



**Savannah River  
National Laboratory®**

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# Savannah River Site Environmental Monitoring Program

*History and Overview of Effluent Monitoring and Environmental Surveillance at SRS*

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*SRS and the Environment*

*March 3, 2021*

# Savannah River Site (SRS)

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- Construction started in 1953, primarily to produce tritium and plutonium for nuclear weapons
- Located in SC, ~ 24 mi. SE of Augusta, GA
- 310 mi<sup>2</sup> with more than 90% forest
- 16 operational areas
- Current primary activities:
  - Tritium processing for nuclear weapons
  - Liquid waste processing
  - Environmental management
  - Plutonium management
  - Research and development (SRNL)



# Presentation Contents

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- SRS EM Video
- Environmental Monitoring (EM) Purpose
- Savannah River Site EM Program Description
- Recent SRS EM Results
- Historical Trends of Key SRS Radioisotopes and Biota



# Purpose of Environmental Monitoring

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- Comply with regulations and laws
- Determine pre-operational conditions
- Measure potential impacts of releases
  - Current and legacy
- Determine effectiveness of cleanup projects
- Perform dose and risk assessments
- Inform stakeholders of environmental quality



# Environmental Monitoring Objectives

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- Pre-operational surveillance
  - Provide a baseline of background concentrations and a framework for the operational environmental monitoring program
- Monitoring and surveillance of ongoing operations and legacy contamination
  - Compliance Monitoring
  - Air and liquid effluent sampling and analysis
  - Environmental media and biota
  - Meteorological monitoring
- Monitoring capabilities for unplanned releases
  - Real-time meteorological monitoring and modeling
  - Protect members of the public in recovery
  - Determine the impacted areas
- Post-operational surveillance
  - Meet decommissioning requirements
  - Control future exposures to the members of the public and the environment

# General Environmental Monitoring Program Components

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- Three main components – Effluent Monitoring, Environmental Surveillance, and Meteorological Monitoring
- **Effluent Monitoring** – Monitor releases to the environment at the point of discharge
  - Radiological Effluent Monitoring
    - *Air releases from facility stacks*
    - *Liquid releases from facility outfalls*
  - Nonradiological Effluent Monitoring
    - *Air releases estimated from standard models*
    - *Liquid releases from facility outfalls (NPDES)*





# General Environmental Monitoring Program Components

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- **Environmental Surveillance** – Performed beyond the point of discharge
  - Radiological Surveillance
    - *Environmental sampling and analysis*
      - Air, water (streams, rivers, basins), foodstuffs, soil, sediment, drinking water, vegetation, wildlife
  - Nonradiological Surveillance
    - *Facility drinking water*
    - *Environmental sampling and analysis*
      - Fish, streams, river, deposition, and rainwater



# General Environmental Monitoring Program Components

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- **Meteorological Monitoring**

- Provide historical and real-time Met data
  - *Routine releases (transport and diffusion)*
  - *Unplanned releases (emergency response)*
  - *Facility design analysis (severe conditions)*

