

Update on SIERRA Code Consolidation

C. Condon, J. Flaherty, J. Hargraves Pacific Northwest National Laboratory



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Software Integration for Environmental Radiological Release Assessments PNNL-SA-197363



Outline



- Motivation and framework for Code Consolidation Efforts
- Status of SIERRA ATD (Atmospheric Transport and Diffusion) Module
 - Example Case
 - Software Quality Assurance Testing
- Sneak peek at SIERRA Source Term

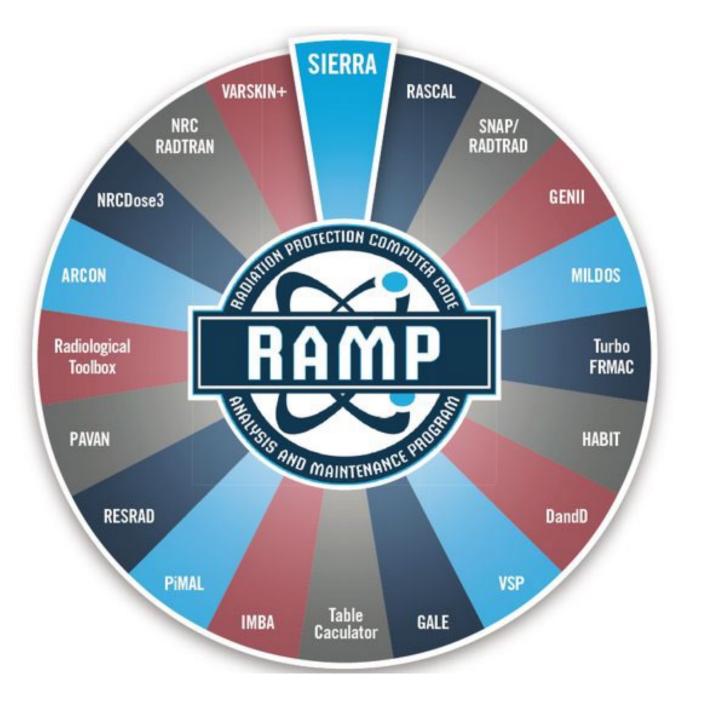


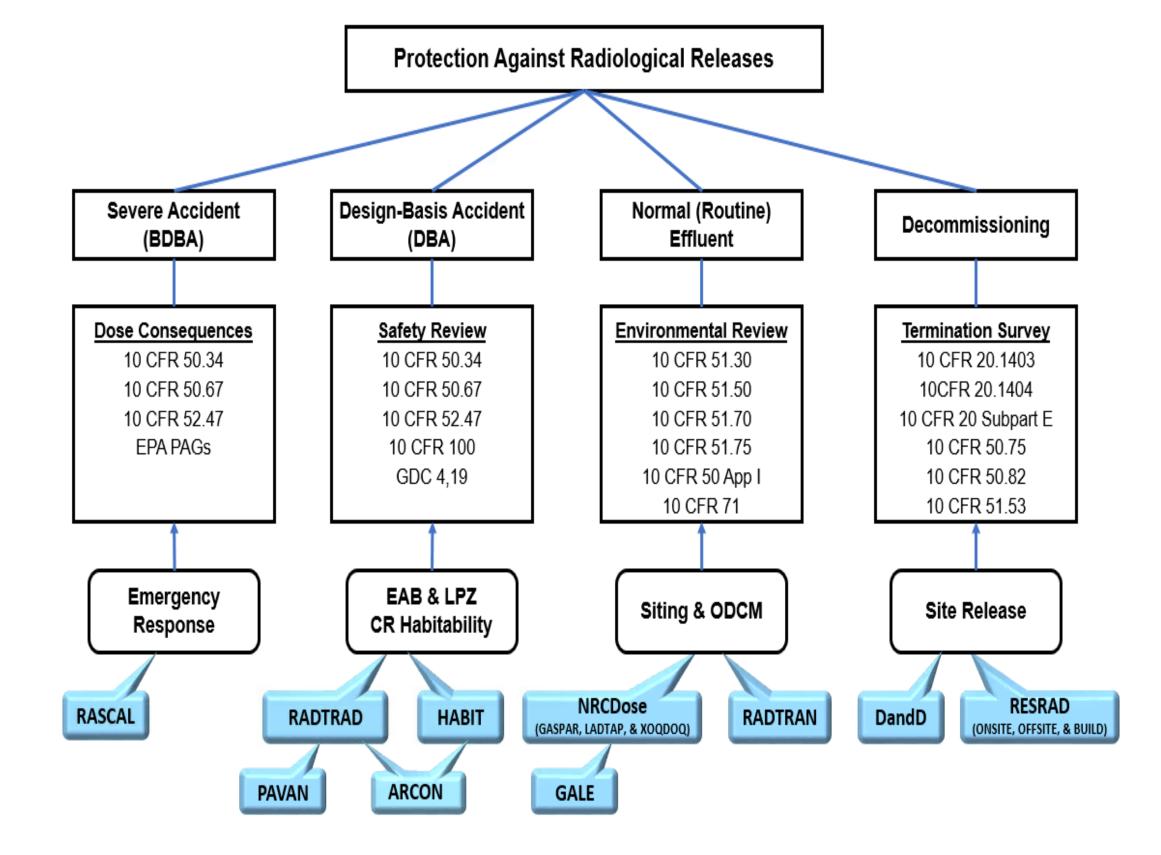


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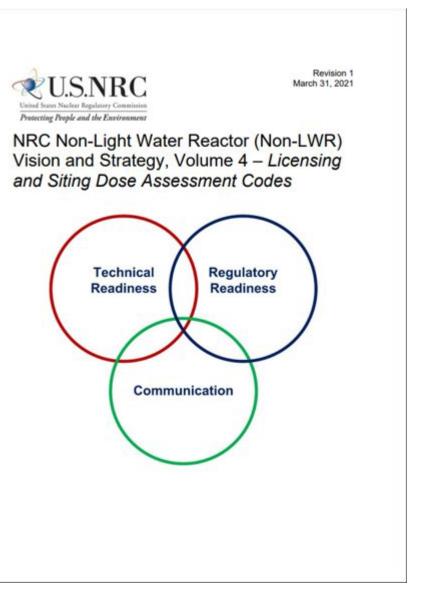
 Software Integration for Environmental Radiological Release Assessments (SIERRA)





Motivation for Code Consolidation – Non LWRs

- NRC Non-Light Water Reactor (Non-LWR) Vision and Strategy, Volume 4 — Licensing and Siting Dose Assessment Codes (RAMP)
 - Describes the computer codes in RAMP and how they would be applied to each of the principal non-LWR design types, and summarizes the tasks necessary to resolve "gaps" in the capability to model and simulate those designs with the accuracy required by the regulator
- Code consolidation can help resolve the identified gaps in the RAMP suite of codes









How can we think about Code Consolidation?

1. Establish definition and scope of Code consolidation:

- a. What problem are we solving with consolidation?
- 2. Categorize the priorities:
 - a. What Code languages should be used?
 - b. How will the consolidate code be structured?
 - c. What codes could be consolidated?
- 3. Establish the requirements:
 - a. Regulatory Requirements
 - b. Modeling requirements
 - c. Data requirements
 - d. Quality Assurance
 - e. Consolidation requirements for efficiency







Motivation for Code Consolidation – Legacy Issues

- Incompatible with non-LWRs
- Ownership issues
- Lack of standardized code development
- Lack of maintenance
- Dated science
- Lack of standardized quality assurances
- Functional redundancy/data transfer
- Inefficiency











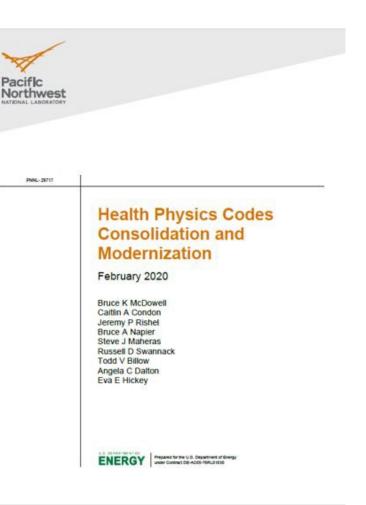
Thesis Statement for RAMP Code Modernization and Consolidation

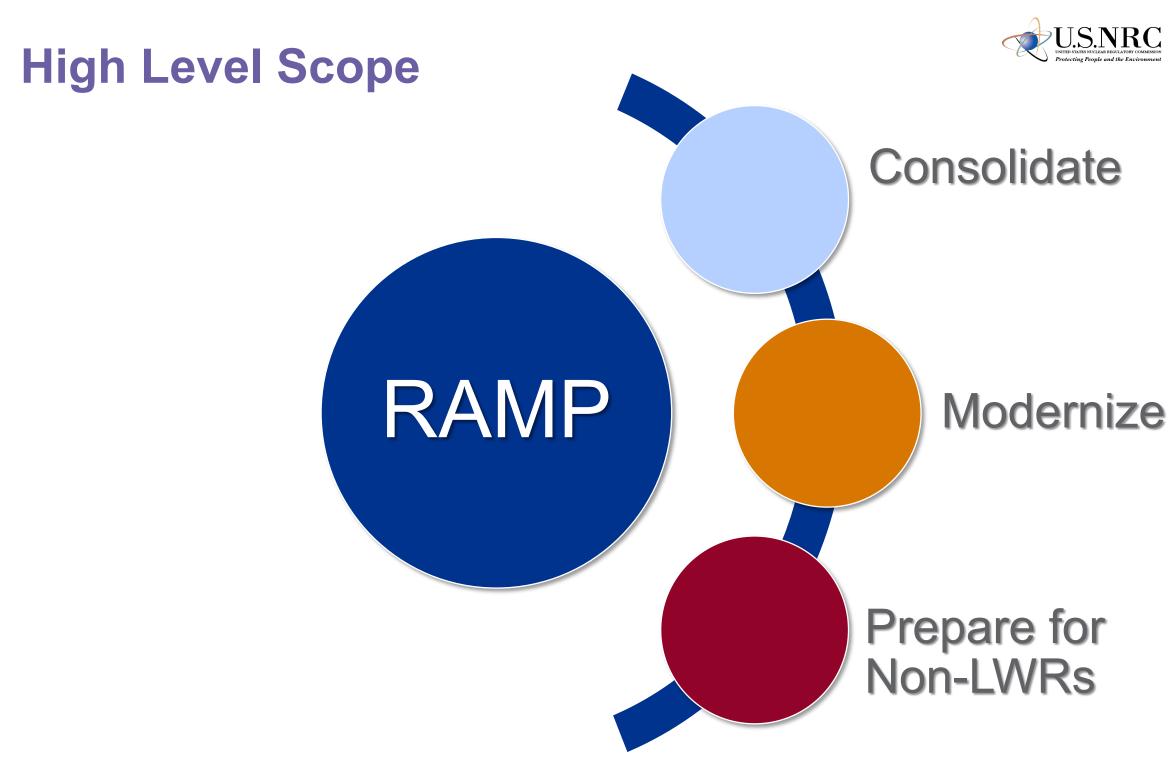
- The computer codes in the RAMP program have been developed since the 1970's to address specific regulatory needs.
- These codes today have numerous current and legacy issues that reduce the efficiency of operation and maintenance of the codes and increase cost. In their current state, these codes are also unable to fully assess radiological doses from advanced non-light water reactor designs.
- These current and legacy issues could be addressed by transforming the current suite of single-purpose radiation protection and dose assessment computer codes to a consolidated functional and modern suite of codes that is modular, flexible, efficient and user-friendly.







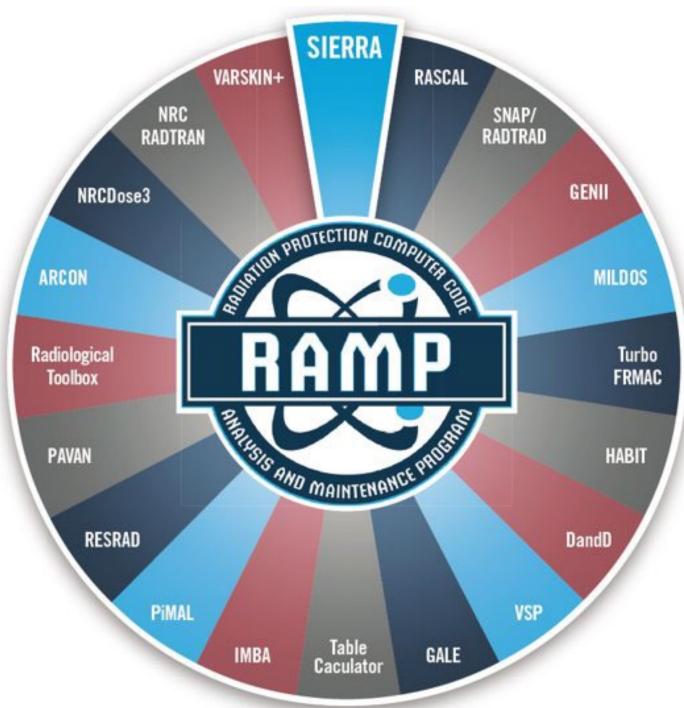


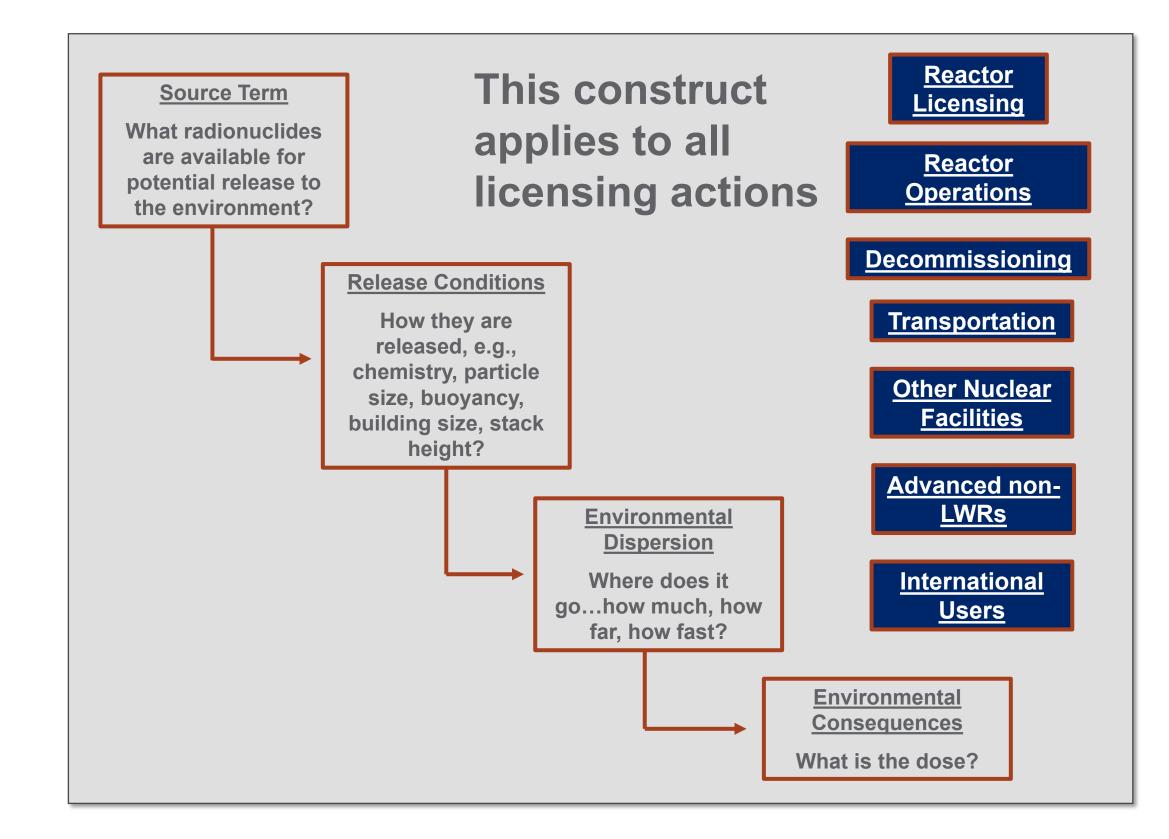












What are the Benefits of the Approach?





Accommodates anticipated needs for non-LWR Designs

- Modernizes code languages and user \checkmark experience
- Reduces number of codes to upgrade and \checkmark maintain
- Standardizes inputs and outputs \checkmark
- Flexible design for future expansion or \checkmark updates
- Addresses known problems \checkmark





Three Pillars of Code Consolidation

SIERRA Version: 0.2.0.0

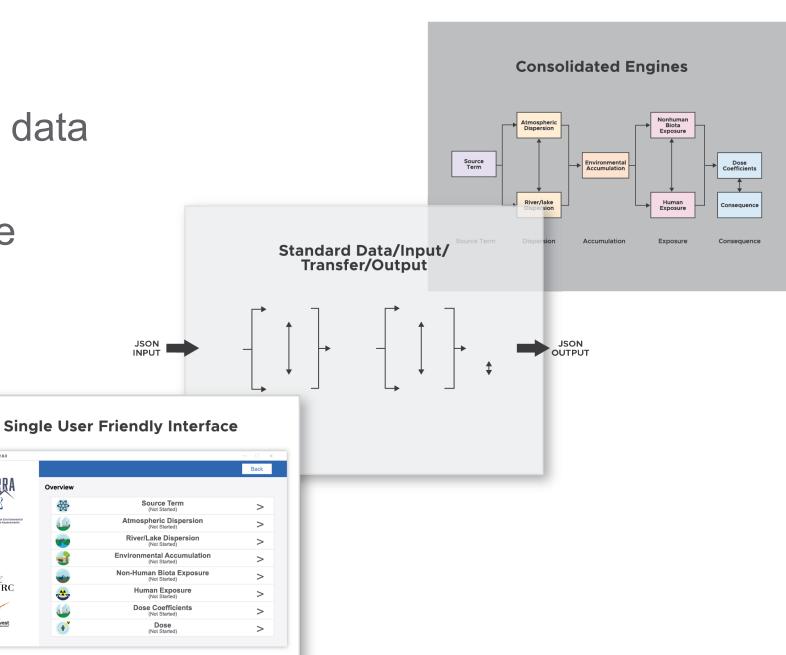
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Overview

- Created consolidated engines/modules
- Developed a standardized data transfer schema
- Built a single user interface



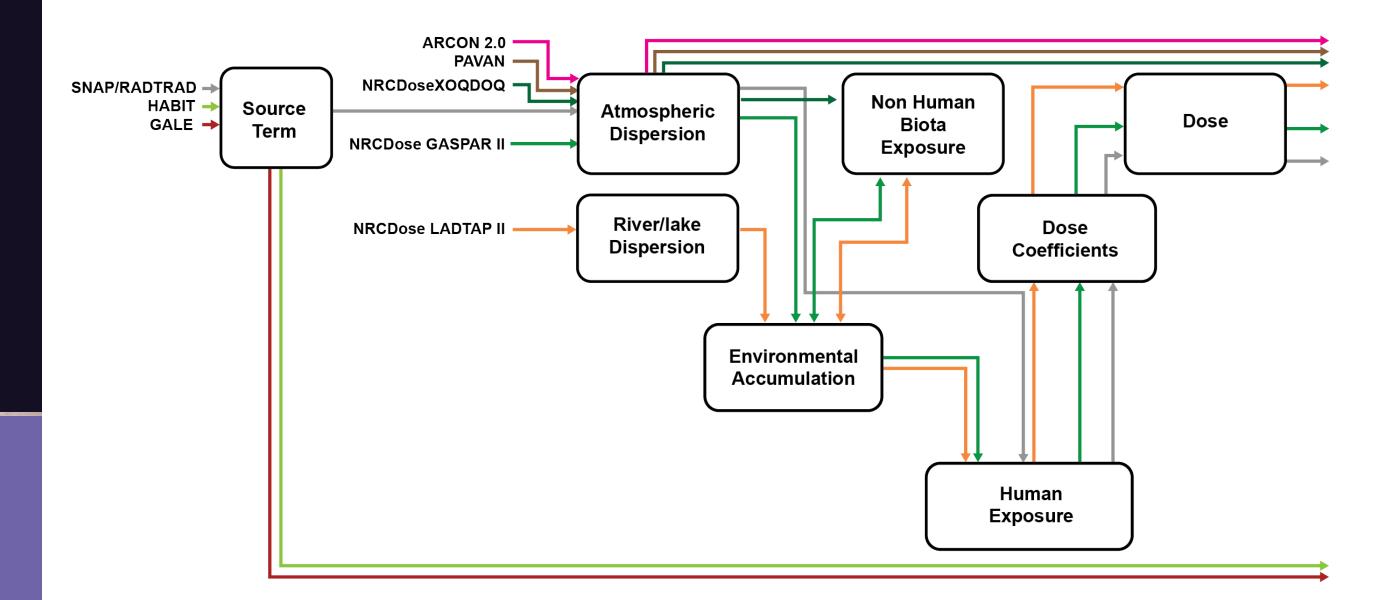






Code Consolidation and Modernization in Context





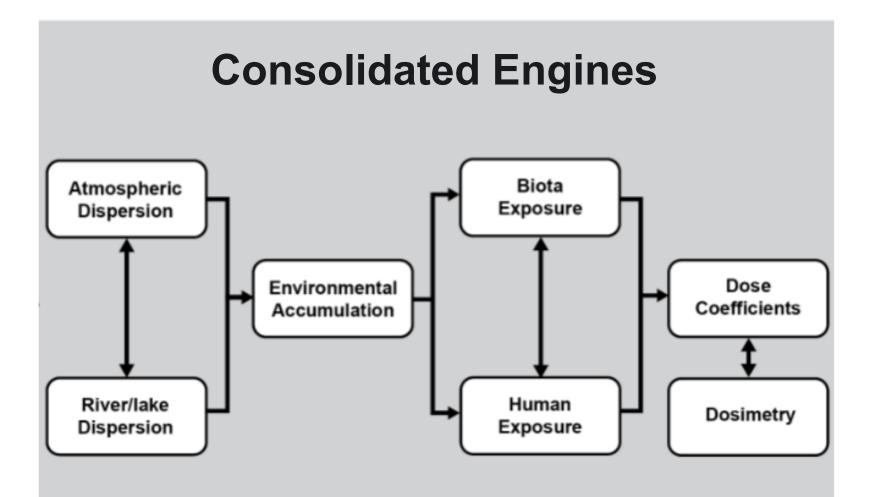






Proposed Functional Engines will consolidate code functions









Standardized Input/Transfer/Output will simplify data transfer



- A JSON schema for the RAMP suite of codes will be
 - Flexible
 - \checkmark Will allow additions of new variables yet unknown for advanced reactor designs
 - \checkmark Variable data will not need to appear in the data transfer file in a particle order, will only need to be in the JSON format and have the associated keyword to signal the code
 - Standardized
 - \checkmark All data transfer into the code, between functional engines, and out to the user will be in the same standard format
 - Modern
 - Widely used format \checkmark





