SOFTWARE RELEASE NOTICE

1. SRN Number: MGFE - SRN - 297

2. Project Title: RDTME Code Development-PCSA

Project No. 1.20.06002.01.103

3. SRN Title: PCSA Tool Version 2.0

4. Originator/Requestor: Biswajit Dasgupta

Date: June 25, 2003

5. Summary of Actions

□ Release of new software

□ Change of access software

X Release of modified software:

□ Software Retirement

X Enhancements made

X Corrections made

6. Validation Status

□ Validated

□ Limited Validation

X Not Validated

Explain: Scheduled for validation May, 2004

7. Persons Authorized Access

Name	Read Only/Read-Write	Addition/Change/Delete
Biswajit Dasgupta / CNWRA	Read-Write	
Roland Benke / CNWRA	Read Only	
Ronald Janetzke / CNWRA	Read-Write	
Albert Lozano / CNWRA	Read-Write	
David Stead / CNWRA	Read-Write	
Cheryl Patton / CNWRA	Read Only	Delete
Amitava Ghosh / CNWRA	Read Only	
Simon Hsiung / CNWRA	Read Only	Addition
Doug Gute / CNWRA	Read Only	Addition
Goodluck Ofoegbu / CNWRA	Read Only	Addition
Troy Maxwell / CNWRA	Read Only	Addition
Vijay Jain / CNWRA	Read Only	Addition
Mysor Nataraja / NRC	Read Only	
Banad Jagannath / NRC	Read Only	
Dave Dancer / NRC	Read Only	
Robert Johnson / NRC	Read Only	
Seoung Lee / NRC	Read Only	Delete

8. Element Manager Approval:

Date: 6-25-03

9. Remarks: Acceptance Test conducted on Windows NT 4 only.

SOFTWARE SUMMARY FORM

01. Summary Date:
June 26, 2003

02. Summary prepared by (Name and phone)
Biswajit Dasgupta (210) 522-6815

03. Summary Action:
REPLACEMENT

04. Software Date:
June 25, 2003

05. Short Title:
PCSA Tool Version 2.0

06. Software Title: PCSA Tool Version 2.0

07. Internal Software ID:
2.0.0

08. Software Type:

□ Automated Data System

X Computer Program

□ Subroutine/Module

09. Processing Mode:

X Interactive

□ Batch

□ Combination

10. Application Area

a. General:
X Scientific/Engineering □ Auxiliary Analyses
□ Total System PA
□ Subsystem PA □ Other

b. Specific:

11. Submitting Organization and Address:

CNWRA/SwRI
6220 Culebra Road
San Antonio, TX 78228

12. Technical Contact(s) and Phone:

Biswajit Dasgupta (210) 522-6815
Ronald Benke (210) 522-5250

13. Software Application:
Preclosure safety analysis for repository project at Yucca Mountain.

14. Computer Platform
IBM-Compatible PC
Pentium II-256 MHz

15. Computer Operating System: Windows NT 4.0

16. Programming Language(s): Visual Basic and FORTRAN

17. Number of Source Program Statements:

18. Computer Memory Requirements:
128 MB

19. Tape Drives: N/A

20. Disk Units: 1 Internal Hard Drive

21. Graphics: XGA 1024x768

22. Other Operational Requirements
N/A

23. Software Availability:
□ Available X Limited □ In-House ONLY

24. Documentation Availability:
□ Available X Preliminary □ In-House ONLY

25.

Software Developer: ____________ Date: 6/25/03

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
QA VERIFICATION REPORT
FOR
→ DEVELOPED OR ACQUIRED TO BE MODIFIED SOFTWARE ←

Software Title/Name: PCSA Tool
Version: 2.0.0
Demonstration workstation: IBM Compatible PC
Operating System: Windows NT4, 2000, or XP
Developer: B. Dasgupta

Software Requirements Description (SRD) [TOP-018, Section 5.3]

SRD Version: 2.0 Revision 02
SRD Approval Date: 7/18/02

SRD and any changes thereto reviewed in accordance with QAP-002 requirements?

Yes: ☑ No: □ N/A: □

Is a Software Change Report(s) (SCR) used for minor modifications (i.e., acquired code), problems or changes to a configured version of software?

Yes: ☑ No: □ N/A: □

Comments:
All changes for Version 2.0.0 were controlled by use of SCRs

Software Development Plan (SDP) [TOP-018, Section 5.4]

SDP Version: Rev 02 and Rev 03
SDP (EM) Approval Date: 6/28/02, 5/13/03

The SDP addresses applicable sections of TOP-018, Appendix B, SDP Template?

Yes: ☑ No: □ N/A: □

Is the waiver (if used) in accordance with specified guidelines?

Yes: □ No: □ N/A: ☑

Comments:

Design and Development [TOP-018, Section 5.5.1 - 5.5.4]

Is code development in accordance with the conventions (i.e., coding conventions)described in the SDP/SCR?
SDP R03 Appendix "Visual Basic Coding Standards")

Yes: ☑ No: □ N/A: □

Module(s) Reviewed: mdlXmlModule1.bas, frmHETables.frm (new for V2.0.0)

Comments:

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
QA VERIFICATION REPORT
FOR
## *→ DEVELOPED OR ACQUIRED TO BE MODIFIED SOFTWARE ←*

Is code internally documented to allow a user to understand the function(s) being performed and to follow the flow of execution of individual routines?

Yes: ☑ No: □ N/A: □

Module(s) Reviewed:
mdlYmlModule1.bas, frmHETables.frm
Comments:

Is development of the code and informal module/subroutine-level testing documented in scientific notebook and/or SCR?
SCRs

Yes: ☑ No: □ N/A: □

SCR's and/or Scientific Notebook(s) Reviewed:
355 (tested 6/20/03) 356 (5/30/03), 357 (4/23/03), 358 (6/2/03), 359 (6/10/03), 360 (5/23/03)
Comments: 362 (4/24/03), 364 (5/15/03), 429 (5/16/03) 430 (5/16/03)

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: 6/25/03, 16:43

Name/Version Displayed: 2.0.0

Comments: "For evaluation only, not for licensing use" disclaimer (code not validated yet)

Medium and Header Documentation [TOP-018, Section 5.5.6]

A program title block of main program contains: Program Title, Customer Name, Customer Office/Division, Customer Contact(s), Customer Phone Number, Associated Documentation, Software Developer and Phone Number, Date, and Disclaimer Notice?

Yes: ☑ No: □ N/A: □

Comments:
Disclaimer is a pop up window

Source code module headers contain: Program Name, Client Name, Contract reference, Revision Number, Revision History, and Reference to SRD/SCR requirement(s)?

Yes: ☑ No: □ N/A: □

Module(s) Reviewed:
mdlYmlmodule1.bas, frmHETables.frm
Comments:

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: CD PCSA Tool Version 2.0.0 Visual Basic 6.0 SP4 WIN NT, 2K, XP
LAHEY LF90 v4.5 ReadMe.txt and Installation Files 6/25/03

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
QA VERIFICATION REPORT
FOR
→ *DEVELOPED OR ACQUIRED TO BE MODIFIED SOFTWARE* ←

Code Reviews [TOP-018, Section 5.5.6]

Are code reviews (if implemented) documented in a scientific notebook or in another format that allows others to understand the code review process and results?

Yes: □ No: ☑ N/A: □

not necessary for changes like these for V 2.0.0

Documented in Scientific Notebook No.: ____________________

Comments:
Informal buddy checks were done

Acceptance and Installation Testing [TOP-018, Section 5.6]

Does *acceptance testing* demonstrate whether or not requirements in the SRD and/or SCR(s) have been fulfilled?

Yes: ☑ No: □ N/A: □

SCRs had detailed testing, Scientific Notebook 581E documented design review of SRD core requirements flow down

Has *acceptance testing* been conducted for each intended computer platform and operating system?

Yes: □ No: ☑ N/A: □

Computer Platforms: PC Operating Systems: NT4 only

Location of Acceptance Test Results: SCRs & Scientific Notebook 581E

Comments:
SCR must indicate testing was limited to NT4 ~~only~~

Has *installation testing* been conducted for each intended computer platform and operating system?

Yes: ☑ No: □ N/A: □

Computer Platforms: PC Operating Systems: Windows NT4, 2000, XP

Location of Acceptance Test Results: Scientific Notebook

Comments:

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: PCSA Tool Version 2.0 User Guide June 2003

Comments:
Approved/Released 6/25/03

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
QA VERIFICATION REPORT
FOR
## *→ DEVELOPED OR ACQUIRED TO BE MODIFIED SOFTWARE ←*

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

Yes: ☑ No: □ N/A: □

Location of Instructions: readme.txt - (reference User Guide also)

Comments:

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: 6/25/03

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

Yes: ☑ No: □ N/A: □

FileList.txt from CD for QA Archives

Comments:

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: Archive CD (QA Records)

Comments:

Have all the script/make files and executable files been submitted to the Software Custodian?

Yes: ☑ No: □ N/A: □

Location of script/make files: Archive CD (QA Records)

Comments:

Software Release [TOP-018, Section 5.9]

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: MGFE-SRN-297

Comments: Dated 6/25/03

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
QA VERIFICATION REPORT
FOR
→ DEVELOPED OR ACQUIRED TO BE MODIFIED SOFTWARE ←

Software Validation [TOP-018, Section 5.10]

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

Not planned for V.2.0.0.

Yes: □ No: □ N/A: ☑

Version and Date of SVTP: ____________________

Date Reviewed and Approved via QAP-002: ____________________

Comments:
Planned for V.3.0 in May 2004

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: ____________________

Date Reviewed and Approved via QAP-002: ____________________

Comments:

Additional Comments:

6/30/03
Software Developer/Date

6/30/03
Software Custodian/Date

```
                              FileList.txt
Listing of all files on PCSA Tool version 2.0.0 Quality Assurance CD:

Date       Time                Size (bytes)|File Name
___________________________________________|______________________________

Files in '\Install' directory:
06/25/03  11:38a             25,916,778 Data.Cab
07/27/00  12:49p              1,513,987 instmsia.exe
07/27/00  12:49p              1,526,275 instmsiw.exe
06/25/03  11:38a             26,124,288 PCSA Tool.msi
06/25/03  11:24a                  1,932 ReadMe.txt
02/07/01  06:47p                102,400 setup.exe
06/25/03  11:29a                 62,685 setup.ini

Files in '\Install\MDAC_Jet\MDAC26sp2' directory:
05/31/02  05:50p              5,287,488 MDAC_TYP.EXE

Files in '\Install\MDAC_Jet\Jet40' directory:
05/21/02  04:19p              3,684,536 Jet40Sp3_Comp.exe

Files in '\Install\IE55' directory:
04/05/01  02:32p                 71,264 ADVAUTH.CAB
04/05/01  02:34p                169,907 AOLSUPP.CAB
04/05/01  02:33p                 83,745 AXA2.CAB
04/05/01  02:32p                  8,029 BRANDING.CAB
04/05/01  02:31p              1,228,544 DCOM95.EXE
04/05/01  02:33p                 35,993 DXDDEX.CAB
04/05/01  02:33p                339,279 DXMINI.CAB
12/08/01  10:12p                  6,340 filelist.dat
04/05/01  02:33p                762,249 FONTCORE.CAB
04/05/01  02:34p                643,814 FONTSUP.CAB
04/24/01  12:29p              2,619,137 FULLSW.CAB
04/05/01  02:31p                286,132 GSETUP95.CAB
04/05/01  02:31p                261,002 GSETUPNT.CAB
04/05/01  02:33p                387,083 HELPCONT.CAB
04/05/01  02:33p                690,173 HHUPD.CAB
04/05/01  02:33p                479,037 ICW.CAB
04/05/01  02:33p                476,305 ICWCON.CAB
10/20/00  04:50p                  2,886 ie.txt
04/05/01  02:33p                528,516 IE4MFC40.CAB
04/05/01  02:33p                218,704 IE501DOM.EXE
04/05/01  02:27p                510,760 ie5setup.exe
04/05/01  02:33p                 70,814 IEDATA.CAB
04/05/01  02:33p                  9,009 IEDATAJA.CAB
04/05/01  02:32p                 21,673 IEEXINST.CAB
04/05/01  02:34p                122,295 IELPKAD.CAB
04/05/01  02:31p              1,322,114 IEMIL_1.CAB
04/05/01  02:32p              2,587,550 IEMIL_2.CAB
04/05/01  02:32p              2,056,681 IEMIL_3.CAB
04/05/01  02:32p              1,267,103 IENT_S1.CAB
04/05/01  02:32p              1,457,103 IENT_S2.CAB
```

```
04/05/01  02:32p          1,457,103 IENT_S3.CAB
04/05/01  02:32p          1,457,103 IENT_S4.CAB
04/05/01  02:32p            946,620 IENT_S5.CAB
04/05/01  02:31p                  0 iesetup.dir
04/05/01  02:34p              1,207 iesetup.ini
04/05/01  02:32p          1,503,549 IEW2K_1.CAB
04/05/01  02:32p          1,716,959 IEW2K_2.CAB
04/05/01  02:32p          2,539,541 IEW2K_3.CAB
04/05/01  02:33p            207,405 IE_EXTRA.CAB
04/05/01  02:32p          1,451,469 IE_S1.CAB
04/05/01  02:32p          1,457,101 IE_S2.CAB
04/05/01  02:32p          1,457,101 IE_S3.CAB
04/05/01  02:32p          1,457,101 IE_S4.CAB
04/05/01  02:32p            765,907 IE_S5.CAB
04/05/01  02:33p          1,521,813 MAILNEWS.CAB
04/05/01  02:33p          2,295,653 MDAC_IE5.CAB
04/05/01  02:33p            535,819 MMSSETUP.CAB
04/05/01  02:32p            415,643 MOBILE95.CAB
04/05/01  02:32p            391,307 MOBILENT.CAB
04/05/01  02:33p            567,271 MPCDCS.CAB
04/05/01  02:33p          1,322,008 MPLAYER2.CAB
04/05/01  02:32p             54,067 MSN_AUTH.CAB
04/05/01  02:33p          1,549,418 NM30.CAB
04/05/01  02:34p            477,936 OAINST.EXE
04/05/01  02:32p             15,721 README.CAB
04/05/01  02:34p            502,082 SCRIPTEN.CAB
04/05/01  02:32p            755,211 SETUPNT.CAB
04/05/01  02:32p            951,664 SETUPW95.CAB
04/05/01  02:34p            168,225 SWFLASH.CAB
06/10/02  11:03a                333 This folder is safe to delete.t
xt
04/05/01  02:32p            158,641 TS95.CAB
04/05/01  02:32p            161,550 TSNT.CAB
04/05/01  02:34p            320,050 VBSCRIPT.CAB
04/05/01  02:33p            811,686 VGX.CAB
04/05/01  02:33p          2,465,378 VMX86_01.CAB
04/05/01  02:33p          2,609,956 VMX86_02.CAB
04/05/01  02:33p            555,923 WAB.CAB
04/05/01  02:34p          1,180,048 WEBFLDRS.CAB

Files in '\Install\IE55\IE55_sp2' directory:
02/16/03  02:25a             72,534 ADVAUTH.CAB
02/16/03  02:25a              8,886 BRANDING.CAB
02/16/03  02:27a              1,116 filelist.dat
02/16/03  02:27a            366,307 HELPCONT.CAB
07/23/01  08:16p              2,886 ie.txt
10/21/02  04:01p            511,616 ie5setup.exe
02/16/03  01:47a            109,906 IEDOM.CAB
02/16/03  02:22a             22,819 IEEXINST.CAB
02/16/03  01:29a                  0 iesetup.dir
02/16/03  02:27a                473 iesetup.ini
```

```
02/16/03  01:54a             1,448,221 IE_S1.CAB
02/16/03  02:02a             1,457,957 IE_S2.CAB
02/16/03  02:10a             1,457,957 IE_S3.CAB
02/16/03  02:18a             1,457,957 IE_S4.CAB
02/16/03  02:21a               546,382 IE_S5.CAB
02/16/03  02:25a               416,943 MOBILE95.CAB
09/19/01  02:04p                19,484 MS01-020_Nimba.htm
02/16/03  02:22a                26,737 README.CAB
02/16/03  01:46a               953,408 SETUPW95.CAB
02/16/03  02:23a               159,493 TS95.CAB

Files in '\Install\IE55\IE55_Update' directory:
01/20/02  12:54p             2,256,528 q313675.exe

Files in '\InstallShieldProject' directory:
06/25/03  01:03p             2,718,052 PCSAV2k.ism

Files in '\SourceCodeDirectory' directory:
06/25/03  01:25p            10,198,599 PCSATool_v2releaseQAbackup.zip

End of list of files.
```