Anemometer

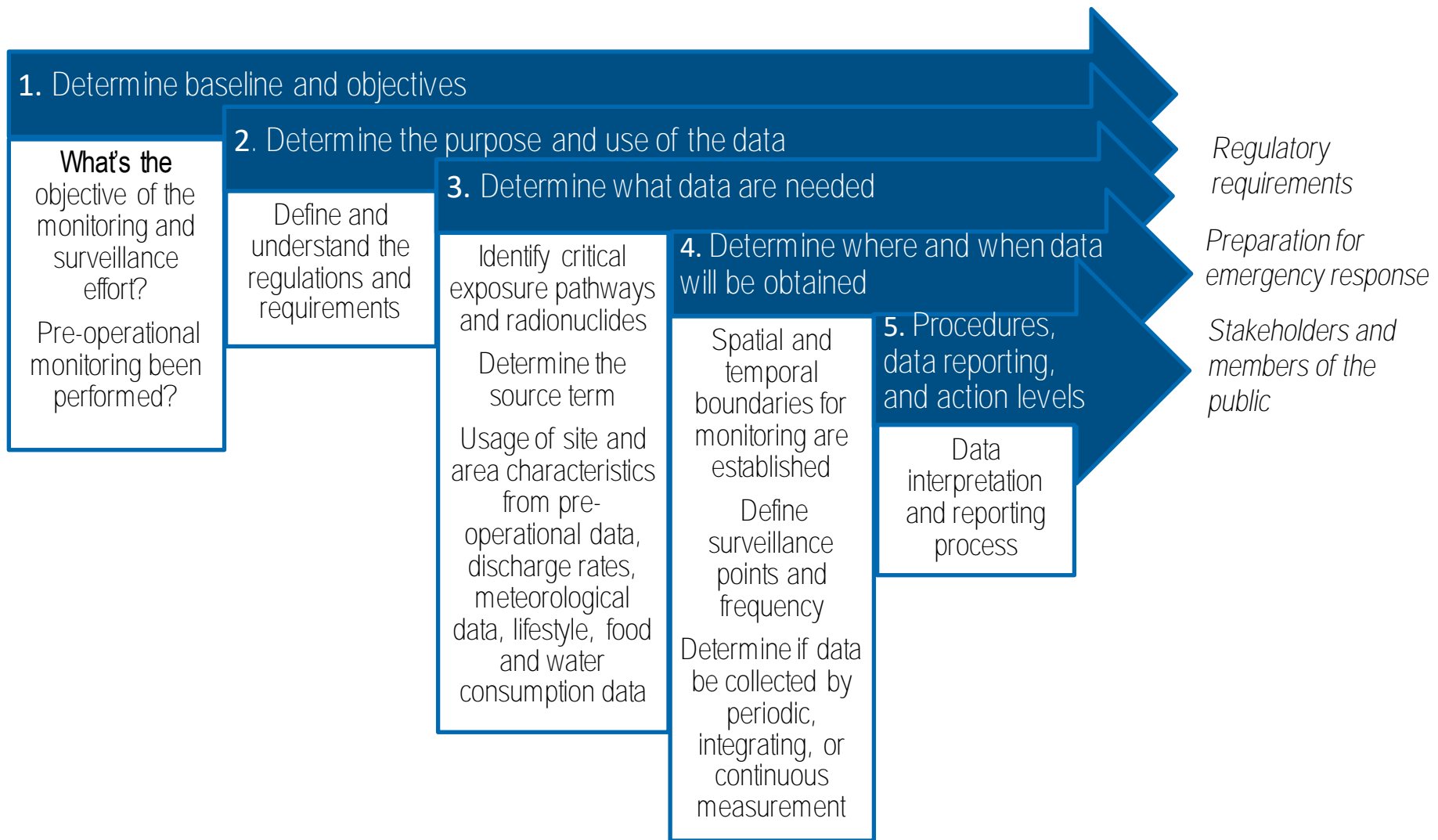


Humidity and Temperature





# General Steps to EM Program Design





# Environmental Monitoring Sampling Media

Fish



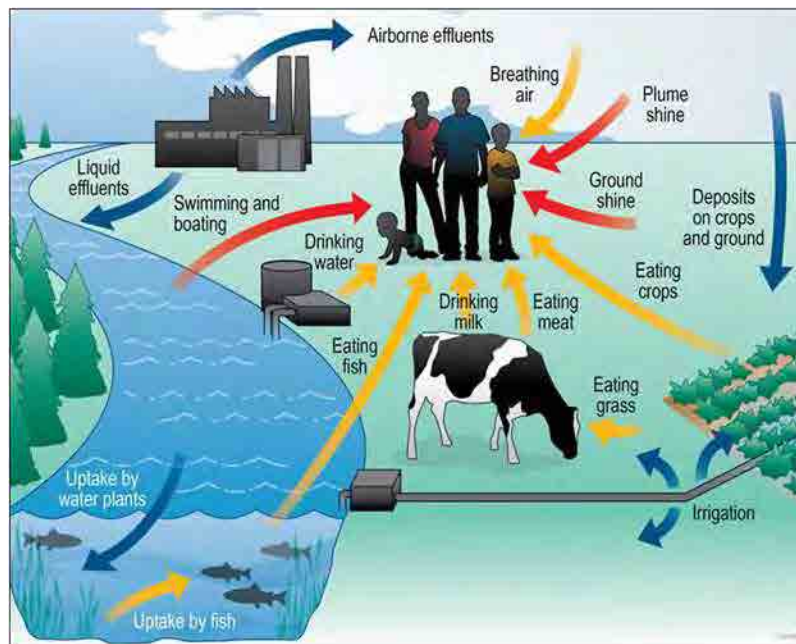
Air



Air



Wildlife



Soil



Surface Water



Foodstuff



Vegetation





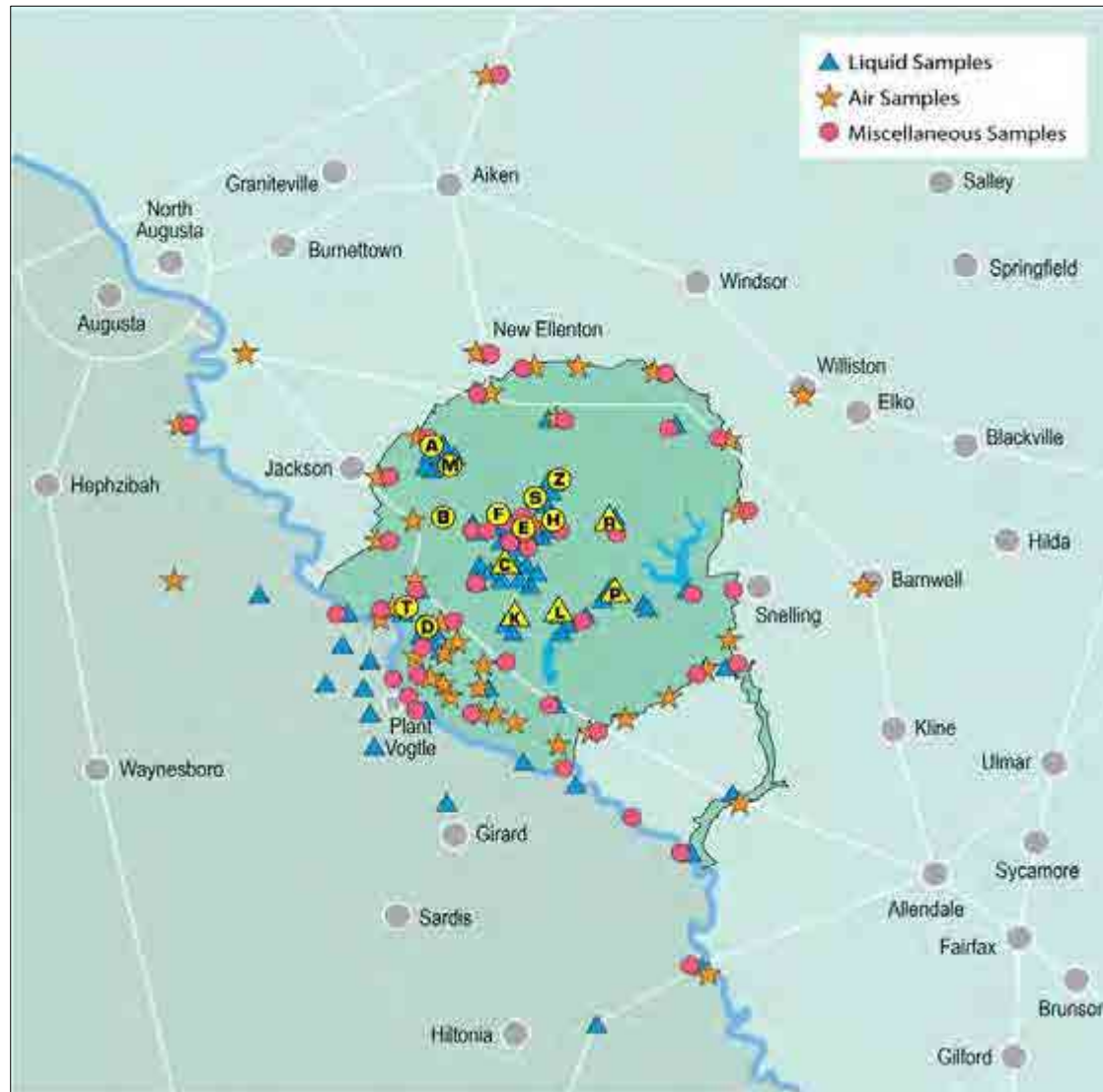
# SRS Environmental Monitoring Program

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- SRS has performed environmental monitoring for more than 60 years
  - Assess impact to the public and environment from Site operations
  - Monitor facility discharges
  - Extensive on- and off-site surveillance, extending to Savannah, GA
  - Sample media: air, water, groundwater, soil, food products (including fish), and vegetation
    - *Chemical*
    - *Radiological*
  - Extensive meteorological monitoring



# Current SRS Environmental Monitoring – Overall Monitoring Locations





# History of SRS Environmental Monitoring


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- Environmental baseline studies during the 1950s included:
  - Scientists from the Universities of Georgia and South Carolina
    - *Collected baseline data on plant and animal communities (Dr. Rhodes' talk)*
  - Team from the Academy of Natural Sciences in Philadelphia under the leadership of Dr. Ruth Patrick
    - *Performed a biological study of the Savannah River*
  - **DuPont's Site Survey team of Health Physics personnel (Reinig et. al.)**
    - *Completed a landmark study of local natural radioactivity at SRS in 1953*




Dr. Ruth Patrick, pioneer in studying the health of freshwater streams and rivers and member of the Academy of Natural Sciences

# History of SRS Environmental Monitoring

 **RECORDS ADMINISTRATION**  
RD138611

DP - 27 ✓

  
Health and Safety

*[Handwritten signatures]*


## NATURAL RADIOACTIVE CONTENTS OF THE SAVANNAH RIVER PLANT

by  
W. C. Reinig, R. E. Gosline,  
E. L. Albenesius, and R. C. Williams  
Health Physics Section  
Savannah River Plant

