Nuclear Plant Effluents Webinar



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Effluent Monitoring



- Each plant monitors discharges of:
 - Noble gas (e.g., krypton, xenon, argon)
 - Tritium normal discharges
 - Tritium leaks and spills
 - Carbon-14
 - Iodine and Particulates (e.g., cobalt, cesium, strontium)
 - Effluent Reports 3 types
 - Individual plant reports (prepared by each plant)
 - Summary reports (prepared by NRC)
 - Tritium reports (plants with groundwater tritium contamination
 - All reports posted on the NRC public web site

NRC's public web site:

http://www.nrc.gov Click on NUCLEAR REACTORS





Click on "Operating Reactors"





Click on "Operational Experience"



NUCLEAR REACTORS	NUCLEAR MATERIALS	RADIOACTIVE WASTE	NUCLEAR SECURITY	PUBL C MEETINGS &	NRC LIBRARY	ABOUT
NUCLEAR REACTO	RS	Home > Nuclear Reacto	ors > Operating Reactors			PRINT
Power Reactors Research & Test F	Reactors	Operating	Reactors			
Operating React	ors	What We Regulate	6		KEY TOPICS	
Operator Licensing	9	NRC regulates the op that generate electric	regulates the operation of 99 commercial nuclear power reactors generate electricity. For more information about power reactors,		Reactor Oversig (ROP)	ht Process
New Reactors Advanced Reactors Operator Licensing for New Reactors		see the location map, list of power reactors, and NRC Project Managers. It also regulates about 36 research and test reactors located primarily at universities where they are used for research, testing, and training. For more information about research and test reactors, see the location map, and NRC Project Managers.			PWR Sump Performance	
					Standard Techn Specifications	ical
					Power Uprates	
					NRC Rulemakin	g Page
					Enforcement Ac	ctions
and the second se		How we Regulate		Licensee Toolkit		
A DESCRIPTION OF THE OWNER.		NRC regulates reactor operations through a combination of regulatory requirements; licensing; safety over light, including inspection,			Power Plant Sec	curity Order
A A	alle ?	assessment of perfor evaluation; and regu components, see:	mance and enprceme latory support activitie:	nt; operational experience s. For details of the first four		
Spotlig	ght	Regulations, GLicensingOversight	Guidance, and Commun	lications		
		 Operational Ex 	morionco			

Click on "Groundwater Contamination (Tritium),



Protecting People and the Environment

HOME FAQ GLOSSARY FACILITY LOCATOR WHAT'S NEW SITE HELP INDEX A-Z CONT CT US BROWSE ALOUD EMAIL UPDATES U.S.NRC Enter term or ADAMS # SEARCH United States Nuclear Regulatory Commission REPORT A SAFETY CONCERN Protecting People and the Environment PUBLIC N ETINGS & NUCLEAR NUCLEAR RADIOACTIVE NUCLEAR NRC ABOUT MATERIALS WASTE SECURITY INVOLVE MENT LIBRARY REACTORS NRC PRINT Home > Nuclear Reactors > Operating Reactors > Operational Experience OPERATING REACTORS Regulations, Guidance, and Reactor Operational Experience Communications Licensing **Reactor Safety Focus Areas KEY TOPICS** Oversight Implementing Lessons As part of operational experience monitoring, the agency will **Operational Experience** Learned from Fukushima periodically encounter certain reactor systems or management areas it identifies as focus areas. This section rescribes focus areas that the agency is reviewing or working to improve and upgrade: RELATED INFORMATION Events Assessment Access Authorization Programs Industry Trends Buried Piping Activities Concrete Degradation C Seabrook Nuclear Power Plant **Operating Experience Smart** Davis-Besse Reactor Jessel Head Degradation Sample (OpESS) Program Fire Protection Program Generic Issues Fitness-for-Duty ograms

Groundwater Contamination (Tritium)

F .

Emergency Preparedness and

Response

Click on "Radioactive Effluent and Environmental Reports"