Software Change Reports

SOFTWARE CHANGE REPORT (SCR)

1. SCR No.: 355 (Software Developer Assigns)	2. Software Title and Version: PCSA Tool, Version 2.0.0	3. Project No: 20.1402.672 (FY02), 20.6002.01.103 (FY03)

4. Affected Software Module(s), Description of Problem(s):
Affected: Database file structure (Template.mdb and other project database files).
All forms in the Frequency Analysis Module (frmInitEventForm.frm, frmInitEventTable.frm, frmEventScenario.frm, frmFaultTree.frm, frmFaultTreeEventTable.frm, frmEventSequenceForm.frm, frmEventSequenceTable.frm, and frmEditTables.frm and mdlYMPModule1.bas. All corresponding report designer forms.

Description: Changes required to implement new PCSA Tool version 2 functionality, as described in the version 2 SRD (Software Requirements Document), and additional changes requested by Biswajit Dasgupta.

5. Change Requested by: Biswajit Dasgupta Date: 7/29/2002	6. Change Authorized by (Software Developer): Biswajit Dasgupta Date: 7/29/2002

7. Description of Change(s) or Problem Resolution (If changes not implemented, please justify):
See attachment.

8. Implemented by: David Stead	Date: 6/20/2003

9. Description of Acceptance Tests:
Run PCSA Tool and verify that the changes have been made.
See attachment.

10. Tested by: J. Menchaca, Albert Lozano	Date: 6/20/2003

Attachment:

Description of changes (item 7):

1. Fault Tree forms renamed and functionality changed: frmFaultTreeForm renamed to frmFaultTree; frmFaultTreeTable renamed to frmFaultTreeEventTable. The Fault Tree sub-module's design has changed to show each Fault Tree in frmFaultTree, and the events for a specific Fault Tree are shown in frmFaultTreeTable. Top Event Names must be unique, and an entry in the 'FaultTree' table may not be deleted unless there are no events in the 'FaultTreeEvents' table associated with its Top Event Name.

2. frmInitEventForm, frmInitEventTable: Added 'DOE' (a Y/N field), 'Hazard ID' fields. Added code to check if 'IE ID', 'IE Freq', or 'DOE' were changed, and require clearing of the dose values in the 'EVG_MASTER' table. Added code to allow editing of the Initiating Event ID only if it has not been used in the 'EVG_MASTER' table (frmEventScenario).
   IDs must be unique.
   Database field changes in 'InitEventTable':
      Changed 'Included for PCSA' to 'Included for Seq Analysis'; added 'Uncertainty', 'Uncertainty Info', 'Freq Calc Details', and 'Justification'.
      Changed 'Remarks' to 'Additional Info.
      Added 'Hazard ID' and 'DOE'.
      All fields allow zero length.

3. frmEventScenario: All scenarios now must be linked to an Initiating Event ID (IE ID), and display associated IE information, and risk calculations. GUI design modified accordingly.
   'Event Sequences' are now called 'Subsequent Events' (all variables & text boxes renamed & database field names changed; the former 'EvSeq' prefix is now 'SubEv').
   IDs must be unique.
   Added code to allow changes to the Event Scenario ID only if the ID is has not been used in the Event Sequence table.
   Removed the data control's .Refresh from cmdCancelRecord_Click(), and .UpdateControls from cmdAddScenario_Click(), to remedy an error caused when user tried to add a record when no records exist, then cancelled and tried to add a record again.
   Added code to disable (gray out) the Subsequent Events command buttons when their frame is disabled, to avoid user confusion.

   Database field changes:
   'EVG_MASTER' table:
      Changed 'Serial_No' to 'Item No'.
      Added 'IE Freq' and 'IE Prob', 'Num Realizations' and 'NoneFilesOnly'.
   'EVG_EVENT_SEQ' table renamed to 'EVG_SubEvents', fields changed:
      'Event Sequence No' changed to 'SubEv Item No'.
      Added 'SubEv ID', 'SubEv Uncertainty?', 'SubEv Linking', 'SubEv Link Details'.
      Renamed 'Event Sequence' to 'Subsequent Event'.
      Renamed all other fields that started with 'EvSeq' to start with 'SubEv'.
   Current fields in EVG_SubEvents':
      'FunctionalID' (unchanged), 'Item No', 'SubEv ID', 'SubEv Item No', 'Subsequent Event', 'SubEv Probability', 'SubEv Uncertainty?', 'SubEv Uncertainty', 'SubEv Linking', 'SubEv Link Details'.

SCR355, continued:

4. frmEventSequenceForm, frmEventSequenceTable: All Event Sequences now must be linked to an Event Scenario ID; risk analysis functionality added (see SCR357, database fields added/changed for dose values, paths, etc). Added ability to show 'DOE' and 'Saphire Data Path' for the Initiating Event in the form view, added automatic deletion of doses if the Event Sequence Frequency was changed. IDs must be unique.

   Current fields in 'EventSequence' table:
   'FunctionalID', 'Item No', 'EvSeq ID', 'EvScen ID', 'EvSeq Freq', 'Description', 'End State', 'Additional Info', 'Saphire Data Path', 'Category', 'Matl at Risk', 'Det Conseq Path', 'Prob Conseq Path', 'Num Realizations', 'Coefficient', 'Dose, PtEst', 'Dose, Mean', 'Dose, Min', 'Dose, 5%', 'Dose, 50%', 'Dose, 95%', 'Dose, Max'.

5. frmEventSequenceTable: Added 'SetFormReferences' to cmdDelRec_Click(), which was missing, causing an error when trying to delete an entry.

6. Added frmEnterNewID to have user enter a new ID when copying an entry in a table-view Frequency Analysis form. The table entry editing form (frmEditTables) has been modified to accommodate frmEnterNewID, for the Top Event Name needed when editing the Fault Tree Event table, and to update the error handlers.

7. Added/updated reports for all components of Frequency Analysis module (Initiating Event, Event Scenario, Fault Tree, Fault Tree Events, Event Sequence).

8. Tab order was revised to match current fields in all forms, where necessary.

Description of Acceptance Tests (item 9) ['✔' means passed test]:

1. Fault Tree forms renamed and functionality changed: frmFaultTreeForm renamed to frmFaultTree ✔; frmFaultTreeTable renamed to frmFaultTreeEventTable ✔. The Fault Tree sub-module's design has changed to show each Fault Tree in frmFaultTree ✔, and the events for a specific Fault Tree are shown in frmFaultTreeEventTable ✔. Top Event Names must be unique, and an entry in the 'FaultTree' table may not be deleted unless there are no events in the 'FaultTreeEvents' table associated with its Top Event Name ✔. Verified code changes in VB and their functionality., A. Lozano

2. frmInitEventForm, frmInitEventTable: Added 'DOE' (a Y/N field), ✔ 'Hazard ID' ✔
   fields. Added code to check if 'IE ID' ✔ (Note: Changing the ID causes a 'Corrupted Database' error,
   'IE Freq' ✔, or 'DOE' ✔ were changed.
   and require clearing of the dose values in the 'EVG_MASTER' ✔ table.
   IDs must be unique (Launches ✔ 'ERROR: Duplicate Initiating Event ID'). Verified by J. Menchaca.

   Database field changes in 'InitEventTable':
   Changed 'Included for PCSA' to 'Included for Seq Analysis' ✔; added 'Uncertainty' ✔, 'Uncertainty Info' ✔, 'Freq Calc Details' ✔, and 'Justification' ✔.
   Changed 'Remarks' to 'Additional Info' ✔.
   Added 'Hazard ID' and 'DOE' ✔.
   All fields allow zero length ✔., Verified using Access 97 by A. Lozano.

3. frmEventScenario: All scenarios now must be linked to an Initiating Event ID (IE ID), and display associated IE information, and risk calculations. GUI design modified accordingly.
   'Event Sequences' are now called 'Subsequent Events' (all variables & text boxes renamed & database field names changed; the former 'EvSeq' prefix is now 'SubEv').

IDs must be unique ✔, launches 'PCSATool - Duplicate Item Numbers [03.0] are not allowed.' warning box (if not unique). Verified by J. Menchaca

Database field changes:
'EVG_MASTER' table:
Changed 'Serial_No' to 'Item No' ✔.
Added 'IE Freq' ✔ and 'IE Prob' ✔, 'Num Realizations' ✔ and 'NoneFilesOnly' ✔.
'EVG_EVENT_SEQ' table renamed to 'EVG_SubEvents' ✔, fields changed:
'Event Sequence No' changed to 'SubEv Item No' ✔.
Added 'SubEv ID' ✔, 'SubEv Uncertainty?' ✔, 'SubEv Linking' ✔, 'SubEv Link Details' ✔.
Renamed 'Event Sequence' to 'Subsequent Event' ✔.
Renamed all other fields that started with 'EvSeq' to start with 'SubEv' ✔.
Current fields in 'EVG_SubEvents' ✔:
'FunctionalID' (unchanged), 'Item No', 'SubEv ID', 'SubEv Item No', 'Subsequent Event', 'SubEv Probability', 'SubEv Uncertainty?', 'SubEv Uncertainty', 'SubEv Linking', 'SubEv Link Details'.
Verified using Access 97 by A. Lozano.

4. frmEventSequenceForm, frmEventSequenceTable: All Event Sequences now must be linked to an Event Scenario ID ✔; risk analysis functionality added (database fields added/changed for dose values, paths, etc) ✔. Added ability to show 'DOE' and 'Saphire Data Path' for the Initiating Event in the form view, added automatic deletion of doses if the Event Sequence Frequency was changed. IDs must be unique. Verified by running the program and observing behavior., A. Lozano

   Current fields in 'EventSequence' table ✔:
   'FunctionalID', 'Item No', 'EvSeq ID', 'EvScen ID', 'EvSeq Freq', 'Description', 'End State', 'Additional Info', 'Saphire Data Path', 'Category', 'Matl at Risk', 'Det Conseq Path', 'Prob Conseq Path', 'Num Realizations', 'Coefficient', 'Dose, PtEst', 'Dose, Mean', 'Dose, Min', 'Dose, 5%', 'Dose, 50%', 'Dose, 95%', 'Dose, Max'.
   Verified using Access 97 by A. Lozano.

5. frmEventSequenceTable: Added 'SetFormReferences' to cmdDelRec_Click(), which was missing, causing an error when trying to delete an entry ✔. Verified by deleting a record in the form. A. Lozano.

