SOFTWARE RELEASE NOTICE

1. SRN Number: 307

2. Project Title: PCSA Tool Development	Project No. 20.06002.01.103
3. SRN Title: RSAC Version 6.2	
4. Originator/Requestor: George Adams	Date: March 10, 2004

5. Summary of Actions

- ☑ Release of new software
- ☐ Release of modified software:
  - ☐ Enhancements made
  - ☐ Corrections made
- ☐ Change of access software
- ☐ Software Retirement

6. Validation Status

- ☑ Validated
- ☐ Limited Validation
- ☐ Not Validated Explain:

7. Persons Authorized Access

Name	Read Only/Read-Write	Addition/Change/Delete
Roland Benke	Read Only	
Biswajit Dasgupta	Read Only	
Lane Howard	Read Only	
Oleg Povetko	Read Only	
Mike Smith	Read Only	
Patrick LaPlante	Read Only	
Gordon Wittmeyer	Read Only	
Asad Chowdhury	Read Only	
Also, distributed as part of the PCSA Tool	Read Only	

8. Element Manager Approval: [signature] Date: 3-10-04

9. Remarks:
The RSAC Version 6.2 software upgrade from Version 6.1 was required to enable the PCSA Tool to be deployed on Windows XP systems.

Please see the attached e-mails for installation instructions.

CNWRA Form TOP-6 (09/01)

SOFTWARE SUMMARY FORM

01. Summary Date: March 10, 2004	02. Summary prepared by (Name and phone) George Adams, (210) 522-4957	03. Summary Action: Replacement
04. Software Date: June 6, 2003 (date of rsac6.exe)	05. Short Title: RSAC Version 6.2	
06. Software Title: Radiological Safety Analysis Computer Program, Version 6.2		07. Internal Software ID: None

08. Software Type: ☐ Automated Data System ☑ Computer Program ☐ Subroutine/Module	09. Processing Mode: ☐ Interactive ☐ Batch ☑ Combination Used in the PCSA Tool in batch mode, may be used separately in interactive mode.	10. Application Area a. General: ☑ Scientific/Engineering ☐ Auxiliary Analyses ☐ Total System PA ☐ Subsystem PA ☐ Other b. Specific: Executable used as a standalone module integrated with the PCSA Tool.
11. Submitting Organization and Address: Idaho National engineering and Environmental Laboratory P.O. Box 1625 Idaho Falls, ID 83415-3428		12. Technical Contact(s) and Phone: Bradley J. Schrader, Ph.D. Health Physicist, Radiological Support

13. Software Application: a) RSAC Version 6.2 calculates consequences for atmospheric release of radionuclides. Doses can be calculated for the inhalation, ingestion, ground surface, and submersion pathways. b) The Users' Manual is included in pdf format on the distribution CD.

14. Computer Platform PC	15. Computer Operating System: DOS based	16. Programming Language(s): N/A (executable only)	17. Number of Source Program Statements: N/A
18. Computer Memory Requirements: None Listed in Users' Manual	19. Tape Drives: N/A	20. Disk Units: N/A	21. Graphics: N/A

22. Other Operational Requirements This version was obtained for use on Windows XP systems.

23. Software Availability: ☑ Available ☐ Limited ☐ In-House ONLY	24. Documentation Availability: ☑ Available ☐ Preliminary ☐ In-House ONLY

25. Developed by others, not at CNWRA

Software Developer: George R Adams Date: March 10, 2004

CNWRA Form TOP-4-1 (05/98)

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
QA VERIFICATION REPORT
FOR
→*ACQUIRED SOFTWARE NOT TO BE MODIFIED*←

Software Title/Name: RSAC
Version: 6.2
Demonstration workstation: PITOR
Operating System: MS DOS
User: G. Adams

NOTE: Acquired software may or may not meet all requirements and will be evaluated on a case-by-case basis.

Installation Testing [TOP-018, Section 5.6]

Has *installation testing* been conducted for each intended computer platform and operating system?
Yes: ☑ No: ☐ N/A: ☐

Computer Platforms: PC Operating Systems: Windows XP " NT
Location of Acceptance Test Results: ___
Comments:. Part of validation report

Software Output [TOP-018, Section 5.5.4]

Is software designed so that individual runs are uniquely identified by date, time, name of software and version?
Yes: ☑ No: ☐ N/A: ☐

Date and Time Displayed: 20040320 Time 14:04
Name/Version Displayed: RSAC-6, Rev. 6.2, 03/11/02
Comments: Date should be 20040315
NOTE: Output identification content and format is typically taken as is.

Medium Documentation [TOP-018, Section 5.5.6]

The physical labeling of software medium (tapes, disks, etc.) contains: Program Name, Module/Name/Title, Module Revision, File type (ASCII, OBJ, EXE), Recording Date, and Operating System(s)?
Yes: ☐ No: ☒ N/A: ☐

Comments: Installation disk from INEL.

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
QA VERIFICATION REPORT
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User Documentation [TOP-018, Section 5.5.7]

Is there a Users' Manual for the software and is it up-to-date?

Yes: ☑ No: ☐ N/A: ☐

User's Manual Version and Date: RSAC-6 Users Manual Date 2001
Comments:

Are there basic instructions for the *installation* and *use* of the software?

Yes: ☑ No: ☐ N/A: ☐

Location of Instructions: User's Guide ch. 2.
Comments: Also in Validation Report

Configuration Control [TOP-018, Section 5.7, 5.9.3]

Is the Software Summary Form (Form TOP-4-1) completed and signed?

Yes: ☑ No: ☐ N/A: ☐

Date of Approval: March 10, 2001

Is the list of files attached to the Software Summary Form complete and accurate?

Yes: ☑ No: ☐ N/A: ☐

Comments: File listing placed on enclosed floppy disk due to size.

Is the source code available or, is the executable code available in the case of (acquired/commercial codes)?

Yes: ☑ No: ☐ N/A: ☐

Location of Source Code: Enclosed CD from INEL.
Comments:
.

Have all the script/make files and executable files been submitted to the Software Custodian?
Only the executable files are being submitted.

Yes: ☑ No: ☐ N/A: ☐

Location of executable files: Enclosed CD from INEL.
Comments:

Software Release [TOP-018, Section 5.9]

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
QA VERIFICATION REPORT
FOR
→ACQUIRED SOFTWARE NOT TO BE MODIFIED←

Upon acceptance of the software as verified above, has a Software Release Notice (SRN), Form TOP-6 been issued and does the version number of the software match the documentation?

Yes: ☑ No: ☐ N/A: ☐

SRN Number: 307

Comments:

Software Validation [TOP-018, Section 5.10]

Has a Software Validation Test Plan (SVTP) been prepared for the ***range of application*** of the software?

Yes: ☐ No: ☐ N/A: ☑

Version and Date of SVTP: ___

Date Reviewed and Approved via QAP-002: ___

Comments: No plan just report

Has a Software Validation Test Report (SVTR) been prepared that documents the results of the validation cases, interpretation of the results, and determination if the software has been validated?

Yes: ☑ No: ☐ N/A: ☐

Version and Date of SVTR: January 2004

Date Reviewed and Approved via QAP-002: March 19, 2004

Comments.:

Additional Comments:

April 26, 2004
Software Evaluator/User/Date

26 Apr 2004
Software Custodian/Date

From: BSCHRADE@inel.gov
Sent: Tuesday, October 07, 2003 12:26 PM
To: gadams@cnwra.swri.edu
Subject: Re: RSAC6.1 - QUESTION - GADAMS -SWRI

George,

You are correct. The version that you have does not have XP compatability. The XP compatable version is available. I need to know where you got the copy you are using. You may be elible for a free upgrade.

