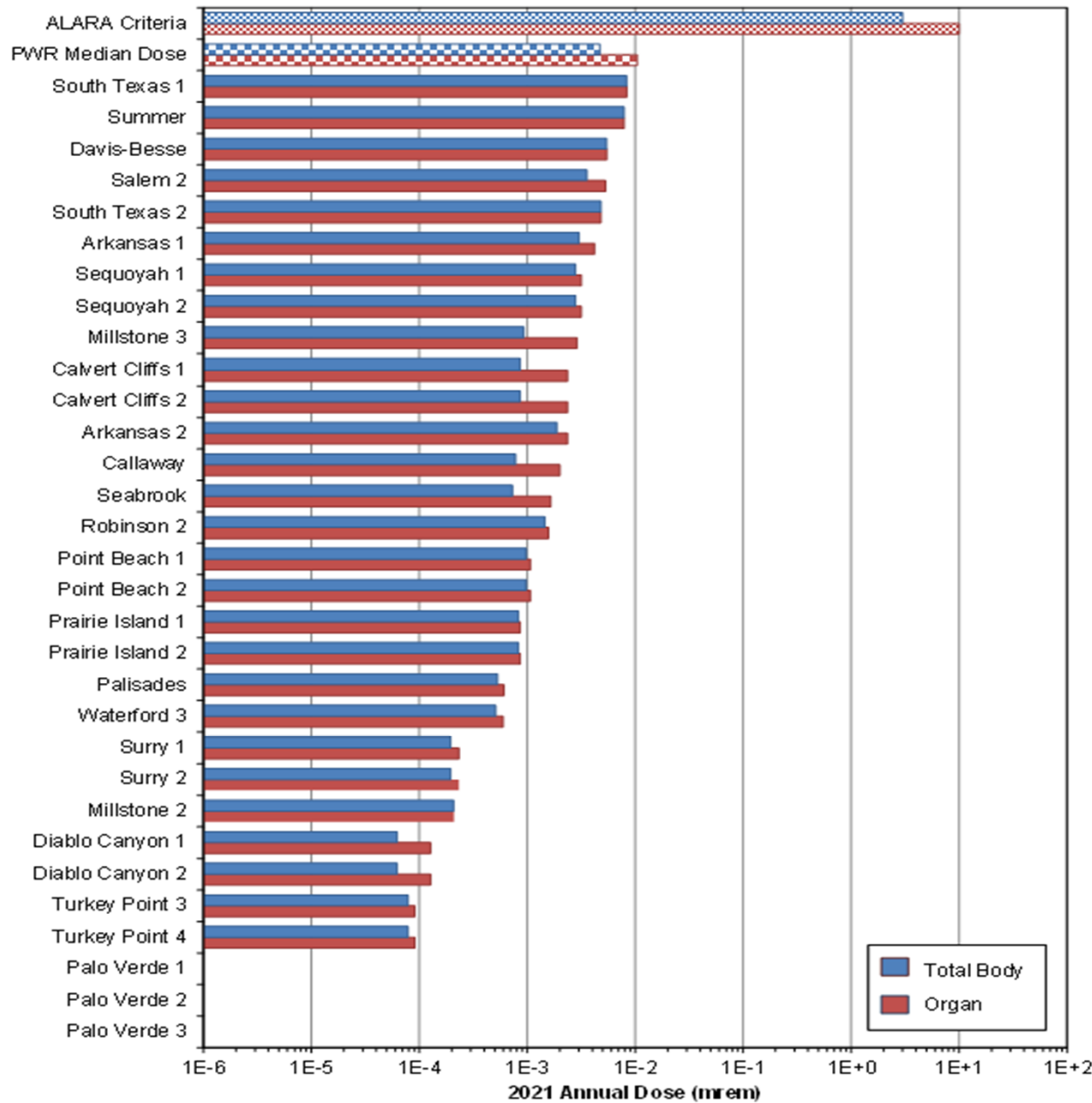
PWR Facility	Total Body Dose (mrem)	Organ Dose (mrem)
<b>PWR Median Dose</b>	<b>4.69E-03</b>	<b>1.04E-02</b>
South Texas 1	8.31E-03	8.34E-03
Summer	7.90E-03	7.90E-03
Davis-Besse	5.42E-03	5.43E-03
Salem 2	3.57E-03	5.32E-03
South Texas 2	4.82E-03	4.82E-03
Arkansas 1	3.02E-03	4.20E-03
Sequoyah 1	2.80E-03	3.17E-03
Sequoyah 2	2.80E-03	3.17E-03
Millstone 3	9.28E-04	2.88E-03
Calvert Cliffs 1	8.57E-04	2.36E-03
Calvert Cliffs 2	8.57E-04	2.36E-03
Arkansas 2	1.88E-03	2.35E-03
Callaway	7.77E-04	2.01E-03
Seabrook	7.30E-04	1.65E-03
Robinson 2	1.45E-03	1.57E-03
Point Beach 1	9.80E-04	1.07E-03
Point Beach 2	9.80E-04	1.07E-03
Prairie Island 1	8.30E-04	8.60E-04
Prairie Island 2	8.30E-04	8.60E-04
Palisades	5.29E-04	6.08E-04
Waterford 3	5.10E-04	5.96E-04
Surry 1	1.96E-04	2.33E-04
Surry 2	1.96E-04	2.33E-04
Millstone 2	2.07E-04	2.09E-04
Diablo Canyon 1	6.26E-05	1.28E-04
Diablo Canyon 2	6.26E-05	1.28E-04
Turkey Point 3	7.84E-05	9.10E-05
Turkey Point 4	7.84E-05	9.10E-05
Palo Verde 1		
Palo Verde 2		
Palo Verde 3		
<b>ALARA Criteria</b>	<b>3</b>	<b>10</b>