6. Added frmEnterNewID to have user enter a new ID when copying an entry in a table-view Frequency Analysis form ✔. The table entry editing form (frmEditTables) has been modified to accommodate frmEnterNewID ✔ and for the Top Event Name needed when editing the Fault Tree Event table ✔, and to update the error handlers ✔. Verified by running the program and observing behavior, A. Lozano.

7. Added/updated reports for all components of Frequency Analysis module (Initiating Event, Event Scenario, Fault Tree, Fault Tree Events, Event Sequence) ✔. Verified by running the program and observing reports., A. Lozano

8. Tab order was revised to match current fields in all forms, where necessary ✔. Verified by running the program and observing TAB key behavior., A. Lozano

SOFTWARE CHANGE REPORT (SCR)

1. SCR No.: 356 (Software Developer Assigns)	2. Software Title and Version: PCSA Tool, Version 2.0.0	3. Project No: 20.1402.672 (FY02), 20.6002.01.103 (FY03)

4. Affected Software Module(s), Description of Problem(s):
This SCR describes the addition of capabilities to the Consequence modules (RSAC). One new form was added to the project. It is frmRSACDir. This form allows a user to specify a directory where the results of an RSAC run will be stored. Another form affected is frmRSACOutput. The FORTRAN programs and file formats were also changed to allow the consequence results to be used by the risk analysis programs.

5. Change Requested by: Biswajit Dasgupta Date: 8/22/ 2002	6. Change Authorized by (Software Developer): Biswajit Dasgupta Date: 8/22/2002

7. Description of Change(s) or Problem Resolution
(If changes not implemented, please justify):

The event sequence dose calculations in risk analysis require the results of a consequence run (RSAC). The frmRSAC_Output form was modified so that the results of a consequence run could be saved for later observation or used in risk analysis. The paths to these runs are specified to risk analysis via the frmResultsTable.

frmRSAC_Output:
Added code to cmdFromFile_Click to assure that user selects a file from the current project's subdirectory (if not, an error message is shown). Added error handlers and comments. Deleted obsolete code. Changed code in cmdSave_Click() to reflect new file names generated by the FORTRAN code.

frmRSACInput:
Deleted obsolete code.

frmWorkerDose:
Fixed a problem where the final doses and intermediate values were not cleared when switching from BWR to PWR or vice-versa.

Tab order was revised to match current fields in all forms, where necessary.

For more detailed information, refer to the PCSA Tool Development-Progress Report II.

8. Implemented by: Albert Lozano and David Stead Albert Lozano	Date: 5/30/2003

9. Description of Acceptance Tests:
See attachment.

10. Tested by: D. Stead, A. Lozano Albert Lozano	Date: 5/30/2003

Attachment

Description of Acceptance Tests (item 9):

frmRSAC_Output.frm
Test that the results from an RSAC run are properly saved. This test is performed by making a deterministic run and saving the results. The directory from the original run is then compared with the save directory. The same is then done for a probabilistic run. This verifies that all the necessary files have been copied. PASSED, D. Stead

File Selection from current project's subdirectory
The common dialog is exercised by attempting to open files from the current project's subdirectory and assure that they open, and by attempting to read files that are not in the current project's subdirectory and assure that they are blocked. PASSED, D. Stead

Added error handlers and comments, deleted obsolete code
The code is examined for the presence of error handlers, and that no unused code exists. PASSED, D. Stead

frmWorkerDose.frm
Fixed a problem where the final doses and intermediate values were not cleared when switching from BWR to PWR or vice-versa. This is tested by switching from PWR to BWR or vice-versa and assuring that the final and intermediate dose values are cleared each time. PASSED, A. Lozano

Tab order was revised to match current fields in all forms, where necessary. This task is verified by popping the appropriate forms and physically observing the selection behavior. PASSED, A. Lozano

SOFTWARE CHANGE REPORT (SCR)

1. SCR No.: 357 (Software Developer Assigns)	2. Software Title and Version: PCSA Tool, Version 2.0.0	3. Project No: 20.1402.672 (FY02), 20.6002.01.103 (FY03)

4. Affected Software Module(s), Description of Problem(s):
This SCR describes the addition of Risk Analysis to the PCSA Tool. Five new forms were added to the project. They are frmRiskAssessment, frmRiskEventSeqResults, frmRiskEventSequence, frmRiskResults, frmRiskTimeChange and frmSelectDirectory . Other forms affected are frmStartUp, frmEditTables, mdifrmMain, mdlYMPModule1, frmResultsTable, frmInitEventTable, frmEditTables, frmEventSequenceTable, and frmInitEventForm.

5. Change Requested by: Biswajit Dasgupta Date: 8/22/2002	6. Change Authorized by (Software Developer): Biswajit Dasgupta Date: 8/22/2002

7. Description of Change(s) or Problem Resolution
(If changes not implemented, please justify):
See attachment.

8. Implemented by: Albert Lozano and David Stead	Date: 6/23/2003

9. Description of Acceptance Tests:
Tested items described in (7) above by running the PCSA Tool and performing a demonstration risk analysis run.

Test results (as enumerated in attachment to (7) above):
Item 1: PASSED.
Item 2: PASSED.
Item 3: PASSED.
Item 4: PASSED.

10. Tested by: Roland Benke Roland R. Ben	Date: 6/23/2003

Attachment

Description of changes (item 7):

Changes made by Albert Lozano:
1. frmRiskAssessment was added, and is the first form that pops up when Risk Assessment is selected from the menu. Initially, the time, initiating event frequency, and initiating event probability are already determined but the doses are blank. The total risk is calculated from this form; however, the total risk cannot be calculated until the scenario doses are calculated. The doses can be calculated by double clicking on either 'Dose, PtEstimate' for deterministic or Dose Mean for probabilistic. This causes frmRiskEventSequence to be shown.

2. frmRiskEventSequence was added, and pops up with a list of the event sequences associated with the scenario. The time for calculation, and the initiating event frequency and probability for the scenario are given as are the event sequence frequencies and paths to the doses for each event sequence. The coefficient column is calculated and is a function of time, initiating event frequency, and the event sequence frequency. The dose path is a subdirectory where the results of an RSAC run are stored. Clicking the Event Dose button initiates the calculation of the Event Scenario dose using a background FORTRAN program pcsa_ietccdf.exe and launches frmRiskEventSeqResults. This form indicates the completion of the fortran program or a indicates a timeout error. If the calculation is successful, the dose value is displayed and the files are stored in the appropriate scenario subdirectory. When the frmRiskEventSequence form is closed, the dose information is transferred to the frmRiskAssessment. The process for calculating the event sequence doses is the same for both the probabilistic and deterministic calculations. This process is repeated for all event sequences.

When the 'Dose, Pt.Estimate' column is full, the 'Deterministic Risk' button is enabled and when the 'Dose, Mean' column is full, the 'Probabilistic Risk' button is enabled. Clicking either button launches the total ri calculation FORTRAN program and the frmRiskResults. This form shows the results for either the deterministic or probabilistic calculations. For more detailed information, refer to the PCSA Tool Development-Progress Report II.

Changes made by D. Stead:
3. Forms frmStartUp, frmEditTables, mdifrmMain, mdiYMPModule1, frmResultsTable, frmInitEventTable, frmEditTables, frmEventSequenceTable, frmInitEventForm, and frmSelectDirectory were modified to allow the user to enter the parameters that are necessary to perform the risk analysis.

4. Removed two tables ('Risk_Scenario' and 'Risk_ScenarioDose') in database. The information contained in the two removed tables has been added to the 'EventSequence' and 'EVG_MASTER' tables. A 'DOE' field has been added to the 'EVG_MASTER' table, and is copied from the 'InitEventTable' upon loading of the Risk Assessment form (frmRiskAssessment). Added 'NoOfPlusSigns' field and 'Risk (rem in time period)' field to the 'Risk Outcome' table. 'NumRealizations' and 'NoneFilesOnly' fields were added to the 'EVG_MASTER' table. Corresponding changes were made to frmEventScenario, frmEventSequenceForm, frmEventSequenceTable, and frmResultsTable to accommodate the database field changes. Tab order was revised to match current fields in all forms, where necessary.

SOFTWARE CHANGE REPORT (SCR)

1. SCR No.: 358 (Software Developer Assigns)	2. Software Title and Version: PCSA Tool, Version 2.0.0	3. Project No: 20.1402.672 (FY02), 20.6002.01.103 (FY03)

4. Affected Software Module(s), Description of Problem(s):
Affected: frmResultsTable, frmResultsSSCITSTable, frmSearchForm.frm, mdlYMPModule1.bas, and corresponding reports.

Description: Changes required to implement new PCSA Tool version 2 functionality, as described in the version 2 SRD (Software Requirements Document), and additional changes requested by Biswajit Dasgupta.

5. Change Requested by: Biswajit Dasgupta Date: 7/29/2002	6. Change Authorized by (Software Developer): Biswajit Dasgupta Date: 7/29/2002

7. Description of Change(s) or Problem Resolution
(If changes not implemented, please justify):
See attachment.

8. Implemented by: David Stead	Date: 6/02/2003

9. Description of Acceptance Tests:
See attachment.

10. Tested by: Albert Lozano	Date: 6/02/2003

Attachment:

Description of changes (item 7):

For both the Results and Results SSCIS views (frmResultsTable and frmResultsSSCISTable):

1. Previous version 1 database tables have been deleted ('Event Tree Analysis' and 'Event Tree SSCIS'), and replaced with the 'Event Sequence' table (already existed and now used for both 'Event Sequence' and project / current level Results views), and a new 'Event Sequence SSCIS' table.

2. For SSCIS, all pertinent data is copied into the separate SSCIS table (from EventSequence to EventSequenceSSCIS table), which also has 2 fields that do not exist in the EventSequence table: 'SSC' and 'Incl f/SA Calc'(Include for Safety Assessment Calculation).

3. Replaced global variable 'iDisplayResults' with 'gbShowCurrentLevel' and simplified construction of SQL statements to improve readability and eliminate redundant code.

4. Added a check for EOF (End Of File) to frmResultsSSCITSTable, LoadAll() before moving to first record, to avoid errors if no records exist.

5. Added unit labels below grid on left, for Dose and Frequency. Changed 'Safety Assessment' button to 'Category Search' in Current Level view, and 'Compliance Assessment' in project-wide view..

6. Allow user to edit doses in SSCIS Results and for DOE scenarios in 'Current Level Results'. For non-DOE scenarios, in 'Current Level Results', user selects the paths to deterministic and probabilistic RSAC runs.

7. Updated reports, and combined the two separate report subroutines (general case and category-specific case) for both the general and SSCIS case into single subroutines to eliminate redundant code and fix a problem when showing the category-specific reports.

8. Added code to prevent showing the Safety Assessment form after a 'Category Search' is done, unless the category specified is 1, and viewing project-wide results.

9. Tab order was revised to match current fields in all forms, where necessary.

Description of Acceptance Tests (item 9):

1. Change 1, Previous version 1 database tables have been deleted and added. This was verified by comparing the Version1 table with the Version 2 tables in the Template.mdb. PASSED

2. Change 2, For SSCIS all pertinent data is copied from EventSequence to EventSequenceSSCIS table which has two extra fields, "SSC" and "Incl/SA Calc". The two extra fields was verified by looking at the tables in Template.mdb for Version 2. PASSED

3. Change 3, The replacement of "iDisplayResults" with gbShowCurrentLevel was verified by examining the source code and running the program to check for proper operation. PASSED

4. Change 4, The addition of the check for EOF was verified by looking at the code. PASSED

5. Change 5, Addition of the unit labels on the grid and button changes were verified visually. PASSED

6. Change 6, Editing of Doses for DOE scenarios and paths for non-DOE scenarios was tested by changing the entries and verifying that the information in the table was updated. PASSED

SCR358, continued:

7. Change 7, Update reports was tested by verifying that the information in the reports is the same as the information that is on the form. PASSED

8. Change 8, Verified that the Safety Assessment form is only shown under the conditions specified. PASSED

9. Change 9, Tab order was verified by pressing the tab key and examining the focus behavior in the forms. PASSED

SOFTWARE CHANGE REPORT (SCR)

1. SCR No.: 359 (Software Developer Assigns)	2. Software Title and Version: PCSA Tool, Version 2.0.0	3. Project No: 20.1402.672 (FY02), 20.6002.01.103 (FY03)

4. Affected Software Module(s), Description of Problem(s):
Affected: Database file structure (Template.mdb, PCSATest.mdb, and other project database files). All forms in the Hazard Analysis Module: (frmMDIFMEAForm.frm, frmMDIFMEATable.frm, frmSELTable.frm, frmWhatIfForm.frm, frmMDIWHATIFTable.frm, frmWhatIfSELTable.frm, frmEnergyAnalysisForm.frm, frmEnergyAnalysisTable.frm, frmEnergyAnalSELTable.frm, and mdlYMPModule1.bas.
All corresponding report designer forms.

New forms: frmHRAForm.frm, frmHRATable.frm, frmHRA_SELTable.frm, frmSevereEvents.frm), and corresponding new report designer forms.

Description: Changes required to implement new PCSA Tool version 2 functionality, as described in the version 2 SRD (Software Requirements Document), and additional changes requested by Biswajit Dasgupta.

