



WELCOME TO THE

2016

RAMP

USERS MEETING

RADIATION PROTECTION COMPUTER
CODE ANALYSIS AND MAINTENANCE
PROGRAM



2016 Fall RAMP Meeting

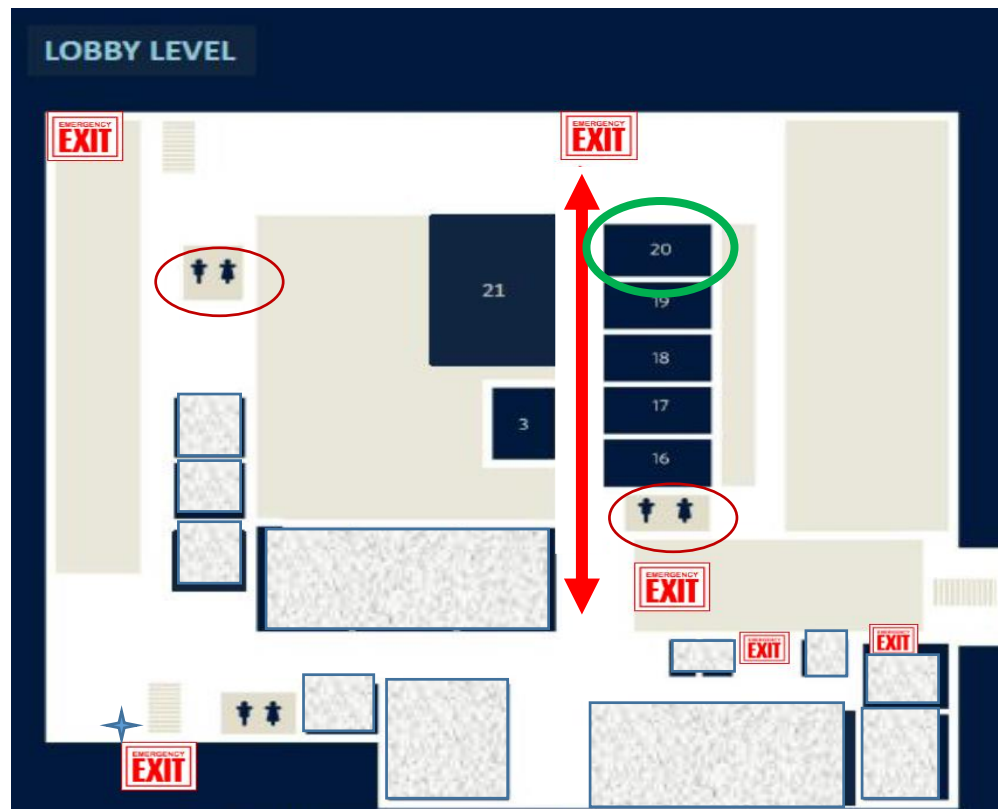



Stephanie Bush-Goddard, Ph. D.

RAMP Program Manager
Radiation Protection Branch
Division of Systems Analysis
Office of Nuclear Regulatory Research

October 17th, 2016

Housekeeping / Emergency Exits



 Restrooms

Meeting Rooms:

- 21 – Eisenhower
- 20 – Jackson
- 19 – Lincoln
- 18 – Monroe
- 17 – Truman
- 16 – Wilson
- 03 – Washington

 Help Desk

★ Exit To Twinbrook
Metro

Welcome Session Speakers

- Welcome
 - Michael Weber, Director, Office of Nuclear Regulatory Research
- The RAMP Program Overview
 - Rebecca Tadesse, Chief Radiation Protection Branch
- User Meeting Information
 - Stephanie Bush-Goddard, RAMP Program Manager
- Networking Session and Break
- Overview of RAMP Codes
 - Code Principle Investigators and Trainers
- Questions and Answers
- Check in for Ops Tour and International Meeting



Welcome to the RAMP Users Meeting

*Enhancing Radiation Protection Worldwide through
Collaborative Code Development and Maintenance*



Mr. Michael Weber
Director of Nuclear Regulatory Research

*Fall 2016 RAMP Meeting
Rockville, MD
October 17th-21th, 2016*

Welcome!

- Welcome to the 2016 Fall RAMP Users Meeting
- Over 400 registered RAMP Users
- Over ~50 participants at this RAMP Meeting
 - Representatives from Countries
 - South Africa, Canada , South Korea, UAE, China and Taiwan
 - US Government Agencies – NRC, EPA, DOC/NIST, DHS, DOD
 - US State agencies - Ohio
 - US National Laboratories – PNNL, ORNL, ANL, SNL
 - Universities – University of Texas, University of Central Florida
 - Industry

Nuclear Regulatory Research

- Mandated by Congress
- Three technical divisions and a support organization:
 - Division of Engineering
 - Division of Risk Analysis
 - Division of Systems Analysis
 - Program Management, Policy Development & Analysis Staff
- About 200 engineers, scientists, analysts, and support staff.
 - ~ 30% M.S. and 30% Ph.D.
- About \$90M funding



Research Mission

- Develop technical bases to support regulatory decisions
- Conduct confirmatory and anticipatory research
- Provide specialized technical expertise and tools
- Partner with national labs, commercial contractors, universities, other government agencies, industry organizations, and international organizations
- Issue Commission and congressionally mandated reports
- Manage the Generic Issues Program

Key Research Areas

- **Radiation and Environmental Protection**
 - Thermal-Hydraulics
 - Fuel and Core
 - Severe Accident and Accident Consequences
 - Risk Assessment
 - Human Reliability and Human Factors
 - Fire Safety
 - Natural Events
 - Materials Performance
 - Structural Performance
 - Digital Instrumentation & Control and Electrical Engineering



www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1925/

Research Roles

- Licensees and applicants have the primary responsibility for nuclear safety and security
- NRC determines if a safety or security issue exists
- NRC conducts confirmatory and anticipatory research to confirm safety and security
- NRC develops tools, codes, and information to confirm safety and security
- NRC does not conduct developmental research

International Research Collaboration

- Strong international cooperation
- 100+ bilateral or multilateral agreements with over 20 countries
 - Cooperative Research Programs
- Shared insights and resources
- Wide range of technical activities, including
 - Fukushima Activities
 - Halden Reactor Project
 - Zirconium Fire during Loss-of-coolant Accident Study
 - Fire Research



Halden Lab

Cooperative Research Programs

- **RAMP:** Radiation Protection Code Analysis and Maintenance Program to exchange information on radiation protection and dose assessment codes.
- **CSARP:** Cooperative Severe Accident Research Program to exchange information on severe accident safety issues related to reactor, spent fuel pool, and plant systems.
- **CAMP:** Code Applications and Maintenance Program to exchange information on thermal-hydraulic safety issues related to reactor and plant systems.
- **SGTIP:** Steam Generator Tube Integrity Program provides data and analysis for predicting the ability of degraded steam generator tubes to withstand normal operating and accident conditions.

Importance of RAMP

- Collaborate on radiation protection, dose assessment, and emergency response computer codes
- Share knowledge about radiation safety through training, code discussions, and “in-kind” contributions
- Refine codes and models based on strengths and deficiencies from the user community
- Enhance nuclear and radiological safety
- Protect people and the environment

Your Role

- Thank you for coming!
- Participate actively
- Share your insights
- Work together for safety
- Build networks
- Strengthen collaboration
- Enjoy Washington



WELCOME TO THE 2016 RAMP USERS MEETING

REBECCA TADESSE, CHIEF
RADIATION PROTECTION BRANCH
OFFICE OF NUCLEAR REGULATORY RESEARCH

Agenda

- What is RAMP?
- Benefits of RAMP membership
- RAMP Website
- RAMP Partners
- What is New in RAMP?
- Future Activities in RAMP
- Schedule at a Glance

What Is RAMP?

- RAMP is a Computer Code Management Program that will support development and maintenance of radiation/dose assessment codes
 - Streamline updates
 - Incorporating the latest accepted state of the art models
 - Prioritize technical updates
 - Achieve consistency in documentation
 - Implement a software QA program
 - Fiscally responsible by leveraging group dynamics
 - Implement centralized and consistent management and control structure
 - Responsive to the RAMP-user needs
 - Leverage the US NRC expertise in member country activities



RAMP Program

- RAMP Program:
 - Internal to NRC
 - Meeting Program Office Request
 - Meeting Software Quality Assurance Requirement
 - Aligning with changes in OIS (i.e. Windows 7)
 - Documenting Resources required to develop computer codes
 - Looking for ways to combine codes for greater efficiencies
 - Domestically and Internationally
 - Sharing expertise
 - Providing funds (~\$20K) to help maintain codes used by Program Offices, Federal and State Agencies, International Regulatory Authorities



Benefits of RAMP

- Why Join RAMP?
- Larger RP community exercises codes more thoroughly
- User forums/groups benefit from multiple users
- More efficient use of resources (larger resource pool)
- Encouraging Organizations to join:
 - Regulators, licensees, vendor groups, etc.

Benefits to Members

- Computer Codes will have:
 - Up-to-date ICRP Reports
 - Country Specific Reactor Types
 - International Units: Sv, Gy
 - Addressing other country specific needs

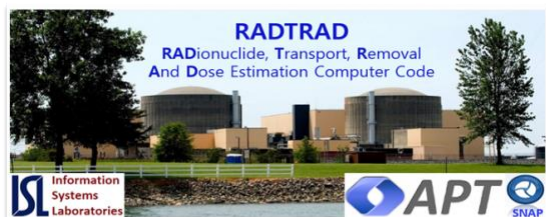
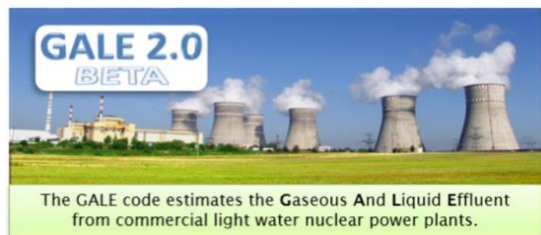


RAMP Website

www.usnrc-ramp.com



Computer Codes on RAMP Website



Atmospheric Codes

RAMP Membership

- RAMP: ~400
- RASCAL: ~150
- VARSKIN: ~350
- Users Forum
- Code Documentation
- Training Modules
- Support



Current RAMP International Agreements



What is New in RAMP?

- Code Updates
 - RASCAL –
 - Online Training Modules
 - Forum – use the forum!!!!
 - RADTRAD –
 - Test Reports, User Manuals
 - HABIT – GUI
 - Added new Dense Gas model
- New to RAMP
 - GENII
 - MILDOS
 - Atmospheric Codes

Future Activities in RAMP

- Include Additional Codes:
 - In talks with DOE for RESRAD, TurboFRMAC
- Updated Software Quality Assurance Program
- Combine Codes for Greater Efficiencies
- Maintain Code Development
 - Ensure Compatible platform
 - Consistent Documentation
- Develop online training and information modules
 - More RASCAL Modules, VARSKIN, RADTRAD
 - Health Physics and Radiation Safety Training
- Meeting regulatory requirements
 - Security and Safeguards

Schedule at a Glance

October 17 - 21, 2016 8am - 5pm		RAMP Users Group 2016 - Description of Training & Events						
Mon., Oct 17 2016	Morning Session	Welcome to RAMP - Opening Ceremony						
	Afternoon Session	RASCAL	VARSKIN	MILDOS	HABIT	Atmospheric Codes		
	"Social Night Out" Evening Event - RAMP Users Group Networking Session							
Tues., Oct 18 2016	Morning Session	RASCAL	VARSKIN	MILDOS	*RAMP Discussions & Meetings			
	Afternoon Session							
Wed., Oct 19 2016	Morning Session	RASCAL	VARSKIN	MILDOS			*RAMP Discussions & Meetings	
	Afternoon Session	GENII	RADTRAD	GALE	PiMAL	Country Meetings		
	4:00 PM - NRC Emergency Response Operations Tour							
Thurs., Oct 20 2016	Morning Session	GENII	RADTRAD	GALE	PiMAL	*RAMP Discussions & Meetings		
	Afternoon Session							
	4:00 PM - NRC Emergency Response Operations Tour							
Fri., Oct 21 2016 <i>* 8am - 12pm</i>	Morning Session	GENII	RADTRAD	GALE	*RAMP Discussions & Meetings			
	Afternoon Session	RAMP Closing Ceremony						



WELCOME TO THE 2016 RAMP USERS MEETING

STEPHANIE BUSH-GODDARD, PH. D.