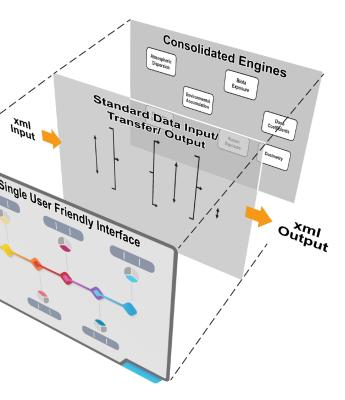
A Single Modern User Interface will improve the User Experience



- User interface will be completely separate from the functional engines
 - Updating or changing the user interface will not inadvertently affect the quality of the functional capabilities
 - ✓ Allows for the possibility of developing a webbased user experience or mobile application
- User interface will require updates and maintenance
 - ✓ Will only have one user interface to maintain



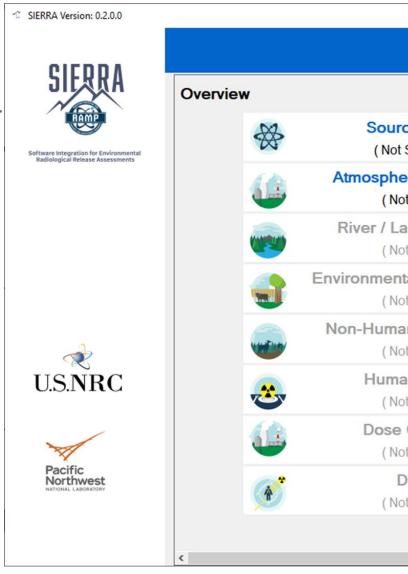




Code Consolidation and Modernization

Phased Release of SIERRA

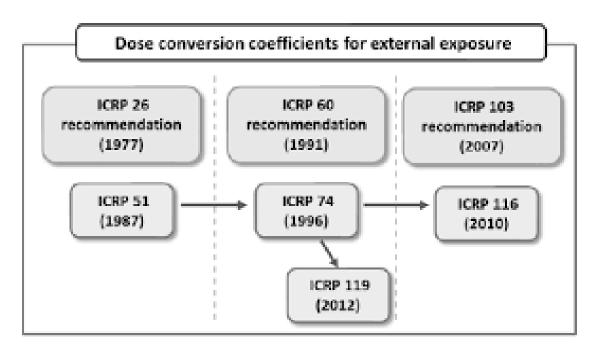
- Software under active development which aims to combine multiple RAMP codes into one easy to use package.
- Release of ATD Module of SIERRA at the end of September 2024.
- Currently have two efforts underway for SIERRA.
 - Atmospheric Dispersion Models (September 2024):
 - ARCON
 - PAVAN
 - XOQDOQ
 - Source Term:
 - GALE (Phase 1) August 2024
 - Advanced reactors (Phase 2) September 2025
 - Environmental Pathways (2026):
 - NRCDose3 (GASPAR & LADTAP)

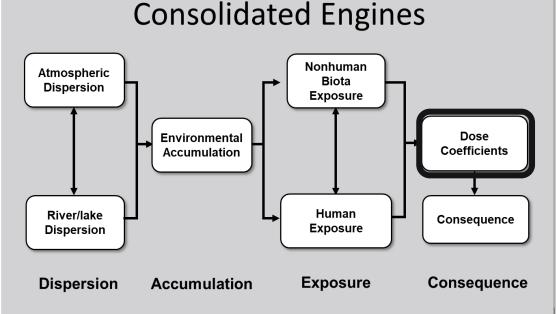


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Lake Dispersion Not Started)	>			
ental Accumulation Not Started)	>			
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man Exposure Not Started)	>			
e Coefficients Not Started)	>			
Dose Not Started)	>			

Update Dose Coefficient Values

- This task involves:
 - Developing dosimetry modules/engines that have the flexibility to use different dose models and dose coefficient values
 - Examining dose coefficient models with respect to aerosol particle size in addition to exploring the impact of tritium and carbon-14 biokinetics since these radionuclides may be in higher quantities in non-LWRs









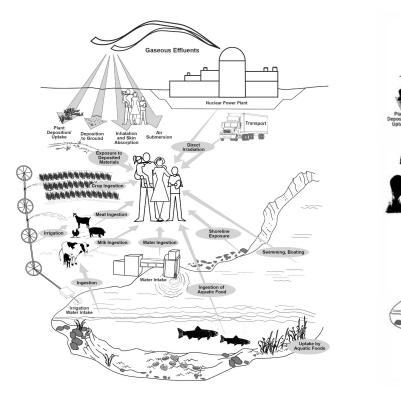






Develop Environmental Pathways Models

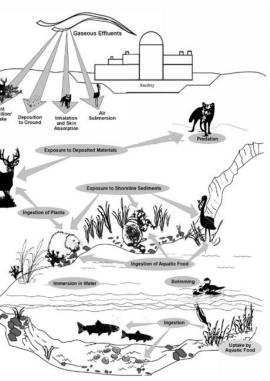
- Purpose:
 - Developing environmental transfer pathways and environmental accumulation
- Current Status:
 - Exploring transferring NRCDose Computer Code into SIERRA
 - Explore additional transfer model pathways for incorporation into SIERRA
 - Explore modeling H-3 and carbon-14 accumulation in the environment













H-3, C-14, and Special Models

High Level Schedule



Project Schedule ¹	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	
Code Consolidation Framework							
Source Term							
ATD Model							
Environmental Pathways ²							
Human & Biota Exposure ²							
Dose Coefficients ²							
Incorporate NRC Feedback							
QA and Verification							
JSON Data Transfer							
User Interface							
Documentation ³					·		
¹ These tasks generally alig	gn with 5 tasks described	l in ACRS Volume 4 briefi	ng.		Phase	a 1 Dovelopment	

+ prieting.

² This is the anticipated development schedule for the modules.

³Documentation–SQAP, Technical Basis Document, User Guide, Training Module.

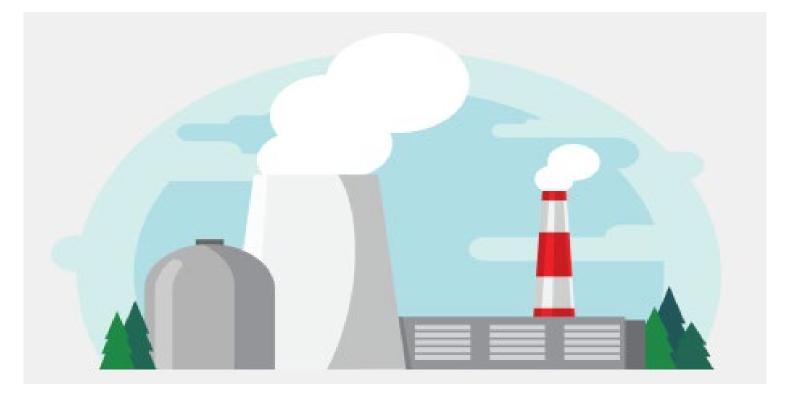
Phase 1 Development Phase 2 Development Continuous Development











SIERRA Atmospheric Transport and Diffusion (ATD) Engine





SIERRA Atmospheric Dispersion Software Development



- A new atmospheric dispersion module was developed (rather than directly using the legacy codes) for SIERRA for the following reasons:
 - To support a single user interface that allows users to access each of the codes (ARCON, PAVAN, XOQDOQ) in a relatively uniform manner
 - To facilitate future development to share data with other health physics codes in SIERRA
 - To allow users to estimate relative concentrations based on hourly meteorological data for all three codes, rather than use JFDs
 - To employ a more modern FORTRAN code development practice, which makes the code easier to maintain in the future







Legacy ATD Codes



Code	Description
ARCON	Used to calculate relative air concentrations (χ /Qs) in su of control room habitability assessments required by general design criteria (GDC) 19 of 10 CFR Part 50 App and RG 1.194.
PAVAN	Used to estimate relative ground-level air concentrations (χ/Qs) resulting from radioactive material releases from basis accidents at NPPs following the methodology in R
NRCDose/ XOQDOQ	Software suite that integrates the functionality of three individual Fortran codes: LADTAP II, GASPAR II, and XO which were developed by the NRC and have been in us NPP licensees and the NRC staff for assessments of liquid radioactive releases and offsite doses, gaseous radioactive effluents and offsite doses, and meteorologic transport and dispersion, respectively. XOQDOQ implent atmospheric dispersion modeling described in RG 1.111





support

pendix A

ns n design-RG 1.145.

XOQDOQ, ise by

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SIERRA ATD Analysis Types / Applicability



SIERRA Analysis Type	Legacy Model	NRC Guidance Document	Applicabilit
Control room habitability	ARCON	RG 1.194 SRP 2.3.4	Evaluate personnel exposures room during accidents
assessment		SRP 15.0.3	Protection against radiation in technical support center
Design basis accident analyses	PAVAN	RG 1.145	Offsite consequence at EAB a design
		SRP2.3.4	Offsite consequence at EAB a assessment
			Determine acceptable EAB an Offsite consequence at EAB a postulated accidents
Routine release analysis	NRCDose / XOQDOQ	RG 1.111	Annual dose assessment to e threshold limit during operation
		SRP 2.3.5	Annual dose assessment to n reasonably achievable (ALAR preliminary plant design





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and LPZ for safety

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ensure below ions meet as low as is RA) criterion during

PNNL Software Development – QA, Success Criteria



- Software QA Plan defines QA approach to provide adequate confidence that
 - Software development process is controlled
 - Software products meet established requirements
- User Interface Success Criteria
 - Invalid entries result in an error message or prevents simulations from running
 - Information displayed within each panel (e.g., meteorology, terrain) are correct
 - Saving / loading files functions correctly
 - When simulations are run, the appropriate output are saved to the appropriate locations
- Atmospheric Modules Success Criteria
 - Meteorology panel summary table in the UI aligns with atmospheric module output
 - The intended analysis is implemented by the code
 - Comparisons with the legacy code primarily fall within a factor of 2, with few cases up to a factor of 10.





PNNL Software Testing Approach



- Independent reviewers test the UI or atmospheric modules by following test cases identified in a Test Plan
- Any issues that were identified was reviewed / corrected by developers
 - New version(s) were tested by independent reviewers to check that the new functionality is appropriate
- User Interface
 - Testing involved setting up cases exclusively through the UI and by loading a JSON file and modifying variables; all cases were run until the outcomes were successful
- Atmospheric Modules
 - Testing involved both input through the UI and direct input to the ATD.exe software
 - Test cases were performed with 19 meteorological files from locations across the US
 - Modifications were made to ensure consistency with the legacy codes





Atmospheric Module Test Result Summary



- Comparisons with legacy codes
 - Statistics
 - Percentage of values within a Factor of 2 (F2) between the ATD and legacy codes
 - Percentage of values within a Factor of 5 (F5) between the ATD and legacy codes
 - Normalized Mean Bias (NMB) between the ATD and legacy codes
 - Outcomes
 - Most results were near the 1:1 line, within F2 and F5
 - Differences observed were unlikely to change conclusions for applications where these models are used
 - Differences attributed to
 - □ Meteorological inputs for PAVAN and XOQDOQ, data were JFD, rather than hourly
 - □ Treatment of calm winds prescribed wind direction based on wind speeds < 2 m/s in legacy, vs distributed in all sectors in ATD
 - □ Log interpolation for PAVAN
 - □ Calculation of percentiles for ARCON

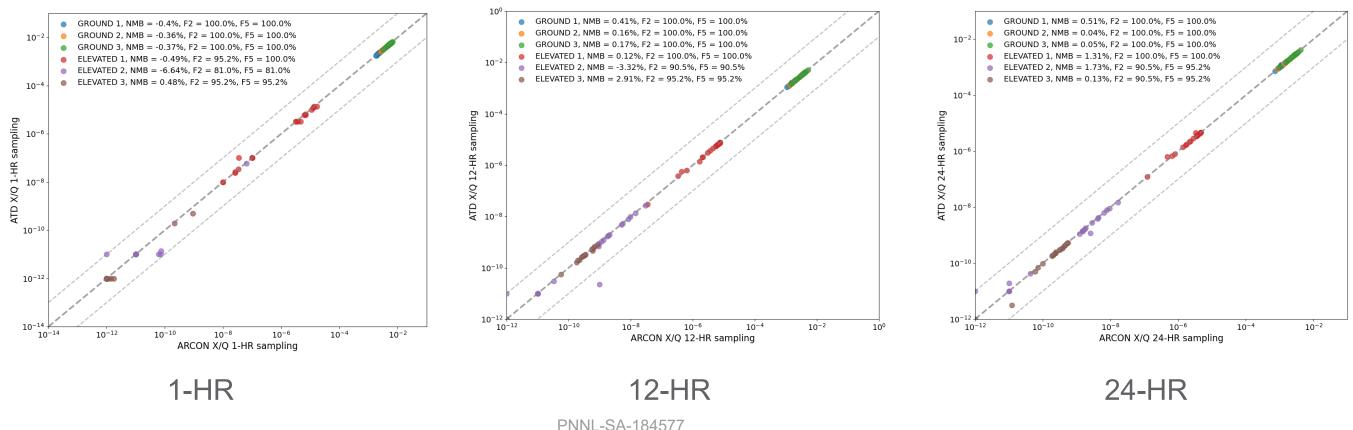




ATD Control Room Comparison with ARCON



- Tests varied direction to source, receptor distance, intake height, building area, vertical stack flow, stack radius
- 3 ground and 3 elevated cases
- Compiled results from all meteorological files



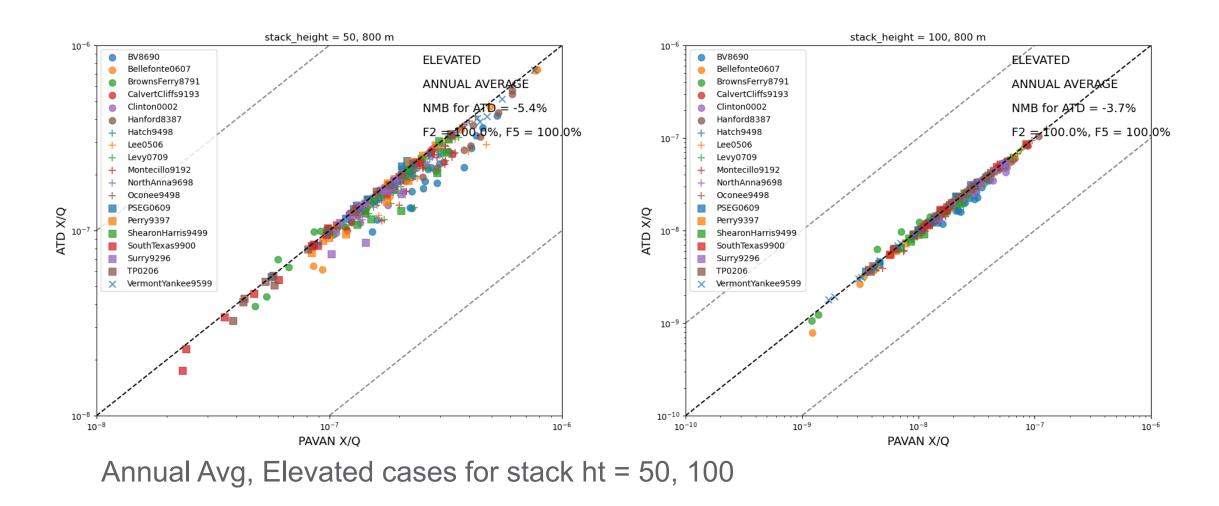




ATD Design Basis Accidents Comparison with PAVAN



- Varied stack diameter, stack flow, and stack height for Elevated cases
- Varied building area and building height for Ground cases



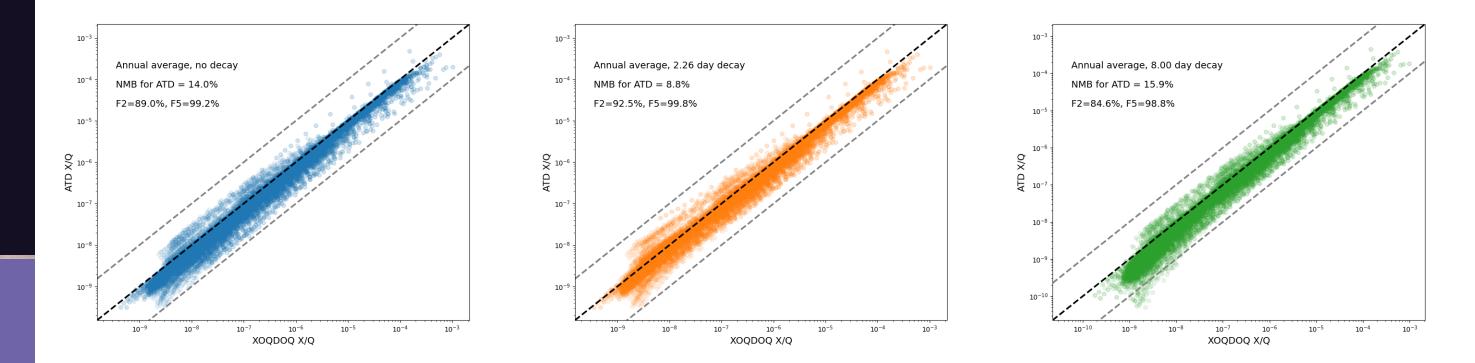




ATD Routine Analysis Comparison with NRCDose (XOQDOQ)



 8 scenarios based on combination of: Elevated vs Ground, With Terrain vs Without Terrain, for Recirculation vs No Recirculation



Results from Recirculation cases





SIERRA ATD UI Overview

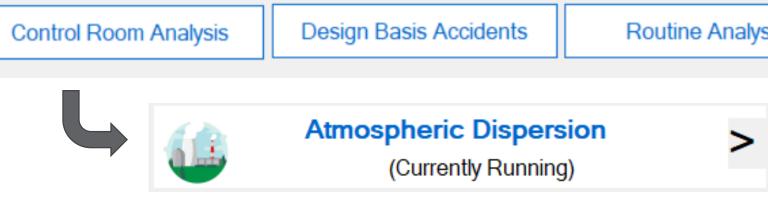




- Regulatory vs Research
- Analysis Types:
 - Control Room Analysis
 - Design Basis Accidents
 - Routine Analysis
- Module Selection:
 - Atmospheric Dispersion



What type of analysis would you like to perform?