Brad

Bradley J Schrader Ph.D. RRPT
Radiological Support Advisory Engineer
Idaho National Engineering & Environmental Laboratory
P.O. Box 1625, MS 3428
Idaho Falls, Idaho 83415-3428

bschrade@inel.gov
(208) 526-3399 Phone
(208) 526-0665 Fax
5697 Pager

George Adams <gadams@cnwra.swri.edu>

George Adams <gadams@cnwra.swri.edu>
10/07/03 10:02 AM
Please respond to gadams

To: bschrade@inel.gov
cc:
Fax to:
Subject: RSAC6.1 - QUESTION - GADAMS -SWRI

Mr. Schrader,

I'm using RSAC 6.1 the distribution CD has the following information on it:
S/N: 4025-5350
CCC-125/RSAC-6
C00125PC386002

The User's Manual indicates that the code runs on a Windows 95/98 or NT machine. I've also found that it runs on a Windows 2000 machine; however, my development environment is a Windows XP machine. Is it possible to get a version of RSAC 6.1 that will execute on a Windows XP machine?

The error that I get is:
Abnormal program termination: Stack fault
CS:EIP = 000Fh:00001367h

I've looked into this problem with XP on the Internet and found other programs with a similar problem (same error message) when executing some DOS programs on XP. I also found a reference from Lahey that indicated their old DOS extended compilers are not compatible with XP. I have found that our software built with Lahey 5.6 does execute on XP, however.

I would appreciate any help you can provide.

Thank you,
George Adams

From: BSCHRADE@inel.gov
Sent: Thursday, October 09, 2003 7:49 AM
To: gadams@cnwra.swri.edu
Subject: RE: RSAC6.1 - QUESTION - GADAMS -SWRI

George,

Sure you can have an upgrade. It will cost you a Diet Pepsi if we meet sometime. I'll have it in the mail today. You will need to have .NET installed on the computer. I'll send a copy on the installation CD in case you don't have it.

Brad

Bradley J Schrader Ph.D. RRPT
Radiological Support Advisory Engineer
Idaho National Engineering & Environmental Laboratory
P.O. Box 1625, MS 3428
Idaho Falls, Idaho 83415-3428

bschrade@inel.gov
(208) 526-3399 Phone
(208) 526-0665 Fax
5697 Pager

George Adams <gadams@cnwra.swri.edu>

George Adams <gadams@cnwra.swri.edu>
10/08/03 04:05 PM
Please respond to gadams

To: BSCHRADE@inel.gov
cc:
Fax to:
Subject: RE: RSAC6.1 - QUESTION - GADAMS -SWRI

Brad,

I work for the Center for Nuclear Waste Regulatory Analyses in San Antonio. The code that I'm using was sent to Roland Benke who also works with me at the Center. The letter that Roland received with the CD containing the code is dated July 16, 2003 and was sent by Barbara Snow (for Hamilton T. Hunter). It was sent from RSICC. The CD distribution that we received is described in the previous email. Roland had indicated that he got the distribution CD for RSAC6.1 from RSICC. He also indicated that you sent him some updated library files by email.

Would it be possible for me to get the upgrade by CD? Would this upgrade also require the new library files? If it would be possible for me to get the upgrade CD, my mailing address is:
George Adams
Southwest Research Institute
Center for Nuclear Waste Regulatory Analyses
6220 Culebra Road
San Antonio, TX 78238-5166

Thank you,
George Adams

-----Original Message-----
From: BSCHRADE@inel.gov [mailto:BSCHRADE@inel.gov]
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To: gadams@cnwra.swri.edu
Subject: Re: RSAC6.1 - QUESTION - GADAMS -SWRI

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Bradley J Schrader Ph.D. RRPT
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(208) 526-3399 Phone
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George Adams <gadams@cnwra.swri.edu>

George Adams <gadams@cnwra.swri.edu>
10/07/03 10:02 AM
Please respond to gadams

To: bschrade@inel.gov
cc:
Fax to:
Subject: RSAC6.1 - QUESTION - GADAMS -SWRI

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S/N: 4025-5350
CCC-125/RSAC-6
C00125PC386002

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Abnormal program termination: Stack fault
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I would appreciate any help you can provide.

Thank you,
George Adams

From: BSCHRADE@inel.gov
Sent: Thursday, October 09, 2003 8:24 AM
To: gadams@cnwra.swri.edu
Subject: Product Key

George,

Here is the product key for the software.

5WR84-IJ3X2-S4T6H-9K2TT-98E6H

If at any time you have questions on a variable or how its used. Right click on it and then click on help and it will take you to the help for that variable. It is a little different. It has enhanced dry deposition evaluation and simplified inputs. It is not backward compatible. XP prevents that. You will need to reinput your scenarios.

Brad

Bradley J Schrader Ph.D. RRPT
Radiological Support Advisory Engineer
Idaho National Engineering & Environmental Laboratory
P.O. Box 1625, MS 3428
Idaho Falls, Idaho 83415-3428

bschrade@inel.gov
(208) 526-3399 Phone
(208) 526-0665 Fax
5697 Pager

From: BSCHRADE@inel.gov
Sent: Saturday, October 25, 2003 7:31 PM
To: gadams@cnwra.swri.edu
Subject: RE: Product Key

you don't need the following
Dosstyle.dll
Rsac6 shortcut
Tnt.exe
other wise it should be fine. I would be interested in your final report.

George Adams <gadams@cnwra.swri.edu>

George Adams <gadams@cnwra.swri.edu>
10/23/03 07:15 AM
Please respond to gadams

To: BSCHRADE@inel.gov
cc: Asadul Chowdhury <achowdhury@cnwra.swri.edu>, Roland Benke <rbenke@cnwra.swri.edu>, Biswajit Dasgupta <bdasgupta@cnwra.swri.edu>
Fax to:
Subject: RE: Product Key

Brad,

Thank you for the CD. I have a question about installing only the rsac standalone portion of the software package without any of the user interface components. The application that we're working on at the Center writes an rsac6.in file, invokes the rsac6.exe, and then retrieves information from the rsac6.out file. We have our own user interface to store information in a common database for analysis. I noticed on the CD that the rsac6 directory contains a set of 15 files. I copied the 15 files into a directory and executed the rsac6 code with the Example1 input data from a command prompt, and I get the same output. What I would like to do is only install what I need to execute the rsac standalone to generate an rsac6.out file from an rsac6.in file. Is it sufficient to install the rsac standalone code by just copying the files from the rsac6 directory of the CD to a directory on the hard drive and execute the rsac6 application directly from that directory? We would use our application to invoke rsac from that directory and, for testing our application, invoke rsac from a command prompt at that directory.

The files that are on the CD in the rsac6 directory are:
Dosstyle.dll
Ex9src
Extfgr
Fones
Intfgr
Modfgr
Nuclib
Pgfeed
Popcq
Rsac6 shortcut
Rsac6.exe
Rsac6.out
Rsac6key
Texthelper.exe
Tnt.exe
Trancon

Thank you,
George Adams

-----Original Message-----
From: BSCHRADE@inel.gov [mailto:BSCHRADE@inel.gov]
Sent: Thursday, October 09, 2003 8:24 AM
To: gadams@cnwra.swri.edu
Subject: Product Key

George,

Here is the product key for the software.

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If at any time you have questions on a variable or how its used. Right click on it and then click on help and it will take you to the help for that variable. It is a little different. It has enhanced dry deposition evaluation and simplified inputs. It is not backward compatible. XP prevents that. You will need to reinput your scenarios.