RAMP PROGRAM MANAGER
RADIATION PROTECTION BRANCH
DIVISION OF SYSTEMS ANALYSIS
OFFICE OF NUCLEAR REGULATORY RESEARCH

Detailed Schedule Monday-Tuesday

Monday	Eisenhower (#21)	Washington Theater (#03)	Jackson (#20)	Lincoln (#19)	Monroe (#18)	Truman (#17)	Wilson (#16)
9am	Welcome - Opening Ceremony (9AM)		Help Desk				
noon	Lunch/Closed						
1pm	RASCAL	RAD Toolbox discussion	Help Desk	HABIT	Atmospheric Codes	VARSKIN	MILDOS
		DCFPAK discussion	Open Networking Area				
5pm	End Sessions/Closed						
6pm	"Social Night Out" Evening Event - RAMP Users Group Networking Session - Miller's Ale House						
Tuesday	Eisenhower (#21)	Washington Theater (#03)	Jackson (#20)	Lincoln (#19)	Monroe (#18)	Truman (#17)	Wilson (#16)
8am	RASCAL		Help Desk		Open Networking Area	VARSKIN	MILDOS
		Open Networking Area		Open Networking Area			
Noon	Lunch/Closed						
1pm	RASCAL		Open Networking Area		CHINA C2C (closed)	VARSKIN	MILDOS
		RADTRAD discussion		Open Networking Area			
5pm	End Sessions/Closed						

Detailed Schedule Wed-Thurs

	Eisenhower (#21)	Washington Theater (#03)	Jackson (#20)	Lincoln (#19)	Monroe (#18)	Truman (#17)	Wilson (#16)
Wednesday							
8am	RASCAL	GENII discussion	Help Desk		GALE	VARSKIN (discussions only)	MILDOS
			Open Networking Area				
		Country to Country Luncheon	Lunch/Closed				
Noon							
1pm				RADTRAD	GALE	PiMAL (disuccsions)	GENII
		Open Networking Area					
4pm	NRC Emergency Response Operations Tour (4PM departure to US NRC HQ)						
5pm	Washington DC Night Time Tour (6:30 PM departure from Hilton)						
Thursday							
8am				RADTRAD	SOUTH KOREA c2c (closed)	PiMAL	GENII
			Open Networking Area				
		RASCAL discussion					
Noon	Lunch/Closed						
1pm			Open Networking Area	RADTRAD	Canada/MILDOS	PiMAL	GENII
	Open Networking Area				Canada NRC discussion (closed)		
	Leave for Ops Tour						
5pm	NRC Emergency Response Operations Tour (4PM departure to US NRC HQ)						

Detailed Schedule Friday

Friday	Eisenhower (#21)	Washington Theater (#03)	Jackson (#20)	Lincoln (#19)	Monroe (#18)	Truman (#17)	Wilson (#16)	
8am		RAD Toolbox discussion	Open Networking Area	RADTRAD	TAIWAN c2c (closed)		GENII	
						Open Networking Area		
		DCFPAC demo				UAE c2c (closed)		
Noon	RAMP Closing Ceremony	Training/Sessions End/Closed						

- Closing Ceremony at 12 noon
- RAMP Attendance Certificates will be distributed
 - Certificates can be mailed
- Please stay for group pictures

NRC Operations Center Tour

- Wednesday and Thursday at 4pm
- Take the Metro – meet at the registration desk



Enjoy Washington! - Washington DC Tour

- **Itinerary:**

- 5:20pm Pick Up: Tour bus arrives at RAMP User Group Meeting Location
- 6:20pm Meet tour guide at the White House Gifts - 3 hour private tour
- 9:00pm Depart Washington DC for Rockville, MD
- 10:00pm Drop Off: Returns to the RAMP User Group Meeting Location

- **Price: \$55.50 per person** pay online.

- Computers in Hilton Atrium



Enjoy Washington - Happy Hour

- Social Night Out
- **Date:** Monday, October 17, 2016
- **Time:** 4:30pm – 7:00pm
- **Location:** Millers Ale House, 1471 Rockville Pike, Rockville, MD 20852
- Program Booklet
 - Welcome Letters
 - Descriptions of Major Training
 - Nearby Dining
 - Local Activities



~~Your~~ Our Role

- We are glad you are here!
- Participate actively
- Share your insights
- Work together to enhance radiation protection and nuclear safety
- Build networks
- Strengthen collaboration
- Enjoy Washington

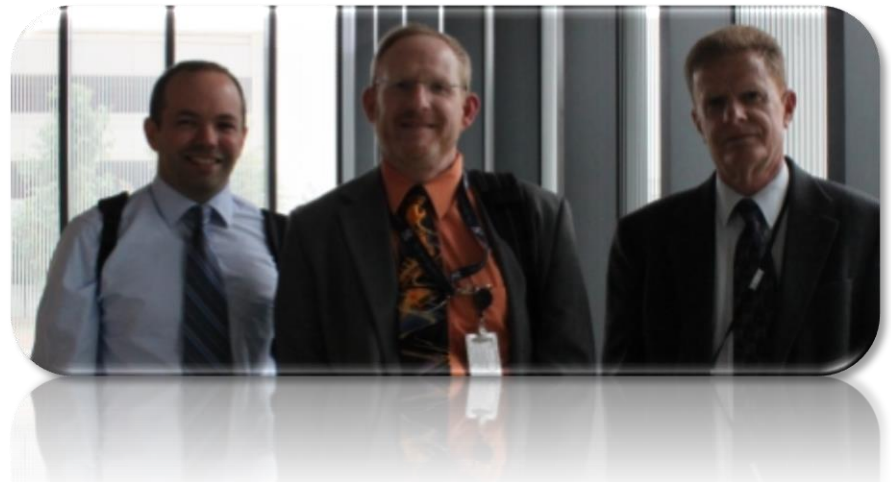


1st RAMP Users' Meeting Highlights

Mike Weber welcoming everyone



Getting to know each other



RAMP Team
and
International
Participants



Establishing Sustainable Relationships



Building networks
through RAMP!



South Africa - RAMP Users' Meeting Highlights



Ask Us! The RAMP Team

April Augustine



Stephanie Bush-Goddard



John Tomon



Abby Foster



Minh-Thuy Nguyen



Vered Shaffer



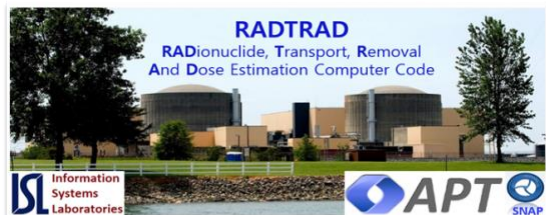
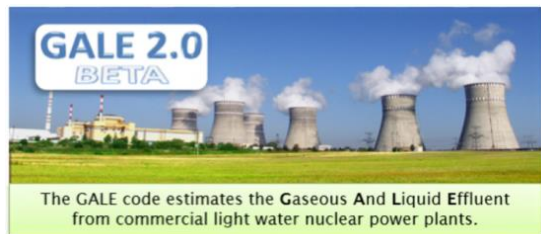
Wendy Chinchilla



Networking Session

Networking Session

Computer Codes on RAMP Website



Atmospheric Codes

RAMP Codes - Introductions

Code	Purpose	Source	Pathway
RASCAL	Response	Normal/Accident	Air
HABIT	Licensing	Design Basis Accident	Air
VARSKIN	Licensing	Normal/Accident	Body
GALE	Licensing	Normal	Air
Atmospheric Codes	Licensing	Normal/Accident	Air
MILDOS	Licensing	Fuel Cycle	Air
RADTRAD	Licensing	Design Basis Accident	Air
D&D	Decommissioning	Non-Rx	Ground/Water
GENII	Research	Normal/Accident	Air/Ground/Water
Rad Toolbox	Research Database	-	-
PIMAL	Research GUI	-	-

RAMP Code Team:

RASCAL

- John Tomon, CHP
 - U.S. NRC, COR
- Jeff Kowalczyk
 - U.S. NRC, Technical Monitor
- George Athey
 - Athey Consulting, Inc.
- Jeremy Rishel
 - Pacific Northwest National Laboratory
- John Fulton
 - Sandia National Laboratory

RAMP Code Team:

SNAP/RADTRAD

- John Tomon, CHP
 - U.S. NRC, COR
- Mark Blumberg
 - U.S. NRC, Technical Monitor
- Bill Arcieri
 - Information Systems Laboratory, Inc.
- Diane Mlynarczyk
 - Information Systems Laboratory, Inc.



RAMP Code Team:

VARSKIN

- Stephanie Bush-Goddard
 - U.S. NRC
- David Hamby, Ph.D.
 - Oregon State University



RAMP Code Team:

GENII

- Stephanie Bush-Goddard
 - U.S. NRC
- Bruce Napier
 - Pacific Northwest National Laboratory
- Jeremy Rishel
 - Pacific Northwest National Laboratory
- April Augustine
 - Pacific Northwest National Laboratory
- Abby Foster
 - Pacific Northwest National Laboratory

RAMP Code Team:

Atmospheric Codes

- Stephanie Bush-Goddard
 - U.S. NRC
- Kevin Quinlan, Technical Monitors
 - U.S. NRC
- Brad Harvey, Technical Monitors
 - U.S. NRC
- Jeremy Rishel
 - Pacific Northwest National Laboratory

RAMP Code Team:

PIMAL

- Tanya Oxenberg, Ph.D.
 - U.S. NRC
- Vered Schaffer, Ph.D.
 - U.S. NRC
- Sami Sherbini, Ph. D.
 - U.S. NRC; Sr. Technical Advisor
- Shaheen Dewji, Ph. D.
 - Oak Ridge National Laboratory
- Michael Bellamy, Ph. D.
 - Oak Ridge National Laboratory
- Nolan Hertel, Ph. D.
 - Oak Ridge National Laboratory
- Mauritius Hiller, Ph. D.
 - Oak Ridge National Laboratory

RAMP Code Team:

GALE

- John Tomon, Ph.D.
 - U.S. NRC, COR
- Ken Geelhood
 - Pacific Northwest National Laboratory
- Walter Luscher, Ph.D.
 - Pacific Northwest National Laboratory
- April Augustine, PMP
 - Pacific Northwest National Laboratory

RAMP Code Team:

HABIT

- Casper Sun, Ph.D.
 - U.S. NRC, COR
- Tom Spicer, Ph. D.
 - University of Arkansas
- Wendy Chinchilla
 - Leidos

RAMP Code Team:

Radiological Toolbox

- Casper Sun, Ph.D.
 - U.S. NRC
- Tanya Oxenberg, Ph.D.
 - U.S. NRC
- Sami Sherbini, Ph. D.
 - U.S. NRC; Sr. Technical Advisor
- Shaheen Dewji, Ph. D.
 - Oak Ridge National Laboratory
- Michael Bellamy, Ph. D.
 - Oak Ridge National Laboratory
- Nolan Hertel, Ph. D.
 - Oak Ridge National Laboratory
- Mauritius Hiller, Ph. D.
 - Oak Ridge National Laboratory