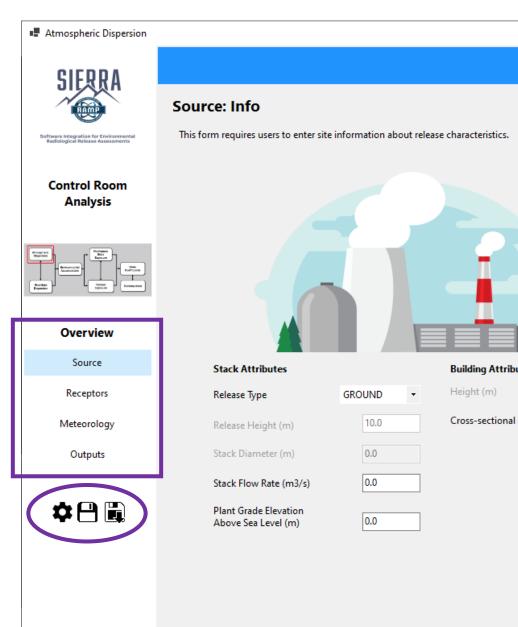


Routine Analysis

SIERRA ATD Control Room Analysis (I)



- The user interface layout is similar for each model
- Left bar navigation
 - Alternate navigation in lower right Next/Back
- Run Analysis in upper right
- Settings/Save/Load
- Source Panel
 - Input variables are available/unavailable depending on Release Type (Ground vs Elevated)







				X	
			Run Analysis		
utes	0.0				
area (m2)	0.0				
					1
		Ne	vt: Recentors		

SIERRA ATD Control Room Analysis (II)



- Basic information for receptors
 - Distance
 - Intake Height
 - Receptor Terrain Height
 - Direction to Source
- Wind Direction Window

Atmospheric Dispersion					
SIERRA					Run Analysis
	Receptors				
Software Integration for Environmental Radiological Release Assessments	Input the receptor(s) where X/Q entered.	should be calculated. Terrain c	lata specific to the site can	also be	
Control Room	Receptor Attributes		Direction to Sour	ce	
Analysis	Receptor Distance (m)	0 (m)	N _{src}		
Receiver Build	Intake Height	0.0 (m)	w	E	
Britan III Branchin Eugender	Terrain Height of Receptor	0.0 (m)			
	Wind Direction Window	90.0 (degrees)	S		
Overview			1	▲ ▼	
Source					
Receptors					
Meteorology					
Outputs					
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				Back	Next: Meteorolog





SIERRA ATD Control Room Analysis (III)

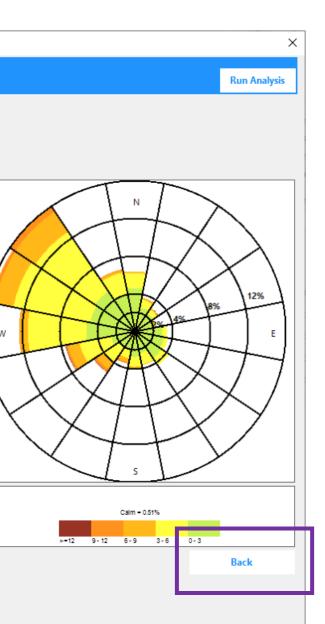


- Select an existing meteorological data file in RG 1.23 format (hourly data)
- Prescribe wind speed calm threshold (0-1 m/s) to be used within the simulation
- Height Type (lower or upper) for polar plot display
- Surface Roughness for site
- Statistical summary of the meteorological data (depends on Height Type and wind speed calm threshold)

RAMP	Meteorology		
Roftware Internation for Environmental	Meteorological File		
Software Integration for Environmental Radiological Release Assessments	Upload a meteorlogical file and provide threshold volume for calm wind speed		
Control Room	C:\SIERRA\Test_Cases_ATD\MET_8387.nr	c Browse	
Analysis			
	Wind Speed Calm Threshold	0.1 (1	m/s)
Reverse Bat	Height Type	Lower 🝷	
Rentation Depender	Surface Roughness Length	0.2 (1	m)
	Total No. of Hours	43824	
Overview	Average Wind Speed	3.34 m/s	
	Min Wind Speed	0.40 m/s	
Source	Max Wind Speed	15.60 m/s	
	Calm Records	221	
Receptors	Calm Wind Speed Frequency	0.5%	
	Data Availability	99.8%	
Meteorology	Incomplete / Missing Records	69	
.			
Outputs			
�₽₪			







SIERRA ATD Control Room Analysis (IV)

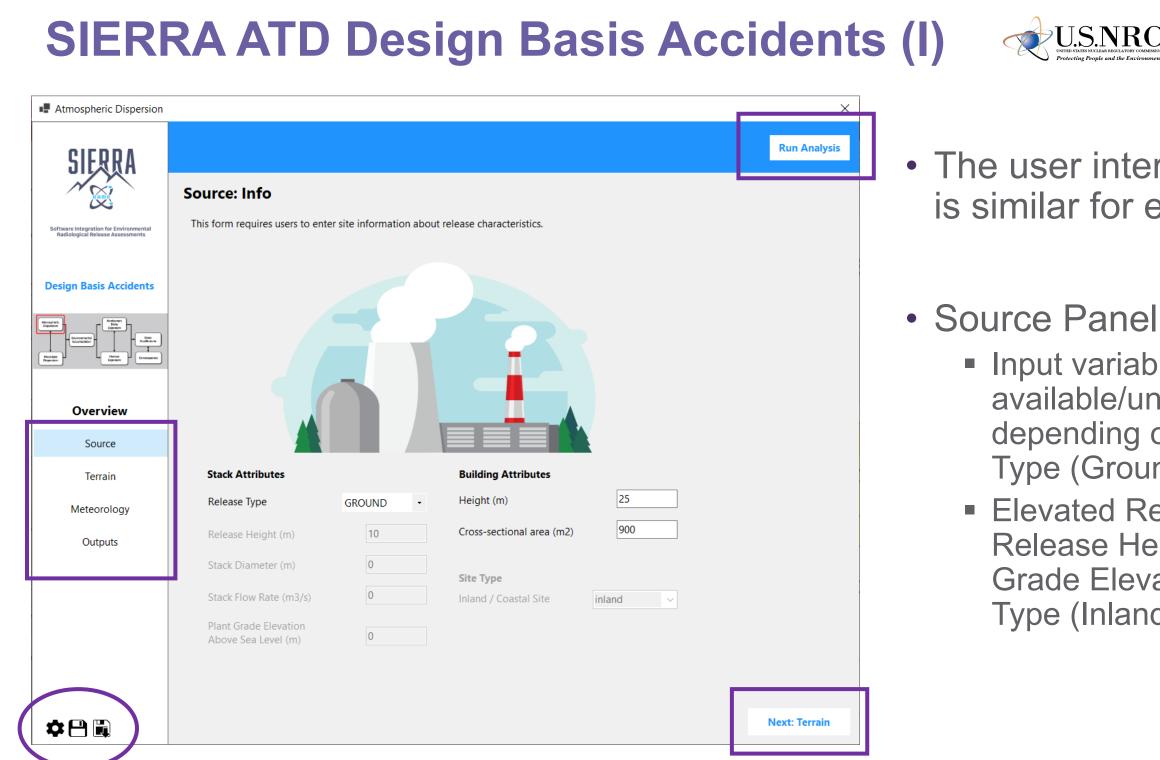


- When the "Run Analysis" button is selected, a command line window is briefly displayed, and then the UI automatically displays the Outputs Panel
- A summary of the output is presented in tabular form
- The model output files (in text format) can also be viewed from the interface
- Output files are also available from C:\SIERRA\Users\Username\Simul ationCaseName\DateTime\outputs

RAMP	Outputs				Mode	l Output	Files					
Software Integration for Environmental Radiological Release Assessments	View Output File (.OUT)		View F	Frequency Fi (.CFD)	ile		/ Hourly (.PLT)	V	/iew Error File (.ERR)	2		
Control Room												
Analysis	Summary Data b	y Averagir	ng Interval									
	AVG. Period (Hour	s)	1-HR	2-HR	4-HR	8-HR	12-HR	24-HR	96-HR	168-HR	360-HR	720-HF
	95th Percentile X/0		4.95E-002	4.08E-002	3.51E-002	2.98E-002	2.35E-002	1.72E-002	1.17E-002	1.03E-002	9.13E-003	8.02E-00
	99.5th Percentile X	VQ Values	7.23E-002	6.83E-002	6.28E-002	5.59E-002	4.56E-002	3.30E-002	1.77E-002	1.47E-002	1.26E-002	1.08E-00
	Summary Data b	y Standar	d Time Inte	rval								
Overview	Standard Interval	95% X/Q	99.5% X/0	2								
	0 to 2 hours	4.95E-002	7.23E-002	2								
Source	2 to 8 hours	2.32E-002	5.04E-002	2								
	8 to 24 hours		2.15E-002									
Receptors	1 to 4 days	9.94E-003	1.26E-002	2								
Meteorology												
Outputs												
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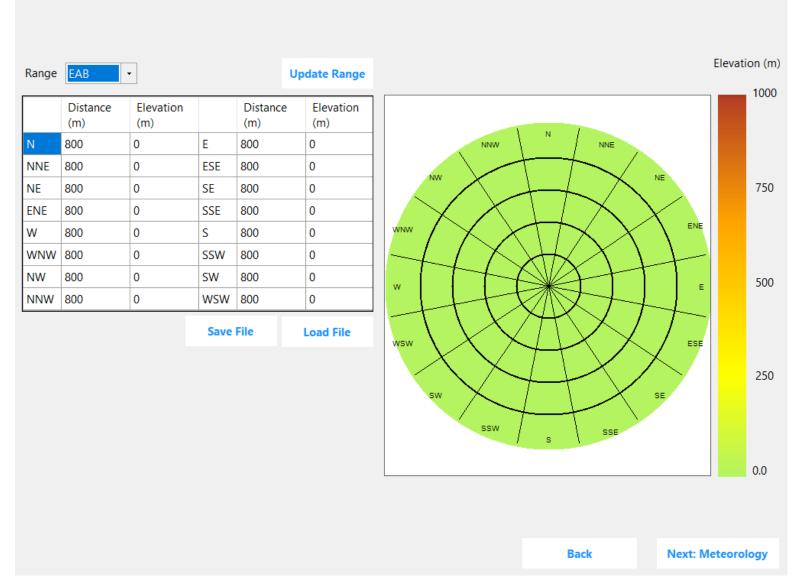


• The user interface layout is similar for each model

Input variables are available/unavailable depending on Release Type (Ground vs Elevated) Elevated Release activates Release Height, Plant Grade Elevation, and Site Type (Inland / Coastal)



SIERRA ATD Design Basis Accidents (II)



Terrain

- EAB and LPZ distance and elevation entries
- Users can save the terrain File" button)







entries for use (by using the "Save File" button) in another simulation (by using the "Load

SIERRA ATD Design Basis Accidents (III)



Meteorological File

Upload a meteorlogical file and provide information on minimum threshold volume for calm wind speed and surface roughness.

Browse

0.1

Lower -

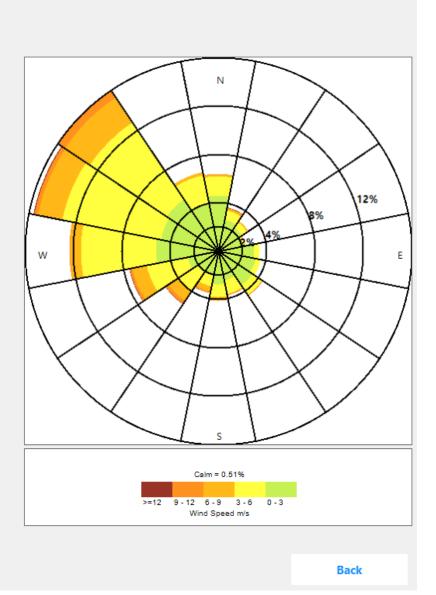
(m/s)

Wind Speed Calm Threshold

C:/SIERRA/Test Cases ATD/MET 8387.nr

Height Type

Total No. of Hours	43824
Average Wind Speed	3.34 m/s
Min Wind Speed	0.40 m/s
Max Wind Speed	15.60 m/s
Calm Records	221
Calm Wind Speed Frequency	0.5%
Data Availability	99.8%
Incomplete / Missing Records	69



- Users select an existing in RG 1.23 format (hourly data)
- used within the simulation
- Users select Height Type (lower or upper) to change polar plot display
- Statistical summary of the meteorological data also wind speed calm threshold





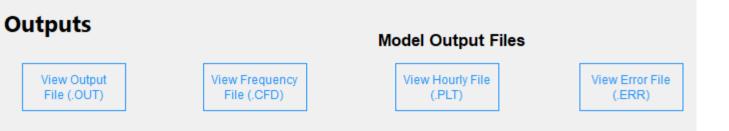


meteorological data file that is

• Users define the wind speed calm threshold (0-1 m/s) to be

changes with Height Type and

SIERRA ATD Design Basis Accidents (IV)



Summary Data by Averaging Interval

Avg. Period	Statistic	Max Sector EAB	Max Sector LPZ	Overall Site EAB	Overall Site LPZ
0-2 Hr Avg. X/Qs	0.5	9.17E-004	1.76E-004	7.24E-004	1.84E-004
0-2 Hr Avg. X/Qs	5	8.39E-005	2.01E-005	2.59E-004	6.63E-005
0-2 Hr Avg. X/Qs	50	1.00E-006	1.00E-006	6.43E-005	1.15E-005
0-8 Hr Avg. X/Qs	0.5	3.83E-004	8.51E-005	5.48E-004	1.36E-004
0-8 Hr Avg. X/Qs	5	5.49E-005	1.36E-005	2.36E-004	6.16E-005
0-8 Hr Avg. X/Qs	50	1.00E-006	1.00E-006	6.82E-005	1.36E-005
8-24 Hr Avg. X/Qs	0.5	2.62E-004	4.99E-005	4.11E-004	8.07E-005
8-24 Hr Avg. X/Qs	5	4.73E-005	8.79E-006	1.94E-004	4.00E-005
8-24 Hr Avg. X/Qs	50	6.15E-006	1.00E-006	5.91E-005	1.03E-005
1-4 Day Avg. X/Qs	0.5	1.35E-004	1.94E-005	2.64E-004	3.79E-005
1-4 Day Avg. X/Qs	5	4.89E-005	6.73E-006	1.58E-004	2.29E-005
1-4 Day Avg. X/Qs	50	6.87E-006	1.00E-006	5.19E-005	7.60E-006
4-30 Day Avg. X/Qs	0.5	7.48E-005	9.02E-006	1.93E-004	2.33E-005
4-30 Day Avg. X/Qs	5	4.16E-005	5.12E-006	1.38E-004	1.79E-005
4-30 Day Avg. X/Qs	50	6.92E-006	1.00E-006	5.07E-005	6.77E-006
Annual Avg. X/Qs		9.21E-006	1.14E-006	6.28E-005	8.12E-006

- When the "Run Analysis" button is selected, a command line window is briefly displayed, and then the UI automatically displays the **Outputs Panel**
- A summary of the output is presented in tabular form
- The model output files (in text format) can also be viewed from the interface
- Output files are also available from CaseName\DateTime\outputs



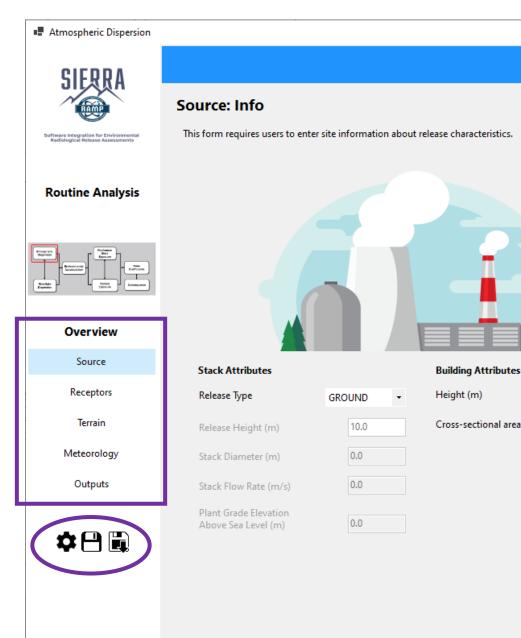




C:\SIERRA\Users\Username\Simulation

SIERRA ATD Routine Analysis (I)

- The user interface layout is similar for each model
- Source Panel
 - Input variables are available/unavailable depending on Release Type (Ground vs Elevated)











					X	
				Run Analysi		
(m2)	0.0					
		ſ	Nex	ct: Receptors		1

SIERRA ATD Routine Analysis (II)



• Add – used to create a new Receptor entry in the table

	Receptor Attrib	utes		
Label		Туре		~
Sector	•	Distance (r	n)	
			Cancel	Ok

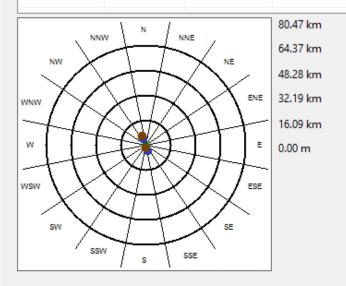
 Receptor Type is either a pre-defined type (milk cow, milk goat, meat animal, residence, vegetable garden, site boundary) or user entry

Receptors

Input the receptor(s) where X/Q should be calculated. Terrain data specific to the site can also entered.

Discrete Receptors

Receptor Label	Receptor Type	Receptor Sector	Receptor Distance (m)	Icon Color
receptor #0	site boundary	S	805	
receptor #1	site boundary	S	966	
receptor #2	site boundary	S	1127	
receptor #3	milk cow	S	1931	
receptor #4	milk cow	NNW	4989	
receptor #5	milk cow	SSE	4345	
receptor #6	residence	S	1931	
receptor #7	residence	NNW	6437	







be	
	Add
	Delete
	Load File
	Save

Back

Next: Terrain

SIERRA ATD Routine Analysis (III)

- Distance and elevation entries for Range 0 through Range 10
- Users can save the terrain entries alone (by using the "Save File" button) for use in another simulation (by using the "Load File" button)

Terrain

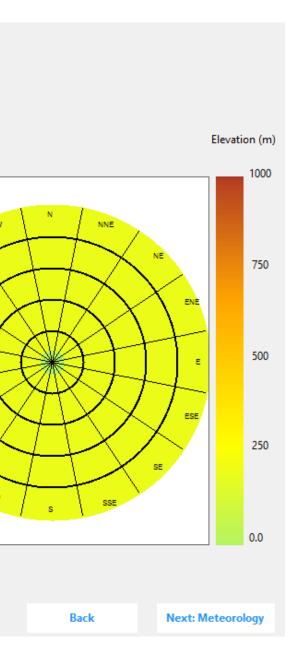
Range	0		•			Update	e Range
		Distance (m)	Elevation (m)		Distance (m)	Elevation (m)	
N		100	0	E	100	0	
NNE		100	0	ESE	100	0	
NE		100	0	SE	100	0	
ENE		100	0	SSE	100	0	www
W		100	0	s	100	0	
WNW		100	0	SSW	100	0	w
NW		100	0	SW	100	0	
NNW		100	0	wsw	100	0	wsw
							· `
				Save Fi		oad File	











SIERRA ATD Routine Analysis (IV)



- Users select an existing meteorological data file that is in RG 1.23 format (hourly data)
- Users define the wind speed calm threshold (0-1 m/s) to be used within the simulation
- Users select Height Type
 (lower or upper) to change
 polar plot display
- Statistical summary of the meteorological data also changes with Height Type and wind speed calm threshold

Meteorology

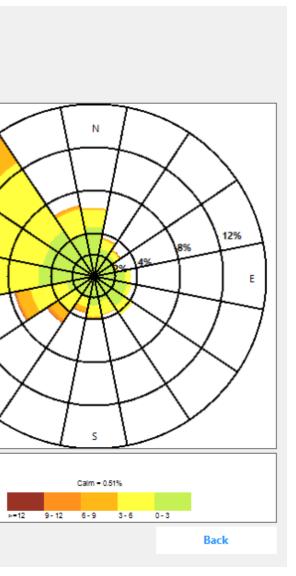
Meteorological File

Upload a meteorlogical file and provide information on minimum threshold volume for calm wind speed and surface roughness.