5. Change Requested by: Biswajit Dasgupta Date: 7/29/2002	6. Change Authorized by (Software Developer): Biswajit Dasgupta Date: 7/29/2002

7. Description of Change(s) or Problem Resolution
(If changes not implemented, please justify):
See attachment.

8. Implemented by: David Stead	Date: 5/28/2003

9. Description of Acceptance Tests:
See attachment.

10. Tested by: Albert Lozano Albert Lozano	Date: 6/10/2003

Attachment, Description of changes (item 7):

1. All Internal Hazard Analysis module 'form view ' forms: Added Tool Tip for Severe Events (frame and 'Justification' box), "Potential to release radiological dose. Select YES or NO and justify your selection in 'Justification'."

2. frmFMEAForm, frmMDIFMEATable: Field name changes - Combined 'Safeguards' and 'DOE Failure Detection' into 'DOE Safeguards & Ctrls' (deleted 'DOE Failure Detection').

3. Added frmHRAForm, frmHRATable, and frmHRA_SELTable for new Human Reliability Analysis sub-module; Field names: 'FunctionalID', 'Item No', 'Category', 'Human Action', 'Human Failure Event', 'Perf Shaping Factors', 'Recovery Action', 'Effect of Failure', 'DOE Safeguards & Ctrls', 'Severe Events', 'Justification', 'Additional Info' (standard view only), 'Remarks' (for Severe Events view only). Created HRA Report.

4. Fixed problem w/frmEnergyAnalSELTable: When editing a record, frmEditTables did not have the 'EventCategory ' clause set, causing a "multiple Item No" error.

5. frmExternalEvents: Added 'Ext Hazard ID' field. Fixed problem when double-clicking the 'Applicability...' field for 'Seismic, Earthquake', which formerly keyed on the grid's column number, rather than identifying the field name text. Added code to deny editing when in 'Show Only Applicable' display mode.

6. frmExternalEventAnalysis: Added 'Ext Hazard ID' field, hide frmExternalEvents while this form is in use, add capability to accept non-numeric entry in 'Event Frequency' field (ask user if non-numeric is OK), except when all 3 option buttons are set to 'Yes', where a valid number is still required. Added code to disable the 'Show Report' button if a field has been edited. Changed from the '_Click' to the '_Change' method to detect editing in text boxes, and added 'bFormHasLoaded' that is set to 'True' after the form has loaded, to prevent the 'Show Report' button from being disabled while the form is being loaded. Improved the error handling when user clicked 'View Report File' and the report file is not found: The behavior has been changed when a file or path is not found; the user gets a warning message saying the file/path was not found, in place of the generic error message with error number/description. Also, a '\Documents' subdirectory has been added to the installation to prevent the 'path not found' error.

7. Added 'frmSevereEvents' form to view Severe Events from all Internal Hazard modules simultaneously.
   Added 'SevereEvents' table in DB, with fields 'Type / Item No', 'Description', 'Remarks'.

8. frmEditTables modified to trim leading or trailing spaces from user's entry in the edit text box.

9. All reports have been updated.

10. Tab order was revised to match current fields in all forms, where necessary.

11. mdlYMPModule1: Fixed a problem in 'gsSuggestNextItemNo_FromGridInUse()' where if grid was empty but its 'rows' propertly was = 2, an error was generated because there was no text in the 'Item No' column. If no text is found, the suggested Item Number will now be '0001.00'.

SCR 359, continued

Attachment, Description of Acceptance Tests (item 9):

1. All Internal Hazard Analysis module 'form view ' forms: Added Tool Tip for Severe Events (frame and 'Justification' box), "Potential to release radiological dose. Select YES or NO and justify your selection in 'Justification'." Verified by running PCSA Tool and observing the tool tips. PASSED

2. frmFMEAForm, frmMDIFMEATable: Field name changes - Combined 'Safeguards' and 'DOE Failure Detection' into 'DOE Safeguards & Ctrls' (deleted 'DOE Failure Detection'). Verified by running PCSA Tool and observing the field names in the aforementioned forms. PASSED

3. Added frmHRAForm, frmHRATable, and frmHRA_SELTable for new Human Reliability Analysis sub-module; Field names: 'FunctionalID', 'Item No', 'Category', 'Human Action', 'Human Failure Event', 'Perf Shaping Factors', 'Recovery Action', 'Effect of Failure', 'DOE Safeguards & Ctrls', 'Severe Events', 'Justification', 'Additional Info' (standard view only), 'Remarks' (for Severe Events view only). Created HRA Report. Verified by running PCSA Tool and observing the field names in the aforementioned forms. PASSED

4. Fixed problem w/frmEnergyAnalSELTable: When editing a record, frmEditTables did not have the 'EventCategory ' clause set, causing a "multiple Item No" error. Verified by running PCSA Tool and editing an entry in the table. PASSED

5. frmExternalEvents: Added 'Ext Hazard ID' field. ✓ Fixed problem when double-clicking the 'Applicability...' field for 'Seismic, Earthquake', which formerly keyed on the grid's column number, rather than identifying the field name text. ✓ Added code to deny editing when in 'Show Only Applicable' display mode. ✓ Verified by running PCSA Tool, observing the new field, editing the 'Seismic, Earthquake' event's applicability, and checking that editing is impossible from the 'Show Only Applicable' view. PASSED

6. frmExternalEventAnalysis: Added 'Ext Hazard ID' field ✓, hide frmExternalEvents while this form is in use ✓, add capability to accept non-numeric entry in 'Event Frequency' field (ask user if non-numeric is OK), except when all 3 option buttons are set to 'Yes', where a valid number is still required. ✓ Added code to disable the 'Show Report' button if a field has been edited. ✓ Changed from the '_Click' to the '_Change' method to detect editing in text boxes ✓, and added 'bFormHasLoaded' that is set to 'True' after the form has loaded, to prevent the 'Show Report' button from being disabled while the form is being loaded. ✓ Improved the error handling when user clicked 'View Report File' and the report file is not found: The behavior has been changed when a file or path is not found; the user gets a warning message saying the file/path was not found, in place of the generic error message with error number/description. ✓ Also, a '\Documents' subdirectory has been added to the installation to prevent the 'path not found' error. ✓ Verified by examining the code and running PCSA Tool. PASSED

7. Added 'frmSevereEvents' form to view Severe Events from all Internal Hazard modules simultaneously. ✓
   Added 'SevereEvents' table in DB, with fields 'Type / Item No', 'Description', 'Remarks'. ✓
   Verified by running PCSA Tool and observing the form and report. PASSED

8. frmEditTables modified to trim leading or trailing spaces from user's entry in the edit text box. Verified by attempting to insert leading and trailing spaces during an edit operation, and verifying that the spaces were stripped from the entry. PASSED

9. All reports have been updated. Verified by running PCSA Tool and showing all applicable reports. PASSED

10. Tab order was revised to match current fields in all forms, where necessary. Verified by running PCSA Tool, and observing the TAB behavior. PASSED

11. mdlYMPModule1: Fixed a problem in 'gsSuggestNextItemNo_FromGridInUse()' where if grid was empty but its 'rows' propertly was = 2, an error was generated because there was no text in the 'Item No' column. If no text is found, the suggested Item Number will now be '0001.00'. Verified by viewing code and running PCSA Tool to assure that Item Number is '0001.00' if grid is empty. PASSED

SOFTWARE CHANGE REPORT (SCR)

1. SCR No.: 360 (Software Developer Assigns)	2. Software Title and Version: PCSA Tool, Version 2.0.0	3. Project No: 20.1402.672 (FY02), 20.6002.01.103 (FY03)

4. Affected Software Module(s), Description of Problem(s):
Description: Changes required to implement new PCSA Tool version 2 functionality, as described in the version 2 SRD (Software Requirements Document), and additional changes requested by Biswajit Dasgupta. Changes to System Menu to accommodate new and changed items, and variable naming changes. Add new data field.

5. Change Requested by: Biswajit Dasgupta Date: 7/29/2002	6. Change Authorized by (Software Developer): Biswajit Dasgupta Date: 7/29/2002

7. Description of Change(s) or Problem Resolution
(If changes not implemented, please justify):
See attachment.

8. Implemented by: David Stead David Stead	Date: 4/16/2003

9. Description of Acceptance Tests:
See attachment.

10. Tested by: Albert Lozano Albert Lozano	Date: 5/23/2003

Attachment, Description of changes (item 7):

1. frmSystemDescription: Added 'Software Systems' field to database table 'SysDescription', System Description form and report. Tab order was revised to match current fields, where necessary.

2. frmStartup.frm: Modified behavior of common dialog boxes used for file selection, to correct problems and simplify their use. Added a check in cmdOpen_Click() to prevent user from creating or opening a project in other than the '\Projects' directory. This would cause errors and prevent the program from functioning.

General & Menu changes:

3. System Menu changed: 'Internal Events' and 'External Events' abbreviated to 'Int. Events' and 'Ext. Events', respectively, in order for the entire menu to fit on one line in 800x600 displays. Added 'Severe Events (ALL)' for new form that shows all Severe Events simultaneously (see SCR359) for description.

4. Added 'SW Reliability' menu item to integrate new Software Reliability module written by Albert Lozano.

5. Added global variable 'gsAppPath', a string that contains the current application's path, to avoid any problems with improper path references. Several variables were renamed to conform with our coding standards. Error handlers were added in many subroutines to make the program more robust.

Description of Acceptance Tests (item 9):

1. Change 1, Added software system field to System Description form, was tested by opening a project in the PCSA Tool and selecting System->Sysdesc from the menu bar.

   The "System Description" Form was displayed and data was entered in the Software Systems text box. The form was closed and then redisplayed to assure that the text box was correctly refreshed from the database. PASSED

2. Change 2, Modified behavior of the common dialog, was tested by attempting creating, opening, and saving operations for correct behavior. PASSED

   Added a check in cmdOpen_Click() to assure that a project databases are in the Projects subdirectory. This functionality was tested by attempting to open projects that were not in the Projects subdirectory to see if the error was trapped. Then a project in the Projects subdirectory was opened to assure that the project did indeed open. PASSED

3. Change 3, Internal Events and External Events changed to Int. Events and Ext. Events respectively. Added Severe Events(All) under Int Events in the menubar.These changes was verified by looking at the PCSA Tool menubar. PASSED

4. Change 4, Added SW Reliability module to the menubar. This change was tested by selecting SW Reliability in the menubar and assuring that the Software Reliability form appeared. PASSED

5. Change 5, Added global variable "gsAppPath", Several variables were renamed to conform to coding standard. Error handlers were added to make subroutines more robust.
   These changes were verified by looking at the source code and running the tool to assure that the changes did not affect the operation. PASSED.

SOFTWARE CHANGE REPORT (SCR)

1. SCR No. 362 (*Software Developer Assigns*):	**2. Software Title and Version:** PCSA Tool, Version 2.0.0	**3. Project No:** 20.1402.672 (FY02), 20.6002.01.103 (FY03)

4. Affected Software Module(s), Description of Problem(s): pcsa_totrisk.f
Risk Assessment Module (RAM), FORTRAN code for calculating system risk, deterministic and system risk, probabilistic.
Code readability: some subroutines have arguments that are not used.

5. Change Requested by: Biswajit Dasgupta Date: 5/1/03	**6. Change Authorized by** (*Software Developer*): Biswajit Dasgupta Date:

7. Description of Change(s) or Problem Resolution (*If changes not implemented, please justify*):

Unused arguments were removed from routines *wrtieoutcomestates(), addccdf,), writecombifile()*, and *writetotalriskfile()*.

8. Implemented by: Ron Janetzke	**Date:** 5-9-03

9. Description of Acceptance Tests:

Verified that unused arguments were removed.

10. Tested by:	**Date:** 6/26/03

SOFTWARE CHANGE REPORT (SCR)

1. SCR No. 363 (Software Developer Assigns):	2. Software Title and Version: PCSA Tool, Version 2.0.0	3. Project No: 20.1402.672 (FY02), 20.6002.01.103 (FY03)

4. Affected Software Module(s), Description of Problem(s):
Risk Assessment Module (RAM), FORTRAN code for calculating event dose, deterministic and event dose, probabilistic.

pcsa_prob.f - all runs are assumed to be probabilistic .

pcsa_ietccdf.f - The code uses the total ('all') ccdf file to determine the number of realizations rather than the lhs.inp file.

5. Change Requested by: Biswajit Dasgupta Date: 7/29/2002	6. Change Authorized by (Software Developer): Biswajit Dasgupta Date: 7/29/2002

7. Description of Change(s) or Problem Resolution (If changes not implemented, please justify):
pcsa_prob.f - routine runtyperd was added to read the run type from file runtype.txt to select deterministic or probabilistic RSAC run types.

Pcsa_ietccdf.f - routine lhsinprd was added to read the lhs.inp file to determine the number of realizations for a total ('all') ccdf.

8. Implemented by: Ron Janetzke	Date: 8/6/2002

9. Description of Acceptance Tests:
See attachment.

10. Tested by: A. Lozano Albert Lozano	Date: 6/25/2003

Attachment, Description of Acceptance Tests:

pcsa_prob.f
The source code was examined and the section of the code
that reads the "runtype.txt" file was reviewed.