Brad

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CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
DOCUMENT REVIEW REQUEST AND TRANSMITTAL CONTROL (REF. QAP-002)

I. DOCUMENT INFORMATION

a. TITLE: Software Validation Test Report for RSAC Version 6.2

b. DOCUMENT TYPE

[ ]	Abstract	[ ]	Presentation/Poster	[X]	Project/Test Plan	[ ]	AP	[ ]	TOP	[ ]	Technical Report (Publication)
[ ]	Peer-Reviewed	[ ]	OPs Plans	[ ]	CQAM	[ ]	QAP	[ ]	Proposal	[ ]	NRC Guidance

* Conference/Journal Title: _____

Special Markings ***(e.g., "Predecisional" or "Proprietary")*** _____ **Licensing Support Network** **Yes** _____ **No** X

Copyright Permission **Yes** _____ **No** X

c. PROJECT INFORMATION

Project No. 20.06002.01.103 Milestone No. NA Subject Code 718.4

CNWRA DOCUMENT NO. Yes _____ No X Assigned No. CNWRA 200__ —

d. SCHEDULE Today's Date 12/31/2003 Scheduled Transmittal Date Not an IM

II. RESPONSIBILITIES (Fill in names on each blank line in this section.)

Author(s) G. Adams, et al. Element Manager A. Chowdhury Assigned Secretary C. Patton

III. REVIEW (See QAP-002 table 1 for applicable review types.)

Review Types & Reviewers Determined by Element Manager — B. Dasgupta for AC — 1/7/04
(Element Manager Signature) (Date)

		Req'd Date	Initials	Completed
X	TECHNICAL (Attach CNWRA form QAP-12.) Reviewer(s): **B. Dasgupta**	1/23/2004	BN	2/6/04
[ ]	PEER (Attach CNWRA form QAP-13.) Reviewer(s):			
[ ]	EDITORIAL Reviewer:			
[ ]	CONCURRENCE Reviewer:			
X	QUALITY ASSURANCE Reviewer: ~~R. Folck~~ R. Brient	1/30/2004	[illegible]	2/12/04
X	PROGRAMMATIC/COPYRIGHT PERMISSION Reviewer: **B. Sagar**	2/13/2004	[illegible]	02/17/04
[ ]	FORMAT Reviewer/Style: NA			
	Verification of Compliance with QAP-002		[illegible]	3/19/04

CNWRA calculations and analyses supporting this report are documented in Scientific Notebook(s): None.

IV TRANSMITTAL

TO: _____ **FROM:** _____

COPIES TO: (Add/delete names as required using current information in "Guidelines for Minimum Distribution of CNWRA Correspondence.") Distribution (listed below)

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES INSTRUCTIONS TO TECHNICAL REVIEWERS

Technical Review Items to Verify

CNWRA
A center of excellence in earth sciences and engineering

REVIEWER: B. Dasgupta

TITLE: Software Validation Test Report for RSAC Version 6.2

Please perform a Technical Review of the subject document in accordance with CNWRA QAP–002, verifying the specific items identified below. Technical comments shall be documented on the attached Comment Resolution Record and presented to the author for resolution. Initial blanks on right side of page to show completion of assigned review.

Required review completion date: 1/23/2004

	TECHNICAL CORRECTNESS	ACCOMPLISHED
	Assumptions are reasonable and documented in sufficient detail that a technically qualified person may review, understand, and verify the analysis without recourse to the originator. (Do not assign if report does not contain data interpretation and analysis.)	
X	Appropriate techniques are used.	BN
	Existing data are qualified (or exempted) in accordance with QAP–015.	
X	Conclusions are properly supported by correctly interpreted data. *(Novel or beyond state-of-the-art techniques or significant uncertainties in data and interpretations warrant application of a Peer Review.)*	BN

Are there calculations? YES [X] NO [ ] If yes, are "over checks" required? YES [X] NO [ ]

If no "over checks" are required, explain why:

If "over checks" are required, specify type(s) of calculation (per Section 3.2 and 3.2.3 of QAP–014) and describe extent of verification.

	Controlled Software	
	Uncontrolled Software	
X	Commercial Off-the-Shelf Software	3.2.3(iii) (Calculations included as a spreadsheet attachment)
	Other Calculation(s)	

X	Calculations are correct, documented and verified in accordance with QAP–014, Section 3.2.3. Document this review by a statement on TOP–3 form explaining which calculations were checked, and how they were checked. Attach verification calculation, in accordance with Section 3.2.4 of QAP–014.	BN

CNWRA FORM QAP–12 (Rev. 10/2002)

Checked RSAC6.OUT file from Test Case 2 (Windows XP)
Also verified spreadsheet calculation with the RSAC output for Ingestion and Submersion.
BN

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES INSTRUCTIONS TO TECHNICAL REVIEWERS

Technical Review Items to Verify

CNWRA
A center of excellence in earth sciences and engineering

READABILITY		ACCOMPLISHED
X	Document is written for the intended audience, with correct grammar and syntax.	
X	Illustrations and tables clearly present basic information and emphasize relationships.	

CONTENT AND FORMAT		ACCOMPLISHED
X	Title reflects the objectives of the document.	
	Abstract states purpose, describes study, and summarizes the pertinent results and conclusions.	
	Introduction states the objectives and scope of the work and presents background information.	
X	Body of the manuscript is logically organized and presents the basic information.	
X	Conclusions and results summarize the principal findings and address each of the objectives of the work.	
X	References are cited in the text and in the references section.	
	Costs and financial tables are included and agree with text.	

ELEMENT MANAGER	DATE	COGNIZANT DIRECTOR	DATE
for AC			1/7/04

CNWRA FORM QAP–12 (Rev. 10/2002)

CNWRA REPORT REVIEW / COMMENT RESOLUTION RECORD

PROJECT NUMBER	DOCUMENT DATE	DOCUMENT NUMBER
20.06002.01.103	January 2004	NA

TITLE: Software Validation Test Report for RSAC Version 6.2

The comments shown below address questions and concerns of a technical and/or programmatic nature which arose in this review. Because of possible implications, they require action and response.	RESPONSE: (Write "accept" and note briefly how comment was incorporated, or give justification if rejected.)
1. Please see the minor edits in the text and comments on the side bar	1. Accept. With the exception of page B-4. The 3000 line has to be entered following dose calculations for the pathways desired.
2. Page 2, Last para, last line. It is not clear whether Table 2 contains the entire input data for Example 2 or only the lines that need modification	2. Accept. Added text to indicate that only the lines identified in Table 2 are changed. The remainder of the file is left unchanged.
3. Page 4, Para 2 - Provide reference to the files in CD listed in section 7.0 here and/or other parts of the text as appropriate.	3. Accept. Referred to the files in the test results section.

REVIEWER SIGNATURE:	DATE:	RESPONDER SIGNATURE:	DATE:
[signature]	1/19/04	[signature]	1-28-04
Response accepted by: [signature]	2/6/04	If resolution cannot be achieved, the matter shall be elevated to the next level of authority.	
Signature	Date	Distribution: This completed form shall be maintained in a record file.	

CNWRA REPORT REVIEW / COMMENT RESOLUTION RECORD

PROJECT NUMBER	DOCUMENT DATE	DOCUMENT NUMBER
20.06002.01.103	January 2004	NA

TITLE: Software Validation Test Report for RSAC Version 6.2

The comments shown below address questions and concerns of a technical and/or programmatic nature which arose in this review. Because of possible implications, they require action and response.	RESPONSE: (Write "accept" and note briefly how comment was incorporated, or give justification if rejected.)
4. Page 4, Para 3. Did you compare the file with "diff" command in UNIX machine? Please clarify.	4. Accept. Clarified text to indicate that the Diff command was used on a UNIX machine.
5. Page 4, Para 5: How is ~~PCSA~~ RSAC involved in PCSA Tool and what modifications were made to test RSAC?	5. Accept. Added clarifying text to indicate that the RSAC executable is invoked directly from a command prompt.
6. Page 4, Para 6: Briefly address why validation of other modules in RSAC are not required.	6. Accept. Added text to indicate that the other modules are not validated because they are not used by the PCS4 Tool. Also, the Cloud Gamma Dose Calculation (9000 series) ~~is not exercised~~ was incorporated into the Pathway Test instead of the 7000 series air immersion calculations. BMA 2-3-2004

REVIEWER SIGNATURE:	DATE:	RESPONDER SIGNATURE:	DATE:
[signature]	1/19/04	[signature]	1-28-04
Response accepted by: [signature]	2/6/04	If resolution cannot be achieved, the matter shall be elevated to the next level of authority.	
Signature	Date	Distribution: This completed form shall be maintained in a record file.	