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May 1, 1953

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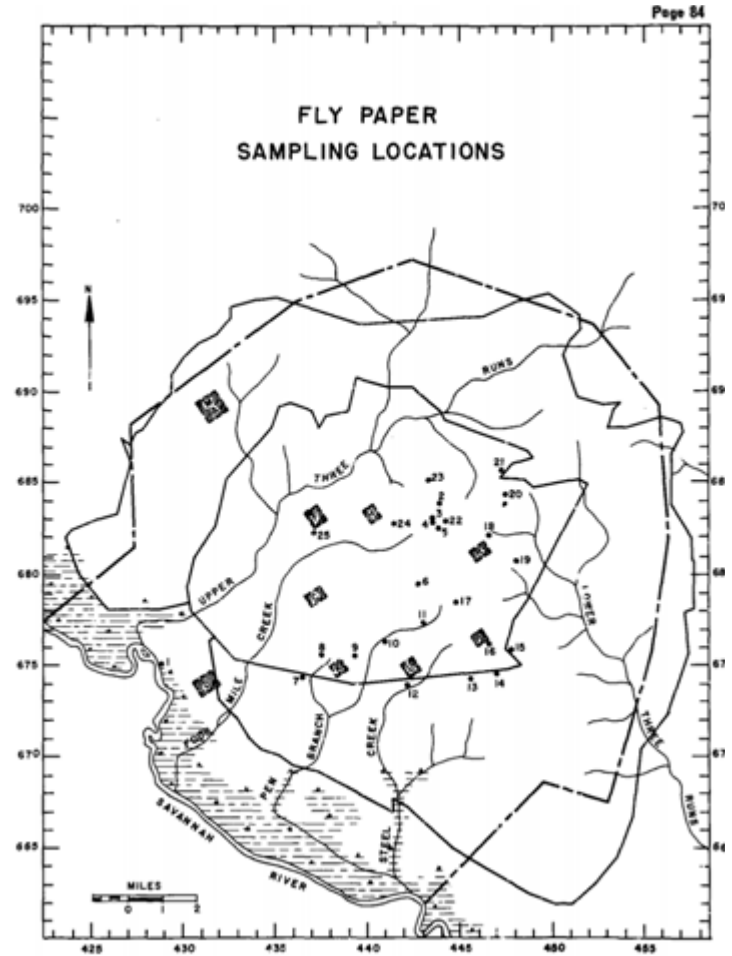
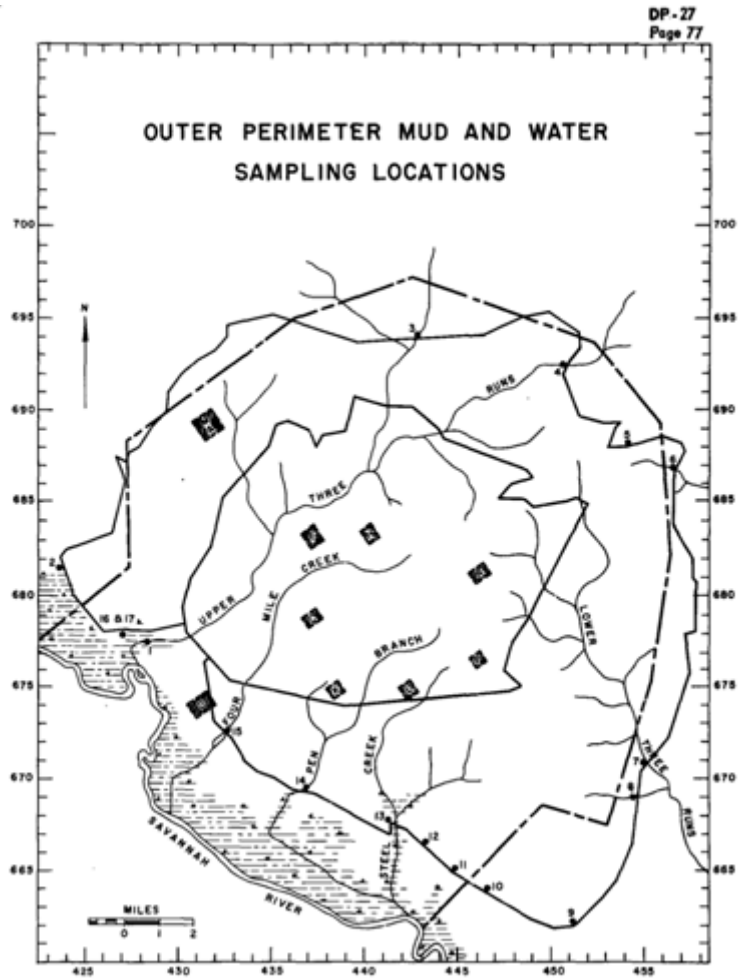
HEALTH AND SAFETY

ABSTRACT

From June 1951 to January 1953, approximately 6600 samples from the environs of the Savannah River Plant were analyzed to establish background levels of naturally occurring radioisotopes prior to plant startup.