Case 1, Deterministic ('0' in RunType.txt):
Criteria: 1. Results are placed in the deterministic subdirectory. 2. Number of realizations in pcsastat.txt should be 1.
An RSAC run was made (pcsa_prob.exe) that verified the results went to the deterministic subdirectory, and that the number of realizations in pcsastat.txt was 1. Test status: PASSED.

```
Partial listing of pcsastat.txt
PCSA Tool dose statistics output
 Path Organ Number   # Realizations Average Realization  Minimum  Realization  5 %tile  Realization 50 %tile  Realization 95 %tile  Realization  Maximum
  Inh,      CEDE,    0,    1,    1.200000E-04,     1,    1.200000E-04,    1,    1.200000E-04,    1,    1.200000E-04,    1,    1.200000E-04,    1,    1.200000E-04
  Ing,      CEDE,    0,    1,    1.490000E-03,     1,    1.490000E-03,    1,    1.490000E-03,    1,    1.490000E-03,    1,    1.490000E-03,    1,    1.490000E-03
  GSu,    EXTEDE,    0,    1,    2.840000E-06,     1,    2.840000E-06,    1,    2.840000E-06,    1,    2.840000E-06,    1,    2.840000E-06,    1,    2.840000E-06
  Sub,    EXTEDE,    0,    1,    7.850000E-06,     1,    7.850000E-06,    1,    7.850000E-06,    1,    7.850000E-06,    1,    7.850000E-06,    1,    7.850000E-06
  Inh, LUNGS    ,    1,    1,    6.950000E-07,     1,    6.950000E-07,    1,    6.950000E-07,    1,    6.950000E-07,    1,    6.950000E-07,    1,    6.950000E-07
  Inh, S WALL   ,    2,    1,    6.670000E-16,     1,    6.670000E-16,    1,    6.670000E-16,    1,    6.670000E-16,    1,    6.670000E-16,    1,    6.670000E-16
  Inh, SI WALL ,     3,    1,    5.680000E-10,     1,    5.680000E-10,    1,    5.680000E-10,    1,    5.680000E-10,    1,    5.680000E-10,    1,    5.680000E-10
  Inh, ULI WALL,     4,    1,    5.720000E-10,     1,    5.720000E-10,    1,    5.720000E-10,    1,    5.720000E-10,    1,    5.720000E-10,    1,    5.720000E-10
  Inh, LLI WALL,     5,    1,    6.200000E-10,     1,    6.200000E-10,    1,    6.200000E-10,    1,    6.200000E-10,    1,    6.200000E-10,    1,    6.200000E-10
  Inh, GONADS   ,    6,    1,    1.310000E-08,     1,    1.310000E-08,    1,    1.310000E-08,    1,    1.310000E-08,    1,    1.310000E-08,    1,    1.310000E-08
```

Case 2, Probabilistic ('1' in RunType.txt):
Criteria: 1. Results are placed in the probabilistic subdirectory. 2. Number of realizations in pcsastat.txt should be greater than 1.
An RSAC run was made (pcsa_prob.exe) that verified the results went to the probabilistic subdirectory, and that the number of realizations in pcsastat.txt was greater than 1. Test status: PASSED.

```
Partial listing of pcsastat.txt
PCSA Tool dose statistics output
 Path Organ Number   # Realizations Average Realization  Minimum  Realization  5 %tile  Realization 50 %tile  Realization 95 %tile  Realization  Maximum
  Inh,      CEDE,    0,   50,    5.442874E-05,    41,    3.150000E-07,   15,    2.840000E-06,    8,    3.060000E-05,   22,    1.530000E-04,   24,    2.900000E-04
  Ing,      CEDE,    0,   50,    8.789576E-03,    41,    3.000000E-06,   12,    1.310000E-04,   19,    2.500000E-03,   24,    4.960000E-02,   44,    5.370000E-02
  GSu,    EXTEDE,    0,   50,    3.573878E-06,    41,    3.280000E-09,   26,    7.780000E-08,   17,    2.160000E-06,   42,    1.620000E-05,   24,    1.850000E-05
  Sub,    EXTEDE,    0,   50,    3.978406E-06,    41,    8.730000E-08,   48,    6.290000E-07,    7,    3.540000E-06,   23,    9.100000E-06,   44,    1.030000E-05
  Inh, LUNGS    ,    1,   50,    4.494274E-06,    46,    2.960000E-08,   16,    1.920000E-07,   19,    3.370000E-06,   23,    1.170000E-05,   45,    1.350000E-05
  Inh, S WALL   ,    2,   50,    3.349090E-15,    41,    2.370000E-17,   11,    1.410000E-16,    5,    2.760000E-15,   22,    8.320000E-15,   24,    1.980000E-14
  Inh, SI WALL ,     3,   50,    1.552005E-09,    41,    1.770000E-12,   46,    7.160000E-11,    7,    9.370000E-10,   20,    4.320000E-09,   24,    1.420000E-08
  Inh, ULI WALL,     4,   50,    2.023048E-09,    41,    8.320000E-12,   46,    7.180000E-11,   14,    1.530000E-09,   23,    5.290000E-09,   24,    1.530000E-08
  Inh, LLI WALL,     5,   50,    2.798056E-09,    41,    1.760000E-11,   11,    1.110000E-10,   50,    2.180000E-09,   22,    6.970000E-09,   24,    1.790000E-08
  Inh, GONADS   ,    6,   50,    3.362678E-07,    46,    1.170000E-09,   16,    4.420000E-09,   19,    2.280000E-07,   23,    9.210000E-07,   45,    1.080000E-06
```

---

pcsa_ietccdf.f
1. Criteria: Verify that the 'lhs.inp' file is used to supply the number of realizations. The source code was examined and the section of the code that reads the "lhs.inp" file was reviewed. Test status: PASSED.

2. Criteria: The results go to the probabilistic subdirectory and the number of realizations in 'pcsastat.txt ' = NOBS in 'lhs.inp '.
An Event Scenario run was made (pcsa_ietccdf.exe) to assure that the results
went to the probabilistic subdirectory for that scenario. We observed that the files were written in the probabilistic subdirectory and examined 'lhs.inp ' and 'pcsastat.txt ' and verified that the number of realizations was = NOBS. Test status: PASSED.

```
Partial listing of lhs.inp
TITLE  LHS run for PCSA Tool for project Project: Rolan Tue Aug 06 11:11:27 2002
NOBS          50
NREPS           1
RANDOM SEED         9999
UNIFORM                          1 group_1_0_0
   0.100000000000000D-001    0.300000000000000
TRIANGULAR                       2 group_2_0_0
   0.200000000000000D-005    0.150000000000000D-004    0.240000000000000D-003
TRIANGULAR                       3 group_3_0_0
   0.150000000000000D-004    0.230000000000000D-002    0.300000000000000
```

Listing of pcsastat.txt showing that the number of realizations is 50 as in lhs.inp.

```
PCSA Tool initiating event ccdf analysis statistics output
 Path Organ Number   # Consequences Average    Index      Minimum     Index      5 %tile     Index     50 %tile     Index     95 %tile     Index       Maximum
  All,     TOTAL,    0,   50,   9.497726E-06,    1,   3.654215E-09,    3,   1.718109E-07,   25,   2.748698E-06,   48,   5.356217E-05,   50,   5.769191E-05
```

SOFTWARE CHANGE REPORT (SCR)

1. SCR No.: 364 (Software Developer Assigns)	2. Software Title and Version: PCSA Tool, Version 2.0.0	3. Project No: 20.1402.672 (FY02), 20.6002.01.103 (FY03)

4. Affected Software Module(s), Description of Problem(s):
Affected: Project Tree Module (frmLevelDescription, frmProjectTreeView), and corresponding report.

Problem: An error / crash would occur if user clicked the 'Add Level' button when no nodes exist.

5. Change Requested by: Biswajit Dasgupta Date: 12/3/2002	6. Change Authorized by (Software Developer): Biswajit Dasgupta Date: 12/3/2002

7. Description of Change(s) or Problem Resolution
(If changes not implemented, please justify):
Added code to frmProjectTreeView to disable the 'Add Level' button if no node is selected (highlighted) in the Project Tree. Added error handlers to make the code more robust, and an 'if' statement in cmdOkay_Click() to avoid crashing if there are no entries in the tree. Changed the multi-line property to 'False' for the level description text boxes on frmLevelDescription to avoid confusion if the 'ENTER' key is pressed. Changed the multi-line property of the text boxes in frmLevelDescription to 'False'. Changed the 'LabelEdit' property of 'trvTreeView' to 'tvwManual' (1) to prevent what appears to be the ability to edit node description text in the tree.

Tab order was revised in frmProjectTreeView.

8. Implemented by: David Stead	Date: 4/16/2003

9. Description of Acceptance Tests:

1. Run PCSATool and verify that the 'Add Level' button is disabled when the active item in the project tree is not at a node.
PASS: When the active item is at an end point.

2. When in the Level Description form try to enter a multiline entry for a description.
PASS. System beeps when a carriage return is typed.

3. Check the tab order for the Project Tree View.
Delete Selection
Define Levels
Show Report
Add Level
Edit Selection
Done

10. Tested by: Jose M. Menchaca	Date: 05/15/03

SOFTWARE CHANGE REPORT (SCR)

1. SCR No.: 429 (Software Developer Assigns)	2. Software Title and Version: PCSA Tool, Version 2.0.0	3. Project No: 20.1402.672 (FY02), 20.6002.01.103 (FY03)

4. Affected Software Module(s), Description of Problem(s):
This SCR describes the addition of a Software Reliability module. Two new forms were added to the project. The main form allows a user to enter information about software systems that will be used in the functional areas of the repository. The other form is used to create new records and to rename an existing software system in the database.

5. Change Requested by: Biswajit Dasgupta Date: 1/6/2003	6. Change Authorized by (Software Developer): Biswajit Dasgupta Date: 1/6/2003

7. Description of Change(s) or Problem Resolution
(If changes not implemented, please justify):
A Software Reliability module was added to the PCSA Tool. This module is based on a paper titled 'Software Reliability Analysis and Repository Preclosure Safety - AnUpdate' prepared by Norman A. Eisenberg, dated September, 2002. The information that is stored is broken down into three sections.

These are:
1. Characterization of the software system and its development process
2. Description of how the software system is integrated into repository operations
3. Identification of potential failures of the software system and the failure consequences.

8. Implemented by: Albert S. Lozano Albert S. Lozano	Date: 3/28/2003

9. Description of Acceptance Tests:
Run PCSATool and verify that the Software Reliability module has been added as described.

Results: Pass
From the main menu of PCSATool the is a SW Reliability menu option. Clicking on this menu item launches a 'Software Systems' form that allows the user to add a Software System and add descriptions according to the following categories:
Characterization
Use in Repository
Potential Failures

The Characterization is accessed through two tabs, the first allows access to Items 1-4 and the second tab allows access to items 5-7.

The Use In Repository is accessed through two tabs, the first allows access to Items 1-6 and the second tab allows access to items 7 and 8.

The Potential Failures has a single tab for access.

10. Tested by: Jose M. Menchaca Jose M.	Date: 05/15/03

SOFTWARE CHANGE REPORT (SCR)

1. SCR No.: 430 (Software Developer Assigns)	2. Software Title and Version: PCSA Tool, Version 2.0.0	3. Project No: 20.1402.672 (FY02), 20.6002.01.103 (FY03)
4. Affected Software Module(s), Description of Problem(s): Add Human Error Probability Module.		
5. Change Requested by: Biswajit Dasgupta Date: 12/5/2002	6. Change Authorized by (Software Developer): Biswajit Dasgupta Date: 12/5/2002	
7. Description of Change(s) or Problem Resolution (If changes not implemented, please justify): Added frmHEPGenerator, and frmHEPTables, which lead user through the process of generating a Human Error Probability value. Modified 'CheckLst.mdb'; a master table was added (HEPTableNames) and two tables were added for each of the Human Error Probability (HEP) tables needed. These HEP tables were taken directly from NRC report 'Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications, Final Report', by A.D. Swain and H.E. Guttmann, NUREG / CR-1278, printed August, 1983, as recommended by our consultant, Norman Eisenberg. A command button pops up a form containing the title, authors, publisher, and disclaimer notice for the aforementioned report, upon which this module was based, for the user's reference.		
8. Implemented by: David Stead	Date: 3/28/2003	
9. Description of Acceptance Tests: Run PCSATool and verify the HEP Generator has been added as described. RESULTS: The HEP generator has been successfully installed on the PCSATool. Clicking the 'Report Info.' button displays a form titled 'Information about Report used for Human Error Probability' that gives the title, authors, publisher, and disclaimer notice for the aforementioned report, upon which this module was based.		
10. Tested by: Jose M. Menchaca	Date: 05/16/03	

REQUIREMENT DESCRIPTION

SOFTWARE REQUIREMENTS DESCRIPTION FOR THE PCSA TOOL Version 3.0 (Revision 03)

Prepared for

U.S. Nuclear Regulatory Commission
Contract NRC–02–02–012

Prepared by

Biswajit Dasgupta
Roland Benke

Center for Nuclear Waste Regulatory Analyses
San Antonio, Texas

July 2003

Approval
Asad Chowdhury

7-10-2003
Date

1. INTRODUCTION

The PCSA Tool is under development to provide the U.S. Nuclear Regulatory Commission (NRC) and the Center for Nuclear Waste Regulatory Analyses (CNWRA) staff a tool to conduct a systematic independent analysis and review of the DOE preclosure safety analysis for a proposed repository at Yucca Mountain, Nevada. As part of a license application for construction authorization and a subsequent license amendment to receive and possess waste at the proposed repository, the DOE must conduct a preclosure safety analysis for the period until permanent closure. The PCSA Tool will be used to identify areas of vulnerability in the DOE safety analysis, to assess the DOE calculation of radiological consequences to workers and the public, and to evaluate the identification of structures, systems, and components important to safety. The PCSA Tool will feature a graphical user interface between the databases, software packages, and utility tools. This Software Requirements Description document describes the overall PCSA Tool function and outlines the proposed revisions planned for Version 3.0. The software requirement descriptions of PCSA Tool Versions 1.0 and 2.0 (Dasgupta et. al, 2001a, 2002a) describe the modifications made to the earlier versions of the PCSA Tool.