Wind Speed Calm Threshold	0.1	(m/s)	
Height Type	Lower -		
Total No. of Hours	43824		
Average Wind Speed	3.34 m/s		w (
Min Wind Speed	0.40 m/s		L
Max Wind Speed	15.60 m/s		' I
Calm Records	221		
Calm Wind Speed Frequency	0.5%		
Data Augustability	99.8%		
Data Availability			







SIERRA ATD Routine Analysis (V)

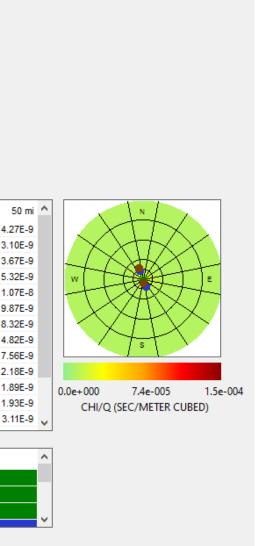
- When the "Run Analysis" button is selected, a command line window is briefly displayed, and then the UI automatically displays the Outputs Panel
- A summary of the output is presented in tabular form
- The model output files (in text format) can also be viewed from the interface
- Output files are also available from C:\SIERRA\Users\Username\Simulatio nCaseName\DateTime\outputs

	ew Output ile (.OUT)			ew Hour le (.PLT		Mc		Outp w Error (.ERR)	File	Files		
	AY, UND	EPLETED						-				
_												
Sector	1 mi	2 mi	3 mi	4 n	ni 5 mi	[1	10 mi	20	mi	30 mi	40 mi	
N	7.59E-6	1.57E-6	4.57E-7	2.26E-	7 1.39E-7	6.0	8E-8	2.12E	-8	1.02E-8	6.32E-9	4.
NNE	5.46E-6	1.13E-6	3.30E-7	1.63E-	7 1.01E-7	4.4	1E-8	1.54E	-8	7.47E-9	4.60E-9	3.
NE	6.56E-6	1.36E-6	3.96E-7	1.97E-	7 1.21E-7	5.3	1E-8	1.86E	-8	8.96E-9	5.49E-9	3.
ENE	9.12E-6	1.89E-6	5.52E-7	2.74E-	7 1.69E-7	7.4	3E-8	2.62E	-8	1.27E-8	7.85E-9	5.
E	1.76E-5	3.66E-6	1.07E-6	5.33E-	7 3.29E-7	1.4	5E-7	5.15E	-8	2.51E-8	1.57E-8	1.
ESE	1.77E-5	3.69E-6	1.08E-6	5.34E-	7 3.29E-7	1.4	4E-7	5.10E	-8	2.45E-8	1.50E-8	9.
SE	1.58E-5	3.27E-6	9.48E-7	4.69E-	7 2.88E-7	1.2	6E-7	4.41E	-8	2.11E-8	1.26E-8	8.
SSE	8.88E-6	1.83E-6	5.29E-7	2.61E-	7 1.60E-7	6.9	7E-8	2.41E	-8	1.16E-8	7.24E-9	4.
S	2.09E-5	4.29E-6	1.22E-6	5.92E-	7 3.58E-7	1.5	1E-7	4.82E	-8	2.11E-8	1.21E-8	7.
SSW	4.72E-6	9.63E-7	2.74E-7	1.33E-	7 8.11E-8	3.4	7E-8	1.17E	-8	5.47E-9	3.38E-9	2.
SW	4.12E-6	8.40E-7	2.38E-7	1.16E-	7 7.01E-8	2.9	9E-8	9.97E	-9	4.64E-9	2.90E-9	1.
WSW	4.01E-6	8.20E-7	2.34E-7	1.14E-	7 6.95E-8	2.9	8E-8	1.00E	-8	4.72E-9	2.92E-9	1.
W	6.19E-6	1.27E-6	3.63E-7	1.78E-	7 1.09E-7	4.6	7E-8	1.59E	-8	7.53E-9	4.66E-9	3.
Locatio	n Type	Sector	Distanc	e (Mi)	Distance (I	M)	Value	2	Co	lor		
site bou	undary	S	0.50		805.00		4.278	-005				
site bou	undary	S	0.60		966.00		3.10E	-005				
site bou	undary	S	0.70		1127.00		2.368	-005				
- 10		· ·	1.00		1021.00	_	<	000				



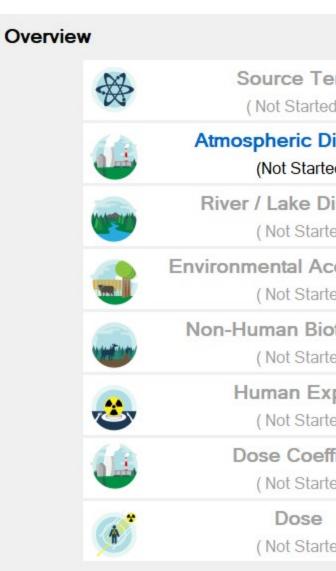






Next Steps

- ATD Beta testing is underway
- Software improvements as an outcome of beta testing will be implemented in CY24
- SIERRA ATD projected to be available from RAMP in winter 2024









erm ed)	>
Dispersion ed)	>
Dispersion ted)	>
ccumulation ted)	>
ota Exposure ted)	>
kposure ted)	>
fficients ted)	>
ted)	>



GALE

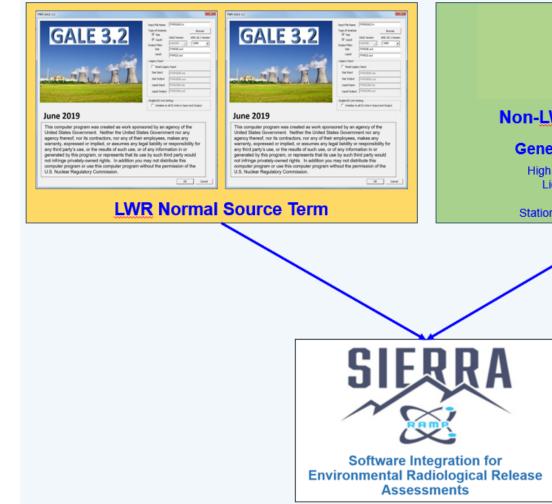
- Gaseous and Liquid Effluents (GALE) → calculate radioactive gaseous and liquid effluents from LWRs
- Calculations based on:
 - Operating Reactors,
 - Field and Lab Tests, and
 - Plant specific design considerations
- Latest live version 3.2 released 2020:
 - Two separate executables for BWRs and PWRs





GALE (cont.)

- Three phase development approach:
 - Phase 1: Incorporate GALE LWR source terms
 - Phase 2: Develop generic non-LWR source terms
 - Phase 3: non-LWR design basis, severe accidents, and transportation source terms



Non-LWR Normal Source Term

Generic Normal Source Terms

High Temperature gas-cooled reactors Liquid metal-cooled fast reactors Molten salt reactors Stationary and transportable microreactor

Source Term Module: Phase 1

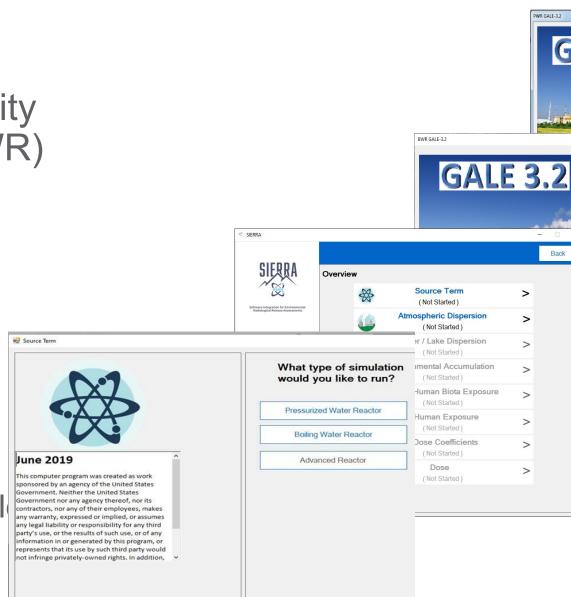


- Provides Source Term data from Light Water Reactors (LWRs):
 - Boiling Water Reactors (BWRs)
 - Pressurized Water Reactors (PWRs)
- From reactor inputs pertaining to normal operational fluxes and processing values, two outputs files are created outlining the gaseous and liquid effluents for any given scenario
- Based intrinsically on the prior functionality of GALE 3.2





- Phase I Input GALE code into SIERRA:
 - Incorporating functionality of GALE (BWR and PWR) into the source term module
 - Status of GALE incorporation into SIERRA:
 - ✓ Release Assessments (SIERRA) code with source term module (Phase-1) to be available in August 2024



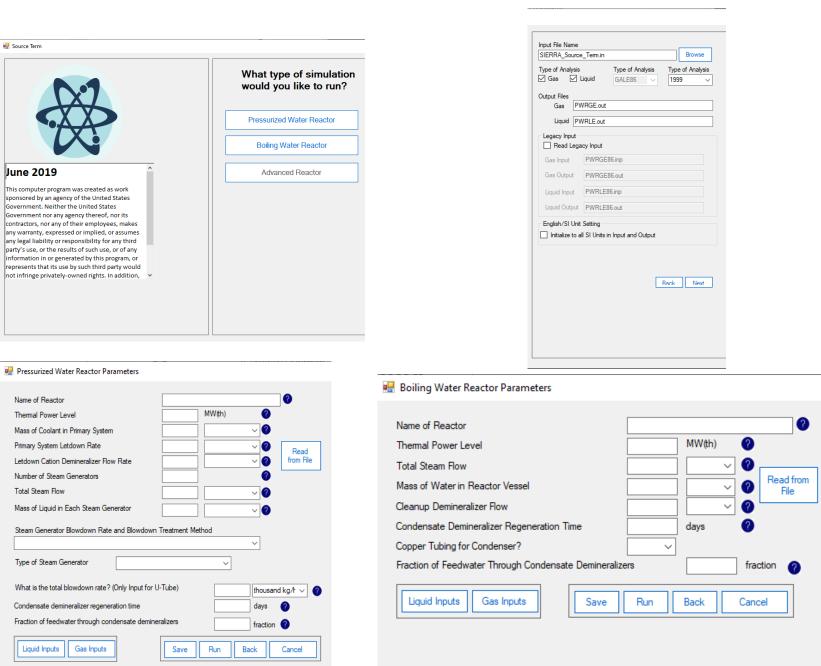






LE	3.2	Input File Name Type of Analysis Gas Cutput Files: Gas Liquid Liquid	GALE Version GALESS PWRGE.out PWRLE.out	Browse ANS-18, 1 Versio 1999
	AA	Cas Cutput Gas Cutput Liquid Input X	PWRGE86.inp PWRGE86.out PWRLE86.inp	
Input File Name Type of Analysis Gas Gas Output Files:	GALE86 ¥ 1999 V		etting all SI Units in Input	t and Output
Gas Liquid Legacy Input Read Lega Gas Input Gas Output	BWRGE.out BWRLE.out SWINDE BWRGE86.inp BWRGE86.out	ored by an a es Governm employees, al liability or f any inform e by such th	ment nor any makes any responsibi nation in or nird party we	y ility for
Liquid Input Liquid Output English/SI Unit S	BWRLE86.inp BWRLE86.out Setting all SI Units in Input and Output	nay not dist thout the pe		the Cancel
tes Govern employees gal liability of any infor se by such may not di	agency of the iment nor any , makes any or responsibility for rmation in or third party would stribute this permission of the			

- UI designed to match **SIERRA-ATD** module within the broader SIERRA framework
- Real-time checks of input values
- Single executable file as opposed to GALE
- Enhanced range buttons on the UI









SIERRA_Source	e_Term.in		Bro	wse
Type of Analysis ☑ Gas ☑ Liquid		Type of Analysis GALE86 🗸	Type of Ar 1999	nalysis ~
Output Files Gas PV	VRGE.out	t		
Liquid PV	VRLE.out			
Legacy Input	icy Input			
Gas Input	PWRG	E86.inp		
Gas Output	PWRG	E86.out		
Liquid Input	PWRLE	E86.inp		
Liquid Output	PWRLE	E86.out		
English/SI Unit	Setting			
Initialize to a	II SI Units	in Input and Output		

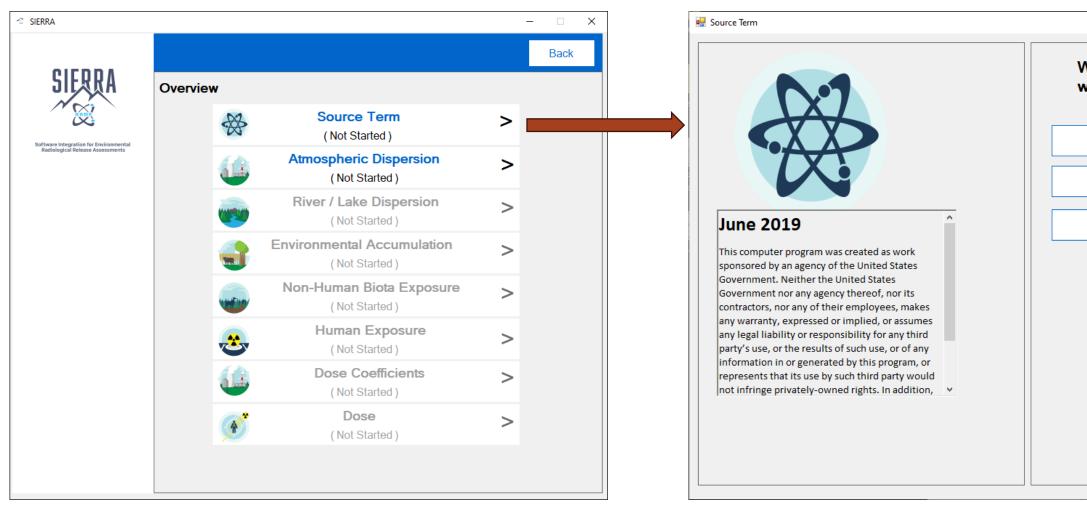


- Coding changes implemented for compatibility in C# language
- File structure changed on back-end to match SIERRA format
- The GUI and the FORTRAN based back-end decouple for ease of future development activities
- Input files can be present outside SIERRA executable directory as opposed to the existing GALE format









Source Term Startup Screen

SIERRA Splash Screen





× What type of simulation would you like to run? Pressurized Water Reactor **Boiling Water Reactor** Advanced Reactor

Source Term Module Additional **Changes and Fixes**



- Source Term Module Testing:
 - Graphical User Interface (GUI) testing Complete
 - Numerical value testing Ongoing
- Bug fixes anticipated to be completed first week of May 2024
- User Acceptance Testing (UAT) starting: June 2024
- Feedback, NRC Reviews: June July 2024
- Update/ Revise documentation: June July 2024
- Final product delivery: August 2024

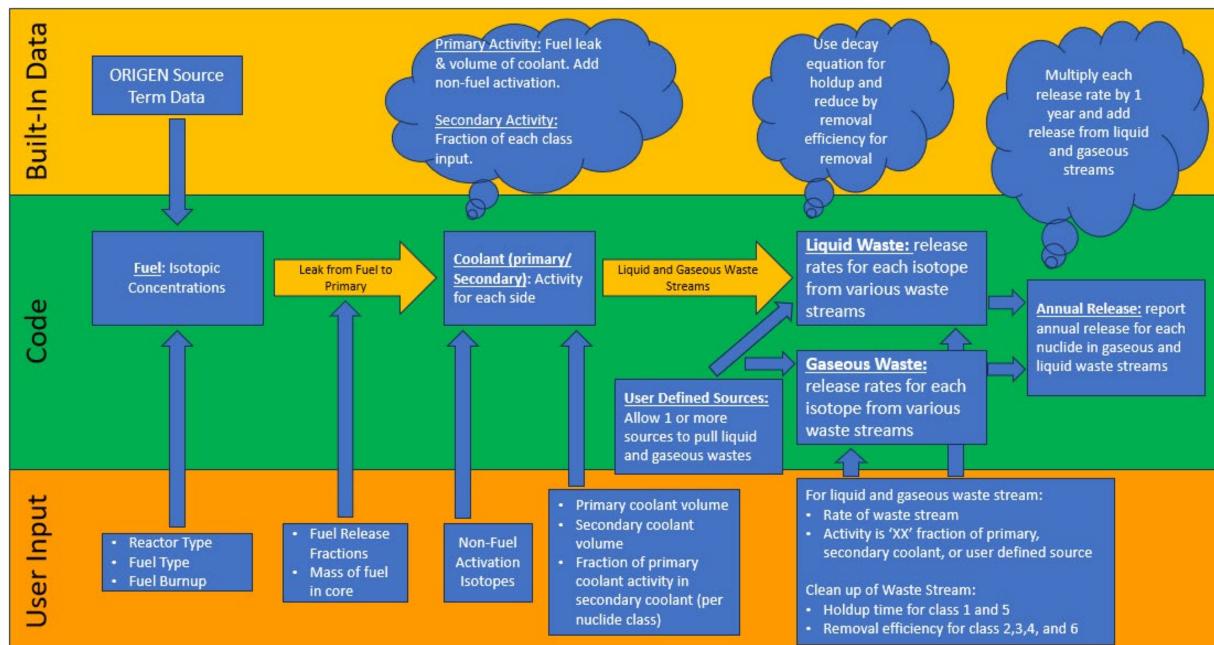




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Phase 2 Concept









Advanced Reactor Concepts of Interest

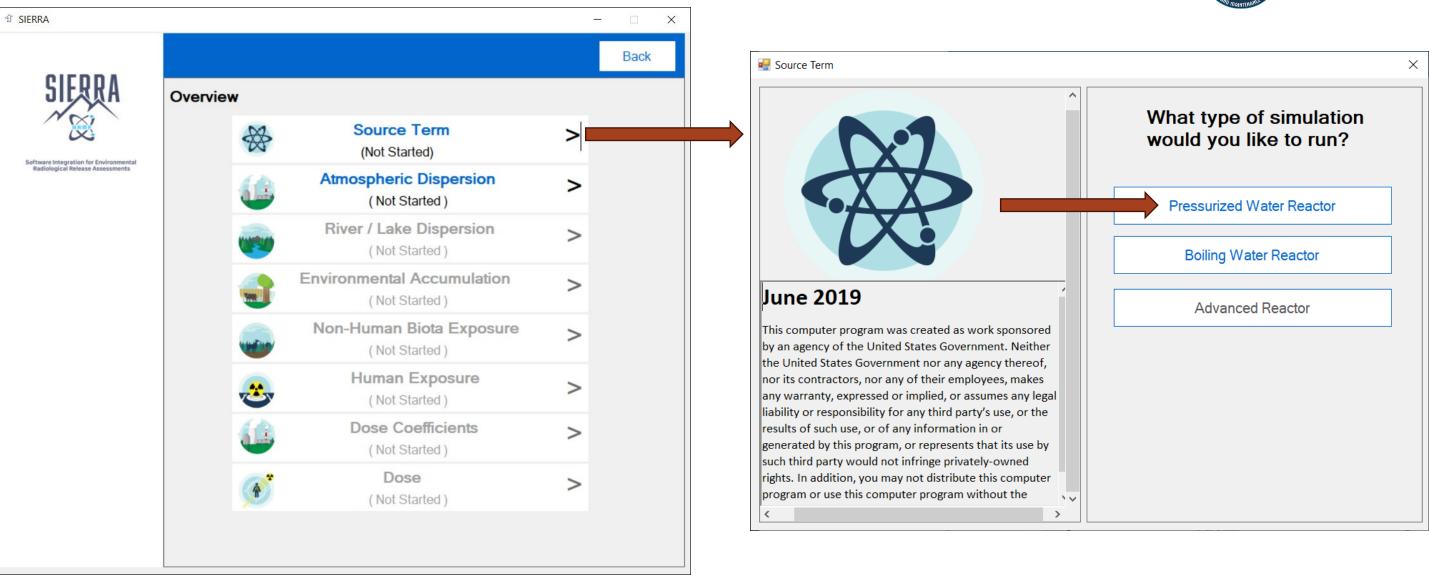


- High Temperature Gas Cooled Reactors
- Liquid metal-cooled fast reactors
- Molten Salt Reactors
- Stationary or transportable microreactors















🛃 Source Term General Inputs

SI Ty ☑ 0 June 2019 This computer program was created as work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor its contractors, nor any of their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for any third party's use, or the results of such use, or of any information in or generated by this program, or represents that its use by such third party would not infringe privately-owned rights. In addition, you may not distribute this computer program or use this computer program without the NU < >

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Input File Name		
SIERRA_Source_Term_PW	RExample.in	Browse
Type of Analysis ☑ Gas ☑ Liquid	Type of AnalysisGALE86	Type of Analysis
Output Files Gas PWRExample	GE.out	
Liquid PWRExample	LE.out	
English/SI Unit Setting	SI Units	







Next

Back



骎 Pressurized Water Reactor F	Parameters					2
	Name of Reactor					2
	Thermal Power Level		N	/W(th)	?	-
	Mass of Coolant in Primary System		t	thousand kg	?	
	Primary System Letdown Rate		I	liters/min	?	Read from
	Letdown Cation Demineralizer Flow	Rate	I	liters/min	?	File
	Number of Steam Generators				?	
	Total Steam Flow		r	million kg/hr	?	
	Mass of Liquid in Each Steam Gene	rator	t	thousand kg	?	
	Steam Generator Blowdown Rate a	nd Blowdown Trea	atment Metho	d	~	
	Type of Steam Generator			\times		
	What is the total blowdown rate? (O	nly Input for U-Tu	ıbe)		thousand	l kg/hr
	Condensate demineralizer regenera	ition time			days	?
	Fraction of feedwater through conde	ensate demineraliz	zers		fraction	?
	Liquid Inputs Gas Inputs		Save	Run Ba	ack	Cancel