# History of SRS Environmental Monitoring



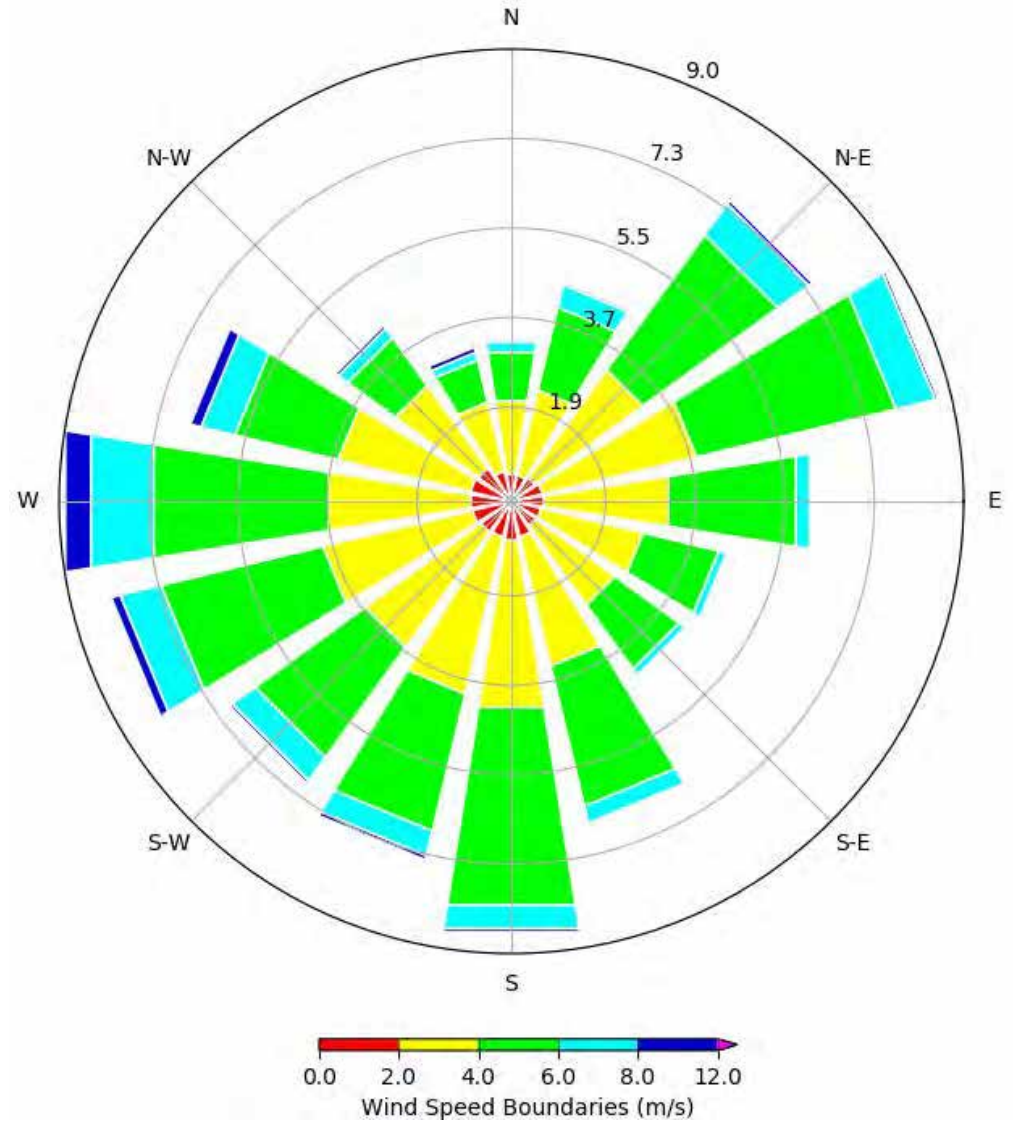
## Current SRS Environmental Monitoring – Meteorological Monitoring

- Eight 200-foot area towers
  - <0.5 miles from area
  - Same elevation
  - Undisturbed forest canopy
- Two research towers
  - WJBF (1,080-foot)
    - *NOAA Carbon Tracker Tower*
  - Flux Tower (Forestry support...)
- Central climatology
  - Comprehensive instrumentation





# Meteorological Monitoring





## Meteorological Monitoring

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- WIND (Weather Information and Display System)
  - Integral part of the Site's and U.S. Southeast Regional's emergency response capabilities