RAMP Code Team:

DandD

- Stephanie Bush-Goddard, Ph. D.
 - U.S. NRC, PM
- Adam Schwartzman
 - U.S. NRC
- Cynthia Barr
 - U.S. NRC

RAMP Codes





Radiological Assessment System for Consequence AnaLysis

Fast running software used in radiological incidents
to assess off-site dose consequences

RASCAL Use

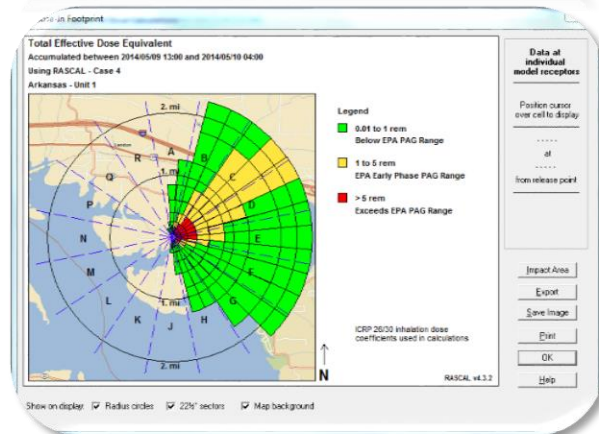
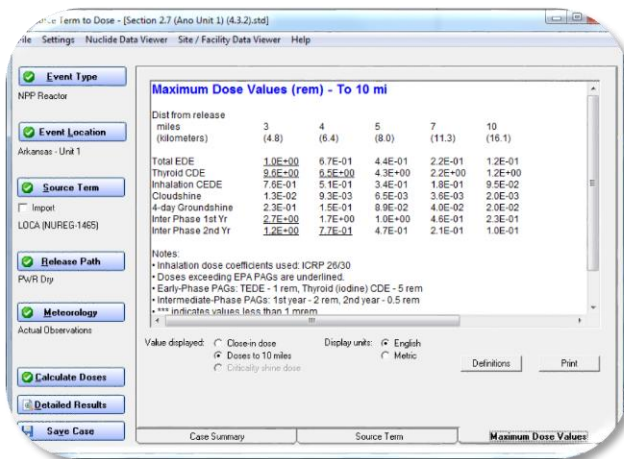
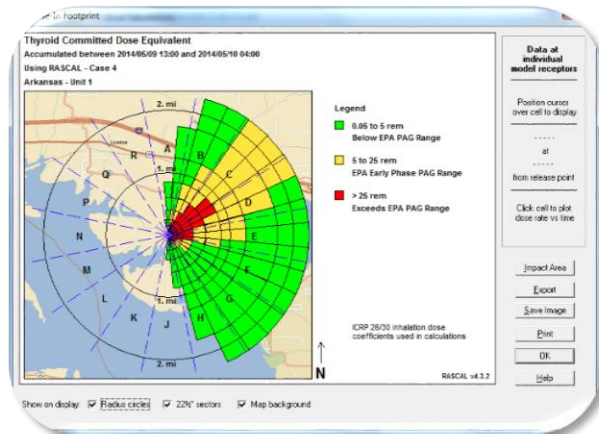
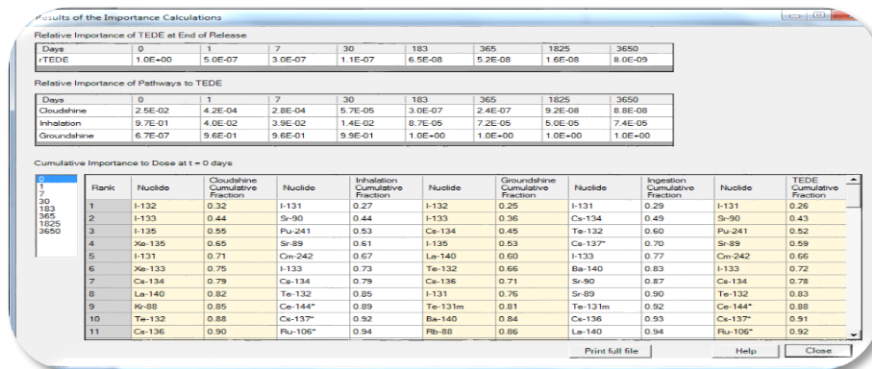
- Who
 - Response organizations
- When
 - Pre-release or plume phase of radiological release to atmosphere
- Why
 - To help inform or evaluate protective actions

RASCAL Methods



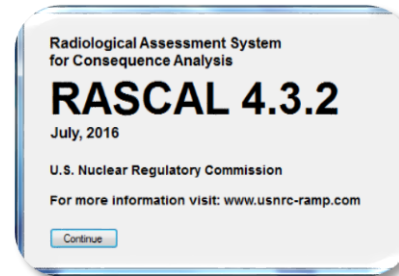
RASCAL Methods

- Tabular and graphical outputs



RASCAL Information

- Version 4.3.2



- Web-Based Training

RASCAL Web-Based Training

This content is provided as introductory courses to RASCAL and is a pre-requisite to instructor-led training.

Module(Link to File)	Module description	Applicable RASCAL User
Module 1 - Introduction to RASCAL	Brief overview providing general information RASCAL capabilities, limitations, and use.	New RASCAL users, managers, and decision-makers.
Module 2 – RASCAL Fundamentals	In-depth course covering how to use RASCAL and the models and methods within.	New RASCAL users.

- RASCAL Version 5.0

RAMP Codes

SNAP/RADTRAD



SNAP/RADTRAD

Symbolic Nuclear Analysis Package
RADionuclide Transport, Removal
And Dose Estimation



Information
Systems
Laboratories

Model Editor

.....
This code is the result of 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, product, or process included in or calculated by this code, or represents that the use by such third party would not infringe upon privately-owned rights. In addition, you may not distribute this computer code to anyone or use this computer code without permission from the United States Nuclear Regulatory Commission.
.....

Symbolic Nuclear Analysis Package, Version 2.4.0, July 09, 2015
(c) 2002-2014 Applied Programming Technology, Inc.

APT PLOT

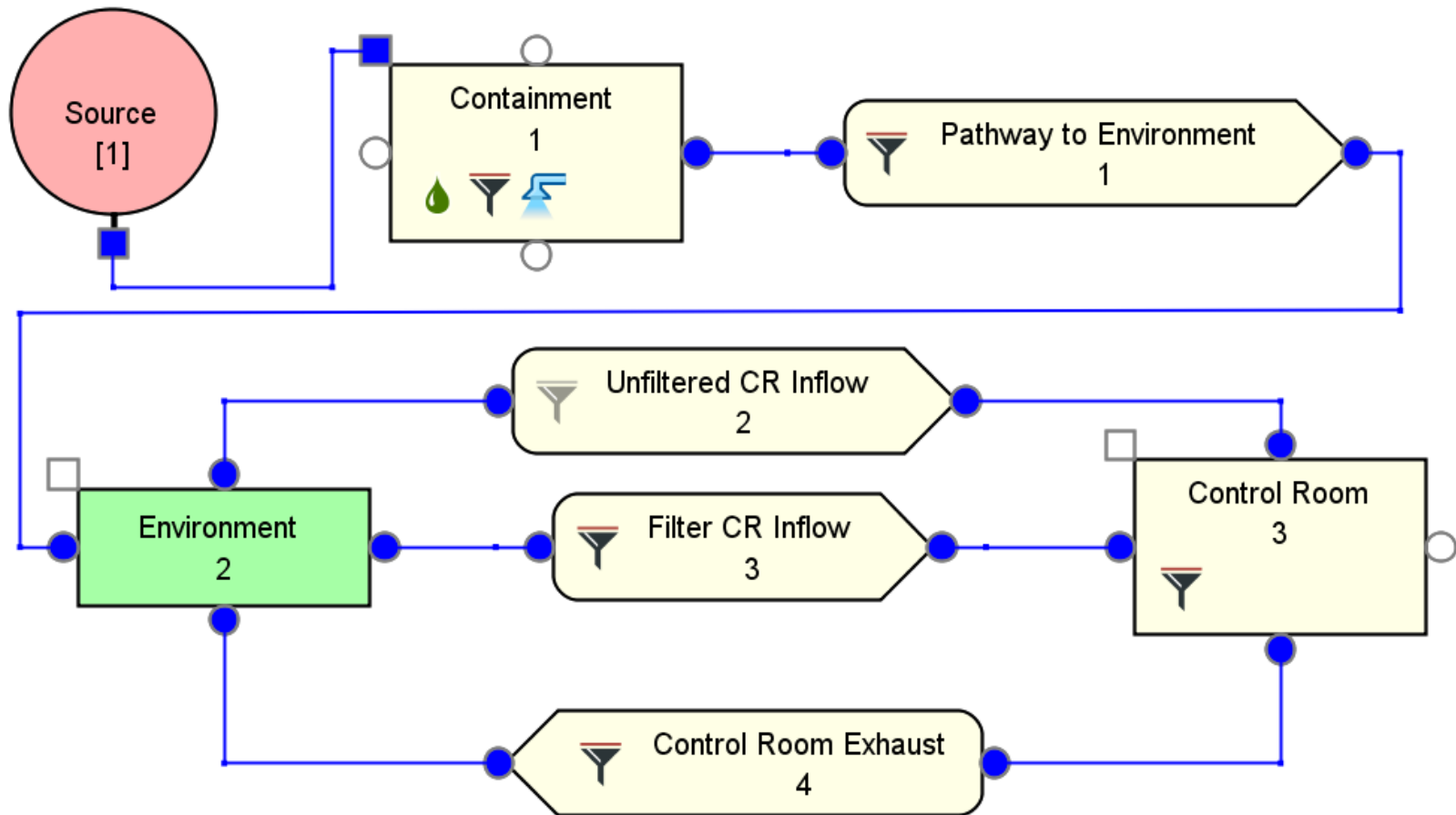
ApPlot 6.5.2
(c) 2006-2014 Applied Programming Technology, Inc.