2. TECHNICAL BASIS

The PCSA Tool is structured after a safety analysis review methodology based on the requirements of 10 CFR Part 63 and guidance provided in Yucca Mountain Review Plan (NRC, 2002) for preclosure safety analysis of the geologic repository operations area. The steps of review methodology along with the relevant sections in Yucca Mountain Review Plan are shown in Figure 1. The figure also shows areas of the review addressed using the PCSA Tool. The PCSA Tool activity is divided into several modules and the tool functions and operates through these modules. The tool modules are used for: (i) designation of functional boundaries (based on functional areas or processes) for focused analysis, (ii) compilation of information required for the analysis (iii) site-specific natural and human-induced hazard analysis and operational hazard analysis; (iv) event sequence analysis and categorization of event sequences; (v) consequence analysis; (vi) safety assessment; (vii) designation of structures, systems, and components commensurate with its importance to safety functions; (viii) assessment of total risk; and (ix) accessing failure rate database. Assessment of total system risk is not a regulatory requirement, but is provided in the tool as an additional capability to gain insight on facility risk.

2.1 SOFTWARE FUNCTION

The PCSA Tool consists of several modules to conduct and review preclosure safety analysis. An overview of the tool modules is illustrated in Figure 2. The tool's functionality and planned revisions under each module are provided next. In general, minor modifications based on user feedback for all modules may be considered in Version 3.0 of the PCSA Tool. In addition, current report capabilities will be enhanced and new reports will be developed using Crystal Report. Graphical display of data in selected modules will be also developed using Crystal Report. Description of each module follows:

(i) Project Tree Module (PTM):

Background

The facility and operations in the geologic repository operations area can be divided into functional areas by specific function, physical area of the facility, or by process as indicated in item (i) in section 2.0. In this module, the functional area defines the boundary of the safety analysis. The preclosure safety analysis steps (ii) to (v) described in section 2.0 can be performed at the functional area level. The results from each functional area are collected and analyzed in steps (vi) and (vii).

Required Modifications

No major revisions are required in PCSA Tool Version 3.0 for this module.

(ii) System Description Module (SDM):

Background

In this module, information required to conduct independent preclosure safety analysis in each functional area is stored.

Required Modifications

The module will be modified to allow more data entry in an organized manner through submenus. Separate forms will be developed for description and functions, facility operations and procedures, human actions, software and remote systems used, characterization of waste and source terms, lists of combustible materials and fire mitigating features, lists of structures, systems, and components including information on design bases and design criteria.

(iii) Hazard Analysis Module (HAM):

Background

The tool has the capability to conduct operational hazard analysis using qualitative approaches: Failure Modes and Effects Analysis technique, What-if analysis, and Energy method. In addition, the tool has the capability to conduct qualitative human reliability and software reliability analyses. This module also contains a database that includes a list of generic external hazards, natural and human-induced. Information on each hazard and review of justification for inclusion or exclusion of it for preclosure safety analysis are also stored in the database.

Required Modifications

In PCSA Tool Version 3.0, forms and tables to store information on fire hazard analysis will be added. Any quantitative analysis required to support fire hazard identification will be done external to the tool and the information will be stored in the database. Addition of this capability was discussed in the future work section of Dasgupta et. al (2002b).

(iv) Frequency Analysis Module (FAM):

Background

In this module, the event scenarios are developed based on postulated initiating events and subsequent event sequences. A frequency of occurrence for an initiating event, and the probability of failure and associated uncertainty for each event sequence are assigned. This module is used to develop and store related information on input and output data associated with event sequence frequency analysis. The event trees and fault trees are modeled and analyzed using the SAPHIRE software. The information abstracted from SAPHIRE analysis is stored in the database through this module.

Required Modifications

(1) Per NRC request, the SAPHIRE will be updated from the version 6.7 used at the present time to currently available version 6.77. (2) In this module each event sequence is categorized based on its frequency of occurrence. The category process will be modified to be strictly consistent with the definitions of Category 1 and Category 2 event sequences in 10 CFR Part 63. (3) A submodule consisting of forms and tables to address seismic fragility analysis will be developed in Version 3.0 of PCSA Tool. Earlier versions of PCSA Tool did not have the capability to conduct a seismic fragility analysis. DOE plans to use seismic fragility analysis to address risks associated with the seismic events. The SAPHIRE software has the capability to conduct seismic fragility analysis which requires seismic hazard curve and fragility data of the components as input. A database containing information on fragility of components would be developed from the information available in the literature. The fragility curves for structures and components unique to the facility, e.g., hot cells, would be reviewed outside the tool.

(v) Consequence Analysis Module (CAM):

Background

The consequence analysis module calculates the radiological dose to the members of the public and workers. This module accepts input data for point estimates (deterministic) and/or probabilistic dose calculations for the public and displays the results in graphical and tabular format. The tool also allows point estimate calculations of the worker dose for fuel handling operations in a pool.

Required Modifications

(1) The reporting and graphics capabilities to display input and output data for consequence analysis will be developed. Earlier versions of PCSA Tool only reported results on the screen. (2) Per NRC request, the RSAC version 5.2 used in the tool will be upgraded to version 6.1. NOTE: Incorporation of MACCS2 software, an NRC consequence analysis code developed by Sandia National Laboratory, is not planned for the PCSA Tool Version 3.0, but will be considered for inclusion in a future version of the PCSA Tool after the new version of the MAACS2 code is available.

(vi) Safety Assessment Module (SAM):

Background

The safety assessment module integrates and analyzes the results obtained from event frequency analysis and consequence analysis. The safety assessment is based on performance objectives for Category 1 and 2 event sequences stipulated in 10 CFR Part 63. For Category 1 event sequences, the safety assessments allowed by this module are frequency-weighted (annualized) dose calculation and screening calculations for combination of events, which evaluate either point estimate doses or mean doses from the probabilistic consequence analysis.

Required Modifications

(1) As mentioned in the Future Works section of Dasgupta et al (2002b), a mathematically rigorous calculation for combinations of events will be added for Version 3.0 of the PCSA Tool. (2) Reporting and graphics capability for this module will be added for Version 3.0 of the PCSA Tool. Earlier versions of the PCSA Tool only reported the results on the screen.

(vii) Risk Assessment Module (RAM):

Background

The total risk of the system will be evaluated using the approach developed by Benke et al. (2002). The risk calculation uses the mean frequency for initiating event and event sequences and either point estimate or probabilistic results from the consequence analysis. The tool calculates a point estimate or complementary cumulative distribution function of the risk. As stated before, although not required by 10 CFR Part 63, this module provides an additional capability to conduct risk assessments for supporting design reviews and safety assessments.

Required Modifications

Reporting and graphics capability for this module will be added for Version 3.0 of the PCSA Tool. Earlier versions of the PCSA Tool only reported the results on the screen.

(viii) Structures, systems and components important to safety module (SSCISM):

Background

The structures, systems and components will be identified whether they are important to safety using a performance-based importance analysis. The existing capability to review structures, systems, and components, as stated in Dasgupta et al. (2002b), is conceptual.

Required Modifications

In PCSA Tool Version 3.0, the feature will be improved to make the identification process user-friendly.

(ix) Failure Rate Database Module (FRDM):

Background

This is not a new module. This module exists in the versions 1.0 and 2.0 of the PCSA Tool. Since modifications were not planned for PCSA Tool Version 2.0, it was not discussed in Revision 2.0 of the Software Requirements Description.

Required Modifications

If information on repository facility design and operations under revision by DOE is available, the failure rate data base will be updated with reliability information to include the systems and components used for the repository operations.

2.2 Mathematical Models

The PCSA Tool uses the Microsoft Access database software and three other existing software packages for mathematical model analyses: (i) System Analysis Program for Hands-on Integrated Reliability Evaluation (SAPHIRE), (ii) Radiological Safety Analysis Computer Program (RSAC), and (iii) MELCOR computer codes. The tool utilizes (i) the SAPHIRE code for event sequence analyses and quantitative frequency evaluation using event tree and fault tree models (Idaho National Engineering and Environmental Laboratory, 1998); (ii) the RSAC code to calculate the radiological dose to a member of the public from atmospheric release of radioactive material (Wenzel, 1994); and (iii) the MELCOR computer code to estimate building discharge fractions (NRC, 2000). Incorporation of the new version, of the MACCS2 code (NRC, 1998) currently under development, is not planned for PCSA Tool Version 3.0 but will be considered after the new version of MACCS2 code is released.

3. COMPUTATIONAL APPROACH

The PCSA Tool serves two primary purposes: store data in a database and perform model analysis. The structure of the PCSA Tool is schematically illustrated in Figure 3. The figure shows the Graphical User Interface, developed using Visual Basic, controlling the functions of the tool by independently linking to databases and software packages. The project database and fixed database were created using Microsoft Access software. The read-only failure rate database contains component failure rates obtained from actuarial data and literature citation of actuarial data sources. In addition, the tool includes failure mode checklist, human error, and performance shaping factor databases. The fixed database is restrained from user modifications. The project database is the workbench for the tool and has been designed to perform specific data management tasks for a systematic preclosure safety analysis. In addition, the input data for model analyses and display of output data from other software packages are also managed by the database. Further details on the computational approach can be obtained from PCSA Tool progress reports (Dasgupta et al., 2001b and 2002b).

3.1 DATA FLOW AND USER INTERFACE

The data flow in the PCSA Tool Version 3.0 is depicted by a typical flow diagram shown in Figure 2. The PCSA Tool uses Visual Basic, a Windows application development system, as the primary programming environment to develop a graphical user interface to connect to Microsoft Access databases and computer codes, SAPHIRE, RSAC, and MELCOR. The graphical user interface consists of a main window with a menu bar at the top. The menu bar lists various functions and categories into which the tool allows the entry of data. By selecting an item on the menu bar, the user will be given more specific options. Many of these options will have suboptions, which may have further suboptions. By clicking on the various options, the user is able to navigate through various programs, forms, tables, and reports. For example, the user may enter data into a table or form, and recall the data at a later time. As discussed earlier, the Microsoft Access database consists of project and failure rate databases. The read-only failure rate database can only be viewed through the graphical user interface. The project database provides several tables for entering, viewing, sorting and filtering of data. The graphical user interface generates input data for model analysis, stores output data, displays graphical results, and generates reports.

The modules in the tool allow the staff to perform and document independent review analyses in a structured and systematic manner. Results of the review are abstracted, as appropriate, for use in other modules of this tool. The abstraction of results into the next module is be automated, while new information is entered manually.

3.2 HARDWARE AND SOFTWARE REQUIREMENTS

The PCSA Tool is being developed to operate on an IBM compatible personal computer installed with Windows NT 4.0. The estimated disk space required is 250 megabytes maximum. The program is currently developed on a Pentium II - 266 megahertz computer with 256 megabytes of Random Access Memory. The final size and memory requirements will be determined at the completion of the tool development. Visual Basic is the chosen programming language for the tool. Visual Basic does not need to be installed on the computer for the executable to run.

The PCSA Tool Version 3.0 is being developed using the following software: Visual Basic 6.0; Microsoft Access 97 SR–2; SAPHIRE Version 6.70; RSAC Version 5.2; MELCOR Version 1.8.5; InstallShield Professional-Windows Installer Edition 2.0; Crystal Reports Developer Edition 8.5; and a suite of utility codes. SAPHIRE is developed, supported and distributed by Idaho National Environmental Laboratory, Idaho Falls, Idaho, 83415. RSAC code is distributed by Radiation Safety Information Computational Center, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee, 37381-6362. MELCOR is developed, supported, and distributed by Sandia National Laboratories, Albuquerque, New Mexico, 87185. InstallShield Professional-Windows Installer Edition 2.0 is distributed by InstallShield Software Corporation, Schaumburg, Illinois 60173-5108. Crystal Reports Developer Edition, Version 8.5 is distributed by Crystal Decisions, Inc., Palo Alto, California 94301-2413. The suite of utility codes, consisting of PCSA_LHS Version 1.0, PCSA_LHSINP Version 1.0, PCSA_PROB Version 1.0, PCSA_RSACRD Version 1.0, PCSA_COMBAN Version 1.0, PCSA_IETCCDF Version 1.0 and PCSA_RISKCCDF Version 1.0 have been developed at CNWRA using the Lahey LF90 Fortran Compiler.

InstallShield Professional-Windows Installer Edition 2.0 will be used to create a PCSA Tool installation setup for Windows NT for distribution to the staff. The setup distribution will install SAPHIRE, RSAC, and MELCOR codes and the CNWRA developed applications. Microsoft Access software will not be required to be installed on the user's computer.

3.3 GRAPHICS AND REPORTING REQUIREMENTS

The tool currently provides graphics and reporting capabilities using the Visual Basic 6.0 chart and report modules respectively. These features, however, provide limited flexibility for display and printing. A graphical display module will be developed using Crystal Report software to display the deterministic and probabilistic dose, and probabilistic risk calculation results. Additionally, Fault Tree and Event Tree models are graphically displayed using features of the SAPHIRE code. The Crystal Reports software will be used to develop, save, and print reports and graphics in a convenient format.

3.4 PRE- AND POST- PROCESSOR

The pre- and post-processor will be an integral part of the tool to develop input data and display results from acquired software packages, particularly for conducting consequence analyses using RSAC and MELCOR codes.