CNWRA REPORT REVIEW / COMMENT RESOLUTION RECORD

PROJECT NUMBER	DOCUMENT DATE	DOCUMENT NUMBER
20.06002.01.103	January 2004	NA

TITLE: Software Validation Test Report for RSAC Version 6.2

The comments shown below address questions and concerns of a technical and/or programmatic nature which arose in this review. Because of possible implications, they require action and response.	RESPONSE: (Write "accept" and note briefly how comment was incorporated, or give justification if rejected.)
7. Page 6. Section 6.2.3. What is the basis for accepting "factor of two"?	7. The nine equations were used to develop a set of simplified hand calculations. We didn't encompass all of the calculations that the actual RSAC code performs. Since the hand calculations were actually a simplified model, we wanted to feel confident that the dose for all radionuclides and pathways would fall within the factor of two limit that was imposed.
8. Page 6: Fonts of the variables in the equation and text should match.	8. Accept. Fonts for equations will be updated
9. Page 7: Equation "Inhalation CEDE" what is Bq? and "1" or "L"	9. Accept Bq stands for becquerel. Added a space between 1Ci to make the conversion factor more obvious.
10. Page 8: "4" in equation for $D_{inhaveg}$ not defined.	10. Accept. Corrected notation in text.

REVIEWER SIGNATURE:	DATE:	RESPONDER SIGNATURE:	DATE:
[signature]	1/19/04	[signature]	1-28-04
Response accepted by: [signature]	2/6/04	If resolution cannot be achieved, the matter shall be elevated to the next level of authority.	
Signature	Date	Distribution: This completed form shall be maintained in a record file.	

CNWRA REPORT REVIEW / COMMENT RESOLUTION RECORD		PAGE 4 OF 4 PAGES
PROJECT NUMBER 20.06002.01.103	DOCUMENT DATE January 2004	DOCUMENT NUMBER NA

TITLE: Software Validation Test Report for RSAC Version 6.2

The comments shown below address questions and concerns of a technical and/or programmatic nature which arose in this review. Because of possible implications, they require action and response.	RESPONSE: (Write "accept" and note briefly how comment was incorporated, or give justification if rejected.)
11. Page 8. 'f' (doing, forge) in equation for Dmuk not defined.	11. Accept. Added the text within variable definitions on page 4
12. Page 9. and Page 11: Should the Ingestion CEDE be sum of dose from equations (6), (7), (8) and (9)? Please clarify	12. Accept. Added text to tables 4, 5, 6, and 7 to clarify
	13.
13. Checked RSAC 6.OUT file from Test Case 2 (Windows XP). Also verified spreadsheet calculation with the RSAC output for Ingestion and Submersion pathways. No response required. 8/20/04	
REVIEWER SIGNATURE: 1/19/04 DATE:	RESPONDER SIGNATURE: 1-28-04 DATE:
Response accepted by: 2/4/04	If resolution cannot be achieved, the matter shall be elevated to the next level of authority.
Signature Date	Distribution: This completed form shall be maintained in a record file.

CNWRA REPORT REVIEW / COMMENT RESOLUTION RECORD

PROJECT NUMBER	DOCUMENT DATE	DOCUMENT NUMBER
20.06002.01.103	January 2004	NA

TITLE: Software Validation Test Report for RSAC Version 6.2

The comments shown below address questions and concerns of a technical and/or programmatic nature which arose in this review. Because of possible implications, they require action and response.	RESPONSE: (Write "accept" and note briefly how comment was incorporated, or give justification if rejected.)
1. Suggest including the spreadsheet as an appendix or enclosure on a diskett/CD.	1. Included the CD containing the test results, spreadsheet and report as an attachment and referenced in Section 7

REVIEWER SIGNATURE:	DATE:	RESPONDER SIGNATURE:	DATE:
[signature]	02/13/04	[signature]	2/17/04
Response accepted by: [signature]	02/17/04	If resolution cannot be achieved, the matter shall be elevated to the next level of authority.	
Signature	Date	Distribution: This completed form shall be maintained in a record file.	

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QA Review	
No comments. Report satisfies TOP-018 requirements for SVT Report.	

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Response accepted by: [signature] 2/12/04 Signature Date	If resolution cannot be achieved, the matter shall be elevated to the next level of authority. Distribution: This completed form shall be maintained in a record file.

Software Validation Test Report for RSAC Version 6.2

January 2004

Center for Nuclear Waste Regulatory Analyses
San Antonio, Texas

Author:
George Adams
Troy Maxwell
Roland Benke

Element Manager

Asadul H. Chowdhury
Manger, Mining, Geotechnical,
and Facility Engineering

3-19-04
Date

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1.0 Scope of the Validation

Version 6.1 of the Radiological Safety Analysis Computer (RSAC) Program was validated in October 2003. However, RSAC version 6.1 is a standalone Disk Operating System (DOS) based application that is not compatible with Windows XP machines. Version 6.2 of RSAC was obtained from Idaho National Engineering and Environmental Laboratory (INEEL). Version 6.2 of the software executes on both Windows NT machines and Windows XP machines. This validation test report repeats the validation testing performed for Version 6.1 of the RSAC software using instead Version 6.2. Validation testing is performed on both Windows NT and Windows XP machines.

The RSAC standalone executable is installed as part of the Preclosure Safety Analysis (PCSA) Tool. The RSAC software is installed by copying files to a target machine. This installation of copying a set of RSAC files from the RSAC Version 6.2 distribution CD to the target Windows NT/XP machine is also verified in section 6.1 of this test plan.

2.0 References

Adams, G., T. Maxwell, B. Dasgupta, and R. Benke. Software Validation Test Plan for PCSA Tool Version 3.0, 2003.

Benke, R. Software Validation Report for RSAC Version 6.1, Center for Nuclear Waste Regulatory Analyses, 2003.

Dasgupta, B., R. Benke, and G. Adams. Software Requirements Description for the PCSA Tool Version 3.0 (Revision 04), 2003.

Wenzel, D.R. and Schrader B.J. The Radiological Safety Analysis Computer Program (RSAC-6) Users' Manual, INEEL/EXT-01-00540. Idaho National Engineering and Environmental Laboratory: Idaho Falls, Idaho. 2001.

3.0 Environment

Installation of the RSAC Version 6.2 software is documented in this section along with the required target platforms. Appendix A provides the installation instructions from e-mails received from B. Schrade, Health Physicist, Radiological Support, INEEL.

3.1 Software

The RSAC executable and associated files are installed as part of the PCSA Tool installation by copying them to the target platform during the PCSA Tool installation. As part of this validation test, the following files are required for RSAC Version 6.2:

ex9src, extfgr, fones, intfgr, modfgr, nuclib, pgfeed, popcq, rsac6.exe, rsac6key, texthelper.exe, trancon

The above twelve files are copied from directory: program files\INEEL\WinRp\Rsac6 on the distribution CD to a directory on the target platform where the testing will be performed.

3.2 Hardware

Validation is to be performed on both a Windows NT and Windows XP machine.

4.0 Prerequisites

The twelve files identified in Section 3.1 have been copied from the RSAC Version 6.2 distribution CD to a test directory on the target machine. Both Windows NT and Windows XP machines are required for the tests identified in Section 6.0.

5.0 Assumptions and Constraints

none

6.0 Test Cases

The validation involves two test cases. The first test case is an installation test designed to verify that the RSAC software correctly installs on both Windows NT and XP machines. The second test case compares the pathway and radionuclide dose generated by the RSAC software to hand calculated doses. This test case repeats the testing performed previously for RSAC 6.1 validation.