🛃 Pressurized Water Reactor P	Parameters					\times
	Name of Reactor	[?
	Thermal Power Level	[MW(th)	?	
	Mass of Coolant in Primary System	[thousand kg	2	
	Primary System Letdown Rate	[liters/min	2	Read from
	Letdown Cation Demineralizer Flow	Rate		liters/min	?	File
	Number of Steam Generators				2	
	Total Steam Flow	[million kg/hr	0	
	Mass of Liquid in Each Steam Gene	erator		thousand kg	2	
	Steam Generator Blowdown Rate a	and Blowdown Tre	eatment Meth	nod	~	
	Type of Steam Generator			~		
	What is the total blowdown rate? (0	Only Input for U-T	ube)		thousand	kg/hr
	Condensate demineralizer regenera	ation time			days	0
	Fraction of feedwater through cond	lensate deminera	lizers		fraction	0
	Liquid Inputs Gas Inputs		Save	Run Ba	ick	Cancel









Pressurized Water Reactor Parameters



Name of Reactor	Sample	PWR	2
Thermal Power Level	3400	MW(th)	?
Mass of Coolant in Primary System	249.4758	thousand kg	?
Primary System Letdown Rate	283.9059	liters/min	? Read fro
Letdown Cation Demineralizer Flow	v Rate 28.39059	liters/min	7 File
Number of Steam Generators	4		?
Total Steam Flow	6.803886	million kg/hr	?
Mass of Liquid in Each Steam Gen	erator 51.02914	thousand kg	?
Steam Generator Blowdown Rate	and Blowdown Treatment	Method	
0 - blowdown is recycled to the cond	ensate system after treatme	ent ~	
Type of Steam Generator	U-Tube	\sim	
What is the total blowdown rate? (Only Input for U-Tube)	34.01943 tho	usand kg/hr
What is the total blowdown rate? (Condensate demineralizer regene		8.4 day	-
	ration time	8.4 day	-









🖳 Pressurized Water Reactor Parameters



Name of Reactor		Sample PWR		0
Thermal Power Level		3400	MW(th)	0
Mass of Coolant in Pri	mary System	249.4758	thousand kg	0
Primary System Letdo	wn Rate	283.9059	liters/min	Read fro
Letdown Cation Demir	neralizer Flow Rate	28.39059	liters/min	Prile
Number of Steam Ger	nerators	4		0
Total Steam Flow		6.803886	million kg/hr	0
Mass of Liquid in Eac	Steam Generator	51.02914	thousand kg	0
Steam Generator Blo	wdown Rate and Blo	wdown Treatment Metho	bd	_
0 - blowdown is recycle	ed to the condensate s	system after treatment	~	
Type of Steam Gener	u-Tub	e	\sim	
What is the total blow	down rate? (Only Inp	out for U-Tube)	34.01943 ti	housand kg/hr
Condensate deminera	lizer regeneration tir	me	8.4 d	ays 🥜
Fraction of feedwater	through condensate	demineralizers	0.65 fi	raction ?
Liquid Inputs	Gas Inputs	Save	Run Back	Cancel











Shim Bleed	Equipment Drain Waste	e Clean Waste	Dirty Waste	Blowdown Waste	Regenerant Wast	e Detergent Was
Liquid Stre	am					
Flow Rate	5450.993	liters/day	?			
Decontam lodine DF Cs and Rb Other DF	DF 2.1e3 1.1e5	Was Prio Was Was	ste Collection ste Collection r to Processir ste Processing Discharge	22.6	days ?	Calculate







Pressurized Water Re	actor Liquid Ra	dwaste Tre	atment Syste	em			
Shim Bleed Equipmen Liquid Stream Flow Rate Activity of Inlet Stream	1249.186	Clean Waste liters/day Fraction of Coolant Act	? Primary	Com	vn Waste bine from us Source		Detergent Waste
Decontamination Fac lodine DF Cs and Rb DF Other DF	5.2e3 2.2e3	 Was Prior Was and Aver Was 	te Collection te Collection r to Processin Discharge rage Fraction tes to be Disc r Processing	Time ng g of	22.7 0.94 0.11	days ? days ?	Calculate
					5	Save Ok	Cancel







Pressurized Water Reactor Liquid Rad	Pressurized Water Reactor Liquid Radwaste Treatment System								
Liquid Stream Flow Rate 3709.704 li Activity of Inlet Stream 0.093	ean Waste Dirty Waste Blowdown Waste Regenerant Waste Detergent Waste Network Combine from Various Sources	Naste							
Cs and Rb DF 1.3e3	 Waste Collection and Processing Waste Collection Time Prior to Processing Waste Processing and Discharge Average Fraction of Wastes to be Discharged After Processing 0.12 (2) 	e							
	Save Ok Cancel]							







Pressurized Water Reactor Liquid F	Radwaste Treatment System	2
Shim Bleed Equipment Drain Waste Liquid Stream Flow Rate 7949.365 Activity of Inlet Stream 0.01	Clean Waste Dirty Waste Blowdown Waste Regenerant Waste Detergent Waste liters/day ? Combine from Various Sources Fraction of Primary? Various Sources	iste
Decontamination Factors (DF)Iodine DF5.4e2Cs and Rb DF1.4e3Other DF1.4e4	Waste Collection and Processing Waste Collection Time Prior to Processing Waste Processing Waste Processing Maste Processing Waste Processing Maste Processing Maste Processing Maste Processing Prior to Processing Maste Processing Maste Processing Maste Processing Maste Processing Mastes to be Discharged Master Master	
	Save Ok Cancel	







Shim Bleed Equipn	nent Drain Waste	Clean Waste	Dirty Waste Bl	owdown Waste	Regenerant Waste	Detergent Wast
Liquid Stream Fraction of Steam		0.8		J	Regeneralit waste	Delergent wast
Decontamination	Factors (DF) 1.5e3 1.5e2	👩 Was	te Collection and te Collection Tim r to Processing te Processing	-	days 🕐	Calculate







Shim Bleed E	quipment Drain Waste	Clean Waste Dirty Waste Blowdown Waste	e Regenerant Waste Deter	gentWast
Liquid Strear Flow Rate	n 12870.4	liters/day		
Decontamina	tion Factors (DF) 5.6e2	Waste Collection and Processing Waste Collection Time Prior to Processing	days 🕜	







🖳 Pressurized	d Water Reactor Liquid	Radwaste Trea	atment Syste	em			×
Shim Bleed	Equipment Drain Waste	Clean Waste	Dirty Waste	Blowdown Waste	Regenerant Waste	Detergent Wa	ste
Liquid St	ream						
Detergen	t Waste Partition Factor	0	?				
					Save Ok	Cancel	





Pressurized Water Reactor Parameters



Name of Reactor		Sample PWR	2		0
Thermal Power Level		3400	MW(th)	?	_
Mass of Coolant in Primary System	n	249.4758	thousand kg	?	
Primary System Letdown Rate		283.9059	liters/min	?	Read fro
Letdown Cation Demineralizer Flow	w Rate	28.39059	liters/min	?	File
Number of Steam Generators		4		?	
Total Steam Flow		6.803886	million kg/hr	?	
Mass of Liquid in Each Steam Ger	nerator	51.02914	thousand kg	?	
Steam Generator Blowdown Rate			hod		
0 - blowdown is recycled to the cond	iensate system a	nter treatment		~~~	
Type of Steam Generator	U-Tube		\sim		
What is the total blowdown rate? (Only Input for U	-Tube)	34.01943	thousand	d kg/hr
Condensate demineralizer regene	ration time		8.4	days	?
Fraction of feedwater through con	densate demine	ralizers	0.65	fraction	0
Gas Inputs		Save	Run Ba	ack	Cancel











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Letdown System	Holdu	up time for fission ga	ases stripp	ed from the p	rimary c	oolant
		Holdup Time for)	Xe	60	days	0
1 - continuous degassification of the fu	ll let \sim	Holdup Time for I	Kr	3.54	days	0
		Fill Time of Decay for the Gas Stripp	y Tanks ber	0	days	0
Containment High Volume Purge Cont	ainment Low Volume Purg	je				
Waste Gas System Particulate Release	Fuel Handling Building	Auxiliary Building	Containn	nent Building		
Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%)	Yes 🗸					
filters? (No = 0% Yes = 99%)	Yes 🗸					
filters? (No = 0% Yes = 99%) lodine						
filters? (No = 0% Yes = 99%) lodine Fraction of lodine Released from 0.13	Yes 🗸					
filters? (No = 0% Yes = 99%) lodine Fraction of lodine Released from Percent of lodine						
filters? (No = 0% Yes = 99%) lodine Fraction of lodine Released from Percent of lodine	fraction			Save		k Cancel









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1 - continuous degassification of the full let Holdup Time for Kr 3.54 days Image: Containment Low Volume Purge iontainment High Volume Purge Containment Low Volume Purge Image: Containment Low Volume Purge Vaste Gas System Particulate Release Fuel Handling Building Auxiliary Building Containment Building Charcoal Adsorbers Reg. Guide 1.140 Reg. Guide 1.140 Reg. Guide 1.140 Removal Efficiency 91 % NUREG-0017 Efficiency HEPA Filters Reg. Guide 1.140 HEPA filters Yes Image: Source Straight	Letdown System			time for fission ga Holdup Time for >			y coolant ys 🕜
In the Gas Stripper 0 days Containment High Volume Purge Volume Purge Waste Gas System Particulate Release Fuel Handling Building Auxiliary Building Charcoal Adsorbers Reg. Guide 1.140 Reg. Guide 1.140 Charcoal Reg. Guide 1.140 Adsorbers? (No = 0% Yes = 99%) Yes NUREG-0017 Efficiency HEPA Filters Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes	1 - continuous degassification o	f the full let $$			_		
Naste Gas System Particulate Release Fuel Handling Building Auxiliary Building Containment Building Charcoal Adsorbers Reg. Guide 1.140 Reg. Guide 1.140 Adsorbers? (No = 0% Yes = 99%) Yes Reg. Guide 1.140 Removal Efficiency 91<% % NUREG-0017 Efficiency HEPA Filters Reg. Guide 1.140 HEPA Filters? (No = 0% Yes = 99%) Yes Yes Iodine Fraction of Iodine 0.13 fraction ? Percent of Iodine 0.05 % ? ?						da	ys 🕜
Charcoal Adsorbers Reg. Guide 1.140 Charcoal Adsorbers? (No = 0% Yes = 99%) Yes Removal Efficiency 91 % ? HEPA Filters Reg. Guide 1.140 HEPA Filters? (No = 0% Yes = 99%) Yes Idoine Yes Fraction of lodine 0.13 Released from 0.13 Percent of lodine 0.05 Removed from Air 0.05	Containment High Volume Purge	Containment Low Vo	ume Purge				
Reg. Guide 1.140 Charcoal Adsorbers? (No = 0% Yes = 99%) Yes Reg. Guide 1.140 Removal Efficiency 91 % ? NUREG-0017 Efficiency HEPA Filters Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes Yes Iodine Praction of lodine Released from 0.13 fraction ? Percent of lodine Removed from Air 0.05 % ? ?	Waste Gas System Particulate R	elease Fuel Handling	Building /	Auxiliary Building	Containmen	Building	
Adsorbers? (No = 0% Yes = 99%) Removal Efficiency HEPA Filters Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes Iodine Fraction of Iodine Released from 0.13 fraction ? Percent of Iodine Removed from Air 0.05 % ?	Charcoal Adsorbers						
HEPA Filters Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes Iodine Fraction of Iodine Released from 0.13 fraction Percent of Iodine Removed from Air 0.05 % ?	Reg. Guide 1.140 Charcoal Adsorbers? (No = 0% Yes = 99%	K) Yes	\sim	Reg	. Guide 1.14(
Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes Iodine Image: Subscript of the subscript of	Removal Efficiency	91	%	O NUREO	a-0017 Efficie	ncy	
filters? (No = 0% Yes = 99%)	HEPA Filters						
Iodine Fraction of Iodine Released from 0.13 fraction Percent of Iodine Removed from Air 0.05	Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%)	Yes	\sim				
Fraction of lodine 0.13 fraction ? Released from 0.05 % ?							
Save Ok Cancel	Percent of lodine						
	Fraction of lodine Released from 0.13 Percent of lodine						
	Fraction of lodine Released from 0.13 Percent of lodine					Save	Ok Cancel
	Fraction of lodine Released from 0.13 Percent of lodine					Save	Ok Cancel









I - continuous degassification of the full let ontainment High Volume Purge Containment Low Volume aste Gas System Particulate Release Fuel Handling Build Charcoal Adsorbers Reg. Guide 1.140 Charcoal Adsorbers? (No = 0% Yes = 99%) Removal Efficiency HEPA Filters Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes	Fill for Purge	the Gas St iliary Buildi	ecay Tanks tripper	1.140	days days	
aste Gas System Particulate Release Fuel Handling Build Charcoal Adsorbers Reg. Guide 1.140 Charcoal Adsorbers? (No = 0% Yes = 99%) Yes Removal Efficiency 92 HEPA Filters Reg. Guide 1.140 HEPA	Purge ding Aux	iliary Buildi	ng Contair Reg. Guide	nment Building		•
aste Gas System Particulate Release Fuel Handling Build Charcoal Adsorbers Reg. Guide 1.140 Charcoal Adsorbers? (No = 0% Yes = 99%) Yes Removal Efficiency 92 HEPA Filters Reg. Guide 1.140 HEPA	ding Aux	F	Reg. Guide	1.140	1	
Charcoal Adsorbers Reg. Guide 1.140 Charcoal Adsorbers? (No = 0% Yes = 99%) Removal Efficiency HEPA Filters Reg. Guide 1.140 HEPA]	F	Reg. Guide	1.140		
Reg. Guide 1.140 Charcoal Yes Adsorbers? (No = 0% Yes = 99%) Yes Removal Efficiency 92 HEPA Filters Reg. Guide 1.140 HEPA]% ?		-			
Adsorbers? (No = 0% Yes = 99%) Removal Efficiency HEPA Filters Reg. Guide 1.140 HEPA]% ?		-			
HEPA Filters Reg. Guide 1.140 HEPA] % 🕜	NU	REG-0017 E	fficiency		
Reg. Guide 1.140 HEPA						
odine action of lodine eleased from 0.13 fraction ?						
emoved from Air 0.05 %						
				Save	Ok	Cancel









Pressurized Water Reactor Gaseous Radwaste Treatn	nent System			
Letdown System 1 - continuous degassification of the full let ∨	Holdup time for fission g Holdup Time for Holdup Time for Fill Time of Deca for the Gas Strip	Xe 60 Kr 3.54 ny Tanks	e primary o days days days	0 0
Containment High Volume Purge Containment Low Volum				
Waste Gas System Particulate Release Fuel Handling Bu		Containment Buildir	<u>ן</u>	
Containment Free Volume 0.07688 million m	13 🕜			
Charcoal Adsorbers				
Reg. Guide 1.140 Charcoal Adsorbers? (No = 0% Yes = 99%) Yes ~	Reg	g. Guide 1.140		
Removal Efficiency 94	🛛 % 🕜 🛛 NURE	G-0017 Efficiency		
HEPA Filters Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes ~				
Row Rate Through Internal Cleanup System 0	.962773 thousand	m3/min 🥜		
lodine				
Fraction of lodine Released from 0.13 fraction ?				
Percent of Iodine Removed from Air 0.05 %		Save		lk Cancel
		Save		Cancel









etdown System	Holdup time for fission gases stripped from the primary coolant Holdup Time for Xe 60 days
1 - continuous degassification of the full let $ \smallsetminus $	Holdup Time for Kr 3.54 days
	Fill Time of Decay Tanks for the Gas Stripper 0 days
/aste Gas System Particulate Release Fuel Handling B ontainment High Volume Purge Containment Low Volu	
Charcoal Adsorbers	ine ruige
Reg. Guide 1.140 Charcoal Adsorbers? (No = 0% Yes = 99%)	✓ Reg. Guide 1.140
Removal Efficiency 96	% 🕜 NUREG-0017 Efficiency
HEPA Filters	
Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%)	~
	Do not include the 2 purges at shutdown
odine	
raction of lodine Released from 0.13 fraction ?	
Percent of lodine Removed from Air 0.05 %	
	Save Ok Cancel







Pressurized Water Reactor Parameters



[Sample PWR			
	Sample FWR			0
[3400	MW(th)	?	-
า [249.4758	thousand kg	?	
[283.9059	liters/min	?	Read fro
v Rate	28.39059	liters/min	?	File
[4		?	
[6.803886	million kg/hr	?	
erator	51.02914	thousand kg	?	
and Blowdown Tr	eatment Meth	od		
lensate system afte	er treatment		\sim	
U-Tube		\sim		
Only Input for U-1	ſube)	34.01943	thousand	d kg/hr
ration time		8.4	days	?
densate deminera	lizers	0.65	fraction	0
	v Rate [v Rate [uerator [and Blowdown Tr lensate system after U-Tube Only Input for U-1 ration time	v Rate 283.9059 4 28.39059 4 6.803886 herator 51.02914 and Blowdown Treatment Meth lensate system after treatment U-Tube Only Input for U-Tube)	249.4758 thousand kg 283.9059 liters/min 283.9059 liters/min 4 6.803886 6.803886 million kg/hr housand kg 6.803886 and Blowdown Treatment Method lensate system after treatment U-Tube ✓ Only Input for U-Tube) 34.01943 ration time 8.4	249.4758 thousand kg ? 283.9059 liters/min ? 28.39059 liters/min ? 4 ? ? 6.803886 million kg/hr ? erator 51.02914 thousand kg ? and Blowdown Treatment Method ? ? lensate system after treatment ~ ? U-Tube ~ ? Only Input for U-Tube) 34.01943 thousand ration time 8.4 days











Letdown System			or fission gases stri p Time for Xe	ipped from the pr	days 🕜	nt
1 - continuous degassification of	the full let 🗸		p Time for Kr	3.54	days 🕜	
			ne of Decay Tanks		udys 😈	
			Gas Stripper	0	days 🕜	
Vaste Gas System Particulate Rel	lease Fuel Handling B	uilding Auxilia	y Building Conta	inment Building		
Containment High Volume Purge	Containment Low Volu	me Purge				
Charcoal Adsorbers						
Reg. Guide 1.140 Charcoal Adsorbers? (No = 0% Yes = 99%)	Yes	\sim	Reg. Guide	1.140		
Removal Efficiency	97	% 🕜	NUREG-0017	Efficiency		
HEPA Filters						
Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%)	Yes	~				
Continuous Containment Purge Ra	ate 28.31685	; m3/min	0			
lodine						
lodine Fraction of lodine Released from 0.13	fraction (?)					
Fraction of lodine Released from 0.13 Percent of lodine	fraction 7					
Fraction of lodine Released from 0.13				Save	Ok	Cancel







Example Use Cases: PWR - GE



******* GALE version: GALE86 ******** ******* ANS-18.1 version: 1999 ********

Sample PWR	PWR
THERMAL POWER LEVEL (MEGAWATTS)	3.40000E+03
PLANT CAPACITY FACTOR	8.00000E-01
MASS OF PRIMARY COOLANT (THOUSAND LBS)	5.50000E+02
PRIMARY SYSTEM LETDOWN RATE (GPM)	7.50000E+01
LETDOWN CATION DEMINERALIZER FLOW (GPM)	7.50000E+00
NUMBER OF STEAM GENERATORS	4.00000E+00
TOTAL STEAM FLOW (MILLION LBS/HR)	1.50000E+01
MASS OF LIQUID IN EACH STEAM GENERATOR (THOUSAND LBS)	1.12500E+02
BLOWDOWN RATE (THOUSAND LBS/HR)	7.50000E+01
CONDENSATE DEMINERALIZER REGENERATION TIME (DAYS)	8.40000E+00
CONDENSATE DEMINERALIZER FLOW FRACTION	6.50000E-01

LIQUID WASTE INPUTS

STREAM	FLOW RATE (GAL/DAY)	FRACTION OF PCA	FRACTION DISCHARGED	COLLECTION TIME (DAYS)	DECAY TIME (DAYS)	DECONT I	AMINATION FA	CTORS OTHERS
EQUIPMENT DRAINS CLEAN WASTE INPUT DIRTY WASTES BLOWDOWN UNTREATED BLOWDOWN	3.30000E+02 9.80000E+02 2.10000E+03 1.72612E+05	1.00000E+00 9.70000E-01 9.30000E-02 1.00000E-02	1.0000E-01 1.1000E-01 1.2000E-01 9.8000E-01 6.3000E-01 1.0000E+00 1.3000E-01	2.26000E+01 2.27000E+01 5.70000E+00 3.80000E+00 5.40000E+00 0.00000E+00 4.70000E+00	9.30000E-01 9.40000E-01 1.30000E-01 1.90000E-01 4.50000E+00 0.00000E+00 3.70000E-01	5.40000E+02	2.10000E+03 2.20000E+03 1.30000E+03 1.40000E+03 1.50000E+02 1.00000E+00 1.60000E+03	1.30000E+04 1.40000E+04 1.60000E+03 1.00000E+00

HOLDUP TIME FOR KRYPTON FILL TIME OF DECAY TANK PRIMARY COOLANT LEAK TO GAS WASTE SYSTEM PAR FUEL HANDLG BLDG IOD PAR' AUXILIARY BLDG IOD PAR CONTAINMENT VOLUME (MIL FREQUENCY OF PRIMARY CO PRIMARY TO SECONDARY LE THERE IS A KIDNEY FILTE CONTAINMENT ATMOSPH PURGE TIME OF CONTA FRACTION IODINE BYPASSI IODINE PARTITION FACTOR FREQUENCY OF CNTMT BLDG CNTMT-HIGH VOL PURGEIOD