ACTOR OPERATIONAL EXPERIENCE	Home > Nuclear Reactors > Operating Reactors > Derational Experience > Groundwate		
ACTOR OPERATIONAL EXPERIENCE	Home > Nuclear Reactors > Operating Reactors > operational Experience > Groundwate		
Access Authorization Programs	Plants	r Contamination (Tritium) at Nuclear	
Actess Addioneducin rograms	Fianco		
Buried Piping Activities	Groundwater Containination (Tritiur	n) at Nuclear	
Davis-Besse Reactor Vessel Head Degradation	Plants	,	
Fire Protection Program	Tritium is a mildly radioactive type of hydrogen that occurs both	RELATED INFORMATION	
Fitness-for-Duty Programs	naturally and during the operation of rulear power plants. Water	Buried Reactor Pipes and	
Groundwater Contamination (Tritium) at Nuclear Plants	released from nuclear plants under controlled, monitored conditions the	Tritium	
Human Factors	NRC mandates to protect public heal h and safety. The NRC recently identified several instances of unint inded tritium releases, and all	Fact Sheet on Environmental Monitoring	
Implementing Lessons Learned from	available information shows no threat to the public. Nonetheless, the	Fact Sheet on Tritium, Radiation Protection Limits, and Drinking Water Standards Radiation Protection	
	NRC is reviewing these incidents to ensure nuclear plant operators		
(OpESS) Program	are needed to the agency's rules and regulations. The following		
Operating Reactor Maintenance	information provides further base: information on tritium and other	Regulation of Padipactive	
Effectiveness	isotopes released from nuclear obwer plants, outlines the status of the	Materials	
Point Beach 2003-2006 -Multiple/Repetitive Degraded Cornerstone Column	unintended thum leaks and the NKC's actions.	Spent Fuel Pools	
PWR Sump Performance	Communications	Buried Piping Activities	
Reactor Pressure Boundary Integrity	Radionuclides in Groundwater	Regulation of Groundwater	
Issues for Pressurized Water Reactors	NRC Actions	Quality at NRC Licensed	
Reactor Vessel Integrity	 Radioactive Effluent and Environmental Reports 	Facilities	
Results and Databases EXIT	 Plant Sites with Licensed Radioactive Material in Groundwater Public Montings 		
	• Public Heedings		

- Click on your nuclear plant, or
- click on "Radioactive Effluent Summary Report" (by year)



Protecting People and the Environment

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Alphabetical List of Operating Nuclear Power Reactors					
• • • • • • • • • • • • • • • • • • • •					
A - G	Н-Р	Q - W			
Arkansas Nuclear One 1 & 2	1.B. Robinson 2	Quad Cities 1 & 2			
Beaver Valley 1 & 2	Haddam Neck	River Bend 1			
Braidwood 1 & 2	Hope Creek 1	Salem 1 & 2			
Browns Ferry 1, 2, & 3	Indian Point 2 & 3	San Onofre 2 & 3			
Brunswick 1 & 2	James A. FitzPatrick	Seabrook 1			
Byron Station 1 & 2	Joseph M. Farley 1 & 2	Sequoyah 1 & 2			
Callaway	Kewaunee	Shearon Harris 1			
Calvert Cliffs 1 &	LaSalle County 1 & 2	South Texas Project 1 & 2			
Catawba 1 & 2	Limerick 1 & 2	St. Lucie 1 & 2			

In accordance with the direction from the Commission, NRC's annual summary radioactive effluent reports are being written for each calendar year. The staff began with the data from calendar year 2007. The currently available NRC summary reports can be found at the links below.

Radioactive Effluent Summary Report by Calendar Year: | 2009 🗵 | 2008 🗵 | 2007 🗵 |

Click on Catawba's "Radioactive Effluent Reports: 2013"



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Radioactive Effluent and Environmental Reports for Catawba 1 & 2

The "Groundwater Questionnaire" describes the state of the groundwater protection program, as of the time the questionnaire was submitted (generally 2007, unless otherwise stated).

The "Effluent Report" lists the quantities of radiony clides released from the site in liquid and gaseous effluents for the calendar year. This report is actually the "Annual Radioactive Effluent Release Report" submitted as required by Federal regulations (10 CFR 50.36a).

The "Environmental Report" lists the measurements of radioactive materials found in the environment surrounding the power plant. This report is actually the "Annual Radiological Environmental Operating Report" submitted as required by Federal egulations.

- Groundwater Questic anaires 🖪
- Radioactive Effluent Reports:
 2013 ☑ | 2012 | 2011 ☑ | 2010 ☑ | 2009 | 2008 ☑ | 2007 | 2006 | 2005 ☑
- Environmental Reports:

2013 🖂 | 2012 🖂 | 2011 🖂 | 2010 🖂 | 2009 🔁 | 2008 🖂 | 2007 🖂 | 2006 🖂 | 2005 🖂

Catawba Letter to NRC

(this is a pdf file, so you scroll instead of clicking)



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April 30, 2014

U.S. Nuclear Regulatory Commission Attention: Document Control Desk Washington, D.C. 20555

Subject: Duke Energy Carolinas, LLC Catawba Nuclear Station, Units 1 and 2 Docket Nos. 50-413 and 50-414 2013 Annual Radioactive Effluent Release Report

Pursuant to Catawba Nuclear Station Technical Specification (TS) 5.6.3 and Selected Licensee Commitment 16.11-16, please find attached the Annual Radioactive Effluent Release Report for the period of January 1, 2013, through December 31, 2013. In accordance with Catawba TS 5.5.1, the Offsite Dose Calculation Manual (ODCM) is included in this submittal.