6.1 Installation Test

This test is conducted to validate the installation of the twelve files identified in Section 3.1 on both a Windows NT and Windows XP machine by copying the files from the RSAC Version 6.2 distribution CD to a test directory on each machine. Examples 2, 3, 4, and 5, from the RSAC Version 6.2 distribution CD, were copied to the rsac6.in file and used to generate output for this test. The generated output file also contains the example input so the results will reflect the accuracy of the input and output for each example. The installation is successful if the results from Examples 2, 3, 4, and 5 agree with the documented results from the RSAC Users' Manual.

6.1.1 Test Input

The RSAC executable requires a single input file (rsac6.in) for its execution. The distribution CD contains example input files labeled Example2, Example3, Example4, and Example5. Therefore, in order to invoke the RSAC executable with example input, each of the example input files is copied one at a time to a new file named rsac6.in and the RSAC executable is invoked with this example data as input. It should be noted that the input information contained in Example 2 differed from the input file described in the RSAC Users' Manual. Since the purpose of this test is to compare the RSAC generated output to documented output, it was necessary to modify the input file for this example to match the input file described in the manual. Table 1 identifies the input file locations from the distribution CD. Table 2 identifies the changes made to Example2 used as test input. Only the lines identified in Table 2 are changed. The remainder of the file is left unchanged.

Table 1. Test Case 6.1 Input

Example	Location (RSAC Version 6.2 distribution CD)
2	Program Files/INEEL/WinRp/Examples/Example2
3	Program Files/INEEL/WinRp/Examples/Example3
4	Program Files/INEEL/WinRp/Examples/Example4
5	Program Files/INEEL/WinRp/Examples/Example5

Table 2. Test Case 6.1 Input File Changes

Example	Example File Lines	Modified Lines to Agree with Manual
2	2000,0 SR 90,0.5 Y 90,0.5 2999	2000,0 SR 90,2. Y 90,2. 2999
	5400,1,60.,10.6,1.	5400,1,40.,10.
	7001,3.33E-4,0,0,.25	7001,3.33E-4,0,0,0,0.25

6.1.2 Test Procedure

This test case is run from a command prompt using rsac6.in files built from Example2, Example3, Example4, and Example5 input files that were provided with the RSAC6 distribution CD.

The following steps are required:
1) Create a test directory on the target platform.
2) Copy the twelve files identified in Section 3.1 to this test directory.
3) Create the rsac6.in text file for Example 2, 3, 4, and 5 by copying each example file (Example2, Example3, Example4, and Example5) to a new file labeled, "rsac6.in." This new file is created for each of the example test runs. Note: for Example2, modify the lines in the file in accordance with Table 2.
4) If the read-only attribute is set for any of the files copied to the test directory, clear this attribute.
5) From a command prompt (DOS prompt), invoke the RSAC software by typing rsac6.exe from the test directory.
6) After execution completes, the output will be generated to text file rsac6.out. Compare the output results in file rsac6.out to the expected output from the RSAC Users' Manual.

6.1.3 Test Results

Two tests were conducted. Test one was conducted on machine JAR JAR. Machine JAR JAR runs Microsoft Windows NT. Test two was conducted on machine Bemore. Machine Bemore runs Microsoft Windows XP. The RSAC output files for the tests conducted on the Windows

NT machine are contained on the CD and labeled: Rsac6_Example2_NT_man_Out.txt, Rsac6_Example3_NT_Out.txt, Rsac6_Example4_NT_Out.txt, and Rsac6_Example5_NT_Out.txt. The RSAC output files for these tests conducted on the Windows XP machine are also contained on the CD and labeled: Rsac6_Example2_XP_man_Out.txt, Rsac6_Example3_XP_Out.txt, Rsac6_Example4_XP_Out.txt, and Rsac6_Example5_XP_Out.txt.

The results from test one (Windows NT) were compared by inspection with those documented in the RSAC Users' Manual. The output doses generated on the Windows NT machine were the same as those documented in the RSAC Users' Manual.

The results from test one (Windows NT) were compared with the results from test two (Windows XP) using the "diff" command on a UNIX machine. A comparison using the "diff" command revealed that the only difference between the Windows NT and Windows XP output were the times of execution. This difference output comparison is included in file DiffExamples_NTvrsXP.txt contained on the CD (Please see attachments in Section 7.0.).

The output doses were the same between the Windows NT and Windows XP machines and the generated doses were the same as those documented in the RSAC Users' Manual and therefore, the validation test was passed.

6.2 Pathway Test

This test case repeats the validation testing performed for RSAC Version 6.1; however, the procedure was modified to test the RSAC software by invoking the executable directly from a DOS command prompt the way it is invoked within the PCSA Tool.

This test repeats the validation conducted under RSAC Version 6.1 testing referred to in the Software Validation Report for RSAC Version 6.1 (Benke, 2003); however, the air immersion dose calculation (7000 series) was replaced with a finite model cloud gamma dose calculation (9000 series). This test simulates an instantaneous radionuclide release into the atmosphere and downwind transport of the radioactive plume and calculates the doses to a receptor via four pathways: inhalation, ground surface exposure, submersion, and ingestion. The objective of this test is to validate the modules of the RSAC code that are utilized by the PCSA Tool. This validation test exercises the following modules (called series in the RSAC documentation): Direct Radionuclide Input (2000 series), Dose Summary Option (3000 series), Dispersion Control Input (5000 series), Internal/External Dose Calculation (7000 series), and Cloud Gamma Dose Calculation (9000 series). Because they are not used by the PCSA Tool, this validation test does not exercise the following modules: Fission Product Inventory Calculation and Inventory Decay (1000 series), Radionuclide Data Constants Change (4000 series), and Fifty-Mile Radius Dose Calculation (8000 series).

6.2.1 Test Input

A single RSAC input file, rsac6.in, is required with the definitions taken from the RSAC Version 6.1 Software Validation Report. However, a 3000 series line was added to the file to summarize dose by pathway and radionuclide which was a feature added to version 3 of the PCSA Tool. In addition, the 7000 series air immersion dose calculation was replaced with a

9000 series cloud gamma dose calculation.

Table 3. Test Case 6.2 Input

Series	Input Section
2000	# Release of 1 Ci for I-129, H-3, and Co-60 2000,0 H 3,1. CO 60,1. I129,1. 2999
3000	# Summary of dose by pathway and radionuclide 3000, 3
5000	# Meteorological Inputs 5000,0 5001,1.,40.,1420.,1.099E3,0,1 5002,.001,.01,0.,.001,.001 5101,10000. 5201,1.,0 5400,2,0,0 5410,1,6,0 5999
7000	# Inhalation Dose Calculation 7000,0,1,2,0,1 7001,3.33E-4,0,0,0 7999
	# Ground Surface Dose Calculation 7000,4,1,2,0,1 7001,0,0,1.,0.7 7999
	# Ingestion Dose Calculation 7000,3,1,2,0,1 7001,0,0,1.,0 7004,1,2,7.,7. 7051,520.,64.,110.,310.,1.,1. 7052,0.57,0.2,1.,0,3.5,3.5,100. 7053,225.,0,0,16.,0,0 7054,0,0,0,2.,0.28,4.9 7055,1.,1.,1.,1. 7999
9000	# Submersion Dose Calc for a FINITE plume 9000, 0, 0.0

Appendix B provides a correctly formatted RSAC input file for use in this validation test.

6.2.2 Test Procedure

This validation test is run from a command prompt using the rsac6.in file from Appendix B created using a standard text editor such as notepad.

The following steps are required:
1) Create a test directory on the target platform.
2) Copy the twelve files identified in Section 3.1 to this test directory.
3) Create the rsac6.in text file and save this file to the test directory.
4) If the read-only attribute is set for any of the files copied to the test directory, clear this attribute.
5) From a command prompt (DOS prompt), invoke the RSAC software by typing rsac6.exe from the test directory.
6) After execution completes, the output will be generated to text file rsac6.out. Compare the dose results in file rsac6.out to spreadsheet calculated doses.