3.5 SOFTWARE VALIDATION

In compliance with the requirements of CNWRA Technical Operating Procedure TOP-018, validation tests will be performed on PCSA Tool Version 3.0. The completion of validation testing of the PCSA Tool is scheduled for May 15, 2004. The stand-alone software SAPHIRE, RASC and MELCOR will be validated separately; however, their validation test reports would be a part of the PCSA Tool validation package. The validation test plans and validation reports for RSAC Version 5.2 and MELCOR Version 1.8.5 have been completed. The validation test plan for SAPHIRE Version 6.77 is under development.

4. REFERENCES

Benke, R., B. Dasgupta, B. Sagar and A.Chowhdury, "A Methodology for Preclosure Risk Assessment for a Geologic Nuclear Waste Repository", Probabilistic Safety Assessment and Management (PSAM6), Proceedings of the 6th Intenational Conference on Probabilistic Safety Assessment and Management, San Juan, Puerto Rico, June 23-28, 2002, Oxford: Elsevier Science, Ltd. Vol. I, pp. 983-988, 2002.

Dasgupta, B., R. Benke, and R. Janetzke. "Software Requirements Description for the PCSA Tool Version 2.0 Beta (Revision 2.0)". San Antonio, TX: Center for Nuclear Waste Regulatory Analyses. 2002a.

Dasgupta, B., R. Benke, B. Sagar, R. Janetzke, and A. Chowdhury. "PCSA Tool Development—Progress Report II". San Antonio, TX: Center for Nuclear Waste Regulatory Analyses. 2002b.

Dasgupta, B., R. Benke, and R. Janetzke. "Software Requirements Description for the PCSA Tool Version 1.0 Beta (Revision 1.0)". San Antonio, TX: Center for Nuclear Waste Regulatory Analyses. 2001a.

Dasgupta, B., R. Benke, D. Daruwalla, A. Ghosh, R. Janetzke, and A. Chowdhury. "PCSA Tool Development—Progress Report". San Antonio, TX: Center for Nuclear Waste Regulatory Analyses. 2001b.

Idaho National Engineering and Environmental Laboratory. "Systems Analysis Programs for Hands-on Integrated Reliability Evaluations (SAPHIRE) Version 6.0, Saphire Reference Manual." Idaho Falls, Idaho: Idaho National Engineering Laboratory. 1998.

NRC. "Yucca Mountain Review Plan-Draft Report for comment". NUREG-1804, Revision 2. Washington, DC: U.S. Nuclear Regulatory Commission. 2002.

NRC. "MELCOR Computer Code Manuals". NUREG/CR-6119, Revision 2. Washington, DC: U.S. Nuclear Regulatory Commission. 2000.

NRC. NUREG–6613, "Code Manual for MACCS2; Volume, Users Guide." Washington, DC: NRC. May. 1998.

Wenzel, D. R. "The Radiological Safety Analysis Computer Program (RSAC-5) User's Manual". WINCO-1123, Revision 1. Idaho Falls, ID: Westinghouse Idaho Nuclear Company, Inc. Idaho National Engineering Laboratory. 1994.

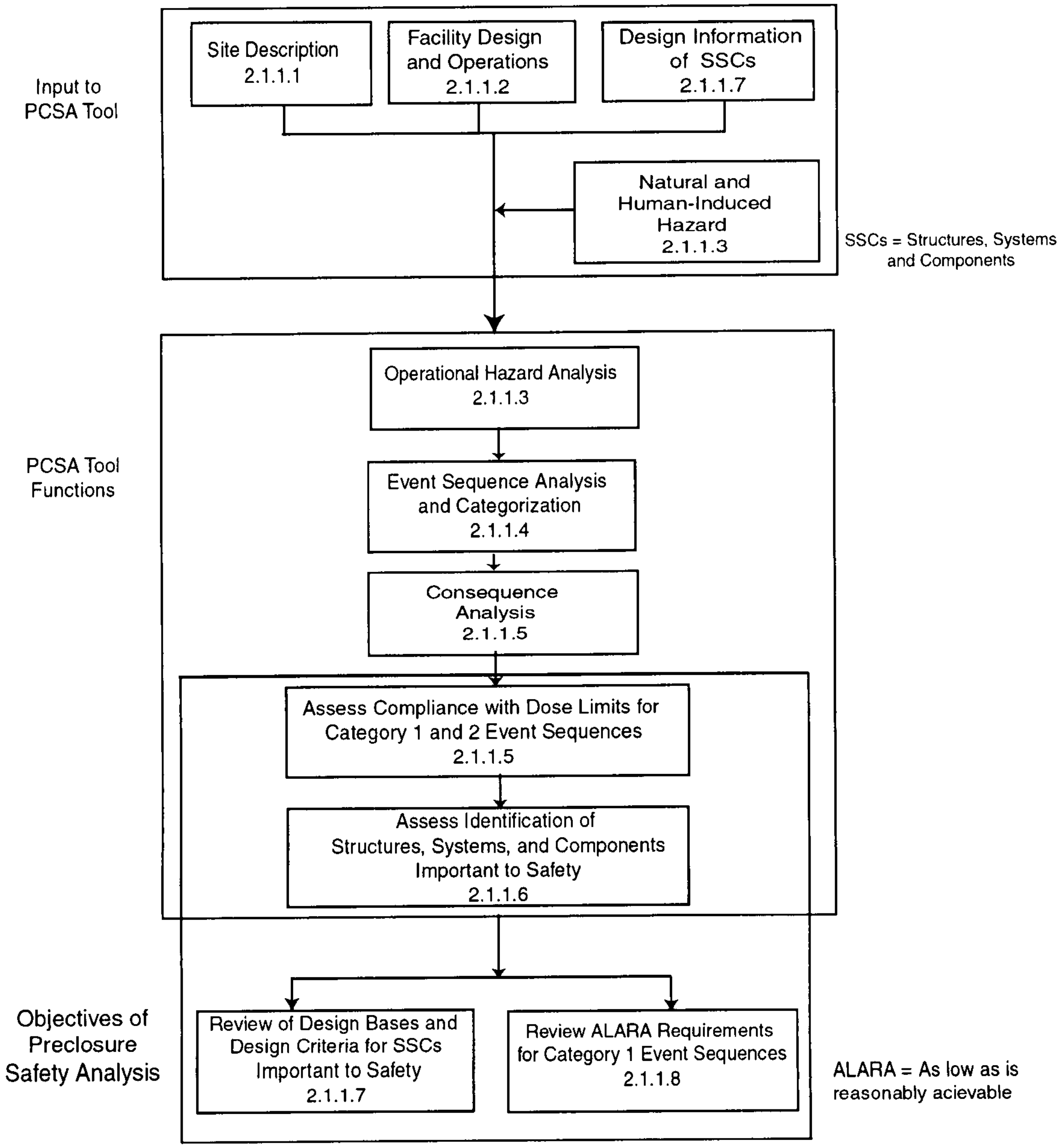
Input to PCSA Tool
Site Description 2.1.1.1
Facility Design and Operations 2.1.1.2
Design Information of SSCs 2.1.1.7
Natural and Human-Induced Hazard 2.1.1.3
SSCs = Structures, Systems and Components
PCSA Tool Functions
Operational Hazard Analysis 2.1.1.3
Event Sequence Analysis and Categorization 2.1.1.4
Consequence Analysis 2.1.1.5
Assess Compliance with Dose Limits for Category 1 and 2 Event Sequences 2.1.1.5
Assess Identification of Structures, Systems, and Components Important to Safety 2.1.1.6
Objectives of Preclosure Safety Analysis
Review of Design Bases and Design Criteria for SSCs Important to Safety 2.1.1.7
Review ALARA Requirements for Category 1 Event Sequences 2.1.1.8
ALARA = As low as is reasonably acievable

Figure 1. Preclosure Safety Analysis Review Methodology and activities of PCSA Tool

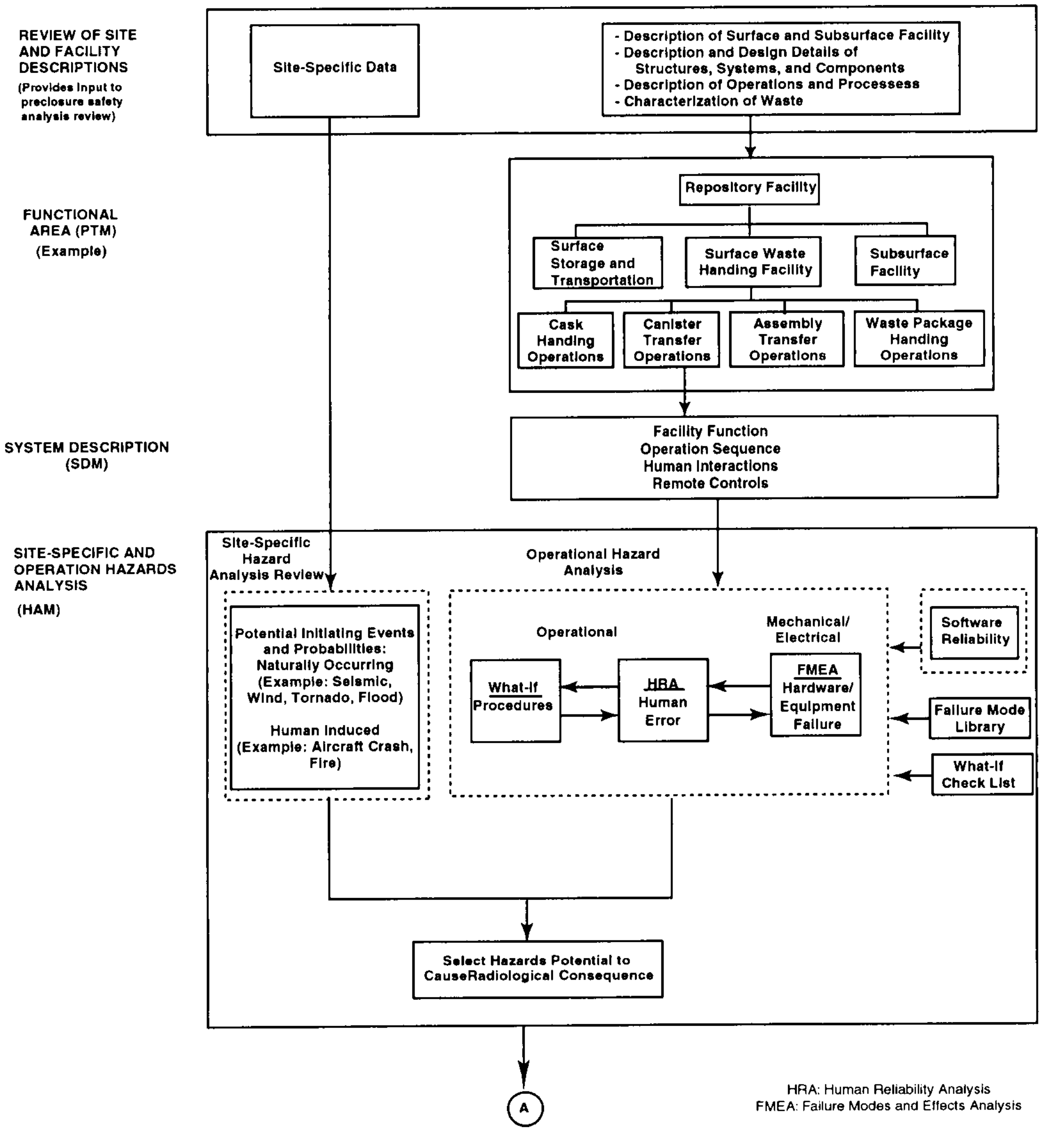
REVIEW OF SITE AND FACILITY DESCRIPTIONS
(Provides input to preclosure safety analysis review)
Site-Specific Data
- Description of Surface and Subsurface Facility
- Description and Design Details of Structures, Systems, and Components
- Description of Operations and Processess
- Characterization of Waste
FUNCTIONAL AREA (PTM)
(Example)
Repository Facility
Surface Storage and Transportation
Surface Waste Handing Facility
Subsurface Facility
Cask Handing Operations
Canister Transfer Operations
Assembly Transfer Operations
Waste Package Handing Operations
SYSTEM DESCRIPTION (SDM)
Facility Function
Operation Sequence
Human Interactions
Remote Controls
SITE-SPECIFIC AND OPERATION HAZARDS ANALYSIS
(HAM)
Site-Specific Hazard Analysis Review
Potential Initiating Events and Probabilities: Naturally Occurring (Example: Seismic, Wind, Tornado, Flood)
Human Induced (Example: Aircraft Crash, Fire)
Operational Hazard Analysis
Operational
Mechanical/ Electrical
What-If Procedures
HRA Human Error
FMEA Hardware/ Equipment Failure
Software Reliability
Failure Mode Library
What-If Check List
Select Hazards Potential to CauseRadiological Consequence
A
HRA: Human Reliability Analysis
FMEA: Failure Modes and Effects Analysis