- Attachment 1 Summary of Gaseous and Liquid Effluents Report
- Attachment 2 Supplemental Information
- Attachment 3 Solid Waste Disposal Report
- Attachment 4 Meteorological Data
- Attachment 5 Unplanned Offsite Releases

Attachment 6 Assessment of Radiation Dose from Radioactive Effluents to Members of the Public (includes fuel cycle dose calculation results)

Catawba effluent data - 2013

How to read exponential notation?



2.06E+01 is read by moving decimal "1" digit to the right

so 2.06E+1 Ci is really 20.6 Ci,

where "Ci" is curies. "Curies" is 37 million transformations per second.

Catawba Nuclear Station Units 1 & 2

REPORT FOR 2013	Unit	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
A. Fission and Activation 1. Total Release 2. Avg. Release Rate	Gases Ci µCi/sec	1.13E+00 1.46E-01	9.14E-01 1.16E-01	7.79E-01 9.81E-02	6.54E-01 8.22E-02	3.48E+00 1.10E-01
B. <mark>Iodine-131</mark> 1. Total Release 2. Avg. Release Rate	<mark>Ci</mark> µCi/sec	0.00E+00 0.00E+00	0.00E+00 0.00E+00	0.00E+00 0.00E+00	0.00E+00 0.00E+00	0 <mark>.00E+00</mark> 0.00E+00
C. Particulates Half Life 1. Total Release 2. Avg. Release Rate	>= 8 day <mark>Ci</mark> µCi/sec	s 0.00E+00 0.00E+00	0.00E+00 0.00E+00	0.00E+00 0.00E+00	0.00E+00 0.00E+00	<mark>0.00E+00</mark> 0.00E+00
D. Tritium 1. Total Release 2. Avg. Release Rate	<mark>Ci</mark> µCi/sec	5.52E+01 7.09E+00	4.85E+01 6.17E+00	5.30E+01 6.67E+00	5.38E+01 6.77E+00	<mark>2.10E+02</mark> 6.67E+00
E. Carbon-14 1. Total Release 2. Avg. Release Rate	<mark>Ci</mark> µCi∕sec	5.42E+00 6.97E-01	5.36E+00 6.82E-01	4.90E+00 6.17E-01	4.87E+00 6.13E-01	<mark>2.06E+01</mark> 6.52E-01

NRC Effluent Summary Reports



- NRC prepares "Radioactive Effluent Summary Reports" for each calendar year
- The link to these annual reports is provided on NRC web site
- So we return to NRC web page for "Radioactive Effluent and Environmental Reports"
- Click on last line, the "Radioactive Effluent Summary Report"

Click on the Radioactive Effluent Summary Reports by year



Radioactive Effluent and Environmental Reports

Each commercial nuclear power plant is required to submit two annual reports, which detail (1) the radioactive effluents discharged from the site, and (2) the effects (if any) on the environment. In addition to these two annual reports, in 2007 each power plant voluntarily submitted answers to a questionnaire related to the voluntary initiative on groundwater protection, initiated by the commercial nuclear power industry.

To see these reports and question aires for a particular nuclear power plant, select the plant name from the following table.

A - GH - PQ - WArkansas Nuclear One 1 & 2H.B. Rubinson 2Quad Cities 1 & 2Beaver Valley 1 & 2Haddam NeckRiver Bend 1Braidwood 1 & 2Hope Creek 1Salem 1 & 2Browns Ferry 1, 2, & 3Indian Point 2 & 3San Onofre 2 & 3Brunswick 1 & 2James A. FitzPatrickSeabrook 1
Arkansas Nuclear One 1 & 2H.B. Robinson 2Quad Cities 1 & 2Beaver Valley 1 & 2Haddam NeckRiver Bend 1Braidwood 1 & 2Hope Creak 1Salem 1 & 2Browns Ferry 1, 2, & 3Indian Point 2 & 3San Onofre 2 & 3Brunswick 1 & 2James A. FitzPatrickSeabrook 1
Beaver Valley 1 & 2Haddam NeckRiver Bend 1Braidwood 1 & 2Hope Creek 1Salem 1 & 2Browns Ferry 1, 2, & 3Indian Point 2 & 3San Onofre 2 & 3Brunswick 1 & 2James A. FitzPatrickSeabrook 1
Braidwood 1 & 2Hope Creek 1Salem 1 & 2Browns Ferry 1, 2, & 3Indian Point 2 & 3San Onofre 2 & 3Brunswick 1 & 2James A. FitzPatrickSeabrook 1
Browns Ferry 1, 2, & 3Indian Point 2 & 3San Onofre 2 & 3Brunswick 1 & 2James A. FitzPatrickSeabrook 1
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Byron Station 1 & 2 Joseph M. Farley 1 & 2 Sequoyah 1 & 2
Callaway Kewaunee Shearon Harris 1
Calvert Cliffs 1 & 2 LaSalle County 1 & 2 South Texas Project 1 & 2
Catawba 1 & 2 Limerick 1 & 2 St. Lucie 1 & 2
In accordance with the direction from the Commission, NRC's annual summary radioactive effluent reports are being written for each calendar year. The staff began with the data from calendar year 2007. The currently
available NRC summary reports can be found at the links below.
Radioactive Entuent Summary Report by Calendar Year: 2009 🗠 2008 🗠 2007 🗠