6.2.3 Test Results

RSAC generated doses are expected to agree with hand calculated values to within a factor of two. Three radionuclides (I-129, H-3, and Co-60) were selected for the validation test based on their significance to the radiological pathway doses during preclosure spent nuclear fuel handling and operations. The following nine-step simplified hand calculations are used for comparison to RSAC generated results:

6.2.4 Equations for Spreadsheet Calculations

The nine steps for the simplified hand calculations yield doses for the pathways of inhalation, ground surface exposure, submersion, and ingestion (these four doses are referred to as the "pathway doses"). Some of the nine steps calculate intermediate quantities, which are used in the calculation of the pathway doses. Validation comparisons are performed on the four pathway doses for each of the calculated radionuclides (inhalation, ground surface exposure, submersion, and ingestion).

(1) Calculate Airborne Concentration

Neglecting dry plume depletion and reflection from the mixing layer height, calculate airborne concentration downwind:

$$\chi = \frac{Q}{\pi u \sigma_y(x)\sigma_z(x)} exp\left(-\frac{h^2}{2\sigma_z^2}\right) \quad (1)$$

where
χ represents the airborne concentration (Ci/m^3) at a downwind distance x (m),
Q represents the released activity release rate (Ci/s)
u represents the average wind speed (m/s),
$\sigma_y(x)$ represents the standard deviation of horizontal dispersion (m) at a downwind distance x,

$\sigma_z(x)$ represents the standard deviation of vertical dispersion (m) at a downwind distance *x*, and *h* represents the stack height (m).

(2) Calculate Inhalation Dose

The inhalation committed effective dose equivalent (CEDE) is calculated in Sv from the following expression:

$$\text{Inhalation CEDE} = \left(\frac{3.7 \times 10^{10}\,\text{Bq}}{1\ \text{Ci}}\right)\left(\text{DCF}_{\text{inh}} \times \chi \times \text{BR} \times t_r\right) \qquad \textbf{(2)}$$

where
DCF_{inh} represents the dose conversion factor for inhalation of the radionuclide of interest (Sv/Bq),
BR represents the breathing rate (m^3/s), and
t_r represents the release duration (s).

Note, this calculation assumes the same duration for release and exposure.

(3) Calculate Ground Surface Dose

The effective dose equivalent (EDE) from ground surface exposure is calculated from the following relationship:

$$\text{Ground Surface EDE} = \text{DRCF}_{\text{gs}} \times \frac{\chi}{Q} \times V_d \times f_{shield} \times \frac{A_0}{\lambda}\left[1 - e^{-\lambda t_e}\right] \qquad \textbf{(3)}$$

where
DRCF_{gs} represents the dose rate conversion factor due to ground surface exposure from the radionuclide of interest (Sv m^2/Bq s),
V_d represents the deposition velocity (m/s),
f_{shield} represents the building shielding factor (unitless),
A_0 represents the undecayed activity released (Bq),
λ represents the radioactive decay constant for the radionuclide of interest (1/s), and
t_e represents the ground surface exposure time (s).

(4) Calculate Air Submersion Dose

Assuming negligible radioactive decay during plume transport, the effective dose equivalent (EDE) from air submersion is calculated from the following relationship:

$$\text{Submersion EDE} = \text{DRCF}_{\text{sub}} \times \frac{\chi}{Q} \times A_0 \qquad \textbf{(4)}$$

where
DRCF_{sub} represents the dose rate conversion factor due to air submersion from the radionuclide of interest (Sv m^3/Bq s).

(5) Calculate Ground Concentration

Assuming negligible radioactive decay during plume transport, the ground concentration, G (Bq/m^2), is calculated:

$$G = \left(\frac{3.7 \times 10^{10}\ \text{Bq}}{1\ \text{Ci}}\right)\left(\chi \times v_d \times t_r\right) \tag{5}$$

where
v_d represents the deposition velocity (m/s).

(6) Calculate Ingestion Dose from Leafy Vegetables

The ingestion dose from leafy vegetables, $D_{leafyveg}$ (Sv), is calculated from the following relationship, which includes contributions from deposited activity on foliage and root uptake:

$$D_{leafyveg} = \text{DCF}_{\text{ing}}\,\text{U}_{\text{leafyveg}}\left(\frac{f_{contam} \times f_{trans,leafveg} \times f_{\text{int,veg}}}{Y_{veg}} + \frac{B_{produce}}{\phi}\right)G \tag{6}$$

where
DCF_{ing} represents the dose conversion factor for ingestion (Sv/Bq),
$\text{U}_{\text{leafyveg}}$ represents the leafy vegetable consumption rate (kg/yr),
f_{contam} represents the fraction of crops contaminated (unitless),
$f_{trans,leafveg}$ represents the translocation fraction of the deposited activity for leafy vegetables (unitless),
$f_{int,veg}$ represents the interception fraction for radionuclide deposition on vegetable foliage (unitless),
Y_{veg} represents the crop yield for vegetables (kg/m^2),
$B_{produce}$ represents the conversion factor for root uptake from contaminated soil to edible portion of crop for produce (Bq/kg crop per Bq/kg soil), and
ϕ represents the effective surface soil density (kg/m^2 soil).

(7) Calculate Ingestion Dose from Nonleafy Vegetables

The ingestion dose from nonleafy vegetables, $D_{nonleafyveg}$ (Sv), is calculated from the following relationship for root uptake:

$$D_{nonleafyveg} = \text{DCF}_{\text{ing}}\,\text{U}_{\text{nonleafyveg}}\left(\frac{f_{contam} \times f_{trans,nonleaf} \times f_{\text{int,veg}}}{Y_{veg}} + \frac{B_{produce}}{\phi}\right)G \tag{7}$$

where
$\text{U}_{\text{nonleafyveg}}$ represents the nonleafy vegetable consumption rate (kg/yr), and
$f_{trans,nonleaf}$ represents the fraction of the deposited activity translocated to the edible portion of the nonleafy vegetable (unitless),

(8) Calculate Ingestion Dose from Milk

Assuming livestock feeds entirely on forage, the ingestion dose from milk, D_{milk} (Sv), is calculated from the following relationship:

$$D_{milk} = \mathrm{DCF_{ing}}\,\mathrm{U_{milk}}\,\mathrm{F_{milk}}\,\mathrm{U_{feed}}\left(\frac{f_{contam} \times f_{trans,forage} \times f_{\mathrm{int,forage}}}{Y_{forage}} + \frac{B_{forage}}{\phi}\right)G \qquad \textbf{(8)}$$

where
U_{milk} represents the milk consumption rate (L/yr),
F_{milk} represents the bioconversion factor for animal's intake of radioactivity to radioactivity in milk (Bq/L milk per Bq/day intake = day/L),
U_{feed} represents the animal's consumption rate of feed (kg/day), and
$f_{trans,forage}$ represents the translocation fraction of the deposited activity for forage (unitless), and
$f_{int,forage}$ represents the interception fraction for radionuclide deposition on forage (unitless), and
Y_{forage} represents the crop yield for forage (kg/m^2), and
B_{forage} represents the conversion factor for root uptake from contaminated soil to edible portion of crop for forage (Bq/kg crop per Bq/kg soil).

(9) Calculate Ingestion Dose from Meat

Assuming livestock feeds entirely on forage, the ingestion dose from meat, D_{meat} (Sv), is calculated from the following relationship:

$$D_{meat} = \mathrm{DCF_{ing}}\,\mathrm{U_{meat}}\,\mathrm{F_{meat}}\,\mathrm{U_{feed}}\left(\frac{f_{contam} \times f_{trans,forage} \times f_{\mathrm{int,forage}}}{Y_{forage}} + \frac{B_{forage}}{\phi}\right)G \qquad \textbf{(9)}$$

where
U_{meat} represents the meat consumption rate (kg/yr),
F_{meat} represents the bioconversion factor for animal's intake of radioactivity to radioactivity in meat (Bq/kg meat per Bq/day intake = day/kg), and
U_{feed} represents the animal's consumption rate of feed (kg/day).