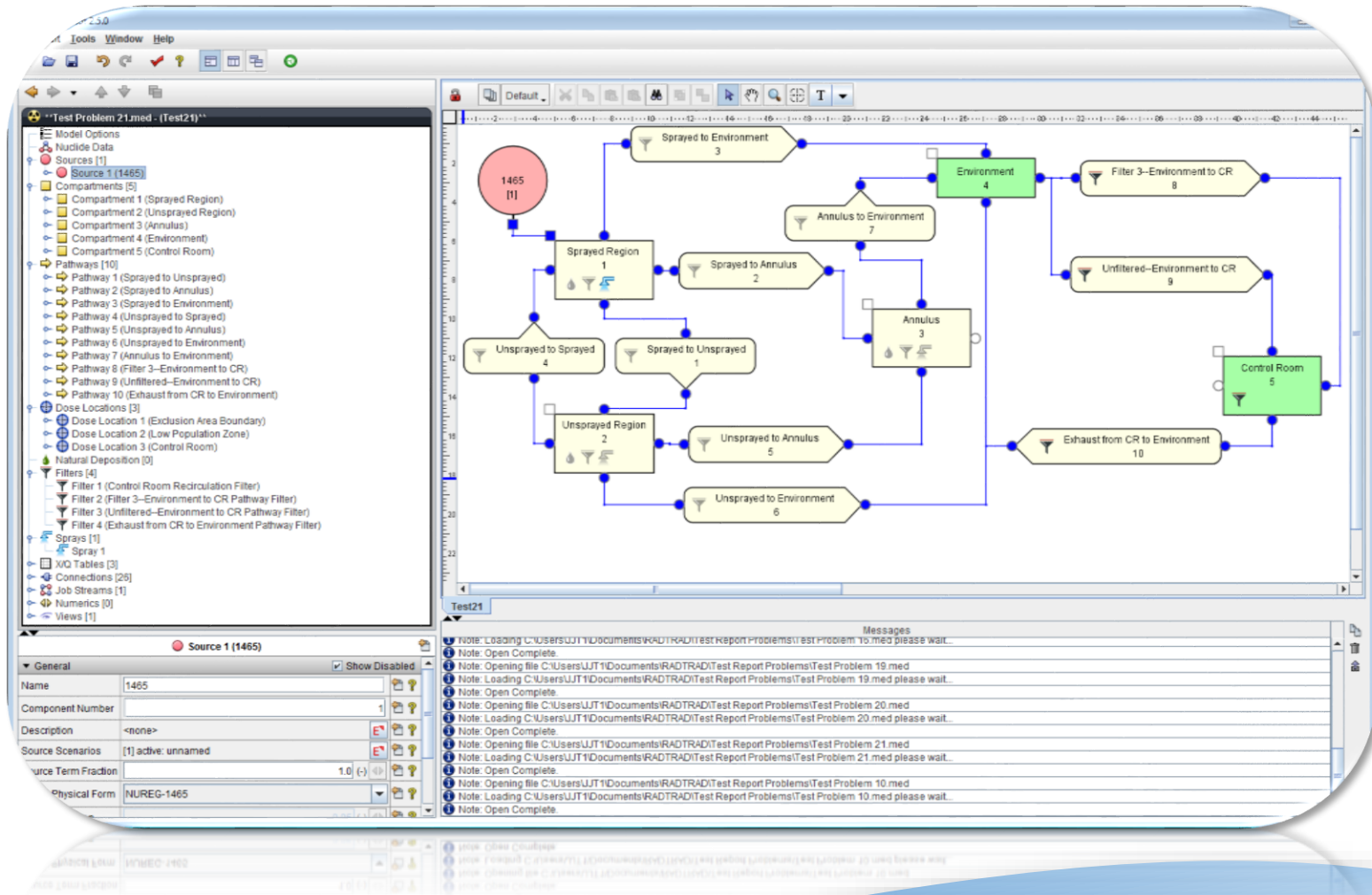
SNAP/RADTRAD Use

- The NRC uses SNAP/RADTRAD as licensing analysis confirmatory code to verify that the plant's design and the licensee's offsite and control room dose calculations following a DBA meet the following criteria:
 - 10 CFR Part 100, "Reactor Site Criteria"
 - 10 CFR 50.67, "Accident Source Term"
 - 10 CFR 50.34, "Contents of applications; technical information"
 - 10 CFR 50, Appendix A, GDC 19, "Control Room"

SNAP/RADTRAD Methods



SNAP/RADTRAD Methods



SNAP/RADTRAD Outputs

SNAP Job Status 2.5.0

File View Tools Help

Job List

- Local
 - RADTRAD/
 - Cooper_FHA_24hrdecay_basecase/
 - RADTRAD/
 - All_Tests/
 - DC_Cook/
 - DC_Cook_FHA_Auxbuilding/
 - Exercise_1/
 - Exercise_2/
 - Exercise_3/
 - Exercise_4/

calcsevr://Local/RADTRAD/RADTRAD/Ex

Job	Priority	Job Type	Plot Files	Submitted	Started	Completed
Base_Job	3	RADTRAD				Oct 14
Exercise_1	4	Stream				Oct 14
PlotStep	5	AptPlot	Complete			Oct 14

input - radtrad.psx
 dfx - radtrad.dfx
 icx_1 - radtrad_1.icx
 srx_1 - radtrad_1.srx
output - radtrad.out
NRC-out - radtradNRC.out
 log - radtrad.log
 screen - radtrad.screen
 Task Log - Base_Job.tasklog

AptPlot - C:\Users\JJT1\laptop\templates\Default.agr (modified)

File Edit Data Plot View Window Tools Help

G0: X, Y = [1031.72, 293.56]

S:1 W:0

Control Room Thyroid Dose

I-131 Through I-135

Dose (rem)

Time (h)

Legend: I-131 (x), I-132 (*), I-133 (+), I-134 (▲), I-135 (▼)

HQPWD: S020351, C:\Users\JJT1\laptop\templates\Default.agr

radtradNRC.out (Base_Job) - File Viewer

Edit Help

Find

Case Sensitive Match Whole Words

WORST TWO-HOUR DOSES

Exclusion Area Bndry	Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
0.0-2.0	1.5919E+01	3.6435E+03	1.6144E+02	

FINAL DOSES

Low Population Zone

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
720.0	1.0555E+01	6.6110E+03	3.0691E+02

Control Room

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
720.0	4.2850E-01	4.9459E+02	2.0290E+01

RADTRAD v4.5.4

copyright (c) 2015 Information Systems Laboratories, inc.
 This software was developed for the U.S. Nuclear Regulatory Commission under Contract no. GS23F0060L NRC-HQ-13-P-04-0099.

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, or 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, of any information in or generated by this program, or represents that its use by such third party would not infringe privately owned rights.

3195 3234

Close

SNAP/RADTRAD Information

- SNAP/RADTRAD
 - SNAP Model Editor (v2.5.0)
 - RADTRAD Plugin (v4.11.2)
 - RADTRAD-AC (v4.5.4)
 - AptPlot (v6.70)
- NUREG/CR-7220
 - SNAP/RADTRAD 4.0: Description of Models and Methods
- Support (FAQs and Forums)
 - Error Reports
 - General Usage Questions
 - Model Questions

RAMP Codes

GALE 2.0



GALE 2.0

Gaseous And Liquid Effluent Computer code

Computerized mathematical model for calculating the releases of radioactive material in gaseous and liquid effluents from BWRs and PWRs.

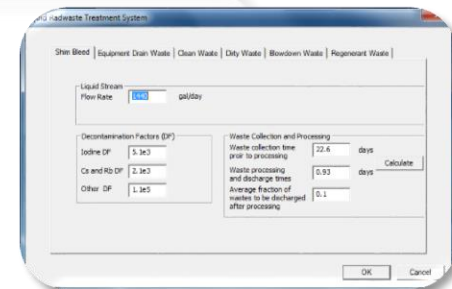
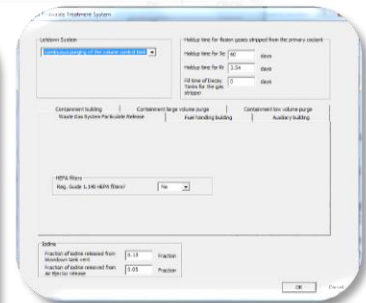
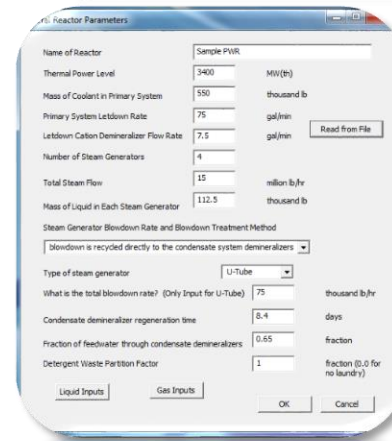
GALE Use

- The NRC uses the GALE code as licensing analysis code to verify (confirm) that the plant's design meets the requirements of Appendix I to Title 10 of the Code of Federal Regulations (CFR) Part 50.



GALE Methods

- GALE 2.0
- Code runs on Microsoft Windows PCs
- GUI was added to facilitate user interactions
- Ability to read legacy input files from GALE
- Code benchmarking was performed to validate GALE 2.0 to GALE 09
- Hard-coded parameters were updated to reflect recent plant operations data



GALE Outputs

- Text file output and Excel spreadsheets

Notepad

Sample PWR

3400.00000 PWR

THERMAL POWER LEVEL (MEGAWATTS)

PLANT CAPACITY FACTOR 0.90

MASS OF PRIMARY COOLANT (THOUSAND LBS) 550.00000

PRIMARY SYSTEM LETDOWN RATE (GPM) 75.00000

LETDOWN CATION DEMINERALIZER FLOW (GPM) 7.50000

FLOWER OF STEAM GENERATORS 4.00000

TOTAL STEAM FLOW (MILLION LBS/HR) 15.00000

MASS OF LIQUID IN EACH STEAM GENERATOR (THOUSAND LBS) 112.50000

BLOWDOWN RATE (THOUSAND LBS/HR) 75.00000

CONDENSATE DEMINERALIZER REGENERATION TIME (DAYS) 8.40000

CONDENSATE DEMINERALIZER FLOW FRACTION 0.48000

LIQUID WASTE INPUTS

STREAM	FLOW RATE (GAL/DAY)	FRACTION OF PCA DISCHARGED	FRACTION DECAY (DAYS)	COLLECTION TIME (DAYS)	DECAY TIME (DAYS)	DECONTAMINATION FACTORS
SHIM BLEED RATE	1.44E+03	1.0000	0.1000	22.6000	0.8300	5.00E+03 2.00E+02 1.00E+03
EQUIPMENT DRAINS	3.30E+02	0.9700	0.1000	22.6000	0.8300	5.00E+03 2.00E+02 1.00E+03
CLEAN WASTE INPUT	5.00E+02	0.0950	0.1000	0.1000	0.1000	5.00E+02 1.00E+03 1.00E+03
UTILITY WASTES	2.10E+03	0.0100	1.0000	3.8000	0.1900	5.00E+02 1.00E+03 1.00E+03
BLowdown	2.16E+04	0.0000	0.0000	0.0000	0.0000	1.00E+03 1.00E+03 1.00E+03
UNDEGRADED BLOWDOWN	0.00E+00	1.0000	0.0000	0.0000	0.0000	1.00E+03 1.00E+03 1.00E+03
REGENERANT SOLS	3.40E+03	0.1000	0.1000	4.7000	0.3700	5.00E+02 1.00E+03 1.00E+03

GASEOUS WASTE INPUTS

THERE IS CONTINUOUS STRIPPING OF FULL LETDOWN FLOW

FLOW RATE THROUGH GAS STRIPPER (GPM) 75.22916

HOLDUP TIME FOR KENOX (DAYS) 60.00000

HOLDUP TIME FOR KRYPTON (DAYS) 3.84000

TIME OF DECAY TANKS FOR THE GAS STRIPPER (DAYS) 0.00000

PRIMARY COOLANT LEAK TO AUXILIARY RIDG (LBS/DAY) 160.00000

GAS WASTE SYSTEM PARTICULATE RELEASE FRACTION 0.01000

FUEL HANDLING BLDG IODINE RELEASE FRACTION 0.10000

AUXILIARY BLDG IODINE RELEASE FRACTION 0.10000

CONTAINMENT VOLUME (MILLION FT³) 2.71800

FREQUENCY OF PRIMARY COOLANT DEGRASSING (TIMES/YR) 2.00000

PRIMARY TO SECONDARY LEAK RATE (LBS/DAY) 75.00000

THERE IS NOT A WINDY FILTER

PWR GALE Outputs (Comprehensibility Mode) Microsoft Excel

GALE 2.0


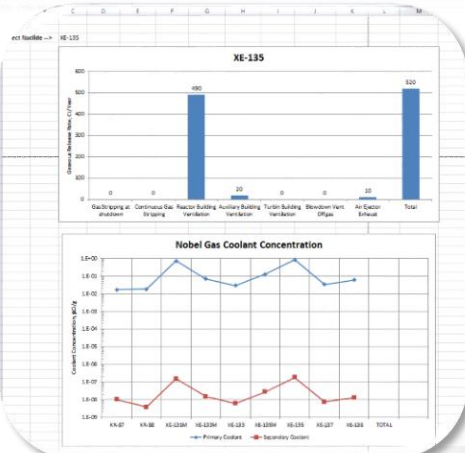
PWR Output

Gaseous Effluent Output Source: C:\SALE2\G\PWR\PWRC.out

Read Edit

Liquid Effluent Output Source: C:\SALE2\G\PWR\PWRL.out

Read Edit

	C	D	E	F	G	H	I	J	K	L	M
				Gas Stripping at shutdown	Continuous Gas Stripping	Reactor Building Ventilation	Auxiliary Building Ventilation	Turbine Building Ventilation	Blowdown Vent Offgas	Air Ejector Exhaust	Total
KR-87		1.70E-02	1.00E-08	0.00E+00	0.00E+00	2.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.00E+00
KR-88		1.80E-02	3.80E-09	0.00E+00	0.00E+00	4.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.00E+00
XE-131M		7.30E-01	1.50E-07	1.10E+01	4.70E+01	1.60E+03	1.70E+01	0.00E+00	0.00E+00	0.00E+00	1.70E+03
XE-133M		7.00E-02	1.50E-08	0.00E+00	0.00E+00	1.10E+02	2.00E+00	0.00E+00	0.00E+00	0.00E+00	1.10E+02
XE-133		2.90E-02	6.00E-09	0.00E+00	0.00E+00	5.80E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.80E+01
XE-135M		1.30E-01	2.70E-08	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	0.00E+00	1.00E+00	7.00E+00
XE-135		8.50E-01	1.80E-07	0.00E+00	0.00E+00	4.90E+02	2.00E+01	0.00E+00	0.00E+00	1.00E+01	5.20E+02
XE-137		3.40E-02	7.10E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
XE-138		6.10E-02	1.30E-08	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	0.00E+00	0.00E+00	2.00E+00
TOTAL		NOBLE GASES	4.80E+03								