NUREG/CR-2907, Vol. 15

Radioactive Effluents from Nuclear Power Plants

Annual Report 2009



NUREG/CR-2907



(now in a pdf file, so clicking doesn't work)

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	3.4	Three-Year Trends in Liquid Effluents
	3.5	Long-Term Trend in Liquid Effluents
	3.6	Radiation Doses from Liquid and Gaseous Effluents
4	Sum	ımary





Table 1.1 Nuclear Power Plants, 2009

Plant Name	Туре	Full Plant Name	Location
Arkansas 1, 2	PWR	Arkansas Nuclear One (ANO), Units 1, 2	Russellville, AR
Beaver Valley 1, 2	PWR	Beaver Valley, Units 1, 2	Shippingport, PA
Braidwood 1, 2	PWR	Braidwood Generating Station, Units 1, 2	Braceville, IL
Browns Ferry 1, 2, 3	BWR	Browns Ferry Nuclear Plant, Units 1, 2, 3	Decatur, AL
Brunswick 1, 2	BWR	Brunswick Steam Electric Plant, Units 1, 2	Southport, NC
Byron 1, 2	PWR	Byron Generating Station, Units 1, 2	Byron, IL
Callaway	PWR	Callaway Plant, Unit 1	Callaway, MO
Calvert Cliffs 1, 2	PWR	Calvert Cliffs Nuclear Power Plant, Units 1, 2	Lusby, MD
Catawba 1, 2	PWR	Catawba Nuclear Station, Units 1, 2	York, SC

Long-term Trend in Gases



Figure 3.15 shows a significant downward trend in the amount of noble gases in gaseous effluents from both BWRs and PWRs. The magnitude of the reduction is a 99.9% reduction in noble gas effluents over the last 35 years. For example, in 1975, the median release for BWRs was greater than 40,000 curies; however, in 2010, the median was 41.09 curies.



Long-term Trends in Liquids



Figure 3.16 indicates a downward trend in the amount of particulate activity in liquid effluents from both BWRs and PWRs. The magnitude of the reduction is significant, i.e., a 99.9% reduction over the last 35 years. For example, in 1978, the median activity of liquid effluents from BWRs was greater than 1,100 millicuries; and in 2010, the median was 1.4 millicuries.