**Table 3.22 PWR Liquid Effluents - Maximum Annual Total Body and Organ Dose, 2021**

*Shown in Descending Order of Organ Dose*

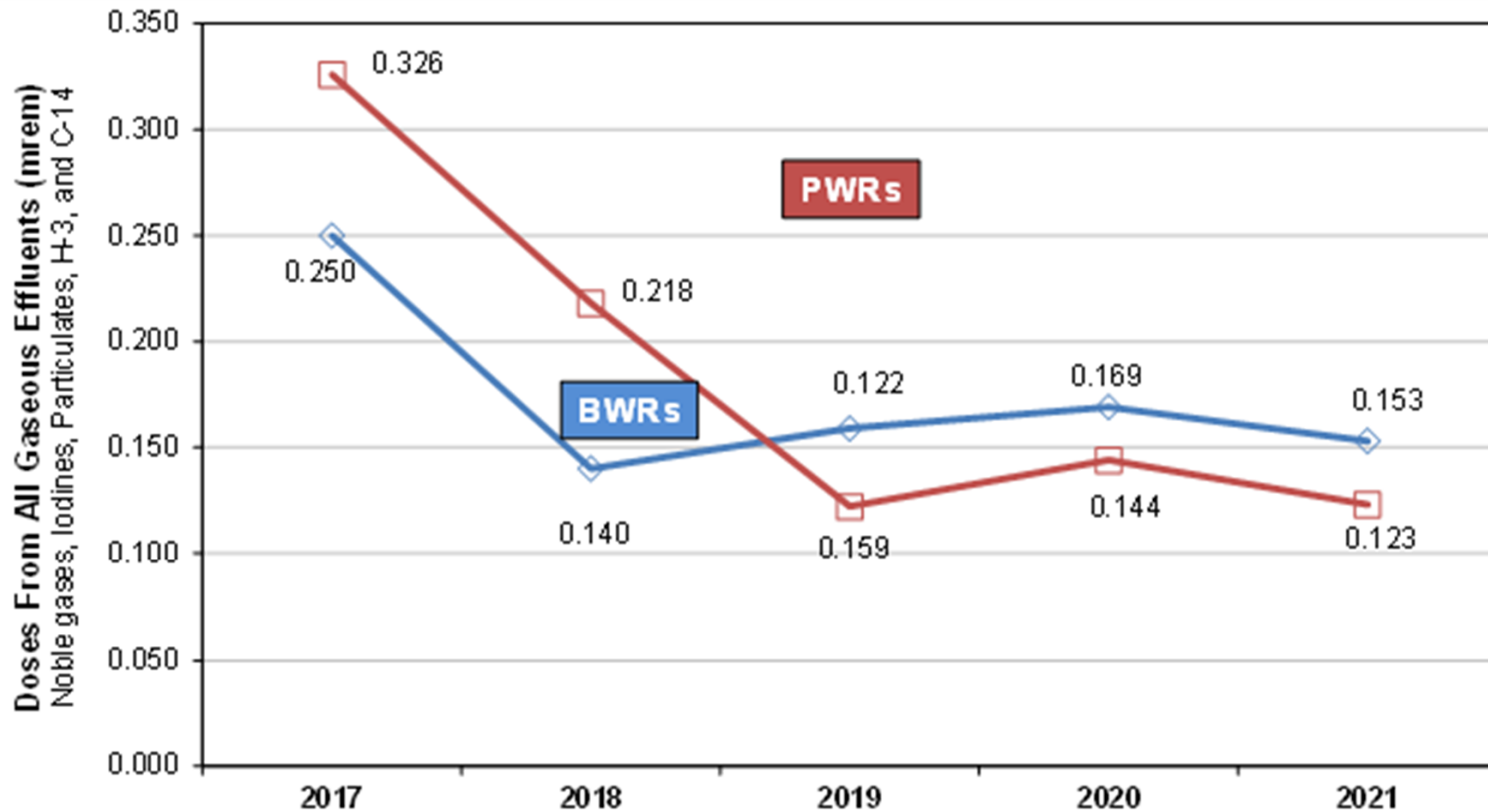


**Figure 3.20  
PWR Liquid  
Effluents -  
Maximum  
Annual  
Total Body  
and Organ  
Dose**

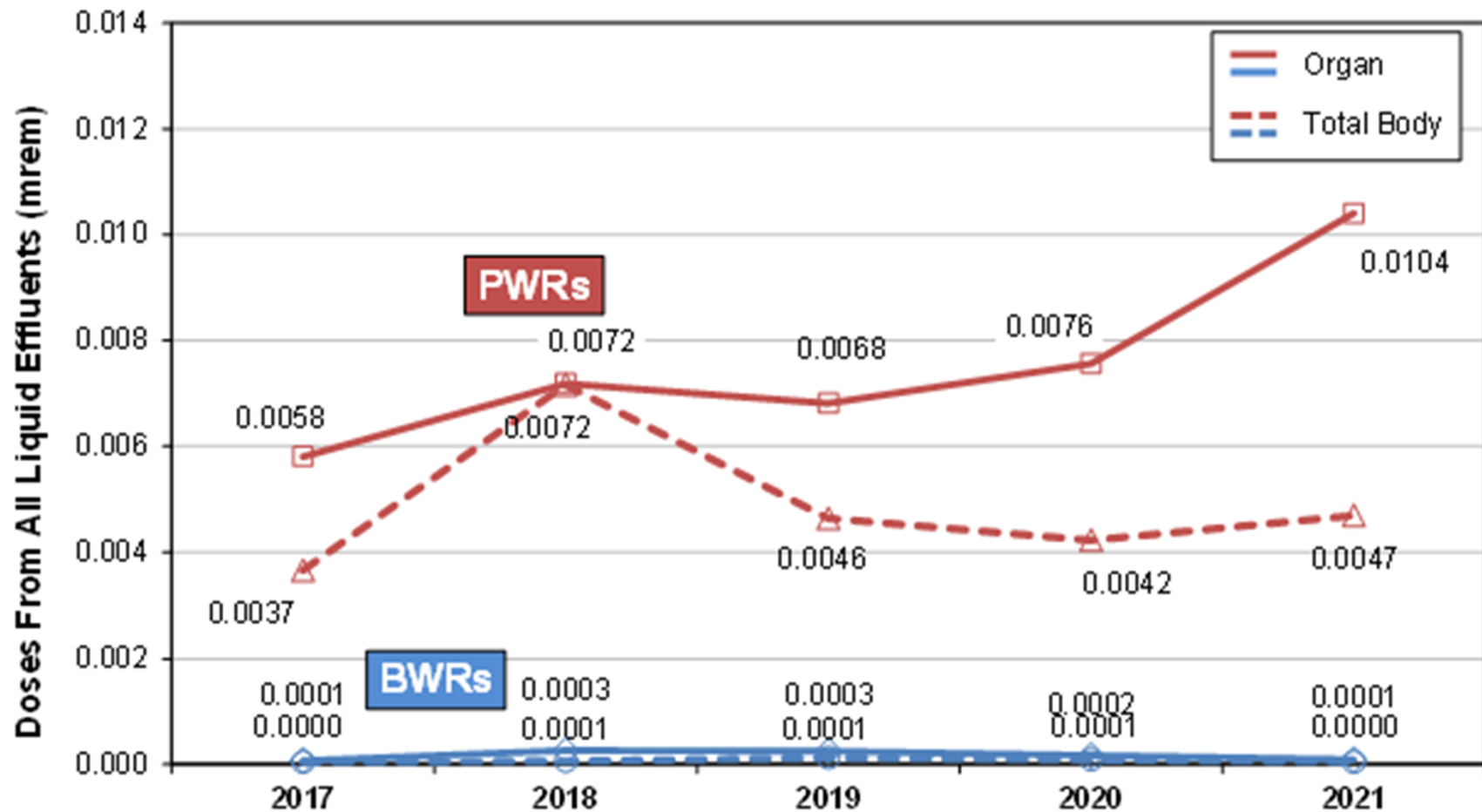


**Figure 3.20  
PWR Liquid  
Effluents -  
Maximum  
Annual  
Total Body  
and Organ  
Dose, *cont.***

**Figure 3.21 Median Maximum Annual Organ Dose, Gaseous Effluents  
5-Year Trend, 2017-2021**



**Figure 3.22 Median Maximum Annual Dose, Liquid Effluents  
 5-Year Trend, 2017-2021**



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