GALE Information

- Version 3.0
- Website Updates



**United States Nuclear Regulatory Commission
Radiation Protection Computer Code
Analysis and Maintenance Program**

Home RASCAL SNAP/RADTRAD HABIT VARSKIN **GALE** Radiological Toolbox PIMAL DandD GENII MILDOS Atmospheric Codes

GALE Navigation

- Registration for the GALE Code
- Download the GALE Code
- Download the GALE User Guide
- Download the GALE Technical Documents
- GALE Support
- GALE Training & Presentation Materials
- GALE SQAP - V & V Testing
- GALE Change Logs

RAMP Navigation

- Contact RAMP Administrators
- RAMP Member Registration
- FAQs
- RAMP Information Policy Paper (SECY-14-0117)
- RAMP Newsletter
- Related Links
- About Us

RAMP Users' Meeting

GALE Overview

The Gaseous and Liquid Effluents (GALE) series of codes consists of four codes that calculate the gaseous and liquid effluent releases from pressurized water reactors (PWRs) and boiling water reactors (BWRs). This FORTRAN-based code uses a combination of input data and hardwired parameters to calculate the source term of radionuclides generated by a nuclear power plant during routine operation. Parameters that vary from plant to plant are treated as "inputs"; GALE asks the operator for input values on each run. Hardwired parameters are plant characteristics that are assumed to be the same for all reactors. GALE is maintained at the Pacific Northwest National Laboratory (PNNL) under contract for the U.S. NRC Office of Research.

The original version of the GALE code developed for the NRC was GALE-86 and is documented in NUREG-0016 rev. 1 and NUREG-0017 rev 1. In the interim years, PNNL has done work for the NRC Office of Research and has created updated versions of the GALE code.

GALE-08 was modified from GALE-86 to use the tables and adjustment equations described in ANS-18.1 (1999) and GALE-09 was modified from GALE-08 to make GALE more applicable to modern reactor operations. GALE-08 and GALE-09 were internal versions of the GALE code, which were created for NRC use and not released for use outside the NRC. No technical changes were made in moving from version GALE-09 to GALE-2.0. The only changes between GALE-09 and GALE-2.0 are related to making the GE and LE subprograms into subroutines that are provided data from the GALE-2.0 graphical user interface (GUI).

GALE-2.0 consists of 4 subprograms to calculate the gaseous effluents (GE) and liquid effluents (LE) in BWRs and PWRs. These subprograms are BWRGE, BWRLE, PWRGE, and PWRLE, respectively. In GALE-2.0, BWRGE and BWRLE were converted into subroutines within GALE-2.0 BWR, and likewise, PWRGE and PWRLE were converted into subroutines within GALE-2.0 PWR.

GALE Navigation

- o [Registration for the GALE Code](#)
- o [Download the GALE Code](#)
- o [Download the GALE User Guide](#)
- o [Download the GALE Technical Documents](#)
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- o [GALE Training & Presentation Materials](#)
- o [GALE SQAP - V & V Testing](#)
- o [GALE Change Logs](#)



RAMP Codes





The GENII Environmental Radiation Dosimetry Software package provides users the capability to estimate environmental dispersion, accumulation, and human and biotic exposure and impacts.

GENII Use

- GENII is designed for use by environmental assessors in industry, government, and academia.
- Uses include annual demonstration of compliance with regulations, accident analyses, and planning for emergency response.
- GENII is an NQA-1 qualified code with extensive documentation.

GENII Methods

- GENII requires input of a radionuclide “source term” describing quantity released to the air or water, or initial concentrations in soil, plants, or animal products.
- GENII includes Gaussian plume and puff dispersion models (which need weather data), surface water transport models, plant and animal bioaccumulation models, and descriptors of human exposure.

GENII Outputs

- Output is in terms of human-readable tabular data on radiation dose and dose rate.

```

INDIVIDUAL DOSE CALCULATION ONLY, NO POPULATION

TIME PERIOD NUMBER 1, CORRESPONDING TO TIME 0.0000 YEARS
MAXIMUM POINT = 1 CORRESPONDING TO DIRECTION 1 AND DISTANCE 1 AT LOCATION
INDIVIDUAL AGE RANGE 0 TO 10 YEARS
MAXIMUM EXPOSED INDIVIDUAL LOCATION

ORGAN      MAX. DOSE (Sv)  TISSUE      CANCER INCIDENCE
Adrenals    4.07E-04      Esophagus   2.44E-05
Bl Wall     4.07E-04      Stomach     2.44E-05
B Surface   5.16E-04      Colon       2.44E-05
Brain       4.07E-04      Liver       2.44E-05
Breasts     4.07E-04      Lung        2.63E-05
Esophagus   4.07E-04      Bone        2.44E-05
St Wall     4.08E-04      Skin        2.44E-05
SI Wall     4.08E-04      Breast      2.44E-05
ULI Wall    4.08E-04      Ovary       2.44E-05
LLI Wall    4.09E-04      Bladder     2.44E-05
Kidneys     4.10E-04      Kidneys     2.44E-05
Liver       4.26E-04      Thyroid     2.48E-05
Lungs       5.18E-04      Leukemia    2.44E-05
Muscle      4.08E-04      Residual    2.44E-05
Ovaries     4.09E-04      Total       2.69E-05
Pancreas    4.08E-04
R Marrow    4.22E-04
Skin        4.08E-04
Spleen      4.08E-04
Testes      4.08E-04
Thymus      4.09E-04
Thyroid     5.42E-04
Uterus      4.07E-04
Effective   4.32E-04

TIME PERIOD NUMBER 1, CORRESPONDING TO TIME 0.0000 YEARS
MAXIMUM LOCATION = 1
INDIVIDUAL EFFECTIVE DOSE AND RISK BY NUCLIDE
NUCLIDE DOSE (Sv)  CANCER INCIDENCE  CANCER FATALITIES
INDIVIDUAL AGE RANGE 0 TO 10 YEARS
AM242     1.62E-05      1.83E-06      0.00E+00
AR41      4.07E-04      2.44E-05      0.00E+00
CM242     0.00E+00      0.00E+00      0.00E+00
CO60      1.93E-06      2.71E-07      0.00E+00
H3        2.01E-09      2.68E-10      0.00E+00
I129      1.99E-06      1.92E-07      0.00E+00
I131      4.77E-06      2.49E-07      0.00E+00
OBT       0.00E+00      0.00E+00      0.00E+00
PU238     0.00E+00      0.00E+00      0.00E+00
XE131m    6.87E-09      4.12E-10      0.00E+00

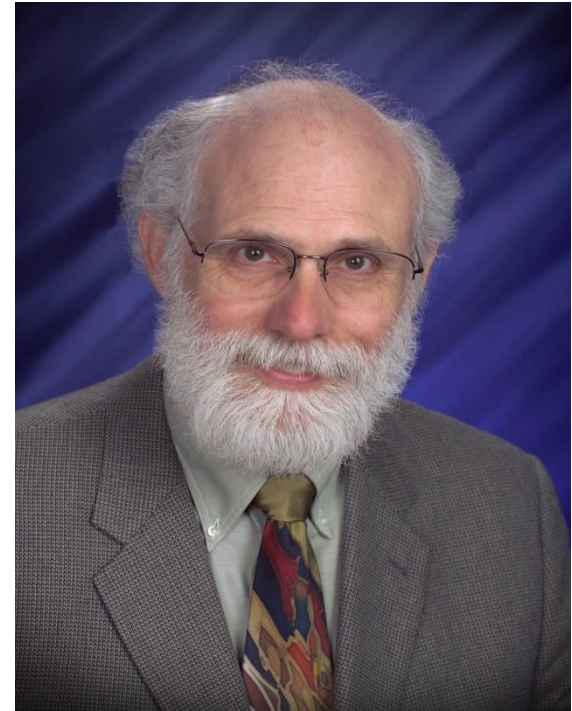
EFFECTIVE DOSE (Sv) BY RELEASE CATEGORY AT MAXIMUM INDIVIDUAL LOCATION:
TRITIUM (PLUS OBT) : 2.01E-09
CARBON-14          : 0.00E+00
NOBLE GASES        : 4.07E-04
IODINE RADIONUCLIDES: 6.75E-06
FRACTURATE NUCLIDES: 1.81E-05
  
```

```

FRACTURATE NUCLIDES: 1.81E-05
IODINE RADIONUCLIDES: 6.75E-06
NOBLE GASES: 4.07E-04
  
```

GENII Information

- Bruce A Napier, CHP
 - Mr. Napier works with the development and operation of models concerned with the environmental transport of radiological and chemical contaminants. His professional experience includes mathematical modeling and calculation of effects to individuals and populations from releases of various contaminants to the environment, as well as management of specific projects.



RAMP Codes

ATMOSPHERIC CODES



ATMOSPHERIC CODES

- ARCON96
- PAVAN
- XOQDOQ



ARCON96

- ARCON96 is a Gaussian dispersion model for calculating short-term relative concentrations (χ/Q 's) at nuclear power plant control room air intakes that would be exceeded no more than 5% of the time.
- Dispersion is near-field, in the vicinity of buildings.
- ARCON96 includes enhanced diffusion coefficients for low wind speed conditions and building wake.

ARCON96 Use

- Used by the NRC for New Reactor Safety Reviews for design-basis accidents
- 10 CFR Part 50, Appendix A, General Design Criterion 19 (GDC 19), Control Room
- Adequate radiation protection shall be provided to permit access and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 5 rem (0.05 Sv) whole body, or its equivalent to any part of the body, for the duration of the accident

PAVAN

- PAVAN is a Gaussian dispersion model for calculating short-term relative concentrations (χ/Q 's) at offsite locations, including the:
- Exclusion Area Boundary (EAB)
- Low Population Zone (LPZ)
- PAVAN uses Pasquill-Gifford (PG) diffusion coefficients with simple modifications to account for low wind speed conditions and building wake for ground-level releases.