Catawba Noble Gas Effluents



PWR Gaseous Releases — Selected Fission and Activation Gases, 2009

Table 3.5

PWR Facility Kr-85 (Ci) Xe-133 (Ci) Xe-135 (Ci) Farley 2 3.52E/04 2.35E-04 2.35E-04 Seabrook 3.2/E-02 4.34E-03 4.34E-03 Beaver Valley 2 7.71E-02 4.44E-03 Point Beach 1 4.33E-03 2.72E-02 2.15E-02 Point Beach 2 4.33E-03 2.72E-02 2.15E-02 Beaver Valley 1 7.14E-02 3.11E-03 3.11E-03 McGuire 1 1.47E-02 5.15E-02 1.65E-02 McGuire 2 1.47F-02 5.15E-02 1.65E-02 Crystal River 3 9.13E-02 1.65E-03 3.27E-01 Kewaunee 1.12E-01 6.32E-03 3.27E-01 Wolf Creek 1.94E-02 2.70E-01 4.83E-02 Diablo Canyon 1 2.02E-01 1.52E-01 2.37E-05 Diablo Canyon 2 2.02E-01 1.52E-01 2.37E-05 Catawba 1 4.05E-03 3.77E-01 3.32E-02				
Farley 23.52E/042.35E-04Seabrook3.2/E-024.34E-03Beaver Valley 27.71E-024.44E-03Point Beach 14.33E-032.72E-022.15E-02Point Beach 24.33E-032.72E-022.15E-02Beaver Valley 17.14E-023.11E-03McGuire 11.47E-025.15E-021.65E-02McGuire 21.47F-025.15E-021.65E-02Crystal River 399.13E-021.65E-03Kewaunee3.06E-029.53E-026.99E-05St. Lucie 12.02E-011.52E-012.37E-01Wolf Creek1.94E-022.70E-014.83E-02Diablo Canyon 12.02E-011.52E-012.37E-05Diablo Canyon 24.05E-033.77E-013.32E-02	PWR Facility	Kr-85 (Ci)	Xe-133 (Ci)	Xe-135 (Ci)
Seabrook3.2 E-024.34E-03Beaver Valley 27.71E-024.44E-03Point Beach 14.33E-032.72E-022.15E-02Point Beach 24.33E-032.72E-022.15E-02Beaver Valley 17.14E-023.11E-03McGuire 11.47E-025.15E-021.65E-02McGuire 21.47E-025.15E-021.65E-02Crystal River 399.13E-021.65E-03Robinson 23.06E-029.53E-026.99E-05St. Lucie 12.53E-033.27E-01Wolf Creek1.94E-022.70E-014.83E-02Diablo Canyon 12.02E-011.52E-012.37E-05Diablo Canyon 24.05E-033.77E-013.32E-02Catawba 14.05E-033.77E-013.32E-02	Farley 2		3.52E-04	2.35E-04
Beaver Valley 2	Seabrook		3.2 E-02	4.34E-03
Point Beach 14.33E-032.72E-022.15E-02Point Beach 24.33E-032.72E-022.15E-02Beaver Valley 17.14E-023.11E-03McGuire 11.47E-025.15E-021.65E-02McGuire 21.477-025.15E-021.65E-02McGuire 39.13E-029.13E-02Kewaunee3.06E-029.53E-026.99E-05St. Lucie 12.53E-033.27E-01Wolf Creek1.94E-022.70E-014.83E-02Diablo Canyon 12.02E-011.52E-012.37E-05Catawba 14.05E-033.77E-013.32E-02	Beaver Valley 2		.71E-02	4.44E-03
Point Beach 24.33E-032.72E-022.15E-02Beaver Valley 17.14E-023.11E-03McGuire 11.47E-025.15E-021.65E-02McGuire 21.47T-025.15E-021.65E-02Crystal River 39.13E-029.13E-02Kewaunee1.12E-016.32E-03Robinson 23.06E-029.53E-026.99E-05St. Lucie 12.53E-033.27E-01Wolf Creek1.94E-022.70E-014.83E-02Diablo Canyon 12.02E-011.52E-012.37E-05Diablo Canyon 24.05E-033.77E-013.32E-02Catawba 14.05E-033.77E-013.32E-02	Point Beach 1	4.33E-03	2.72E-02	2.15E-02
Beaver Valley 17.14E-023.11E-03McGuire 11.47E-025.15E-021.65E-02McGuire 21.47F-025.15E-021.65E-02Crystal River 39.13E-029.13E-02Kewaunee1.12E-016.32E-03Robinson 23.06E-029.53E-026.99E-05St. Lucie 12.53E-033.27E-01Wolf Creek1.94E-022.70E-014.83E-02Diablo Canyon 12.02E-011.52E-012.37E-05Diablo Canyon 24.05E-033.77E-013.32E-02Catawba 14.05E-033.77E-013.32E-02	Point Beach 2	4.33E-03	2.72E-02	2.15E-02
McGuire 11.47E-025.15E-021.65E-02McGuire 21.47F-025.15E-021.65E-02Crystal River 39.13E-029.13E-02Kewaunee1.12E-016.32E-03Robinson 23.06E-029.53E-026.99E-05St. Lucie 12.53E-033.27E-01Wolf Creek1.94E-022.70E-014.83E-02Diablo Canyon 12.02E-011.52E-012.37E-05Catawba 14.05E-033.77E-013.32E-02Catawba 24.05E-033.77E-013.32E-02	Beaver Valley 1		7.14E-02	3.11E-03
McGuire 21.477-025.15E-021.65E-02Crystal River 39.13E-029.13E-02Kewaunee1.12E-016.32E-03Robinson 23.06E-029.53E-026.99E-05St. Lucie 12.53E-033.27E-01Wolf Creek1.94E-022.70E-014.83E-02Diablo Canyon 12.02E-011.52E-012.37E-05Diablo Canyon 24.05E-033.77E-013.32E-02Catawba 14.05E-033.77E-013.32E-02	McGuire 1	1.47E-02	5.15E-02	1.65E-02
Crystal River 39.13E-02Kewaunee1.12E-016.32E-03Robinson 23.06E-029.53E-026.99E-05St. Lucie 12.53E-033.27E-01Wolf Creek1.94E-022.70E-014.83E-02Diablo Canyon 12.02E-011.52E-012.37E-05Diablo Canyon 24.05E-033.77E-013.32E-02Catawba 14.05E-033.77E-013.32E-02	McGuire 2	1.475-02	5.15E-02	1.65E-02
Kewaunee1.12E-016.32E-03Robinson 23.06E-029.53E-026.99E-05St. Lucie 12.53E-033.27E-01Wolf Creek1.94E-022.70E-014.83E-02Diablo Canyon 12.02E-011.52E-012.37E-05Diablo Canyon 22.02E-011.52E-013.32E-05Catawba 14.05E-033.77E-013.32E-02Catawba 24.05E-033.77E-013.32E-02	Crystal River 3		9.13E-02	
Robinson 23.06E-029.53E-026.99E-05St. Lucie 12.53E-033.27E-01Wolf Creek1.94E-022.70E-014.83E-02Diablo Canyon 12.02E-011.52E-012.37E-05Diablo Canyon 22.02E-011.52E-012.37E-05Catawba 14.05E-033.77E-013.32E-02Catawba 24.05E-033.77E-013.32E-02	Kewaunee		1.12E-01	6.32E-03
St. Lucie 1 2.53E-03 3.27E-01 Wolf Creek 1.94E-02 2.70E-01 4.83E-02 Diablo Canyon 1 2.02E-01 1.52E-01 2.37E-05 Diablo Canyon 2 2.02E-01 1.52E-01 2.37E-05 Catawba 1 4.05E-03 3.77E-01 3.32E-02 Catawba 2 4.05E-03 3.77E-01 3.32E-02	Robinson 2	3.06E-02	9.53E-02	6.99E-05
Wolf Creek1.94E-022.70E-014.83E-02Diablo Canyon 12.02E-011.52E-012.37E-05Diablo Canyon 22.02E-011.52E-012.37E-05Catawba 14.05E-033.77E-013.32E-02Catawba 24.05E-033.77E-013.32E-02	St. Lucie 1		2.53E-03	3.27E-01
Diablo Canyon 1 2.02E-01 1.52E-01 2.37E-05 Diablo Canyon 2 2.02E-01 1.52E-01 2.37E-05 Catawba 1 4.05E-03 3.77E-01 3.32E-02 Catawba 2 4.05E-03 3.77E-01 3.32E-02	Wolf Creek	1.94E-02	2.70E-01	4.83E-02
Diablo Canyon 2 2.02E-01 1.52E-01 2.37E-05 Catawba 1 4.05E-03 3.77E-01 3.32E-02 Catawba 2 4.05E-03 3.77E-01 3.32E-02	Diablo Canyon 1	2.02E-01	1.52E-01	2.37E-05
Catawba 1 4.05E-03 3.77E-01 3.32E-02 Catawba 2 4.05E-03 3.77E-01 3.32E-02	Diablo Canyon 2	2.02E-01	1.52E-01	2.37E-05
Catawba 2 4.05E-03 3.77E-01 3.32E-02	Catawba 1	4.05E-03	3.77E-01	3.32E-02
	Catawba 2	4.05E-03	3.77E-01	3.32E-02