<https://weather.srs.gov/atg/static/pdf/SRNL-TR-2020-00197.pdf>

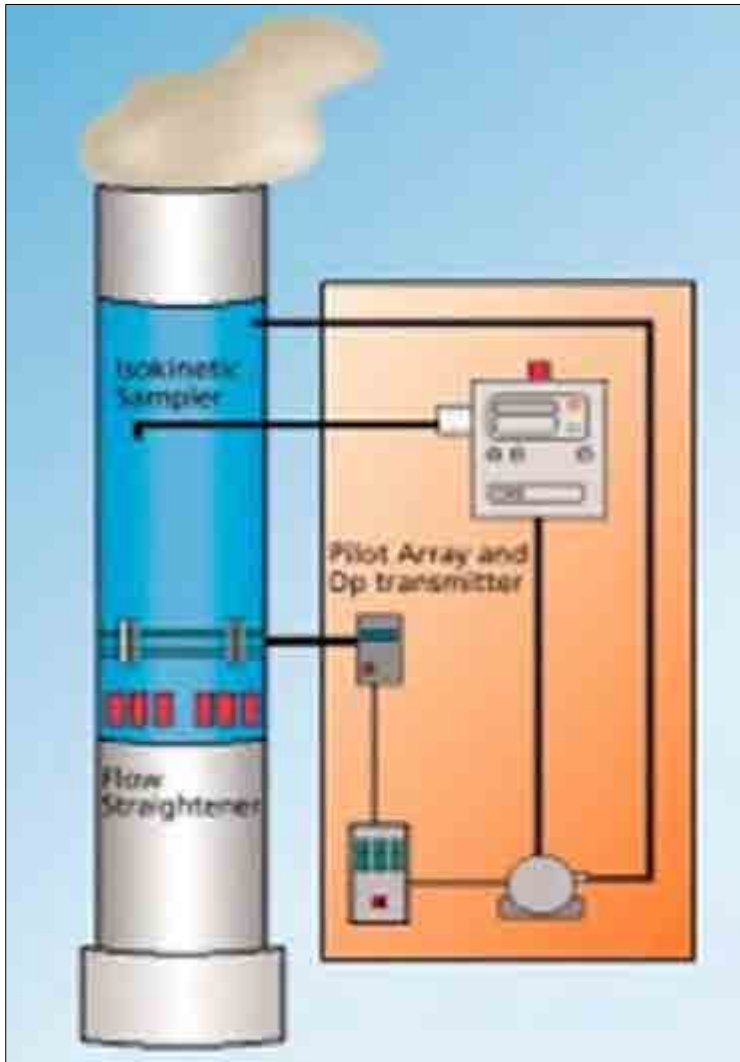
## Current SRS Environmental Monitoring – Air Effluent Monitoring

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- Airborne effluents can be in the form of gases, particles suspended in gases, or vapors
- Program design framework comes from national standards for performance
  - ANSI/HPS N13.1-2011
  - ISO-2889-2010
- Regulations
  - **EPA's National Emission Standards for Hazardous Air Pollutants (NESHAP)**, Clean Air Act (CAA)
  - DOE Order 458.1
- Radiological Monitoring
  - Sampling and analysis or inline monitoring (tritium)
- Nonradiological
  - No continuous monitoring (some periodic checks)
  - Standard EPA required modeling techniques
  - Facility inventories and Met data



# Air Effluent Monitoring – Isokinetic Sampling



Isokinetic Sampling Probes





# Air Effluent Sampling - Air Filter Collection and Lab Analysis

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SRS has a state-of-the-art Environmental and Bioassay Laboratory located onsite in B Area



# Air Effluent Monitoring – NESHAPs Monitoring Requirements

Potential Impact Category (PIC Level)	Monitoring and Sampling Criteria	PEDE (mrem/yr)	Actual EDE (mrem/yr)
1	Continuous sampling and to include a real time monitor and alarm	>0.1	>1E-02
2	Continuous Sampling and off-line periodic analysis	>0.1	≤1E-02
3	Periodic quarterly sampling and off-line analysis	≤0.1	>1E-05
4	Annual administrative review of facility uses to confirm absence of radioactive materials in forms and quantities not conforming to prescribed specification and/or limits	≤0.1	≤1E-05

SRS currently has:

- 2 PIC level 2 airborne sources (291-H & 291-F)
- 15 PIC level 3 airborne sources (H Area, SRNL, L Area, K Area, C Area, F Area)
- 177 PIC level 4 airborne sources (many Tank Farm tanks)