PAVAN Use

- Used by the NRC for New Reactor Environmental Impact Statements and Safety Reviews for design-basis accidents
- 10 CFR 52.79(a)(1)(vi), Contents of applications; technical information in final safety analysis report
- Perform an assessment assuming a fission product release from the core into the containment
- An individual located at any point on the boundary of the EAB for any 2-hour period would not receive a dose in excess of 25 rem (0.25 Sv) TEDE
- An individual located at any point on the outer boundary of the LPZ would not receive a dose in excess of 25 rem (0.25 Sv) TEDE during the entire period of the passage of the radioactive cloud

XOQDOQ

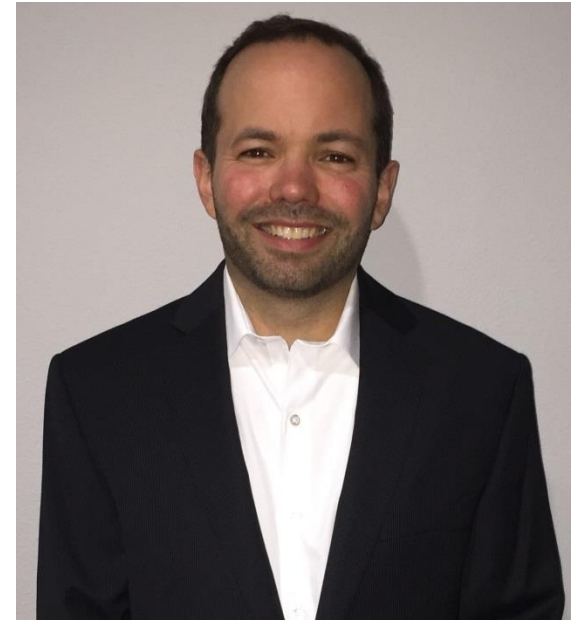
- XOQDOQ is a Gaussian dispersion model for calculating long-term relative concentrations (χ/Q 's) and deposition (D/Q 's) at user-specified locations and standard radial distances/segments out to 50 miles
- XOQDOQ plume horizontal distribution is assumed to be evenly distributed within the 22.5 degree downwind sector (sector-averaging)
- For ground-level releases, plume vertical diffusion coefficient modified to account for building wake

XOQDOQ Use

- Used by the NRC for New Reactor Environmental Impact Statements and Safety Reviews to access impacts from routine releases
- 10 CFR Part 20, Subpart D, Radiation Dose Limits for Individual Members of the Public
- The annual average concentrations of radioactive material released in gaseous effluents at the boundary of the unrestricted area do not exceed the values specified in Table 2 of Appendix B to Part 20
- Intended to result in doses below 0.05 rem (0.5 mSv)
- Appendix I of 10 CFR Part 50, Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet ALARA Criterion for Radioactive Material in Reactor Effluents
- Section II.B: Unrestricted annual air dose < 10 mrad (0.1 mGy) gamma or 20 mrad (0.2 mGy) beta
- Section II.C: Unrestricted annual individual organ dose from all pathways of exposure < 15 mrem (0.15 mSv)
- Section II.D: radwaste system cost-benefit analysis based on population dose out to 50 miles

Atmospheric Codes Information

- Jeremy Rishel
 - Mr. Rishel support the RAMP Atmospheric Codes, including ARCON96, PAVAN, and XOQDOQ. In addition, Mr. Rishel supports the development of the NRC's RASCAL emergency response code.



jeremy.rishel@pnnl.gov

509-375-6974

RAMP Codes





- An algorithm to compute ionizing dose to the skin following radiological contamination
- Photon dosimetry
 - attenuation, buildup, electron scatter
- Electron dosimetry
 - Bragg energy loss, backscatter
- The code agrees well with the EGSnrc probabilistic transport code

VARSKIN Use

- Used by NRC Staff and Licensees
- To show compliance with 10 CFR 20.1201(c)
- As stated therein, the shallow dose equivalent to skin is calculated at the location receiving the highest dose within a 10 cm² area at a tissue depth of 70 microns
- Various tissue depths and dose-averaging areas are possible

VARSKIN Methods

- Data entry is condensed to a single screen
 - includes specification of source geometry, nuclide(s), source strength, tissue depth, and protective clothing characteristics
- A point-kernel deterministic model is used for both photon and electron dosimetry
- Electron source term considers beta or positron emissions, with internal conversion and Auger electrons

VARSKIN Outputs

Non Volume Averaged Results

Help

Radionuclide: Activity

Co-60 [7.42]: 1.00E+00 μ Ci
Sr-90 [7.42]: 1.00E+00 μ Ci

All Radionuclides

Unit Selection
☒ English Units
☐ SI Units

	Initial Dose Rate	Dose (No Decay)	Decay-Corrected Dose		Initial Dose Rate	Dose (No Decay)	Decay-Corrected Dose
Electron	5.13E-01 rad/h	5.13E-01 rad	5.13E-01 rad	Electron	8.70E-01 rad/h	8.70E-01 rad	8.70E-01 rad
Photon	0.00E+00 rad/h	0.00E+00 rad	0.00E+00 rad	Photon	1.28E-02 rad/h	1.28E-02 rad	1.28E-02 rad
Total	5.13E-01 rad/h	5.13E-01 rad	5.13E-01 rad	Total	8.83E-01 rad/h	8.83E-01 rad	8.83E-01 rad

Date/Time 8/26/2016 7:44:47 AM Source Geometry Point Source

Air Gap Thickness 0.00E+00 mm Irradiation Time 6.00E+01 min

Skin density thickness 7.00E+00 mg/cm² Irradiation Area 1.00E+01 cm²

Print Results Close

VARSKIN Information

- Current version is VARSKIN 5.2
- V5.3 will be released shortly
- User's Group has ~350 members
 - <https://web.engr.oregonstate.edu/varskin>
- Our wish list includes:
 - User's Group technical conference
 - Web-based use
 - Injected-source scenario
 - Sensitivity/uncertainty methods

RAMP Codes



MILDOS 4

Radiological Dose from Uranium Milling



MILDOS 4

Radiological Dose from Uranium Milling

Estimates the radiological impacts of airborne emissions from uranium milling facilities, both conventional uranium ore operations and operations associated with in situ recovery facilities

MILDOS Use

- Who – Uranium recovery facility applicants / licensees and NRC staff
- When – Prior to facility construction or modification
- Why – Give reasonable assurance that public health standards will not be exceeded (dose from Rn daughters included) (10 CFR 20, 40 CFR 90)



MILDOS Methods

- Inputs
 - U- and Th-series isotope concentrations
 - Recovery facility /environmental parameters
- Models/Calculations
 - Particulate emission model for ore/tailings
 - Gaussian plume air dispersion with plume rise, dry+wet deposition, gravitational settling
 - Individual and population dose estimates for inhalation, external, and ingestion exposure

MILDOS Outputs

MILDOS-AREA 4.0
Current file - F:\MILDOS4\UserFiles\Case1.mla
File Calculations View Help
Case Information Met Data Population Soil / Food Map Results
Standard Report Interactive Results ECL Check 40CFR190

MILDOS-AREA 4

Case Title: Case 1
Version: MILDOS-AREA 4.0
File: F:\MILDOS4\UserFiles\Case1.mla
Date: 04/25/2016 13:12:17

Table of Contents

- Input Listing
 - Parameters
 - Receptors
 - Sources
 - Vegetable Ingestion Parameters
 - Population Ingestion Parameters
 - 80km Population
 - 80km Vegetation
 - 80km Meat
 - 80km Milk
 - Meteorological Joint Freq Data
 - Dose Coefficients
 - Food Transfer Factors
- Individual Results
 - Normalized Air Concentrations (X/Q)
 - Pathway Doses
 - Time Step 1

MILDOS-AREA 4.0
Current file - F:\MILDOS4\UserFiles\Case1.mla
File Calculations View Help
Case Information Met Data Population Soil / Food Map Results
Standard Report Interactive Results ECL Check 40CFR190

MILDOS-AREA 4

Location Option
☐ Individual receptors
☒ Population grid

Result Type
☐ Normalized air concentrations (X/Q) [s/m3]
☒ Media concentrations [Ci/m3, Ci/m2, Ci/kg]
☐ Dose rate [mrem/y]

Source
Yellocake Stack

Time Step
4 - 1 year(s)

Particle Size
3 um

Radionuclide
U-238

Update Results Table

	Direction	Distance	Air	Ground	VegAbove	Potato	VegBelow	PastureGrass	FeedGrain
	N	1-2 km	7.31E-16	6.86E-10	1.22E-12	1.28E-13	1.28E-13	2.64E-12	1.22E-12
	N	2-3 km	4.02E-16	3.78E-10	6.70E-13	7.05E-14	7.05E-14	1.45E-12	6.70E-13
	N	3-4 km	2.57E-16	2.42E-10	4.28E-13	4.51E-14	4.51E-14	9.28E-13	4.28E-13
	N	4-5 km	1.79E-16	1.68E-10	2.98E-13	3.13E-14	3.13E-14	6.45E-13	2.98E-13
	N	5-10 km	7.82E-17	7.35E-11	1.30E-13	1.37E-14	1.37E-14	2.82E-13	1.30E-13
	N	10-20 km	1.89E-17	1.78E-11	3.16E-14	3.32E-15	3.32E-15	6.84E-14	3.16E-14
	N	20-30 km	6.85E-18	6.43E-12	1.14E-14	1.20E-15	1.20E-15	2.47E-14	1.14E-14
	N	30-40 km	3.70E-18	3.48E-12	6.17E-15	6.50E-16	6.50E-16	1.34E-14	6.17E-15
	N	40-50 km	2.34E-18	2.19E-12	3.89E-15	4.10E-16	4.10E-16	8.43E-15	3.89E-15
	N	50-60 km	1.62E-18	1.52E-12	2.70E-15	2.84E-16	2.84E-16	5.85E-15	2.70E-15
	N	60-70 km	1.20E-18	1.13E-12	2.00E-15	2.10E-16	2.10E-16	4.33E-15	2.00E-15
	N	70-80 km	9.27E-19	8.71E-13	1.54E-15	1.63E-16	1.63E-16	3.35E-15	1.54E-15
	NNE	1-2 km	7.71E-16	7.25E-10	1.28E-12	1.35E-13	1.35E-13	2.78E-12	1.28E-12
	NNE	2-3 km	4.42E-16	4.15E-10	7.35E-13	7.74E-14	7.74E-14	1.59E-12	7.35E-13
	NNE	3-4 km	2.87E-16	2.70E-10	4.78E-13	5.03E-14	5.03E-14	1.04E-12	4.78E-13
	NNE	4-5 km	2.01E-16	1.89E-10	3.35E-13	3.53E-14	3.53E-14	7.26E-13	3.35E-13
	NNE	5-10 km	8.81E-17	8.27E-11	1.47E-13	1.54E-14	1.54E-14	3.18E-13	1.47E-13
	NNE	10-20 km	1.90E-17	1.87E-11	3.23E-14	3.50E-15	3.50E-15	7.20E-14	3.23E-14

MILDOS Information

- Version 4 released in May 2016
 - New
 - Th-232 series radionuclides (Th ores)
 - Sensitivity analysis
 - Meteorological data pre-processor
 - More user accessible parameters
 - Revised
 - Area source model
 - Graphical user interface (complete re-write of GUI + code)
- Currently updating default parameter values

RAMP Codes



PIMAL

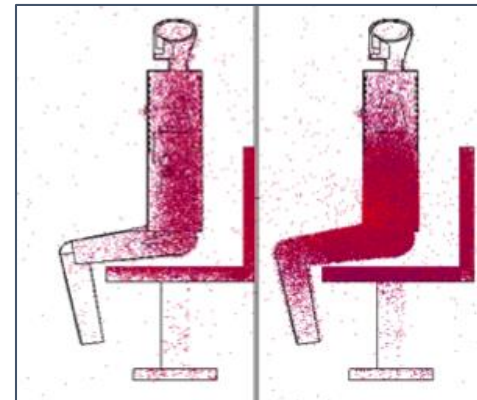
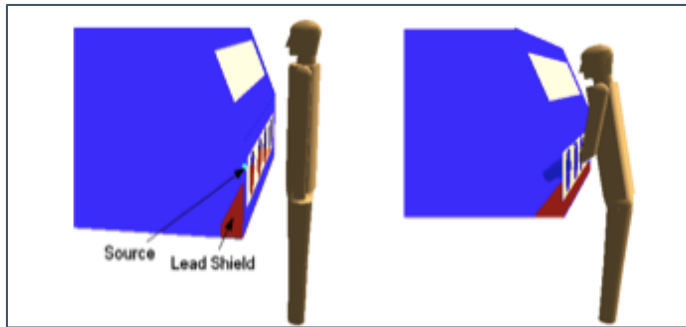


- PIMAL 4.1.0 software employs a graphical interface to adjust the posture of a phantom.
- Generates a corresponding input file for the Monte Carlo N-Particle (MCNP) radiation transport code;
- Performs the radiation transport simulations for dose calculations in MCNP.