Catawba Liquid Effluents



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- Routine, planned tritium releases Protecting People and the Environment

PWR Liquid Effluents — Tritium (Ci)

PWR Facility	H-3
Watts Bar	1.70E+03
South Texas 2	1.35E+03
Callaway	1.16E+03
Wolf Creek	1.11E+03
Diablo Canyon 1	1.09E+03
Diablo Canyon 2	1.09E+03
Byron 1	1.02E+03

PW	/ <mark>Facility</mark>	H-3
PWR Me	an Release	5.68E+02
Arkansas	2	5.68E+02
Surry 1		4.93E+02
Surry 2		4.93E+02
Davis-R	sse	4.71E+02
Catawba	1	4.61E+02
Catawba	2	4.61E+02

Typical Nuclear Plant Effluents (2010 Data)



•	Gas	ses Effluents	<u>BWRs</u>	<u>PWRs</u>	
	_	Tritium	25 Ci (191 max)	32 Ci (1190) max)
	_	Noble gas	11 Ci (450 max)	Ci (207	' max)
	_	C-14	12 Ci (18 max)	8.5 Ci (13 r	nax)
	_	lodine	1 mCi (20 max)	I	mCi (2 max)
	—	Particulates	mCi (6.60moax) 0.2	I	mCi (0.4 max)
				0.002 0.002	
•	Liq	uid Effluents			
	_	Tritium	5 Ci (150 max)	568 Ci (17	'00 max)
	_	lodine	mCi (0.4 max)		mCi (10 max)
	_	Particulates	^{0.01} .5 mCi (40 max)		mCi (0.12 max)
	—	Noble gas		0.003	
	_	C-14	None	0.01 No	ne
		No	ne	None	