GASEOUS WASTE INPUTS

PERCENT OF IODINE REMOVE THERE IS NOT AN ON-SITE LAUNDRY







THERE IS CONTINUOUS STRIPPING OF FULL LETDOWN FLOW	
FLOW RATE THROUGH GAS STRIPPER (GPM)	7.52292E+01
HOLDUP TIME FOR XENON (DAYS)	6.00000E+01
HOLDUP TIME FOR KRYPTON (DAYS)	3.54000E+00
FILL TIME OF DECAY TANKS FOR THE GAS STRIPPER (DAYS)	0.00000E+00
FILL TIME OF DECAY TANKS FOR THE GAS STRIPPER (DAYS) PRIMARY COOLANT LEAK TO AUXILIARY BLDG (LB/DAY)	1.60000E+02
GAS WASTE SYSTEM PARTICULATE RELEASE FRACTION	1.00000E-02
FUEL HANDLG BLDG IODINE RELEASE FRACTION	9.00000E-02
PARTICULATE RELEASE FRACTION	1.00000E-02
AUXILIARY BLDG IODINE RELEASE FRACTION	8.00000E-02
PARTICULATE RELEASE FRACTION	1.00000E-02
CONTAINMENT VOLUME (MILLION FT3)	2.71500E+00
FREQUENCY OF PRIMARY COOLANT DEGASSING (TIMES/YR)	2.00000E+00
PRIMARY TO SECONDARY LEAK RATE (LB/DAY)	7.50000E+01
THERE IS A KIDNEY FILTER	
CONTAINMENT ATMOSPHERECLEANUP RATE (THOUSAND CFM)	
PURGE TIME OF CONTAINMENT (HOURS)	1.60000E+01
FRACTION IODINE BYPASSING CONDENSATE DEMINERALIZER	
IODINE PARTITION FACTOR (GAS/LIQUID) IN STEAM GENERATOR	
······································	2.00000E+00
CNTMT-HIGH VOL PURGEIODINE RELEASE FRACTION	4.00000E-02
PARTICULATE RELEASE FRACTION	1.00000E-02
CNTMT LOW VOL PURGE RATE (CFM)	1.00000E+03
CNTMT LOW VOL PURGE IODINE RELEASE FRACTION	3.00000E-02
	1.00000E-02
	1.70000E+03
FRACTION IODINE RELEASED FROM BLOWDOWN TANK VENT	1.30000E-01
PERCENT OF IODINE REMOVED FROM AIR EJECTOR RELEASE	5.00000E-02
THERE TO NOT AN ON OTHE TANDERS	

Example Use Cases: PWR - GE



Sample PWR				GASEO	US RELEASE RATE	- CURIES PER YEA	R	GASEOUS REL	EASE RATE - CURI	ES PER YEAR
	PRIMARY COOLANT (MICRO-CI/GM)	SECONDARY COOLANT (MICRO-CI/GM)	 FU	EL HANDLING	BUILDING REACTOR	VENTILATION AUXILIARY	TURBINE	BLOWDOWN VENT OFFGAS	AIR EJECTOR EXHAUST	TOTAL
I-131	1.98363E-03	6.10073E-08	0	.00000E+00	0.00000E+00	5.00000E-04	0.00000E+00	1.90000E-03	0.00000E+00	2.40000E-03
I-132	5.99038E-02	7.95718E-07	7	.10000E-04	8.20000E-04	1.50000E-02	0.00000E+00	2.50000E-02	0.00000E+00	4.20000E-02
I-133	1.39188E-01	3.75488E-06	1	.60000E-03	2.70000E-03	3.50000E-02	1.60000E-04	1.20000E-01	0.00000E+00	1.60000E-01
I-134	3.39759E-01	2.26814E-06	4	.00000E-03	4.40000E-03	8.60000E-02	0.00000E+00	7.00000E-02	0.00000E+00	1.60000E-01
I-135	2.59109E-02	5.47555E-07	3	.10000E-04	4.0000E - 04	6.60000E-03	0.00000E+00	1.70000E-02	0.00000E+00	2.40000E-02

0.00000E+00 APPEARING IN THE TABLE INDICATES RELEASE IS LESS THAN 0.0001 CI/YR FOR I

TOTAL H-3 RELEASED VIA GASEOUS PATHWAY = 1.10000E+03 CI/YR

C-14 RELEASED VIA GASEOUS PATHWAY = 7.30000E+00 CI/YR

AR-41 RELEASED VIA CONTAINMENT VENT = 3.40000E+01 CI/YR

Sample PWR

	PRIMARY	SECONDARY	GAS STR		RATE - CURIES PI BU	ER YEAR ILDING VENTILATIO	ON	GASEOUS REL	EASE RATE - CURI	ES PEF
	COOLANT (MICRO-CI/GM)	COOLANT (MICRO-CI/GM)	SHUTDOWN	CONTINUOUS	REACTOR	AUXILIARY	TURBINE	BLOWDOWN VENT OFFGAS	AIR EJECTOR EXHAUST	1
KR-85M	1.12298E-02	2.38634E-09	0.00000E+00	0.00000E+00	3.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	3.(
KR-85	5.71525E-03	1.18292E-09	3.00000E+00	6.70000E+02	1.30000E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	6.9
KR-87	1.51391E-02	8.90536E-09	0.00000E+00	0.00000E+00	1.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1.0
KR-88	1.41622E-02	2.98979E-09	0.00000E+00	0.00000E+00	3.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	3.0
XE-131M	3.45671E-02	7.10283E-09	0.00000E+00	1.20000E+02	6.80000E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1.9
XE-133M	1.18169E-02	2.53219E-09	0.00000E+00	0.00000E+00	1.60000E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1.6
XE-133	2.50634E-03	5.18553E-10	0.00000E+00	0.00000E+00	4.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	4.0
XE-135M	1.26796E-01	2.63345E-08	0.00000E+00	0.00000E+00	2.00000E+00	3.00000E+00	0.00000E+00	0.00000E+00	1.00000E+00	6.0
XE-135	3.55501E-02	5.85531E-10	0.00000E+00	0.00000E+00	1.80000E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1.8
XE-137	3.37855E-02	7.05520E-09	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.0
XE-13 8	5.96281E-02	1.27076E-08	0.00000E+00	0.00000E+00	0.00000E+00	1.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1.0
TOTAL NO	BLE GASES									9.3

0.00000E+00 APPEARING IN THE TABLE INDICATES RELEASE IS LESS THAN 1.0 CI/YR FOR NOBLE GAS







RIES	PER	YEAR
	тс	TAL
	6.90 1.00 3.00 1.90 1.60)000E+00)000E+02)000E+00)000E+00)000E+02)000E+01)000E+00
	1.80	0000E+00 0000E+01 0000E+00 0000E+00 0000E+02

Example Use Cases: PWR - GE



NUCLIDE	Sample PWR	WASTE GAS SYSTEM	AIRBORNE PARTICUL BUIL FUEL HANDLING	ATE RELEASE RATH DING VENTILATION REACTOR		
CR-51		1.40000E-07	1.80000E-06	9.00000E-05	3.20000E-06	
MN-54		2.10000E-08	3.00000E-06	5.20000E-05	7.80000E-07	
CO-57		0.00000E+00	0.00000E+00	8.10000E-06	0.00000E+00	
CO-58		8.70000E-08	2.10000E-04	2.50000E-04	1.90000E-05	
CO-60		1.40000E-07	8.20000E-05	2.60000E-05	5.10000E-06	
FE-59		1.80000E-08	0.00000E+00	2.70000E-05	5.00000E-07	
SR-89		4.40000E-07	2.10000E-05	1.30000E-04	7.50000E-06	
SR-90		1.70000E-07	8.00000E-06	5.10000E-05	2.90000E-06	
ZR-95		4.80000E-08	3.60000E-08	0.00000E+00	1.00000E-05	
NB-95		3.70000E-08	2.40000E-05	1.80000E-05	3.00000E-07	
RU-103		3.20000E-08	3.80000E-07	1.60000E-05	2.30000E-07	
RU-106		2.70000E-08	6.90000E-07	0.00000E+00	6.00000E-08	
SB-125		0.00000E+00	5.70000E-07	0.00000E+00	3.90000E-08	
CS-134		3.30000E-07	1.70000E-05	2.50000E-05	5.40000E-06	
CS-136		5.30000E-08	0.00000E+00	3.10000E-05	4.80000E-07	
CS-137		7.70000E-07	2.70000E-05	5.40000E-05	7.20000E-06	
BA-140		2.30000E-07	0.00000E+00	0.00000E+00	4.00000E-06	
CE-141		2.20000E-08	4.40000E-09	1.30000E-05	2.60000E-07	







TOTAL

9.50000E-05 5.60000E-05 8.10000E-06 4.80000E-04 1.10000E-04 2.80000E-05 1.60000E-04 6.20000E-05 1.00000E-05 4.20000E-05 1.70000E-05 7.80000E-07 6.10000E-07 4.80000E-05 3.20000E-05 8.90000E-05 4.20000E-06 1.30000E-05

Example Use Cases: PWR - LE



******* GALE version: GALE86 *******		LIQUID WASTE INPU	rs							
****** ANS-18.1 version: 1999 ********		STREAM	FLOW RATE (GAL/DAY)	FRACTION OF PCA	FRACTION DISCHARGED	COLLECTION TIME (DAYS)	DECAY TIME (DAYS)	DECONI I	CS	TORS OTHERS
Sample PWR THERMAL POWER LEVEL (MEGAWATTS) PLANT CAPACITY FACTOR MASS OF PRIMARY COOLANT (THOUSAND LBS) PRIMARY SYSTEM LETDOWN RATE (GPM) LETDOWN CATION DEMINERALIZER FLOW (GPM) NUMBER OF STEAM GENERATORS TOTAL STEAM FLOW (MILLION LBS/HR) MASS OF LIQUID IN EACH STEAM GENERATOR (THOUSAND LBS) MASS OF WATER IN STEAM GENERATORS (THOUSAND LBS) BLOWDOWN RATE (THOUSAND LBS/HR) PRIMARY TO SECONDARY LEAK RATE (LBS/DAY) CONDENSATE DEMINERALIZER REGENERATION TIME (DAYS) FISSION PRODUCT CARRY-OVER FRACTION HALOGEN CARRY-OVER FRACTION CONDENSATE DEMINERALIZER FLOW FRACTION	PWR 3.40000E+03 8.00000E-01 5.50000E+02 7.50000E+01 7.50000E+00 1.50000E+00 1.25000E+02 7.50000E+01 7.50000E+01 8.40000E+00 5.00000E-03 1.00000E-01	CON CASE OF WASTE INFE HOL HOL FIL GAS AUX CON FRE CNT CNT CNT STE FRA PER	1.44000E+03 3.3000E+02 9.80000E+02 2.10000E+03 1.72612E+05 V 4.31530E+04 3.40000E+03 UTS RE IS CONTINUC DUP TIME FOR P L TIME OF DECZ WASTE SYSTEM ILLARY BLDG FAINMENT VOLUE QUENCY OF CNTT AT-HIGH VOL PUE AT LOW VOL PUE TION VOL PUE TION IODINE F CENT OF IODINE	9.30000E-02 1.00000E-02 1.00000E-02 0US STRIPPING (ENON (DAYS) (RYPTON (DAYS) AY TANKS FOR T PARTICULA IODINE RE PARTICULA (MILLION FT (AT BLDG HIGH V JRGE IODINE REL PARTICULA RGE IODINE REL PARTICULA RGE IODINE REL PARTICULA RGE IODINE REL PARTICULA RGE IODINE REL PARTICULA RELEASED FROM	OL PURGE (TIME LEASE FRACTION TE RELEASE FRA EASE FRACTION TE RELEASE FRA S/HR) BLOWDOWN TANK AIR EJECTOR R	2.26000E+01 2.27000E+01 5.7000E+00 3.80000E+00 5.40000E+00 4.70000E+00 4.70000E+00 4.70000E+00 8. (DAYS) CTION CTION S/YR) CTION CTION CTION	9.30000E-01 9.40000E-01 1.30000E-01 4.50000E+00 0.00000E+00 3.70000E-01 3.54000E+00 0.00000E+00 1.00000E-02 8.00000E-02 2.71500E+00 2.00000E+02 1.00000E-02 1.00000E-02 1.00000E+03 3.00000E-02 1.00000E+03 3.00000E-02 1.30000E-02 1.30000E-02	5.10000E+03 5.20000E+03 5.30000E+02 1.50000E+03 1.00000E+02 5.60000E+02	2.10000E+03 2.20000E+03 1.30000E+03 1.40000E+03	1.10000E+05 1.20000E+05 1.30000E+04 1.60000E+03 1.00000E+04 1.60000E+04





Example Use Cases: PWR - LE

		COOLANT CON	ICENTRATIONS						ADJUSTED	DETERGENT	TOTAL
UCLIDE	HALF-LIFE (DAYS)	PRIMARY (MICRO CI/ML)	SECONDARY	BORON RS (CURIES)	MISC. WASTES (CURIES)	SECONDARY (CURIES)	TURE BLDG (CURIES)	TOTAL LWS (CURIES)	TOTAL (CI/YR)	WASTES (CI/YR)	(CI/YR)
CORRORTO	N AND ACTIVAT	TON PRODUCTS									
NA 24	6.25000E-01	4.70000E-02	0.00000E+00	0.00000E+00	3.00000E-05	0.00000E+00	5.00000E-05	8.00000E-05	4.65000E-03	0.00000E+00	4 700005
CR 51	2.77997E+01	3.10000E-03	0.00000E+00	0.00000E+00		0.00000E+00	1.00000E-05	2.00000E-05	9.60000E-04	0.00000E+00	
MDN 54	3.02996E+02	1.60000E-03	0.00000E+00	0.00000E+00		0.00000E+00	0.00000E+00	1.00000E-05	5.20000E-04	0.00000E+00	
TE 55	9.49624E+02	1.20000E-03	0.00000E+00	0.00000E+00		0.00000E+00	0.00000E+00	1.00000E-05	3.90000E-04	0.00000E+00	
FE 59	4.49994E+01	3.00000E-04	0.00000E+00	0.00000E+00		0.00000E+00	0.00000E+00	0.00000E+00	9.00000E-05	0.00000E+00	
0 58	7.12991E+01	4.60000E-03	0.00000E+00	0.00000E+00		0.00000E+00	1.00000E-05	3.00000E-05	1.46000E-03	0.00000E+00	
O 60	1.92116E+03	5.30000E-04	0.00000E+00	0.00000E+00		0.00000E+00	0.00000E+00	0.00000E+00	1.70000E-04	0.00000E+00	
ZN 65	2.44997E+02	5.10000E-04	0.00000E+00	0.00000E+00		0.00000E+00	1.00000E-05	1.00000E-05	7.20000E-04	0.00000E+00	
W187	9.95833E-01	2.50000E-03	0.00000E+00	0.00000E+00		0.00000E+00	0.00000E+00	1.00000E-05	3.30000E-04	0.00000E+00	
IP239	2.34997E+00	2.20000E-03	0.00000E+00	0.00000 E+ 00		0.00000 E+ 00	0.00000 E+ 00	1.00000E-05	4.40000E-04	0.00000 E+ 00	
ISSION	PRODUCTS										
R 89	5.19994E+01	1.40000E-04	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	4.00000E-05	0.00000E+00	4.00000E
R 91	4.02917E-01	9.60000E-04	0.00000E+00	0.00000E+00		0.00000E+00	0.00000E+00	0.00000E+00	7.00000E-05	0.00000E+00	7.00000E
Y 91M	3.47234E-02	4.60000E-04	0.00000E+00	0.00000E+00		0.00000E+00	0.00000E+00	0.00000E+00	4.00000E-05		4.00000
Y 93	4.25000E-01	4.20000E-03	0.00000E+00	0.00000E+00		0.00000E+00	0.00000E+00	1.00000E-05	3.10000E-04	0.00000E+00	
R 95	6.49992E+01	3.90000E-04	0.00000E+00	0.00000E+00		0.00000E+00	0.00000E+00	0.00000E+00	1.20000E-04	0.00000E+00	
B 95	3.49996E+01	2.80000E-04	0.00000E+00	0.00000E+00		0.00000E+00	0.00000E+00	0.00000E+00	9.00000E-05	0.00000E+00	
99	2.79167E+00	6.40000E-03	0.00000E+00	0.00000E+00		0.00000E+00	1.00000E-05	2.00000E-05	1.36000E-03	0.00000E+00	
99M	2.50000E-01	4.70000E-03	0.00000E+00	0.00000E+00		0.00000E+00	1.00000E-05	2.00000E-05	1.13000E-03	0.00000E+00	
J103	3.95995E+01	7.50000E-03	0.00000E+00	0.00000E+00		0.00000E+00	1.00000E-05	4.00000E-05	2.35000E-03	0.00000E+00	
1103M	3.95847E-02	0.00000E+00	0.00000E+00	0.00000E+00		0.00000E+00	1.00000E-05	4.00000E-05	2.34000E-03	0.00000E+00	2.30000
1106	3.66995E+02	9.00000E-02	0.00000E+00	4.00000E-05		0.00000E+00	1.70000E-04	5.00000E-04	2.91300E-02	0.00000E+00	2.90000
1106	3.47219E-04	0.00000E+00	0.00000E+00	4.00000E-05	2.90000E-04	0.00000E+00	1.70000E-04	5.00000E-04	2.91300E-02	0.00000E+00	2.90000
5110M	2.52997E+02	1.30000E-03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1.00000E-05	4.20000E-04	0.00000E+00	4.20000
5110	2.82405E-04	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	5.00000E-05	0.00000E+00	5.00000
E129M	3.39996E+01	1.90000E-04	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	6.00000E-05	0.00000E+00	6.00000
129	4.79183E-02	2.40000E-02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	6.00000E-05	0.00000E+00	6.00000
2131M	1.25000E+00	1.50000E-03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	2.30000E-04	0.00000E+00	2.30000
2131	1.73617E-02	7.70000E-03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	4.00000E-05	0.00000E+00	4.00000
1131	8.04990E+00	2.00000E-03	0.00000E+00	1.00000E-05	1.40000E-04	0.00000E+00	1.00000E-05	1.60000E-04	9.34000E-03	0.00000E+00	9.30000
132	3.25000E+00	1.70000E-03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1.00000E-05	3.80000E-04	0.00000E+00	3.80000
132	9.58333E-02	6.00000E-02	0.00000E+00	0.00000E+00	7.00000E-05	0.00000E+00	2.00000E-05	9.00000E-05	5.26000E-03	0.00000E+00	5.30000
1133	8.75000E-01	2.60000E-02	0.00000E+00	1.00000E-05	5.20000E-04	0.00000E+00	6.00000E-05	5.80000E-04	3.41100E-02	0.00000E+00	3.40000
134	3.66679E-02	1.00000E-01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	2.90000E-04	0.00000E+00	2.90000
3134	7.48742E+02	4.00000E-05	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	2.20000E-04	0.00000E+00	2.20000
135	2.79167E-01	5.50000E-02	0.00000E+00	0.00000E+00	2.70000E-04	0.00000E+00	6.00000E-05	3.30000E-04	1.95900E-02	0.00000E+00	2.00000
3136	1.29998E+01	8.70000E-04	0.00000E+00	3.00000E-05	2.00000E-05	0.00000E+00	0.00000E+00	6.00000E-05	3.49000E-03	0.00000E+00	3.50000
3137	1.09572E+04	5.00000E-05	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1.00000E-05	3.20000E-04	0.00000E+00	3.20000
A137M	1.77089E-03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000 E+ 00	0.00000E+00	1.00000E-05	3.00000E-04	0.00000 E+ 00	3.00000
A140	1.27998E+01	1.30000E-02	0.00000E+00	0.00000 E+ 00	4.00000E-05	0.00000E+00	2.00000E-05	6.00000E-05	3.72000E-03	0.00000E+00	3.70000
140	1.67500E+00	2.50000E-02	0.00000E+00	0.00000E+00	6.0000E-05	0.00000 E+ 00	4.00000E-05	1.00000E-04	5.94000E-03	0.00000 E+ 00	5.90000
141	3.23996E+01	1.50000E-04	0.00000E+00	0.00000 E+ 00	0.00000E+00	0.00000 E+ 00	0.00000 E+ 00	0.00000 E+ 00	5.00000E-05	0.00000 E+ 00	5.00000
143	1.37500E+00	2.80000E-03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000 E+ 00	0.00000E+00	1.00000E-05	4.40000E-04	0.00000 E+ 00	4.40000
8143	1.36998E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000 E+ 00	0.00000E+00	0.00000 E+ 00	4.00000E-05	0.00000 E+ 00	4.00000
2144	2.83996E+02	4.00000E-03	0.00000E+00	0.00000E+00	1.00000E-05	0.00000 E+ 00	1.00000E-05	2.00000E-05	1.28000E-03	0.00000 E+ 00	1.30000
R144	1.20143E-02	0.00000E+00	0.00000E+00	0.00000E+00	1.00000E-05	0.00000 E+ 00	1.00000E-05	2.00000E-05	1.28000E-03	0.00000 E+ 00	1.30000
LL OTHE	RS	2.06020E-01	0.00000 E+ 00	0.00000E+00	0.0000E+00	0.00000E+00	0.00000E+00	0.00000 E+ 00	1.00000E-05	0.00000 E+ 00	1.00000
OTAL											
XCEPT	TRITIUM)	7.09890E-01	1 00000E-05	1 60000E-04	1 89000E-02	0.00000E+00	7 200008-04	2 780008-02	1 62780E-01	0.000002+00	1 60000

NOTE: 0.00000E+00 INDICATES THAT THE VALUE IS LESS THAN 1.00000E-05.