PIMAL Use

- The simple GUI interface permits definition of phantom geometry, internal and external source simulation and visualization, and native execution to MCNP yielding absorbed organ dose values.

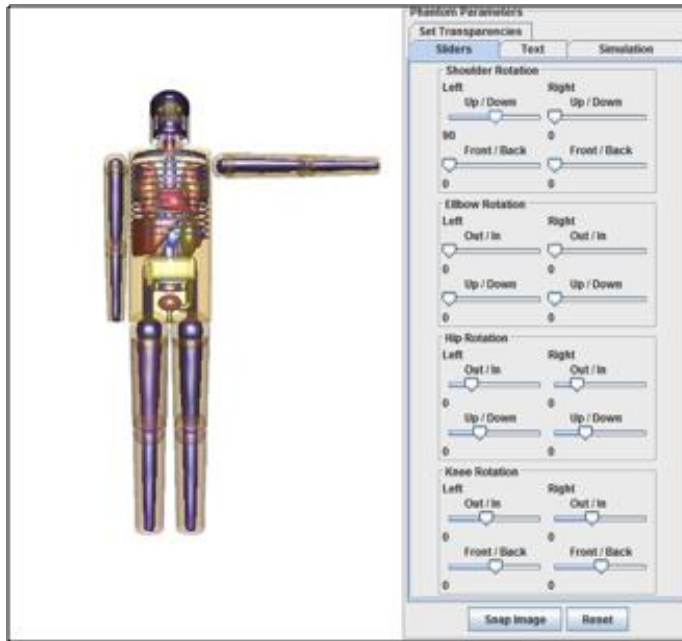
PIMAL as a glovebox worker in a traditional vertical upright posture (left) and in a realistic posture better representing the worker's position (right). [1]



PIMAL phantoms modeled as I-131 patient seated on a bus behind a member of the public. [2]

PIMAL Methods

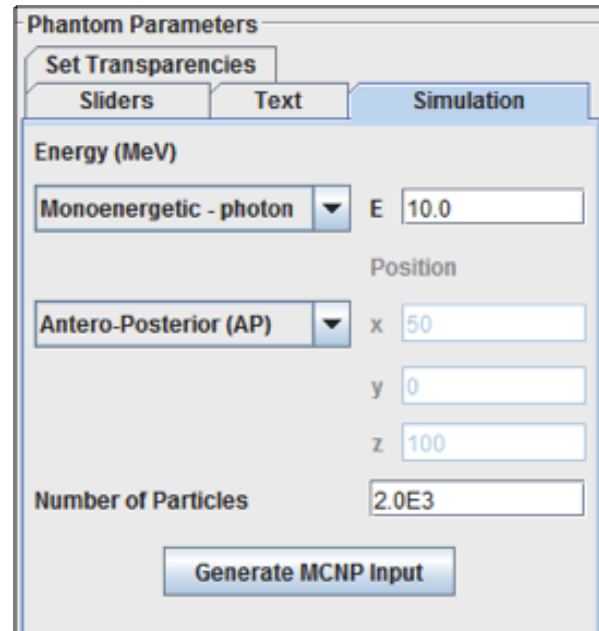
- Geometry Customization
 - Phantom geometry can be articulated using slider bars or textbox input of joint angle.
 - Customizable joints: shoulders, elbows, hips, knees



Screenshot of
PIMAL 4.1.0 GUI
Interface with
sliders to define
joint articulation
of limbs.

PIMAL Methods

- Source Configuration
 - Source Energies and Spectra
 - Radionuclide sources (^{60}Co , ^{131}I , ^{134}Cs)
 - X-ray sources (80-120 kVp)
 - Neutron spectra (AmBe or PuBe)
 - External Source Configuration
 - Point source (user specified X, Y, Z coordinates)
 - Standard irradiation geometries (AP, PA, RLAT, LLAT, ISO)
 - Organ Volume Sources
 - Brain, Thyroid, Heart Wall/Content, Stomach Wall/Content, Liver, Left/Right/Both Lungs, Left/Right Kidney, Pancreas



The screenshot shows the 'Phantom Parameters' dialog box with the 'Simulation' tab selected. The 'Energy (MeV)' section has a dropdown menu set to 'Monoenergetic - photon' and a text box for 'E' with the value '10.0'. The 'Position' section has a dropdown menu set to 'Antero-Posterior (AP)' and three text boxes for 'x' (50), 'y' (0), and 'z' (100). The 'Number of Particles' section has a text box with the value '2.0E3'. A 'Generate MCNP Input' button is located at the bottom.

Phantom Parameters	
Set Transparencies	
Sliders	Text
Simulation	
Energy (MeV)	
Monoenergetic - photon	E 10.0
Position	
Antero-Posterior (AP)	x 50
	y 0
	z 100
Number of Particles	
	2.0E3
Generate MCNP Input	

PIMAL source configuration simulation tab.

PIMAL Methods

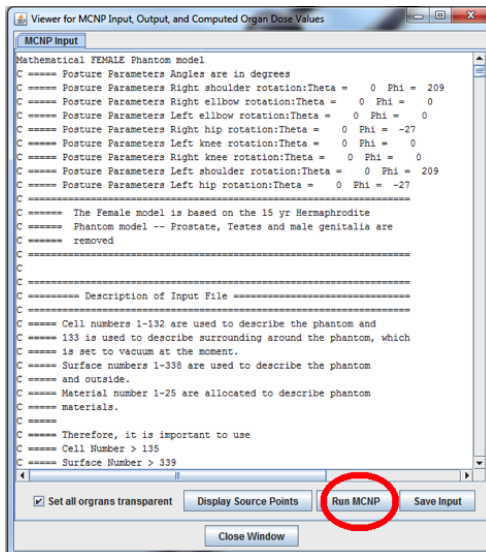
- Source Visualization
 - PIMAL has the ability to natively visualize the pre-defined sources, both internal and external.



PIMAL Source Visualization – LLAT external plane (left); internal brain source (right).

PIMAL Outputs

- MCNP input (.i) file is generated and executed. The option to modify the input file and execute via the MCNP command prompt is also possible for more advanced MCNP users.



Absorbed Dose (Gy/Source Particle) for NPS=2.5E7

Organs	Photon Dose Tally: 216	Relative Error (1 sigma) Tally: 216
ovaries	5.1683E-18	0.0778
bone marrow	6.0012E-18	0.0080
colon	4.8027E-18	0.0197
lungs	5.5763E-18	0.0135
stomach	5.2699E-18	0.0360
urinary bladder	4.5299E-18	0.0377
breast	6.1668E-18	0.0216
liver	5.2679E-18	0.0174
esophagus	5.0845E-18	0.0462
thyroid	5.3600E-18	0.0735
skin	7.1396E-18	0.0064
bone surface	5.5923E-18	0.0086
adrenals	5.2758E-18	0.0724
brain	6.2817E-18	0.0172
Extrathoracic airways	5.5954E-18	0.0481
small intestine	4.8281E-18	0.0203
kidneys	5.2553E-18	0.0272
muscle	5.2566E-18	0.0056
pancreas	5.0244E-18	0.0370
spleen	5.0218E-18	0.0394
thymus	5.1751E-18	0.0582
uterus	4.9582E-18	0.0481
eyes	6.0958E-18	0.0729

Export to ASCII Close

- Summary table of organ absorbed doses and relative errors appear upon completion of the MCNP simulation.
- Output table can be easily exported to an ASCII file.
- MCNP output (.o) file is also saved in the working directory should users want to analyze the output in detail.

PIMAL Information

- References

- [1] Akkurt, Hatice, Kursat Bekar, and K. Eckerman. "Assessment of Organ Doses for a Glovebox Worker Using Realistic Postures with PIMAL and VOXMAT." Trans. of Am. Nuc. Soc 101 (2009): 671-673.
- [2] Dewji, S., et al. "Estimated dose rates to members of the public from external exposure to patients with ¹³¹I thyroid treatment." Medical physics 42.4 (2015): 1851-1857.

- Contact

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RAMP Codes



**RADIOLOGICAL
TOOLBOX**

Rad Toolbox

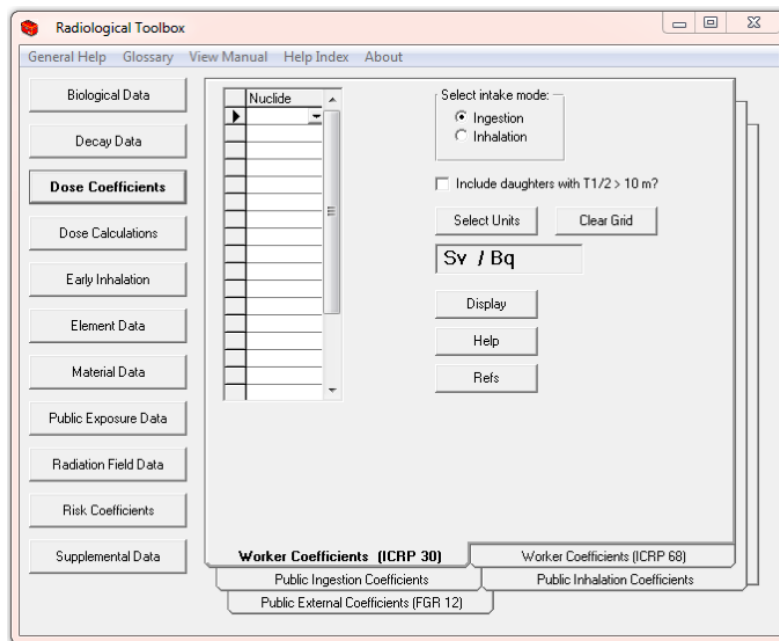


**RADIOLOGICAL
TOOLBOX**

Radiological Toolbox 3.0.0 software is designed to provide electronic access to a vast and varied array of data needed in the field of radiation protection and shielding.

RadToolbox Use

- Initially designed to serve the needs of the radiation protection specialist in the field, provides invaluable information to radiation protection and shielding specialists in electronic format.



RadToolbox Methods

- Biological Data

The Biological Data section consists of the following:

- Biokinetic Models from ICRP 68 and 72
- Bioassay Data consisting of urinary and fecal excretion data and retention data
- Composition of Tissues from Coursey et al.
- Organ Masses from ICRP Publications 23, 72, and 89
- ICRP 89 Reference Values providing an extensive set of anatomical and physiological reference values
- Radiation Health Effects, both deterministic and stochastic, of ionizing radiation summarized from various sources

RadToolbox Methods

- Decay Data
 - Energies and intensities of the radiations emitted during nuclear transformations (decays) from ICRP Publication 107.
- Dose Coefficients
 - Access to 5 sets of nuclide-specific dose coefficients.
 - For each coefficient dataset, it is possible to display up to 20 nuclides at a time for a chosen route of exposure or intake.
- Dose Calculations
 - The Dose Calculations collection was developed to enable rather simple numerical calculations of dose for a mixture of radionuclides.
 - Mixture can consist of up to 20 radionuclides.