The total ingestion dose is calculated as the sum of ingestion doses from leafy vegetables, nonleafy vegetables, milk, and meat.

6.2.5 Comparison of Spreadsheet Calculations to RSAC Output

Three radionuclides (I-129, H-3, and Co-60) were selected for the validation test based on their significance to the radiological pathway doses during preclosure spent nuclear fuel handling and operations. The nine steps from the previous section were followed, and the results for the four pathway doses are presented in Tables 4– 7. These hand calculations are included on the CD in file RSAC_2ValidationSpreadsheet.xls. The pathway doses were within a factor of 2 for each radionuclide calculated by RSAC when tested on both Windows XP and Windows NT machines. The same values were generated using Version 6.2 of the RSAC software as were generated previously from Version 6.1 of the RSAC software and these values were within a factor of 2 when compared with spreadsheet calculations. Therefore, the validation test was passed.

Two tests were conducted. Test one was conducted on machine PITOR. Machine PITOR runs Microsoft Windows XP. Test two was conducted on machine ASTINIUS. Machine ASTINIUS runs Microsoft Windows NT. Input and output files from these tests are included on the CD. For test 1, the rsac6. in and rsac6.out files are included in subdirectory

\TestCase2\TestOne(WindowsXP) and for test 2, the rsac6.in and rsac6.out files are included in subdirectory \TestCase2\TestTwo(WindowsNT). Both machines produced the same values for Pathway Contribution to the Effective Dose Equivalent (EDE) and Finite Model Cloud Gamma shown below:

```
                                                EXTERNAL EDE

   DOWNWIND DISTANCE =  1.000E+04 (m)            DOSE =  3.94E-08 (Sv)

*** PATHWAY CONTRIBUTION TO THE EDE  (Sv), DOWNWIND DISTANCE =  1.00E+04 (m)

   NUCLIDE       INHALATION  INGESTION   GROUND SUR  AIR IMMERS     TOTAL
-------------    ----------  ----------  ----------  ----------  ----------
 10030  H-  3      5.19E-09    7.70E-07    0.00E+00       -        7.75E-07
270600 Co- 60      1.17E-05    4.50E-04    3.15E-05       -        4.93E-04
531290  I-129      8.08E-06    6.51E-02    3.22E-06       -        6.51E-02
-------------    ----------  ----------  ----------  ----------  ----------
   SUBTOTALS       1.98E-05    6.56E-02    3.47E-05       -        6.56E-02
                                      FINITE MODEL CLOUD GAMMA     3.94E-08
                                                                  ----------
                                                          TOTAL    6.56E-02
```

Table 4. Results for Inhalation Dose.

Radionuclide	Inhalation Committed Effective Dose Equivalent (Sv)		Ratio (Validation Calculation to RSAC Version 6.2)
	Validation Calculation (Equation 2)	RSAC Version 6.2	
I-129	8.90×10^{-6}	8.08×10^{-6}	1.1
H-3	3.28×10^{-9}	5.19×10^{-9}	0.63
Co-60	1.12×10^{-5}	1.17×10^{-5}	1.0

Table 5. Results for Ground Surface Exposure Dose.

Radionuclide	Ground Surface Effective Dose Equivalent (Sv)		Ratio (Validation Calculation to RSAC Version 6.2)
	Validation Calculation (equation 3)	RSAC Version 6.2	
I-129	3.25×10^{-6}	3.22×10^{-6}	1.0
H-3	$0.00\times10^{+0}$	$0.00\times10^{+0}$	(same value)
Co-60	2.77×10^{-5}	3.15×10^{-5}	0.88

Table 6. Results for Submersion Dose.

Radionuclide	Submersion Effective Dose Equivalent (Sv)		Ratio (Validation Calculation to RSAC Version 6.2)
	Validation Calculation (equation 4)	RSAC Version 6.2 (Finite plume model)*	
I-129	2.17×10^{-10}		
H-3	1.89×10^{-13}		
Co-60	7.18×10^{-8}		
Total	7.20×10^{-8}	3.94×10^{-8}	1.83

*RSAC Version 6.2 calculates the submersion dose using a finite plume model and provides only a single dose value as output. Therefore, the sum of the radionuclide calculated doses is compared to this single dose value.

Table 7. Results for Ingestion Dose.

Radionuclide	Ingestion Committed Effective Dose Equivalent (Sv)		Ratio (Validation Calculation to RSAC Version 6.2)
	Validation Calculation (sum of doses from equations 6–9)	RSAC Version 6.2	
I-129	9.90×10^{-2}	6.51×10^{-2}	1.5
H-3	6.31×10^{-7}	7.70×10^{-7}	0.82
Co-60	2.37×10^{-4}	4.50×10^{-4}	0.53

7.0 Notes

Doses are not calculated for chronic releases. Therefore, a specialized dose calculation for tritium (H-3), to account for tritiated water reaching equilibrium with the water in plants, was not performed.

There is one attachment to this validation report. An electronic copy of this validation report will be included in this attachment in file, RSAC6_2 Validation Report.wpd.

Attachments:

1. CD containing the following files:

    \RSAC6_2 Validation Report.wpd

    \RSAC6_2ValidationSpreadsheet.xls

    \TestCase1\DiffExamples_NTvrsXP.txt

    \TestCase1\Rsac6_Example2_NT_man_Out.txt

    \TestCase1\Rsac6_Example2_XP_man_Out.txt

    \TestCase1\Rsac6_Example3_NT_Out.txt

    \TestCase1\Rsac6_Example3_XP_Out.txt

    \TestCase1\Rsac6_Example4_NT_Out.txt

    \TestCase1\Rsac6_Example4_XP_Out.txt

    \TestCase1\Rsac6_Example5_NT_Out.txt

    \TestCase1\Rsac6_Example5_XP_Out.txt

    \TestCase2\TestOne(WindowsXP)\rsac6.in

    \TestCase2\TestOne(WindowsXP)\rsac6.out

    \TestCase2\TestTwo(WindowsNT)\rsac6.in

    \TestCase2\TestTwo(WindowsNT)\rsac6.out

Appendix A

The PCSA Tool installs the RSAC software by copying a set of RSAC files to a specified directory within the installation path. In order to install the RSAC software in a similar manner for validation testing, the following instructions from INEEL were used to identify the files required to be copied to the test directory. The required files are identified in Section 3.1.

From: BSCHRADE@inel.gov

Sent: Saturday, October 25, 2003 7:31 PM

To: gadams@cnwra.swri.edu

Subject: RE: Product Key

you don't need the following

Dosstyle.dll

Rsac6 shortcut

Tnt.exe

other wise it should be fine. I would be interested in your final report.

George Adams <gadams@cnwra.swri.edu>

George Adams <gadams@cnwra.swri.edu>

10/23/03 07:15 AM

Please respond to gadams

To: BSCHRADE@inel.gov

cc: Asadul Chowdhury <achowdhury@cnwra.swri.edu>, Roland Benke <rbenke@cnwra.swri.edu>, Biswajit Dasgupta <bdasgupta@cnwra.swri.edu>

Fax to:

Subject: RE: Product Key

Brad,

Thank you for the CD. I have a question about installing only the rsac standalone portion of the software package without any of the user interface components. The application that we're working on at the Center writes an rsac6.in file, invokes the rsac6.exe, and then retrieves information from the rsac6.out file. We have our own user interface to store information in a common database for analysis. I noticed on the CD that the rsac6 directory contains a set of 15 files. I copied the 15 files into a directory and executed the rsac6 code with the Example1 input data from a command prompt, and I get the same output. What I would like to do is only install what I need to execute the rsac standalone to generate an rsac6.out file from an rsac6.in file. Is it sufficient to install the rsac standalone code by just copying the files from the rsac6 directory of the CD to a directory on the hard drive and execute the rsac6 application directly from that directory? We would use our application to invoke rsac from that directory and, for testing our application, invoke rsac from a command prompt at that directory.