# Air Effluent Monitoring – 2019 Results

## 2019 Airborne Effluent Releases of Gases and Vapors

Radionuclide	Half-Life		Calculated	Reactors	Separations	SRNL	Total
<b>Gases and Vapors (Curies)</b>							
<b>H-3 (oxide)</b>	<b>12.3</b>	<b>y</b>	<b>2.46E+02</b>	<b>9.85E+02</b>	<b>6.71E+03</b>		<b>7.94E+03</b>
<b>H-3 (elemental)</b>	<b>12.3</b>	<b>y</b>			<b>1.31E+03</b>		<b>1.31E+03</b>
<b>H-3 Total</b>	<b>12.3</b>	<b>y</b>	<b>2.46E+02</b>	<b>9.85E+02</b>	<b>8.02E+03</b>		<b>9.25E+03</b>
<b>C-14</b>	<b>5700</b>	<b>y</b>	<b>9.48E-08</b>		<b>5.00E-02</b>		<b>5.00E-02</b>
<b>Hg-203</b>	<b>46.6</b>	<b>d</b>	<b>6.51E-10</b>				<b>6.51E-10</b>
<b>Kr-85</b>	<b>10.8</b>	<b>y</b>			<b>1.07E+04</b>		<b>1.07E+04</b>
<b>I-129</b>	<b>1.57E+07</b>	<b>y</b>	<b>4.31E-05</b>		<b>9.95E-03</b>	<b>8.67E-07</b>	<b>9.99E-03</b>
<b>I-131</b>	<b>8.02</b>	<b>d</b>	<b>7.01E-10</b>				<b>7.01E-10</b>

2019 Total for All 76 Reported Airborne Effluent Particulate Radionuclides is <0.1Curie

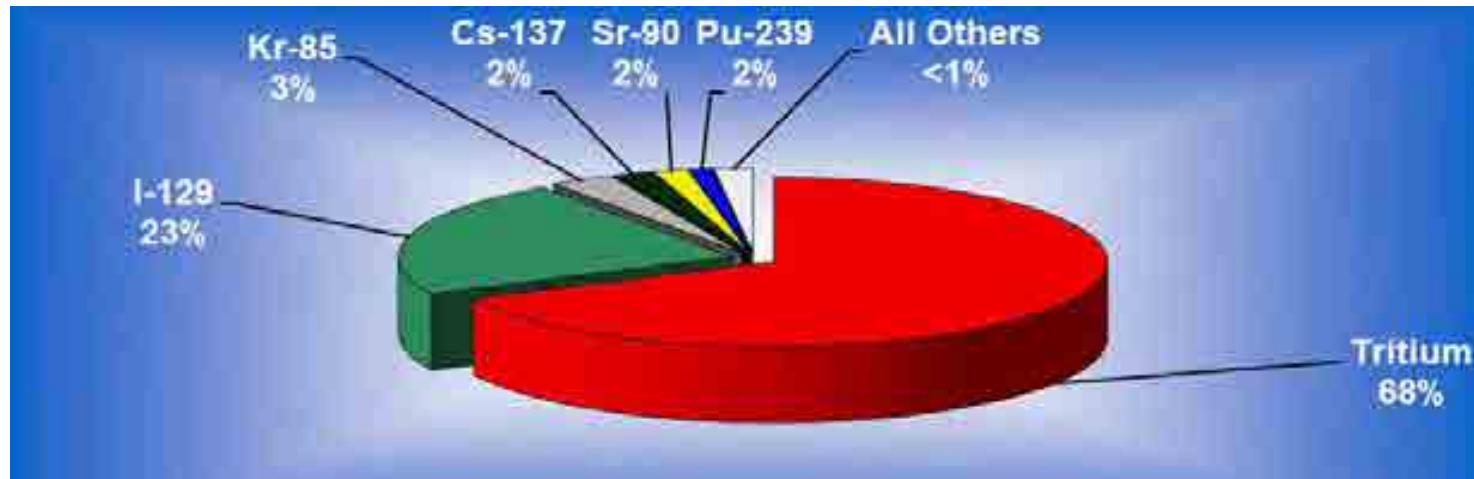


# Air Effluent Monitoring – 2019 Results

## Potential Doses to the Representative Person and to the NESHAP MEI from SRS Atmospheric Releases in 2019 and Comparison to the Applicable Dose Standard

	MAXDOSE-SR Site Boundary DOE 458.1	CAP88-PC (EPA NESHAP) Site Boundary	CAP88-PC (EPA NESHAP) TRL Worker
<b>Calculated dose (mrem)</b>	0.018	0.018	0.0097
<b>Applicable Standard (mrem)</b>	10 <sup>(a)</sup>	10 <sup>(b)</sup>	10 <sup>(a)</sup>
<b>Percent of Standard (%)</b>	0.18	0.18	0.097

Radionuclide Contributions to the 2019 SRS Air Pathway Dose of 0.018 mrem (0.00018 mSv)