RadToolbox Methods

- Early Inhalation
 - Early Inhalation collection provides a means to derive inhalation dose coefficients for deterministic health effects.
- Dose Coefficients
 - Access to five sets of nuclide-specific dose coefficients. For each coefficient dataset, it is possible to display up to 20 nuclides at a time for a chosen route of exposure or intake.
- Dose Calculations
 - Developed to enable rather simple numerical calculations of dose for a mixture of radionuclides. The mixture can consist of up to 20 radionuclides.

RadToolbox Methods

- Risk Coefficients
 - Provides access to the risk coefficients of Federal Guidance Report 13. The data is presented for each of 14 cancer sites.
 - Mortality Risk Coefficient -- an estimate of the risk to an average member of the US population of dying from cancer as a result of the intake of the radionuclide or external exposure to its emitted radiations.
 - Morbidity Risk Coefficient -- a comparable estimate of the average total risk of experiencing a radiogenic cancer, whether or not the cancer is fatal.

RadToolbox Methods

- Element Data

- Provides access to interaction coefficients for alpha, electron, photon, and neutron radiations in elemental absorbers.
- User may select the type of data (coefficient) for display and its units as well as plot it as a function of energy.

- Material Data

- Provides access to various radiological properties of materials. Interaction and kerma coefficients for the materials are derived using elemental compositions.

RadToolbox Methods

- Public Exposure Data
 - The Public Exposure Data collection contains data such as:
 - Natural Background Radiation
 - Background Radiation in the Body
 - Radionuclides in Materials
 - Radionuclides in Devices
 - Primordial Radionuclides
 - Typical Exposures during Medical Procedures

RadToolbox Methods

- Radiation Field Data
 - Radiation Field Data collection provides access to conversion coefficients for the operational dose quantities and organ dose coefficients for mono-energetic neutron and photon radiation fields.
 - Organ dose coefficients are available for antero-posterior, postero-anterior, left-lateral, right-lateral, rotational, and isotropic exposure geometries.

RadToolbox Methods

- Supplemental Data
 - Provides access to other radiation and radiation protection data which includes:
 - SI Units
 - Physical Constants
 - Conversion Factors
 - International Nuclear and Radiological Event Scale (INES)
 - Formulas
 - Web Pages
 - DOE Dose Ranges
 - Transport Package Regulations (A1/A2 Table)

RadToolbox Information

Contact

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Slide acknowledgements: Issac D'Agostino (CRPK-Georgia Tech Intern)

RAMP Codes

DCFPAK



DCFPAK

- The software and data package DCFPAK (Dose Coefficient File Package) provides electronic access to
- Nuclear decay data
- Dose and risk coefficients for exposure to radionuclides
- Eight versions of DCFPAK from 1996 through 2008
- Current version DCFPAK 3.0 has an expanded set of radionuclides addressed in the inhalation and ingestion scenarios
- DCFPAK 4.0 is due for release shortly

DCFPAK Project

- A joint project between Oak Ridge, Argonne, and Sandia National Laboratories to resolve key issues with DCFPAK
- Transform DCFPAK data into a common format
- Provide a common DCFPAK version across the user community

- Provide a common point



DCFPAK Web Application

[Home](#) [About](#) [Coefficient Viewer](#) [Coefficient Downloader](#)

DCFPAK Home

Project Summary: The software and data package DCFPAK (Dose Coefficient File Package) has been developed to allow electronic access to dose coefficients for radiation protection decisions published in ICRP Publications 30 and 68.



Coefficient Viewer

View the decay chain, dose coefficients, and other properties of Radionuclides.

[View](#)



Coefficient Downloader

Download the decay chain, dose coefficients, and other properties of Radionuclides.

[Download](#)



About

Find out more about DCFPAK and view documentation related to the web app.

[About](#)

- Solution was to develop
- a DCFPAK Website.
- <https://www.dcfpak.org>,

DCFPK Output

- Exportable as XML

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DCFPAK Information

- With release of DCFPAK 4.0 pending
- Dose coefficients are living values
- Real-time update capabilities through web interface
- Looking for support by users
- Software sustainability and maintenance
- Knowledge management

DCFPAK Information

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<https://ric.nrc-gateway.gov/docs/bios/bio1-280.htm>



RAMP Codes

HABIT

Licensing

ent Air



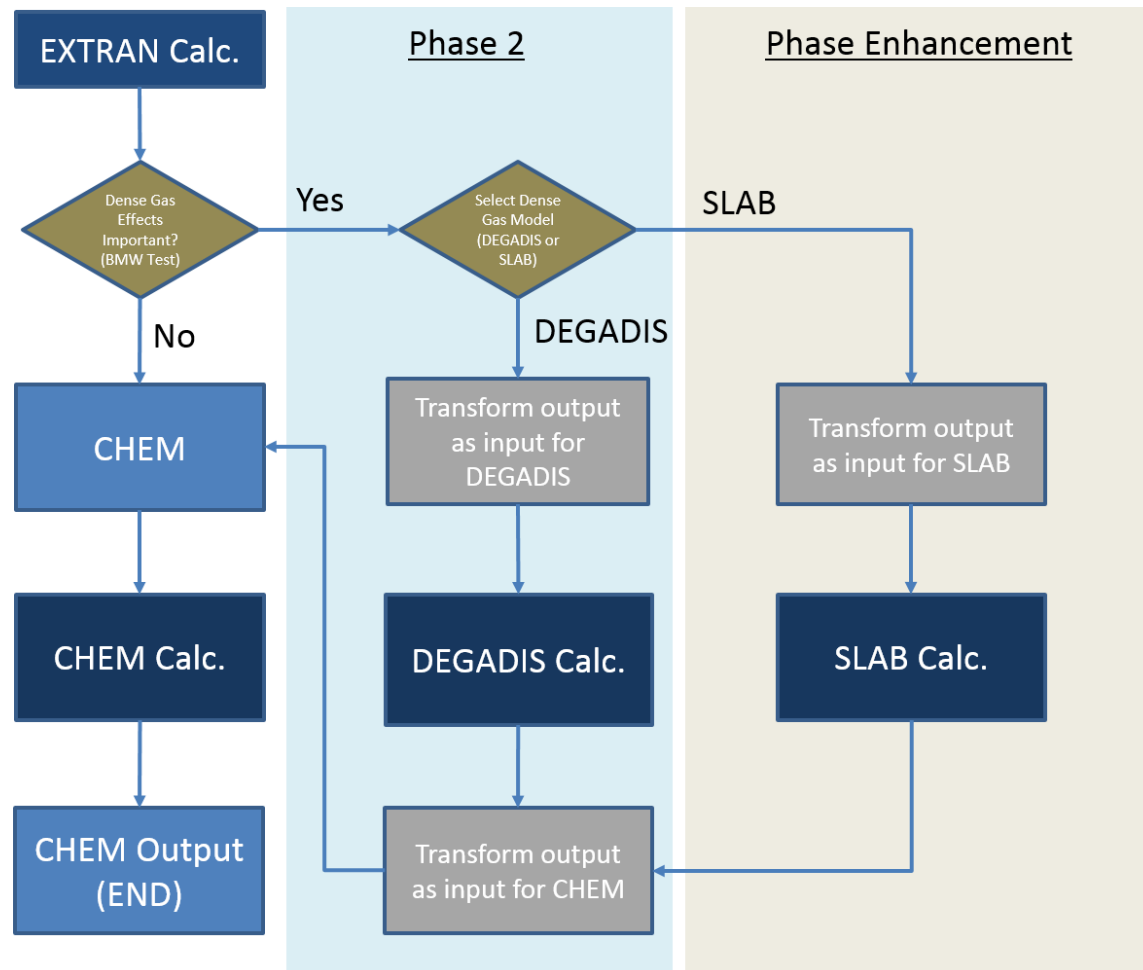


Computer Codes for Evaluation of Control Room Habitability (HABIT)

HABIT Use

- Used by NRC as licensing analysis confirmatory code to verify that the plants design and licensee's Control Room Habitability for postulated Release of Toxic Chemical meet the criteria.
- Regulatory Guide (RG) 1.78, "Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release," endorses HABIT computational code.
- Designed for examining control-room (CR) habitability following a postulated release of toxic chemical in air.

HABIT Flowchart



HABIT Methods

- HABIT uses Gaussian puff dispersion with modified building-wake diffusion algorithm by Ramsdell (1995).
- Added well-established models DEGADIS v2.1 (1989) and SLAB (1985) for diffusion simulation of denser-than-air chemicals.
- Added Britter and McQuaid (1988) methods to auto-detect when dense-gas effects will be important for any accident scenarios.

HABIT Information

- User Manual for HABIT V 2.01
- HABIT Quality Assurance Program manual
- NUREG/CR-6210, “Computer Codes for Evaluation of Control Room Habitability (HABIT)”
- RG 1.78

RAMP Codes

HABIT

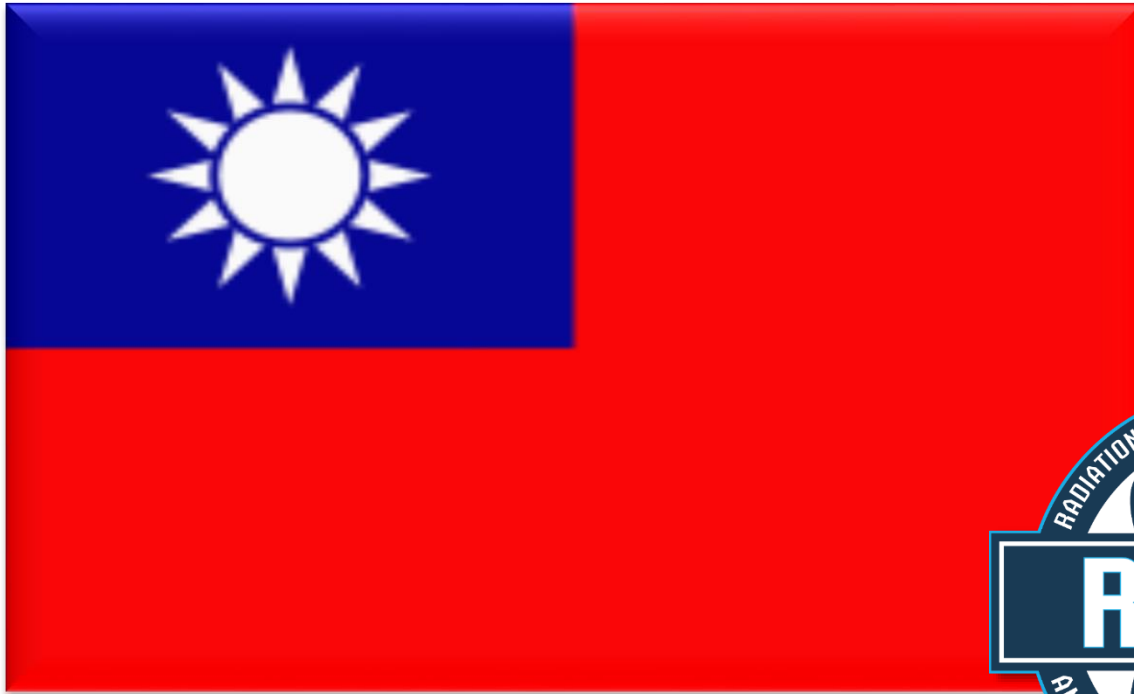
Licensing

Design Basis Accident Air



RAMP 2017 International Meeting

See you in Taiwan – April 2017



Questions?