The files that are on the CD in the rsac6 directory are:

Dosstyle.dll

Ex9src

Extfgr

Fones

Intfgr

Modfgr

Nuclib

Pgfeed

Popcq

Rsac6 shortcut

Rsac6.exe

Rsac6.out

Rsac6key

Texthelper.exe

Tnt.exe

Trancon

Thank you,

George Adams

-----Original Message-----

From: BSCHRADE@inel.gov [mailto:BSCHRADE@inel.gov]
Sent: Thursday, October 09, 2003 8:24 AM
To: gadams@cnwra.swri.edu
Subject: Product Key

George,

Here is the product key for the software.

5WR84-IJ3X2-S4T6H-9K2TT-98E6H

If at any time you have questions on a variable or how its used. Right click on it and then click on help and it will take you to the help for that variable. It is a little different. It has enhanced dry deposition evaluation and simplified inputs. It is not backward compatible. XP prevents that. You will need to reinput your scenarios.

Brad

Bradley J Schrader Ph.D. RRPT
Radiological Support Advisory Engineer
Idaho National Engineering & Environmental Laboratory
P.O. Box 1625, MS 3428
Idaho Falls, Idaho 83415-3428

bschrade@inel.gov
(208) 526-3399 Phone
(208) 526-0665 Fax
5697 Pager

Appendix B

RSAC 6 Input File:

```
* Validation Test for RSAC V.6.2
# Release of 1 Ci for I-129, H-3, and Co-60
2000,0
H  3,1.
CO 60,1.
I129,1.
2999
# Meteorological Inputs
5000,0
5001,1.,40.,1420.,1.099E3,0,1
5002,.001,.01,0.,.001,.001
5101,10000.
5201,1.,0
5400,2,0,0
5410,1,6,0
5999
# Inhalation Dose Calculation
7000,0,1,2,0,1
7001,3.33E-4,0,0,0
7999
# Ground Surface Dose Calculation
7000,4,1,2,0,1
7001,0,0,1.,0.7
7999
# Ingestion Dose Calculation
7000,3,1,2,0,1
7001,0,0,1.,0
7004,1,2,7.,7.
7051,520.,64.,110.,310.,1.,1.
7052,0.57,0.2,1.,0,3.5,3.5,100.
7053,225.,0,0,16.,0,0
```

```
7054,0,0,0,2.,0.28,4.9
7055,1.,1.,1.,1.
7999
# Submersion Dose Calc for a FINITE plume
9000, 0, 0.0
3000, 3
10000
```

RSAC 6 Input File Annotated:

* Validation Test for RSAC V.6.2

Release of 1 Ci for I-129, H-3, and Co-60

2000,0

H 3,1.

CO 60,1.

I129,1.

2999

Meteorological Inputs

5000,0

5001,1.,40.,1420.,1.099E3,0,1

<<5001==> 1 m/s wind velocity, 40 m stack height, 1420 m mixing layer depth, 1.099E3 g/m^3 air density, 0 = no plume depletion by wet deposition, 1 = plume depletion by dry deposition>>

5002,.001,.01,0.,.001,.001

<<5002==> deposition velocity for: solids = 0.001 m/s, halogens = 0.01 m/s, noble gases = 0. m/s, cesium = 0.001 m/s, and ruthenium = 0.001 m/s>>

5101,10000.

<<5101==> downwind distance = 10000 m>>

5201,1.,0

<<5201==> instantaneous release is desired leakage decay constant K1 = 1 and leakage decay constant K2 = 0>>

5400,2,0,0

<<5400==> option 2 identifies the use of program-calculated standard deviations of plume concentration>>

5410,1,6,0

<<5410==> option 1 identifies the use of Hilsmeier-Gifford σs, option 6 identifies weather class F (moderately stable), option 0 identifies ground level release

5999

Inhalation Dose Calculation

7000,0,1,2,0,1

<<7000==> option 0 identifies ICRP-30 Inhalation, program default parameters, option 1 identifies doses for each radionuclide, option 2 identifies a dose unit of Sv, option 0 identifies that the calculation is done for all elements, and option 1 identifies all organs>>

7001,3.33E-4,0,0,0

<<7001==> breathing rate 3.33e-4 m^3/s>>

7999

Ground Surface Dose Calculation

7000,4,1,2,0,1

<<7000==> option 4 identifies ground surface, option 1 identifies doses for each radionuclide, option 2 identifies a dose unit of Sv, option 0 identifies that the calculation is done for all elements, and option 1 identifies all organs>>

7001,0,0,1.,0.7

<<7001==> value 1 is the time in years that the receptor is exposed to the contaminated ground surface, value 0.7 is the building shielding factor>>

7999

Ingestion Dose Calculation

7000,3,1,2,0,1

<<7000==> option 3 identifies ingestion with supplied parameters (line 7004), option 1 identifies doses for each radionuclide, option 2 identifies a dose unit of Sv, option 0 identifies that the calculation is done for all elements, and option 1 identifies all organs>>

7001,0,0,1.,0

<<7001==> value 1 is the number of years that crops are grown on the contaminated soil. It should be 1 year for dose during the year of intake.>>

7004,1,2,7.,7.

<<7004==> option 1 identifies that program default transfer parameters are used and printed out, option 2 identifies that user-supplied ingestion parameters are on 705X lines, value 7 for time period in days that crops are exposed to contamination during the growing season, value 7 for harvest duration time period in days>>

7051,520.,64.,110.,310.,1.,1.

<<7051==> value 520 kg/yr for stored vegetable usage factor, value 64 kg/yr for fresh vegetable usage factor, value 110 kg/yr for meat usage factor, value 310 L/yr for milk usage factor, value 1 for fraction of stored vegetables from garden, and value 1 for fraction of fresh vegetables from garden>>

7052,0.57,0.2,1.,0,3.5,3.5,100.

<<7052==> value 0.57 for retention factor for activity on forage, value 0.2 for retention factor for activity on vegetables, value 1.0 for retention factor for iodines on forage, value 0 (1/h) for removal rate constant for crops, value 3.5 days for vegetable exposure time to plume for chronic release, value 3.5 days for forage exposure time to plume for chronic release, value 100 days for HTO removal half time>>

7053,225.,0,0,16.,0,0

<<7053==> value 225 kg/m^2 for effective surface density for soil, value 0 days for stored vegetable holdup time after harvest, value 0 days for fresh vegetable holdup time after harvest, value 16 kg/day for animals daily forage feed, value 0 days for feed-milk receptor transfer time, and value 0 days for slaughter to consumption time>>

7054,0,0,0,2.,0.28,4.9

<<7054==> value 0 for fraction of year that animals graze, value 0 for fraction of feed that is pasture when animal grazes on pasture, value 0 days for stored feed holdup time, value 2 kg/m^2 vegetable vegetation yield, value 0.28 kg/m^2 for forage vegetation yield, value 4.9 g/m^3 absolute humidity>>

7055,1.,1.,1.,1.

<<7055==> value 1 for fraction of annual stored vegetables that are contaminated by acute release, value 1 for fraction of annual fresh vegetables that are contaminated by acute release, value 1 for fraction of annual stored forage that is contaminated by acute release, value 1 for fraction of annual fresh forage that is contaminated by acute release>>

7999

Submersion Dose Calc for a FINITE plume

9000, 0, 0.0

<<9000==> value 0 for finite plume calculations, value 0.0 for decay time for leakage rate>>

3000, 3

<<3000==> value 3 for summary of dose by pathway and radionuclide>>

10000