TRITIUM RELEASE 2.90000E+02 CURIES PER YEAR

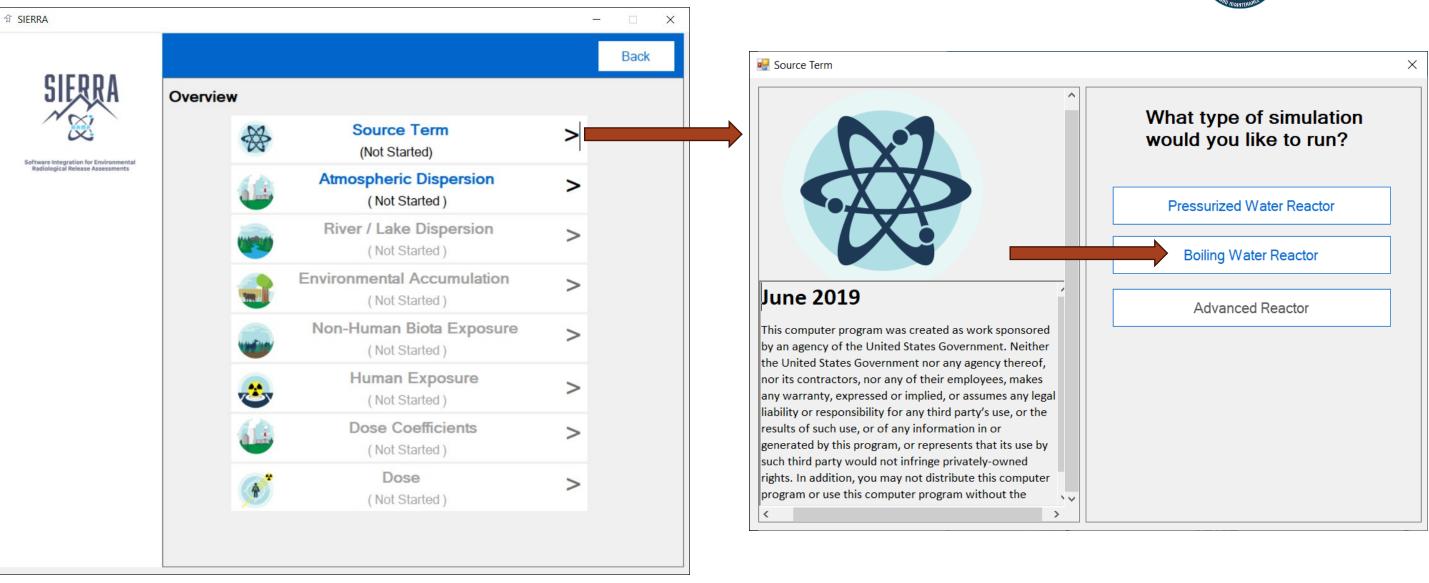










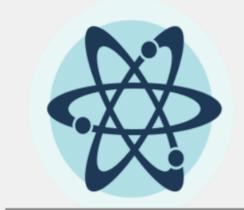








🖷 Source Term General Inputs



June 2019

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Input File Name		
SIERRA_Source_Term_B	WRExample.in	Browse
Type of Analysis Gas Guiquid	Type of Analysis GALE86 ~	Type of Analysis
Output Files Gas BWRExamp	leGE.out	
Liquid BWRExamp	leLE.out	
English/SI Unit Setting O English Units	SI Units	

Back	Next









Name of Reactor	
Thermal Power Level	MW(th)
Total Steam Flow	million kg/hr 🕜
Mass of Water in Reactor Vessel	million kg 🕜 Read from File
Cleanup Demineralizer Flow	million kg/hr
Condensate Demineralizer Regeneration Time	days 🕜
Copper tubing for condenser?	\checkmark
Fraction of Feedwater Through Condensate Deminerali	izers fraction ?
Liquid Inputs Gas Inputs Save	Run Back Cancel





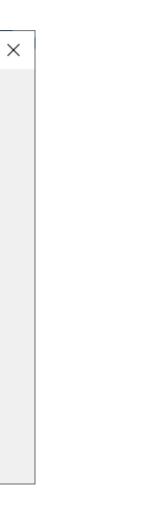




Name of Reactor	
Thermal Power Level	MW(th)
Total Steam Flow	million kg/hr 🕜
Mass of Water in Reactor Vessel	Read from File
Cleanup Demineralizer Flow	million kg/hr 🥜
Condensate Demineralizer Regeneration Time	days 🕜
Copper tubing for condenser?	\sim
Fraction of Feedwater Through Condensate Deminerali	zers fraction ?
Liquid Inputs Gas Inputs Save	Run Back Cancel









Name of Reactor	BWR Samp	le 🕜
Thermal Power Level	3400	MW(th)
Total Steam Flow	68	million kg/hr 🕜
Mass of Water in Reactor Vessel	0.17	million kg 🕜 Read from File
Cleanup Demineralizer Flow	0.59	million kg/hr 🕜
Condensate Demineralizer Regeneration Time	56	days 🕜
Copper tubing for condenser?	No v	
Fraction of Feedwater Through Condensate Demineraliz	zers	1.0 fraction 🕜
Liquid Inputs Gas Inputs Save	Run	Back Cancel







🚽 Boiling Water Reactor Parameters	
Name of Reactor	BWR Sample
Thermal Power Level	3400 MW(th) 🕜
Total Steam Flow	68 million kg/hr 🕜
Mass of Water in Reactor Vessel	0.17 million kg 🕜 Read from File
Cleanup Demineralizer Flow	0.59 million kg/hr 🕜
Condensate Demineralizer Regeneration Time	56 days 🕜
Copper tubing for condenser?	No v
Fraction of Feedwater Through Condensate Demineralizer	
Liquid Inputs Gas Inputs Save	Run Back Cancel







•	Boiling	Water	Reactor	Liquid	Radwaste	Treatment Sy	stem
---	---------	-------	---------	--------	----------	--------------	------

Liquid Stream Flow Rate Activity of Inlet Str	eam 0.15		ombine from ious Sources
Decontamination lodine DF Cs and Rb DF Other DF	Factors (DF) 1.1e3 ? 1.2e2 ? 1.3e3 ?	Waste Processing	Interview Interview
			Save Ok Cancel









•	Boiling	Water	Reactor	Liquid	Radwaste	Treatment Sy	stem
---	---------	-------	---------	--------	----------	--------------	------

Flow Rate Activity of Inlet Stre	am 0 12		ombine from ious Sources
Decontamination F lodine DF Cs and Rb DF Other DF	1.5e3 1.6e4	Waste Collection and Pr Waste Collection Time Prior to Processing Waste Processing and Discharge Average Fraction of Wastes to be Discharged After	and and any of the second s
			Save Ok Cancel









•	Boiling	Water	Reactor	Liquid	Radwaste	Treatment System
---	---------	-------	---------	--------	----------	------------------

Liquid Stream Flow Rate Activity of Inlet Stre	Fr	ers/day 🕜 Co	ombine from ious Sources
Decontamination F lodine DF Cs and Rb DF Other DF	Factors (DF)	Waste Processing	3.2 days 0.7 days 1.75 ?
			Save Ok Cancel









•=	Boiling	Water	Reactor	Liquid	Radwaste	Treatment S	System
----	---------	-------	---------	--------	----------	-------------	--------

Liquid Stream Flow Rate Activity of Inlet Str	eam 0.02 Fr		ombine from rious Sources
Decontamination lodine DF Cs and Rb DF Other DF	Factors (DF)	Waste Processing	days Calculate 0.7 days 0.75 Image: Calculate
			Save Ok Cancel









•	Boiling	Water	Reactor	Liquid	Radwaste	Treatment System
---	---------	-------	---------	--------	----------	------------------

Liquid Stream Flow Rate	6435 lite	rs/day 🕜	
Decontamination lodine DF Cs and Rb DF Other DF	Factors (DF) 2.1e4 2.2e5 2.3e5 ?	Waste Processing	9.4 days ? 0.44 days ? 0.62 ?
			Save Ok Cancel









•	Boiling Water Re	eactor Liquid Rady	waste Treatment	System	
	High Purity Waste	Low Purity Waste	Chemical Waste	Regenerant Solutions Waste	Detergent Waste
	Detergent Waste	e Partition Factor	0.0	fraction (0.0 for no laundry)	
				Save	Ok Cancel









Name of Reactor	BWR Samp	le 🕜
Thermal Power Level	3400	MW(th) 🕜
Total Steam Flow	68	million kg/hr 🕜
Mass of Water in Reactor Vessel	0.17	million kg 🕜 Read from File
Cleanup Demineralizer Flow	0.59	million kg/hr 🕜
Condensate Demineralizer Regeneration Time	56	days 🕜
Copper tubing for condenser?	No v	
Fraction of Feedwater Through Condensate Deminera	alizers	1.0 fraction 🕜
Gas Inputs Save	Run	Back Cancel







Х

Containment Building Turbine Building Charcoal Adsorbers Reg. Guide 1.140 Charcoal adsorbers? Yes > Removal Efficiency Information Below 91 % ? Reg. Guide 1.140 Charcoal adsorbers? Yes > HEPA Filters Reg. Guide 1.140 HEPA Reg. Guide 1.140 HEPA Reg. Guide 1.140 HEPA Reg. Guide 1.140 HEPA Gland Seal Sea Efficiency Information Below 92 % ? HEPA Filters Reg. Guide 1.140 Charcoal adsorbers? Yes > Gland Seal Steam Row 0.54 % Gland Seal Holdup Time 0.1 % hours ? Image: Sea Efficiency Information Below ? HEPA Filters Reg. Guide 1.140 Charcoal adsorbers? Yes > Image: Sea Efficiency Information Below 92 % ? HEPA Filters Reg. Guide 1.140 Charcoal adsorbers? Yes > Image: Sea Efficiency Information Below ? HEPA Filters Reg. Guide 1.140 Charcoal adsorbers? Yes > Image: Sea Efficiency Information Below ? ? HEPA Filters Reg. Guide 1.140 Charcoal adsorbers? Yes > Image: Sea Efficiency Information Below ? ? Reg. Guide 1.140 Charcoal adsorbers? Yes > Image: Sea Efficiency Information Below ? ? <t< th=""><th>Boiling Water Reactor Gaseous Radwaste Treatment System</th><th></th></t<>	Boiling Water Reactor Gaseous Radwaste Treatment System	
Reg. Guide 1.140 Charcoal adsorbers? Yes Removal Efficiency (Range 0 - 100) 91 See Efficiency Information Below 91 HEPA Filters Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes Auxiliary Building Charcoal Adsorbers Reg. Guide 1.140 Charcoal adsorbers? Reg. Guide 1.140 Charcoal adsorbers? Yes Reg. Guide 1.140 Charcoal adsorbers? Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) 92<% Gland Seal Steam Row Gland Seal Holdup Time Idoine Released filters? (No = 0% Yes = 99%) Yes Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes HEPA Filters Reg. Guide 1.140 Charcoal adsorbers? Yes <th>-</th> <th>Turbine Building</th>	-	Turbine Building
See Efficiency Information Below 91 See Efficiency Information Below 94 Auxiliary Building Charcoal Adsorbers Reg. Guide 1.140 Charcoal adsorbers? Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) 92 % Wes HEPA Filters Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes HEPA Filters Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes HEPA Filters Reg. Guide 1.140 Charcoal adsorbers? Yes Reg. Guide 1.140 Charcoal adsorbers? Yes Reg. Guide 1.140 Charcoal adsorbers? Yes Removal Efficiency (Range 0 - 100) See Efficiency Information Below 93 % Yes HEPA Filters Reg. Guide 1.140 HEPA filters? Neg. Guide 1.140 Charcoal adsorbers? Yes Removal Efficiency (Range 0 - 100) See Efficiency Information Below 93 % PhepA Filters Reg. Guide 1.140 HEPA filters? Neg.		
Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes Auxiliary Building Charcoal Adsorbers Reg. Guide 1.140 Charcoal adsorbers? Yes Removal efficiency (Range 0 - 100) See Efficiency Information Below 92 % ? HEPA Filters Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes Auxiliary Building Charcoal Adsorbers 0.54 thousand kg/h Gland Seal Gland Seal Gland Seal 0.1 hours ? Gland Seal 0.05 fraction ? HEPA Filters Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes		
filters? (No = 0% Yes = 99%) Yes Auxiliary Building Charcoal Adsorbers Reg. Guide 1.140 Charcoal adsorbers? Removal efficiency (Range 0 - 100) See Efficiency Information Below 92<%	HEPA Filters	HEPA Filters
Auxiliary Building Charcoal Adsorbers Reg. Guide 1.140 Charcoal adsorbers? Yes Removal efficiency (Range 0 - 100) 92 92 % (Gland Seal Steam Flow 0.1 hours (Gland Seal Holdup Time 0.167 (Gland Seal Holdup Time (Gland Seal		
Reg. Guide 1.140 Charcoal adsorbers? Yes Removal efficiency (Range 0 - 100) 92 See Efficiency Information Below 92 HEPA Filters Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes Radwaste Building Charcoal Adsorbers Reg. Guide 1.140 Charcoal adsorbers? Yes Removal Efficiency (Range 0 - 100) See Efficiency Information Below 93< % ?	Auxiliary Building	
Removal efficiency (Range 0 - 100) See Efficiency Information Below 92 ************************************	Charcoal Adsorbers	Gland Seal Steam Flow 0.54 thousand kg/h
See Efficiency Information Below 92 4 HEPA Filters Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes Radwaste Building Charcoal Adsorbers Reg. Guide 1.140 Charcoal adsorbers? Yes Removal Efficiency (Range 0 - 100) 93 % ? HEPA Filters Reg. Guide 1.140 HEPA Marcoal Adsorption Coefficient Mass of Charcoal 21.77 Thousand kg ?	Reg. Guide 1.140 Charcoal adsorbers? Yes 🗸	Gland Seal Holdup Time 0.1 hours
Reg. Guide 1.140 HEPA filters? (No = 0% Yes = 99%) Yes Air Ejector Origas Air Ejector Vent 0.167 hours Origas Charcoal Adsorbers Reg. Guide 1.140 Charcoal adsorbers? Yes Reg. Guide 1.140 Charcoal Below 93 % Origas Yes Kr Dynamic Adsorption Coefficient 105 cm3/g Origon Xe Dynamic Adsorption Coefficient 2410 cm3/g Origon Mass of Charcoal 21.77		
filters? (No = 0% Yes = 99%) Yes Radwaste Building Iodine Released Charcoal Adsorbers 0.76 Reg. Guide 1.140 Charcoal adsorbers? Yes Removal Efficiency (Range 0 - 100) 93 See Efficiency Information Below 93 We Efficiency Information Below 93 We Efficiency Information Below 93 Charcoal Adsorption Coefficient 105 Charcoal Collary System? Yes Kr Dynamic Adsorption Coefficient 105 Cmarcoal Collary System? 2410 Charcoal Collary System? 2410 Common Coefficient 2410 Common Coefficient 2410 Charcoal Collary System? 21.77	HEPA Filters	Air Ejector Offgas
Radwaste Building 0.76 fraction Charcoal Adsorbers From Air Ejector Vent 0.76 fraction Reg. Guide 1.140 Charcoal adsorbers? Yes Charcoal Delay System? Yes Removal Efficiency (Range 0 - 100) 93 % ? Kr Dynamic Adsorption Coefficient 105 cm3/g ? HEPA Filters Reg. Guide 1.140 HEPA Yes Mass of Charcoal 21.77 thousand kg ?		
Reg. Guide 1.140 Charcoal adsorbers? Yes Yes <td>Radwaste Building</td> <td>0.76 traction</td>	Radwaste Building	0.76 traction
Reg. Guide 1.140 Charcoal adsorbers? Yes Removal Efficiency (Range 0 - 100) 93 % See Efficiency Information Below 93 % HEPA Filters 2410 cm3/g Reg. Guide 1.140 HEPA Mass of Charcoal 21.77 thousand kg ? ************************************	Charcoal Adsorbers	Charcoal Delay System? Yes 🗸
Nemoval Endency (nange 0 - 100) 93 % ? See Efficiency Information Below 93 % ? HEPA Filters Xe Dynamic Adsorption Coefficient 2410 cm3/g ? Mass of Charcoal 21.77 thousand kg ?	Reg. Guide 1.140 Charcoal adsorbers? Yes 🗸	
HEPA Filters Mass of Charcoal 21.77 thousand kg ?		
Reg. Guide 1.140 HEPA	HEPA Filters	
		Mass of Charcoal 21.77 thousand kg ?
	Reg. Guide 1.140 NUREG=0016	Save Ok Cancel
Reg. Guide 1.140 NUREG=0016 Save Ok Cancel		





Pressurized Water Reactor Parameters



[Sample PWR			
	Sample FWR			0
[3400	MW(th)	?	-
า [249.4758	thousand kg	?	
[283.9059	liters/min	?	Read fro
v Rate	28.39059	liters/min	?	File
[4		?	
[6.803886	million kg/hr	?	
erator	51.02914	thousand kg	?	
and Blowdown Tr	eatment Meth	od		
lensate system afte	er treatment		\sim	
U-Tube		\sim		
Only Input for U-1	ſube)	34.01943	thousand	d kg/hr
ration time		8.4	days	?
densate deminera	lizers	0.65	fraction	0
	v Rate [v Rate [uerator [and Blowdown Tr lensate system after U-Tube Only Input for U-1 ration time	v Rate 283.9059 4 28.39059 4 6.803886 herator 51.02914 and Blowdown Treatment Meth lensate system after treatment U-Tube Only Input for U-Tube)	249.4758 thousand kg 283.9059 liters/min 283.9059 liters/min 4 6.803886 6.803886 million kg/hr housand kg 6.803886 and Blowdown Treatment Method lensate system after treatment U-Tube ✓ Only Input for U-Tube) 34.01943 ration time 8.4	249.4758 thousand kg ? 283.9059 liters/min ? 28.39059 liters/min ? 4 ? ? 6.803886 million kg/hr ? erator 51.02914 thousand kg ? and Blowdown Treatment Method ? ? lensate system after treatment ~ ? U-Tube ~ ? Only Input for U-Tube) 34.01943 thousand ration time 8.4 days









Example Use Cases: BWR - GE



LIQUID WASTE INPUT STREAM	S FLOW RATE	FRACTION OF PCA	FRACTION DISCHARGED	COLLECTION TIME	DECAY TIME	DEC	ONTAMINATION	FACTORS
	(GAL/DAY)			(DAYS)	(DAYS)	I	CS	OTHERS
HIGH PURITY WASTE	2.86400E+04	1.50000E-01	1.00000E-02	1.40000E+00	7.00000E-02	1.10000E+03	1.20000E+02	1.30000E+03
LOW PURITY WASTE	5.70000E+03	1.30000E-01	8.00000E-01	3.10000E+00	6.00000E-01	1.50000E+03	1.60000E+04	1.70000E+04
CHEMICAL WASTE	6.00000E+02	2.00000E-02	1.75000E+00	3.20000E+00	7.00000E-01	1.80000E+03	1.90000E+04	2.00000E+04
REGENERANT SOLS	1.70000E+03		6.20000E-01	9.40000E+00	4.40000E-01	2.10000E+04	2.20000E+05	2.30000E+05

PMD Samela	BWR
BWR Sample	DWK
THERMAL POWER LEVEL (MEGAWATTS)	3.40000E+03
PLANT CAPACITY FACTOR	8.00000E-01
TOTAL STEAM FLOW (MILLION LBS/HR)	1.50000E+01
MASS OF WATER IN REACTOR VESSEL (MILLION LBS)	3.80000E-01
CLEAN-UP DEMINERALIZER FLOW (MILLION LBS/HR)	1.30000E-01
CONDENSATE DEMINERALIZER REGENERATION TIME (DAYS)	5.60000E+01
FRACTION FEED WATER THROUGH CONDENSATE DEMIN	8.30000E-01
REACTOR VESSEL HALOGEN CARRYOVER FACTOR	2.00000E-02