# Current SRS Environmental Monitoring – Liquid Effluent Monitoring

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- Regulations
  - DOE Order 458.1
  - **EPA's Clean Water Act (CWA)**
  - National Pollution Discharge Elimination System (NPDES)
    - *Enforced by SCDHEC*
- Program design is from DOE guidance and NPDES requirements
  - Source categories similar to NESHAP
- Water monitoring design alternatives
  - Online monitoring systems
  - Periodic grab sampling
  - Flow proportional sampling of water
  - Time proportional sampling of water
- Radiological and nonradiological
  - Similar monitoring systems



# Nonradiological Effluent Monitoring - NPDES

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- SCDHEC (USEPA) inspects all mandated activities
  - Compliance Evaluation Inspection (CEI)
  - Compliance Sampling Inspection (CSI)
  - Performance Audit Inspection (PAI)
  - Lab Certification
- Compliance is reported through monthly Discharge Monitor Reporting to SCDHEC and in the Annual Site Environmental Report (ASER)



Visual assessment of an industrial stormwater outfall sample



Field technician collects a compliance sample at an industrial wastewater outfall

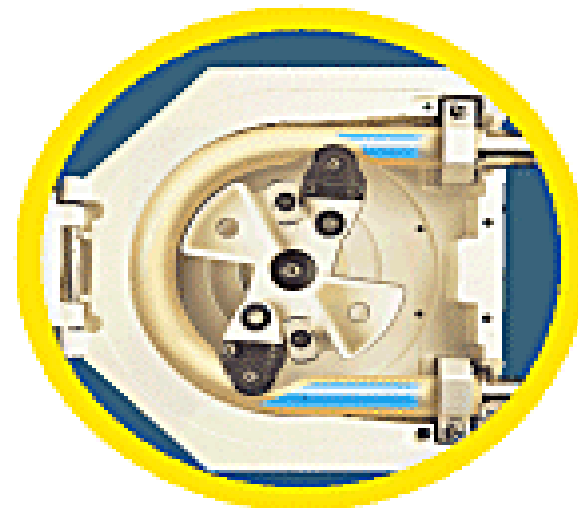


# Liquid Effluent Monitoring – Timed Integrated Sampling

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Peristaltic Pump





## Liquid Effluent Monitoring – Radiological Source Categories

Category	Sum of Fractions of DCS	Dose
I	Greater than 1.0	>100 mrem/year
II	Greater than 0.1, but less than 1.0	10-100 mrem/year
III	Greater than 0.001, but less than 0.1	>0.1- <10 mrem/year
IV	Less than 0.001, but radionuclide inventory is above the limits	<0.1 mrem/year
V	Less than 0.001 and radionuclide inventory is below the limits	<0.1mrem/year

SRS currently has:

- 5 level 2 category liquid effluent sources (F Area, H Area, S Area)
- 12 level 3 category liquid effluent sources (A Area, F Area, H Area, K Area, L Area, S Area)

# Radiological Liquid Effluent Monitoring – 2019 Results

## 2019 Radioactive Liquid Releases by Site Stream - (Curies)

	<b>Upper Three Runs</b>	<b>FourMile Branch</b>	<b>Pen Branch</b>	<b>Lower Three Runs</b>	
<b>Nuclide</b>	<b>(A,M,F,H)</b>	<b>(F,H,SRTE)</b>	<b>(K,L)</b>	<b>(P,R)</b>	<b>Totals</b>
H-3 <sup>a</sup>	8.11E+01	2.14E+02	1.29E+02	2.99E-01	<b>4.52E+02</b>
C-14	3.43E-04	1.50E-02			<b>1.53E-02</b>
Sr-90	1.51E-06	1.31E-02	0.00E+00		<b>1.31E-02</b>
Tc-99	0.00E+00	1.66E-02			<b>1.66E-02</b>
I-129	0.00E+00	8.92E-03			<b>8.92E-03</b>
Cs-137	1.17E-04	8.12E-03	0.00E+00	0.00E+00	<b>2.10E-01</b>
Ra-226	1.82E-02	1.11E-03			<b>1.93E-02</b>
U-234	3.62E-04	2.50E-07			<b>3.62E-04</b>
U-235	2.07E-02	1.37E-03			<b>2.20E-02</b>
U-238	0.00E+00	8.61E-05			<b>8.61E-05</b>
Np-237	1.70E-05	1.04E-04			<b>1.21E-04</b>
Pu-238	3.93E-06	5.45E-06			<b>9.38E-06</b>
Pu-239	0.00E+00	1.16E-05			<b>1.16E-05</b>
Am-241	0.00E+00	2.17E-06			<b>2.17E-06</b>
Cm-244		2.32E-03			<b>2.32E-03</b>
Alpha	6.79E-04	3.72E-04	0.00E+00	3.86E-03	<b>4.91E-03</b>
Beta	1.97E-03	1.67E-03	2.06E-02	1.75E-02	<b>4.18E-02</b>