Radiation Dose to the Public

National Council on Radiation Protection



NCRP Report No. 160, *Ionizing Radiation Exposure of the Population of the United States*

Purchase

In 2006, Americans were exposed to more than seven times as much ionizing radiation from medical procedures as was the case in the early 1980s, according to a new report on population exposure released March 3rd by the National Council on Radiation Protection and Measurements (NCRP) at its annual meeting in Bethesda, Maryland. In 2006, medical exposure constituted nearly half of the total radiation exposure of the U.S. population from all sources.

The increase was primarily a result of the growth in the use of medical imaging procedures, explained Dr. Kenneth R. Kase, senior vice president of NCRP and chairman of the scientific committee that produced the report. "The increase was due mostly to the higher utilization of computed tomography (CT) and nuclear medicine. These two imaging modalities alone contributed 36 percent of the total radiation exposure and 75 percent of the medical radiation exposure of the U.S. population." The number of CT scans and nuclear medicine procedures performed in the United States during 2006 was estimated to be 67 million and 18 million, respectively.



Radiation Dose



The NCRP estimated that the average person in the United States receives about 620 mrem (rounded value) of radiation dose each year from all sources, as follows:

- 311 mrem from natural background
- 300 mrem from medical sources
- 13 mrem from consumer products
- Average person from nuclear power plants None (as reported by NCRP)
- Average person living next to plants is less than 1 mrem (based on plant reports)

NUREG-CR/2907 Catawba - Gaseous Doses Maximum Exposed Individual



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7.70E-1 is 0.77 mrem (compared to 620 mrem from all sources)

PWR Facility	Annual Organ Dose (mrem)	PWR Facility
Salem 2	4.08E-05	North Anna 1
Salem 1	1.04E-04	North Anna 2
Vogtle 2	3.56E-04	Point Beach 1

1.30E-02 1.32E-02

1.32E-02

1.48E-02 1.48E-02

Sequoyah 2

Ft. Calhoun

Prairie Island 1 Prairie Island 2

PWR Median Dose

	Table 3.18		
PWR Gaseous Effluents	— Maximum Annu	al Organ Dose, 2	009

Harris System Operational	8.47E-01 15
Catawba 2	7.70E-01
Catawba 1	7.70E-01

Annual Organ Dose (mrem) 1.55E-02 1.55E-02 1.61E-02

Catawba - Liquid Doses Maximum Exposed Individual



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Annual Organ Dose (mrem) 9.13E-03 8.25E-03 9.67E-03 1.27E-02 9.62E-03 1.61E-02 1.40E-02 1.49E-02 2.23E-02 2.23E-02 2.86E-02 3.06E-02 3.54E-02 3.54E-02

2.51E-02 is 0.0251 mrem (compared to 620 mrem from all sources)

Table 3.20 PWR Liquid Effluents — Maximum Annual Total Body and Organ Dose, 2009

PWR Facility	Annual Total Body Dose (mrem)	Annual Organ Dose (mrem)		PWR Facility	Annual Total Body Dose (mrem)
Palo Verde 1				Farley 1	6.10E-03
Palo Verde 2				South Texas 1	8.19E-03
Palo Verde 3				Davis-Besse	7.81E-03
Robinson 2	4.23E-05	4.76E-05		Harris	5.87E-03
Salem 2	2.72E-05	8.89E-05		Ginna	9.57E-03
Salem 1	3.22E-05	8.60E-05		Farley 2	6.42E-03
Crystal River 3	5.53E-05	1.14E-04]	Watts Bar	1.13E-02
Turkey Point 3	3.93E-04			Vogtle 1	1.18E-02
Turkey Point 4	3.93E-04]	Cook 1	2.22E-02
Surry 1	1.55E-04	2.52E-04	1	Cook 2	2.22E-02
Surry 2	1.55E-04	2.52E-04		Three Mile Island 1	2.77E-02
Diablo Canyon 1	1.67E-04	4.20E-04		Ft. Calhoun	2.80E-02
Diablo Canyon 2	1.67E-04	4.20E-04		Catawba 1	2.51E-02
Indian Point 3	2.49E-04	4.59E-04		Catawba 2	2.51E-02
14	E O I E O I	7 0 5 5 0 4		<u> </u>	0.045.00