GASEOUS WASTE INPUTS

GLAND SEAL ST	EAM FLOW (THOUSAND LBS/HR)	1.20000
GLAND SEAL HO	LDUP TIME (HOURS)	1.00000
AIR EJECTOR O	FFGAS HOLDUP TIME (HOURS)	1.67000
CONTAINMENT B	LDGIODINE RELEASE FRACTION	1.00000
	PARTICULATE RELEASE FRACTION	1.00000
TURBINE BLDG	IODINE RELEASE FRACTION	6.00000
	PARTICULATE RELEASE FRACTION	1.00000
GLAND SEAL VE	NT, IODINE PF	9.50000
AIR EJECTOR O	FFGAS IODINE PF	2.40000
AUXILIARY BLD	G IODINE RELEASE FRACTION	8.00000
	PARTICULATE RELEASE FRACTION	1.00000
RADWASTE BLDG	IODINE RELEASE FRACTION	7.00000
	PARTICULATE RELEASE FRACTION	1.00000
THERE IS NO C	HARCOAL DELAY SYSTEM	

BWR Sample

NUCLIDE	COOLANT CONC. (MICROCURIES/G)	CONTAINMENT BLDG.	TURBINE BLDG.		S RELEASE RAT S PER YEAR) RADWASTE BLDG.	e GLAND SEAL	AIR EJECTOR	MECH VAC PUMP	TOTAL
I-131 I-133	2.20000E-03 1.50000E-02			2.03984E-03 1.39080E-02					
		H-3 RELEASED H-3 RELEASED TOTAL H-3 REL C-14 RELEASED	FROM CONTAINM EASED VIA GAS	ENT BLDG. VEN EOUS PATHWAY	TILATION SYST	EM 2.6000 5.2000	0E+01 CI/YR 0E+01 CI/YR 0E+01 CI/YR 0E+00 CI/YR		





0000E+00
0000E-01
7000E-01
00008400

- 00000E+00 00000E+00 00000E-02
- 0000E-01
- 10000E-01
- 0000E-02
- 0000E-02
- 00000E-02
 - 00E-02

Example Use Cases: BWR - GE

NUCLIDE	COOLANT CONC. (MICROCURIES/G)	CONTAINMENT BLDG.	TURBINE BLDG.		S RELEASE RAT S PER YEAR) RADWASTE BLDG.	E GLAND SEAL	AIR EJECTOR	MECH VAC PUMP	TOTAL
		1. 500008.01							
AR-41	0.00000E+00	1.50000E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	9.40000E+02	0.00000E+00	9.53712E+02
KR-83M	5.90000E-04	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	2.00000E+00	2.60000E+04	0.00000E+00	2.64607E+04
KR-85M	1.00000E-03	1.00000E+00	2.50000E+01	3.00000E+00	0.00000E+00	4.00000E+00	4.60000E+04	0.00000E+00	4.65179E+04
KR-85	4.00000E-06	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1.90000E+02	0.00000E+00	1.90896E+02
KR-87	3.30000E-03	0.00000E+00	6.10000E+01	2.00000E+00	0.00000E+00	1.20000E+01	1.40000E+05	0.00000E+00	1.43810E+05
KR-88	3.30000E-03	1.00000E+00	9.10000E+01	3.00000E+00	0.00000E+00	1.20000E+01	1.50000E+05	0.00000E+00	1.51215E+05
KR-89	2.10000E-02	0.00000E+00	5.80000E+02	2.00000E+00	2.90000E+01	2.20000E+01	1.10000E+05	0.00000E+00	1.13521E+05
XE-131M	3.30000E-06	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1.60000E+02	0.00000E+00	1.57425E+02
XE-133M	4.90000E-05	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	2.30000E+03	0.00000E+00	2.33349E+03
XE-133	1.40000E-03	2.70000E+01	1.50000E+02	8.30000E+01	2.20000E+02	5.00000E+00	6.70000E+04	1.30000E+03	6.85379E+04
XE-135M	4.40000E-03	1.50000E+01	4.00000E+02	4.50000E+01	5.30000E+02	1.30000E+01	1.30000E+05	0.00000E+00	1.35930E+05
XE-135	3.80000E-03	3.30000E+01	3.30000E+02	9.40000E+01	2.80000E+02	1.40000E+01	1.80000E+05	5.00000E+02	1.80338E+05
XE-137	2.60000E-02	4.50000E+01	1.00000E+03	1.35000E+02	8.30000E+01	3.30000E+01	2.00000E+05	0.00000E+00	2.02739E+05
XE-138	1.50000E-02	2.00000E+00	1.00000E+03	6.00000E+00	2.00000E+00	4.30000E+01	4.40000E+05	0.00000E+00	4.39881E+05
TOTAL NO	BLE GASES								1.50000E+06

0.00000E+00 APPEARING IN THE TABLE INDICATES RELEASE IS LESS THAN 1.0 CI/YR FOR NOBLE GAS

BWR S	Sample					
NUCLIDE	CONTAINMENT BLDG.	AIRBORN TURBINE BLDG.		RELEASE RATE S PER YEAR) RADWASTE BLDG.	MECH VAC. PUMP	TOTAL
CR-51	2.00000E-04	9.00000E-06	9.00000E-06	7.00000E-06	1.00000E-06	2.30000E-04
MN-54	4.00000E-04	6.00000E-06	1.00000E-05	4.00000E-05	0.00000E+00	4.60000E-04
CO-58	1.00000E-04	1.00000E-05	2.00000E-06	2.00000E-06	0.00000E+00	1.10000E-04
FE-59	9.00000E-05	1.00000E-06	3.00000E-06	3.00000E-06	0.00000E+00	9.70000E-05
CO-60	1.00000E-03	1.00000E-05	4.00000E-05	7.00000E-05	5.60000E-07	1.10000E-03
ZN-65	1.00000E-03	6.00000E-05	4.00000E-05	3.00000E-06	3.40000E-07	1.10000E-03
SR-89	3.00000E-05	6.00000E-05	2.00000E-07	0.00000E+00	0.00000E+00	9.00000E-05
SR-90	3.00000E-06	2.00000E-07	7.00000E-08	0.00000E+00	0.00000E+00	3.30000E-06
NB-95	1.00000E-03	6.00000E-08	9.00000E-05	4.00000E-08	0.00000E+00	1.10000E-03
ZR-95	3.00000E-04	4.00000E-07	7.00000E-06	8.00000E-06	0.00000E+00	3.20000E-04
MO-99	6.00000E-03	2.00000E-05	6.00000E-04	3.00000E-08	0.00000E+00	6.60000E-03
RU-103	2.00000E-04	5.00000E-07	4.00000E-05	1.00000E-08	0.00000E+00	2.40000E-04
AG-110M	4.00000E-07	0.00000E+00	2.00000E-08	0.00000E+00	0.00000E+00	4.20000E-07
SB-124	2.00000E-05	1.00000E-06	3.00000E-07	7.00000E-07	0.00000E+00	2.20000E-05
CS-134	7.00000E-04	2.00000E-06	4.00000E-05	2.40000E-05	3.20000E-06	7.70000E-04
CS-136	1.00000E-04	1.00000E-06	4.00000E-06	0.00000E+00	1.90000E-06	1.10000E-04
CS-137	1.00000E-03	1.00000E-05	5.00000E-05	4.00000E-05	8.90000E-06	1.10000E-03
BA-140	2.00000E-03	1.00000E-04	2.00000E-04	4.00000E-08	1.10000E-05	2.30000E-03
CE-141	2.00000E-04	1.00000E-04	7.00000E-06	7.00000E-08	0.0000E+00	3.10000E-04







Example Use Cases: BWR - LE



******** GALE version: GALE86 ********

****** ANS-18.1 version: 1999 ********

BWR Sample	BWR
THERMAL POWER LEVEL (MEGAWATTS)	3.40000E+03
PLANT CAPACITY FACTOR	8.00000E-01
TOTAL STEAM FLOW (MILLION LBS/HR)	1.50000E+01
MASS OF WATER IN REACTOR VESSEL (MILLION LBS)	3.80000E-01
CLEAN-UP DEMINERALIZER FLOW (MILLION LBS/HR)	1.30000E-01
CONDENSATE DEMINERALIZER REGENERATION TIME (DAYS)	5.60000E+01
FISSION PRODUCT CARRY-OVER FRACTION	1.00000E-03
HALOGEN CARRY-OVER FRACTION	2.00000E-02
FRACTION FEED WATER THROUGH CONDENSATE DEMIN	8.30000E-01

LIQUID WASTE INPUTS

STREAM	FLOW RATE	FRACTION OF PCA	FRACTION DISCHARGED	COLLECTION TIME	DECAY TIME	DECONT	AMINATION FAC	TORS
	(GAL/DAY)			(DAYS)	(DAYS)	I	CS	OTHERS
CHEMICAL WASTE	5.70000E+03 6.00000E+02	1.30000E-01 2.00000E-02	8.00000E-01 1.75000E+00	3.10000E+00 3.20000E+00	6.00000E-01 7.00000E-01	1.50000E+03 1.80000E+03	1.60000E+04 1.90000E+04	1.70000E 2.00000E
REGENERANT SOLS	1.70000E+03		6.20000E-01	9.40000E+00	4.40000E-01	2.10000E+04	2.20000E+05	2.30000

GASEOUS WASTE INPUTS

GLAND SEAL STEAM FLOW (THOUSAND LBS/HR)	1.20000E+00
GLAND SEAL HOLDUP TIME (HOURS)	1.00000E-01
AIR EJECTOR OFFGAS HOLDUP TIME (HOURS)	1.67000E-01
CONTAINMENT BLDG IODINE RELEASE FRACTION	1.00000E+00
PARTICULATE RELEASE FRACTION	1.00000E+00
TURBINE BLDG IODINE RELEASE FRACTION	6.00000E-02
PARTICULATE RELEASE FRACTION	1.00000E-02
GLAND SEAL VENT, IODINE PF	9.50000E-01
AIR EJECTOR OFFGAS IODINE PF	2.40000E-01
AUXILIARY BLDG IODINE RELEASE FRACTION	8.00000E-02
PARTICULATE RELEASE FRACTION	1.00000E-02
RADWASTE BLDG IODINE RELEASE FRACTION	7.00000E-02
PARTICULATE RELEASE FRACTION	1.00000E-02
THERE IS NO CHARCOAL DELAY SYSTEM	





RS 0E+03 0E+04 0E+04 0E+04 0E+05

Example Use Cases: BWR - LE

		CONCENTRATION IN PRIMARY			O DISCHARGE CA		ADJUSTED	DETERGENT	TOTAL
CLIDE	HALF-LIFE (DAYS)	COOLANT (MICRO-CI/ML)	HIGH PURITY (CURIES)	LOW PURITY (CURIES)	(CURIES)	(CURIES)	TOTAL (CI/YR)	WASTES (CI/YR)	(CI/YR)
RROSIO	N AND ACTIVAT	TION PRODUCTS							
24	6.25000E-01	2.00000E-03	4.00000E-05	1.00000E-05	0.00000E+00	6.00000E-05	8.40000E-04	0.00000E+00	8.40000E-0
32	1.42998E+01	4.00000E-05	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	5.00000E-05	1.80000E-04	2.30000E-0
51 54	2.77997E+01 3.02996E+02	3.00000E-03 4.00000E-05	1.30000E-04 0.00000E+00	1.40000E-04 0.00000E+00	1.00000E-05 0.00000E+00	2.80000E-04 0.00000E+00	4.05000E-03 5.00000E-05	4.70000E-03 3.80000E-03	8.70000E-03 3.80000E-03
56	1.07500E-01	2.50000E-02	8.00000E-05	0.00000E+00	0.00000E+00	8.00000E-05	1.19000E-03	0.00000E+00	1.20000E-0
55	9.49624E+02	1.00000E-03	5.00000E-05	5.00000E-05	0.00000E+00	1.00000E-04	1.41000E-03	7.20000E-03	8.60000E-0
59	4.49994E+01	3.00000E-05	0.00000E+00	0.00000E+00	0.0000E+00	0.00000E+00	4.00000E-05	2.20000E-03	2.20000E-0
58	7.12991E+01	1.00000E-04	0.00000E+00	0.00000E+00	0.0000E+00	1.00000E-05	1.40000E-04	7.90000E-03	8.00000E-0
60	1.92116E+03	2.00000E-04	1.00000E-05	1.00000E-05	0.00000E+00	2.00000E-05	2.80000E-04	1.40000E-02	1.40000E-03
63 65	3.36021E+04 1.06667E-01	0.00000E+00 3.00000E-04	0.00000E+00 0.00000E+00	0.00000E+00 0.00000E+00	0.00000E+00 0.00000E+00	0.00000E+00 0.00000E+00	0.00000E+00 1.00000E-05	1.70000E-03 0.00000E+00	1.70000E-0
64	5.33333E-01	3.00000E-03	6.00000E-05	2.00000E-05	0.00000E+00	7.00000E-05	1.08000E-03	0.00000E+00	1.10000E-0
65	2.44997E+02	1.00000E-04	0.00000E+00	0.00000E+00	0.00000E+00	1.00000E-05	1.40000E-04	0.00000E+00	1.40000E-0
69M	5.75000E-01	2.00000E-03	4.00000E-05	1.00000E-05	0.00000E+00	5.00000E-05	7.70000E-04	0.00000E+00	7.70000E-0
187	9,95833E-01	3.00000E-04	1.00000E-05	0.00000E+00	0.00000E+00	1.00000E-05	1.80000E-04	0.00000E+00	1.80000E-0
239	2.34997E+00	8.00000E-03	2.90000E-04	2.10000E-04	1.00000E-05	5.10000E-04	7.46000E-03	0.00000E+00	7.50000E-0
SSION	PRODUCTS								
83	1.00417E-01	6.00000E-03	2.00000E-05	0.0000E+00	0.00000E+00	2.00000E-05	3.40000E-04	0.00000E+00	3.40000E-0
84	2.20841E-02	7.00000E-03	0.00000E+00	0.00000E+00	0.0000E+00	0.00000E+00	1.00000E-05	0.00000E+00	1.0000E-0
89	5.19994E+01	1.00000E-04	0.00000E+00	0.00000E+00	0.00000E+00	1.00000E-05	1.40000E-04	9.00000E-05	2.30000E-0
90	1.02632E+04	1.00000E-05	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1.00000E-05	1.00000E-05	2.00000E-0
91 91	4.02917E-01 5.87993E+01	4.00000E-03 4.00000E-05	6.00000E-05 0.00000E+00	1.00000E-05 0.00000E+00	0.00000E+00 0.00000E+00	7.00000E-05 1.00000E-05	1.09000E-03 9.00000E-05	0.00000E+00 8.00000E-05	1.10000E-0
92	1.12917E-01	1.00000E-02	3.00000E-05	0.00000E+00	0.00000E+00	4.00000E-05	5.10000E-04	0.00000E+00	5.10000E-0
92	1.47083E-01	6.00000E-03	8.00000E-05	1.00000E-05	0.00000E+00	9.00000E-05	1.25000E-03	0.00000E+00	1.20000E-0
93	4.25000E-01	4.00000E-03	6.00000E-05	1.00000E-05	0.0000E+00	8.00000E-05	1,15000E-03	0.00000E+00	1.10000E-0
95	6.49992E+01	1.00000E-05	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1.00000E-05	1.10000E-03	1.10000E-0
95	3.49996E+01	1.00000E-05	0.00000E+00	0.00000E+00	0.0000E+00	0.00000E+00	1.00000E-05	1.90000E-03	1.90000E-0
98	3.54179E-02	4.00000E-03	0.00000E+00	0.0000E+00	0.00000E+00	0.00000E+00	2.00000E-05	0.00000E+00	3.00000E-0
99 99M	2.79167E+00 2.50000E-01	2.00000E-03 2.00000E-03	8.00000E-05 7.00000E-05	6.00000E-05 6.00000E-05	0.00000E+00 0.00000E+00	1.40000E-04 1.30000E-04	1.98000E-03 1.92000E-03	6.00000E-05 0.00000E+00	2.00000E-03 1.90000E-03
103	3.95995E+01	2.00000E-05	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	3.00000E-05	2.90000E-04	3.20000E-0
104	1.25004E-02	8.00000E-02	0.00000E+00	0.00000E+00	0.0000E+00	0.00000E+00	1.00000E-05	0.00000E+00	1.00000E-0
105	1.85000E-01	2.00000E-03	1.00000E-05	0.00000E+00	0.0000E+00	1.00000E-05	2.10000E-04	0.00000E+00	2.10000E-0
106	3.66995E+02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	8.90000E-03	8.9000E-0
110M	2.52997E+02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1.20000E-03	1.20000E-0
129M	3.39996E+01	4.00000E-05	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	5.00000E-05	0.0000E+00	5.00000E-0
131M	1.25000E+00	1.00000E-04	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	7.00000E-05	0.00000E+00	7.00000E-0
131	8.04990E+00	2.20000E-03	1.10000E-04	1.01000E-03	9.20000E-04	2.03000E-03	2.96900E-02	1.60000E-03	3.10000E-0
132 132	3.25000E+00 9.58333E-02	1.00000E-05 2.20000E-02	0.00000E+00 7.00000E-05	0.00000E+00 1.00000E-05	0.00000E+00 0.00000E+00	0.00000E+00 8.00000E-05	1.00000E-05 1.15000E-03	0.00000E+00 0.00000E+00	1.00000E-0
133	8.75000E-01	1.50000E-02	4.60000E-04	1.90000E-03	5.00000E-05	2.41000E-03	3.51900E-02	0.00000E+00	3.50000E-03
134	3.66679E-02	4.30000E-02	2.00000E-05	0.00000E+00	0.00000E+00	2.00000E-05	3.40000E-04	0.00000E+00	3.40000E-0
134	7.48742E+02	3.00000E-05	1.00000E-05	0.00000E+00	0.00000E+00	2.00000E-05	2.40000E-04	1.10000E-02	1.10000E-02
135	2.79167E-01	2.20000E-02	2.80000E-04	3.50000E-04	1.00000E-05	6.40000E-04	9.32000E-03	0.00000E+00	
136	1.29998E+01	2.00000E-05	1.00000E-05	0.0000E+00	0.00000E+00	1.00000E-05	1.50000E-04	3.70000E-04	5.2000E-0
137	1.09572E+04	8.00000E-05	4.00000E-05	0.00000E+00	0.00000E+00	4.00000E-05	6.40000E-04	1.60000E-02	1.70000E-0
138 139	2.23619E-02 5.75714E-02	1.00000E-02 1.00000E-02	1.00000E-05 1.00000E-05	0.00000E+00 0.00000E+00	0.00000E+00 0.00000E+00	1.00000E-05 1.00000E-05	1.90000E-04 1.70000E-04	0.00000E+00 0.00000E+00	1.90000E-0 1.70000E-0
140	1.27998E+01	4.00000E-04	2.00000E-05	2.00000E-05	0.00000E+00	4.00000E-05	5.20000E-04	9.10000E-04	1.40000E-0
141	3.23996E+01	3.00000E-05	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	5.00000E-05	2.30000E-04	2.80000E-0
142	6.38911E-02	5.00000E-03	1.00000E-05	0.00000E+00	0.00000E+00	1.00000E-05	1.20000E-04	0.00000E+00	1.20000E-0
143	1.37500E+00	3.00000E-05	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	2.00000E-05	0.00000E+00	2.00000E-0
143	1.36998E+01	4.00000E-05	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	5.00000E-05	0.00000E+00	5.0000E-0
44 OTHE	2.83996E+02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	3.90000E-03	3.90000E-0
- orne		1.14010E-01	1.50000E-04	4.00000E-05	0.0000E+00	2.00000E-04	2.90000E-03	0.0000E+00	2.90000E-0
AL									
	TRITIUM)	4 162002-01	2 39000E-03	3 970008-03	1 000008-03	7.35000E-03	1.07350E-01	8 93300E-02	2 00000E-0

NOTE: 0.00000E+00 INDICATES THAT THE VALUE IS LESS THAN 1.00000E-5.

TRITIUM RELEASE 5.10000E+01 CURIES PER YEAR









Thank you



Example Use Cases: Extra Source Term Screens

Low Purity Waste: moderate/high electrical conductivity							
	1	rage Flow	Fraction of Primary Coolant Activity (PCA)				
Equipment Drains From	m:	~					
Drywell							
Reactor Building							
Turbine Building							
Radwaste Building							
Auxiliary Building							
Fuel Pool Building							
Other							
Uncollected Valve and pump Seal							
Water Resulting From Dewatering of							
Other							
Total							
Ca	lculate	Use Values	Cancel				

Waste collection time, and proc	cessing and	dischar
Volume of Collection Tank		
Rate Into Collection Tank		
Are there redundant tanks?		
Limiting Equipment Flow Capacity of Cleanup		
Volume of Final Tank Following Cl	eanup	
Rate of Addition Waste Into Final	Tank	
Flow Capacity of Final Tank Discharge Pump		
Waste Collection Time Prior to Pr	ocessing	
Waste Processing and Discharge	e Time	
Rate into collection tank	Rate of addit waste into fir tank	
Collection Tank	→	Limiting Process