Tritium Leaks



Many plants have had leaks - see list below

- Nuclear plants monitor for tritium leaks into ground water
- Each plant's groundwater tritium results are provided in their annual effluent or environmental reports
- NRC publishes the <u>historical</u> and <u>current</u> maximum values for each plant on the NRC public web page



List of Leaks and Spills



- 6 month updates published on NRC web site
- 45 sites have had > 20,000 pCi/L
- 15 sites currently have > 20,000 pCi/L



List of Tritium Leaks:



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Click on "Plant Sites with Licensed Radioactive Materia Protecting People and the Environment in Groundwater" (i.e., list of plants with tritium leaks)



Plant Sites with Licensed Radioactive Material in Groundwater

The U.S. Nuclear Regulatory Commission (NRC) regulations require nuclear power plants to check for the presence of radioactive materials on site property and in the environment. Licensees routinely check their site and the environment for the presence of radioactive materials. The instruments used to perform these checks can detect extremely small concentrations of radioactive materials. As a result of one or more of the causes listed below, radioactive materials (most notably tritium) have been identified in ground moisture or ground water at several commercial nuclear power plants:

- 1. system leaks (e.g., pipes, valves, tanks)
- 2. evaporation of liquids
- 3. condensation of vapors
- 4. as the result of routine, approved releases

The NRC has prepared the following list of reactor sites where tritium has been detected in ground moisture or groundwater on facility property:

List of Leaks and Spills at Nuclear Power Plants

Groundwater Tritium



List of Historical Leaks and Spills At U.S. Commercial Nuclear Power Plants

It is imperative that the preceding paragraphs accompany any reproduction of this list so that the information is communicated in the proper context.

Plant	Historical Maximum Tritium Concentration, pCi/l	Date of Historical Maximum Tritium	Current Concentration of Tritium, pCi/l
Beaver Valley	25,583	September, 2010	19,200
Braidwood	247,000	1998	2,430
Browns Ferry	2,050,000	April, 2010	1,013
Brunswick	19,000,000	December, 2010	3,539,000
Byron	82,000	February, 2006	911
Callaway	1,600,000	July, 2014	1,600,000
Catawba	47,500	October, 2007	11,300

- Comparison Values
 - EPA drinking water at faucet (tap): 20,000 pCi/L = 4 mrem
 - EPA 40 CFR 190 public dose limit:
 - NRC in surface waters:

= 25 mrem

= 50 mrem

Catawba effluent report



ATTACHMENT 9

Information to Support the Nuclear Energy Institute (NEI)

2013 Catawba ARERR Groundwater Well Data Section

Duke Energy implemented a Ground Water Protection program in 2007. This initiative was developed to ensure timely and effective management of situations involving inadvertent releases of licensed material to ground water. As part of this program, Catawba Nuclear Station monitored forty-six wells in 2013.

Wells are typically sampled quarterly or semi-annually. Ground water samples are regularly analyzed for tritium and gamma emitters, select wells being analyzed for difficult to detect radionuclides. No gamma or difficult to detect radionuclides (other than naturally occurring radionuclides) were identified in well samples during 2013. Results from sampling during 2013 confirmed existing knowledge of tritium concentrations in site ground water.

Two leak events meeting the criteria for voluntary notification to NEI occurred at Catawba in 2013. On May 15, 2013 Conventional Waste Water piping used to transfer Turbine Building Sump water to the Conventional Waste Ponds leaked greater than 100 gallons of water containing tritium above the station critical level to the ground. The second notification event occurred on October 19, 2013. During planned maintenance activities for draining of secondary condenser water to the conventional waste ponds, water levels in the conventional waste pond rose to a level which caused the settling pond valve pit to overflow more than 100 gallons of water containing tritium above the station critical limits. Neither event was determined to pose a risk to the public because the EPA Drinking Water Limit, 20,000 pCi/L, was not exceeded, and both leaks were contained within the site boundaries. Remediation of both events has been completed.

Catawba tritium data



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1 pCi/L is extremely small, 1 part in a million <u>times</u> a million or

1 part in 1,000,000,000,000

2.35E+02 is 235 pCi/L

- 1.05E+03 is 1,050 pCi/L
- EPA drinking water is 20,000 pCi/L

Well	Location	Tritium Concentration (pCi/l)				# of
Name	Location	1st QTR	2nd QTR	3rd QTR	4th QTR	Samples
C100R	U-1 SFP	NS	NS	NS	NS	0
C100DR	U-1 SFP	2.35E+02	1.98E+02	2.58E+02	<mda< td=""><td>4</td></mda<>	4
C101R	U-1 SFP	1.05E+03	1.03E+03	5.45E+02	3.80E+02	4
C101DR	U-1 SFP	6.23E+02	7.95E+02	8.68E+02	6.81E+02	4



Questions and Discussion