Figure 2-a. PCSA Tool Module and Data Flow Diagram

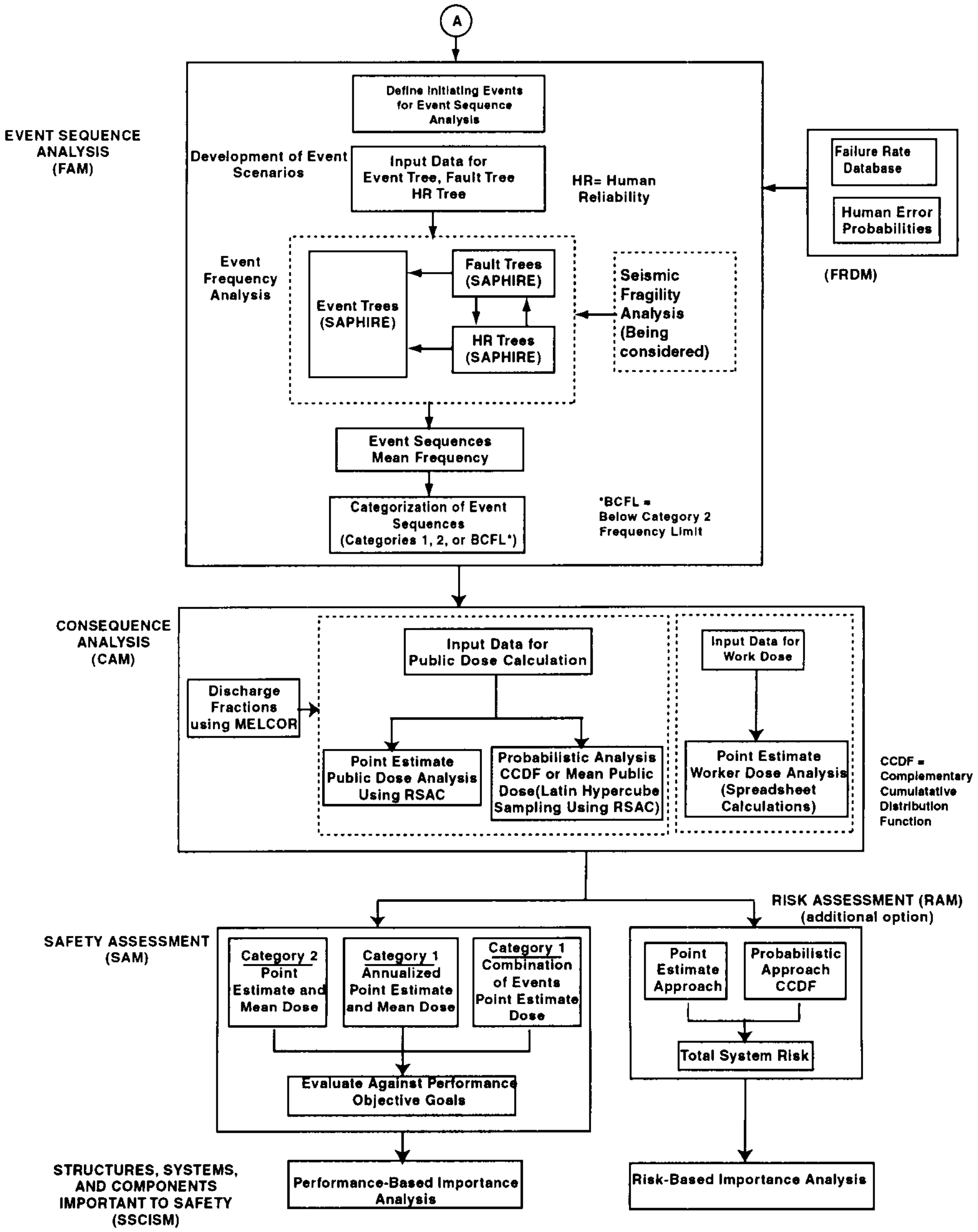
A
EVENT SEQUENCE ANALYSIS (FAM)
Define Initiating Events for Event Sequence Analysis
Development of Event Scenarios
Input Data for Event Tree, Fault Tree HR Tree
HR= Human Reliability
Failure Rate Database
Human Error Probabilities
(FRDM)
Event Frequency Analysis
Event Trees (SAPHIRE)
Fault Trees (SAPHIRE)
HR Trees (SAPHIRE)
Seismic Fragility Analysis (Being considered)
Event Sequences Mean Frequency
Categorization of Event Sequences (Categories 1, 2, or BCFL*)
*BCFL = Below Category 2 Frequency Limit
CONSEQUENCE ANALYSIS (CAM)
Discharge Fractions using MELCOR
Input Data for Public Dose Calculation
Point Estimate Public Dose Analysis Using RSAC
Probabilistic Analysis CCDF or Mean Public Dose(Latin Hypercube Sampling Using RSAC)
Input Data for Work Dose
Point Estimate Worker Dose Analysis (Spreadsheet Calculations)
CCDF = Complementary Cumulatative Distribution Function
SAFETY ASSESSMENT (SAM)
Category 2 Point Estimate and Mean Dose
Category 1 Annualized Point Estimate and Mean Dose
Category 1 Combination of Events Point Estimate Dose
Evaluate Against Performance Objective Goals
RISK ASSESSMENT (RAM) (additional option)
Point Estimate Approach
Probabilistic Approach CCDF
Total System Risk
STRUCTURES, SYSTEMS, AND COMPONENTS IMPORTANT TO SAFETY (SSCISM)
Performance-Based Importance Analysis
Risk-Based Importance Analysis

Figure 2-b. PCSA Tool Module and Data Flow Diagram (continued)

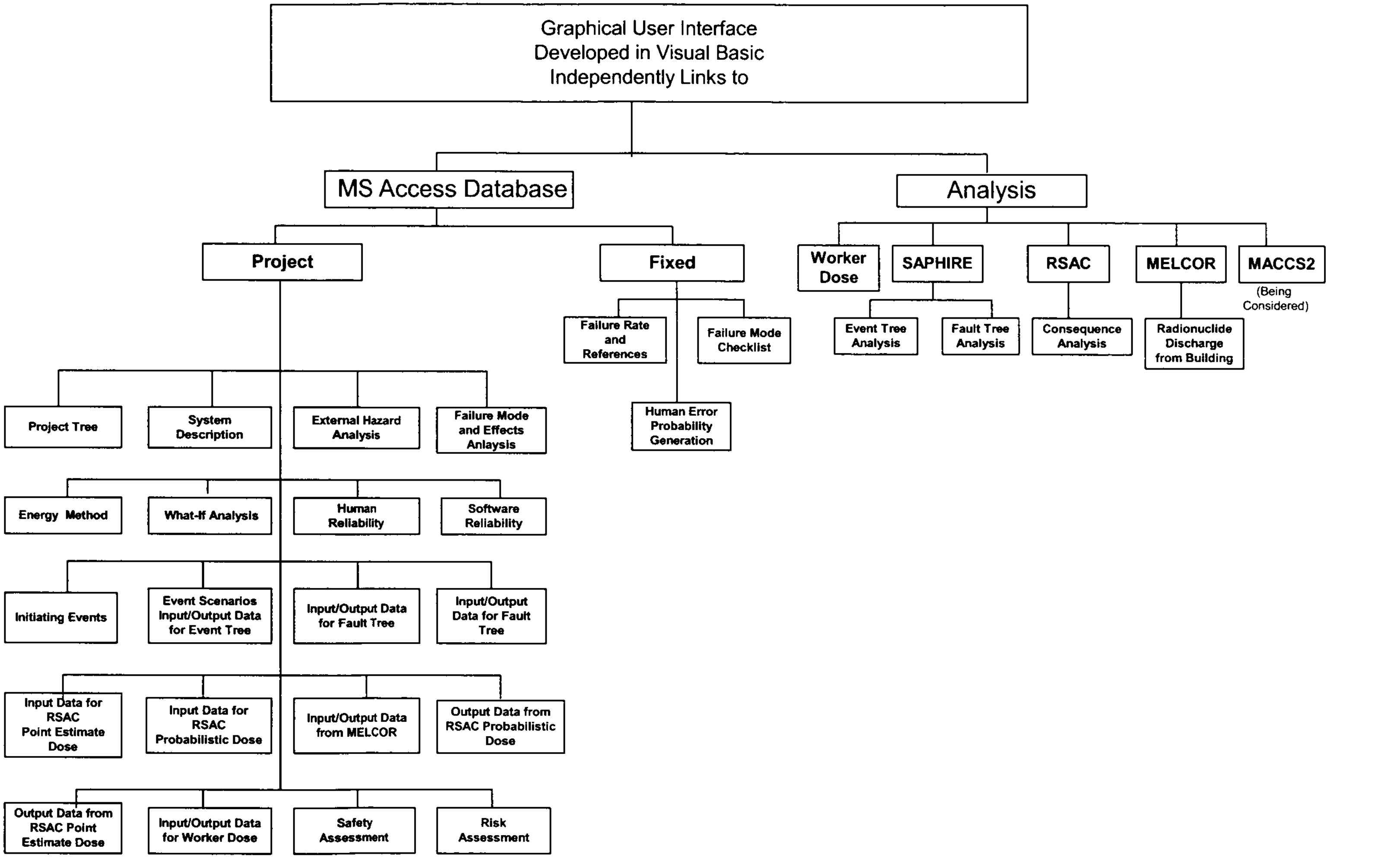
Graphical User Interface
Developed in Visual Basic
Independently Links to
MS Access Database
Analysis
Project
Fixed
Worker Dose
SAPHIRE
RSAC
MELCOR
MACCS2
(Being Considered)
Failure Rate and References
Failure Mode Checklist
Human Error Probability Generation
Event Tree Analysis
Fault Tree Analysis
Consequence Analysis
Radionuclide Discharge from Building
Project Tree
System Description
External Hazard Analysis
Failure Mode and Effects Anlaysis
Energy Method
What-If Analysis
Human Reliability
Software Reliability
Initiating Events
Event Scenarios Input/Output Data for Event Tree
Input/Output Data for Fault Tree
Input/Output Data for Fault Tree
Input Data for RSAC Point Estimate Dose
Input Data for RSAC Probabilistic Dose
Input/Output Data from MELCOR
Output Data from RSAC Probabilistic Dose
Output Data from RSAC Point Estimate Dose
Input/Output Data for Worker Dose
Safety Assessment
Risk Assessment

Figure 3. PCSA Tool Structure

SOFTWARE REQUIREMENTS DESCRIPTION FOR THE PCSA TOOL Version 2.0 (Revision 02)

Prepared for

U.S. Nuclear Regulatory Commission
Contract NRC–02–97–009

Prepared by

Biswajit Dasgupta
Roland Benke
Ronald Janetzke

Center for Nuclear Waste Regulatory Analyses
San Antonio, Texas

July 2002

7/18/2002

for Approval
Asad Chowdhury

Date

1. INTRODUCTION

The PCSA Tool Version 2.0 is under development to provide a capability to the U.S. Nuclear Regulatory Commission (NRC) and the Center for Nuclear Waste Regulatory Analyses (CNWRA) staff to conduct an independent analysis and review of the DOE preclosure safety analysis for a proposed repository at Yucca Mountain, Nevada. As part of a license application for construction authorization and a subsequent license amendment to receive and possess waste at the proposed repository at Yucca Mountain, Nevada, the DOE must conduct and present results of a preclosure safety analysis for the period until permanent closure. The PCSA Tool will be used to identify areas of vulnerability in the DOE safety analysis, to assess the DOE calculation of radiological consequences to workers and the public, and to evaluate DOE identification of structures, systems, and components important to safety. The PCSA Tool will feature a graphical user interface between the databases, software packages, and utility tools. This Software Requirements Description document describes the overall PCSA Tool function and outlines the proposed revisions planned for Version 2.0.

2. TECHNICAL BASIS

The PCSA Tool structure is modeled after a safety analysis review methodology based on the requirements of 10 CFR Part 63 for preclosure safety analysis of the geologic repository operations area. The review methodology is shown in Figure 1. Activity under each section is divided into several modules and the tool functions are accessible through these modules. The tool modules perform: (i) site-specific hazard analysis and operational hazard analysis; (ii) event sequence analysis and categorization of event sequences; (iii) consequences analysis; (iv) safety assessment; (v) designation of structures, systems, and components commensurate with their importance to safety functions; and (vi) assessment of total risk. Assessment of total system risk is not a regulatory requirement, but is provided in the tool as an additional capability to gain additional risk insights.

2.1 SOFTWARE FUNCTION

The PCSA Tool consists of several modules to conduct and review preclosure safety analysis. The tool's functionality and planned revisions under each module are provided next.

Project Tree Module (PTM): The facility and operations in the geologic repository operations area can be divided into functional areas by specific function, physical area of the facility, or by process. In this module, the functional area defines the boundary of the safety analysis. The preclosure safety analysis steps (i) to (iii) described in section 2 can be performed at the functional area level. The results from each functional area are collected and analyzed using steps (iv) to (vi). No revisions have been planned for this module.

System Description Module (SDM): The information (description and design details, facility operations and procedures, human actions, characterization of waste and source terms etc.) required in the preclosure safety analysis for each functional area is maintained using the

System description feature. Minor modification of this module will be made to insert data on human actions.

Hazard Analysis Module (HAM): Analyses for external hazards, natural and human-induced, are conducted using the external hazard analysis feature. Development of this feature has been completed. The tool has the capability to conduct operational hazard analysis using qualitative approaches: Failure Modes and Effects Analysis technique, What-if analysis, and Energy method. Qualitative human reliability analysis capability will be added to this module.

Frequency Analysis Module (FAM): In this module, the event scenarios are developed based on postulated initiating events and subsequent event sequences. Frequency of occurrence for initiating event, and probability of failure and associated uncertainty for each event sequence are assigned. This module is used to maintain the input and output data for event tree and fault tree analyses associated with event frequency analysis. The event sequences are categorized based on the frequency category limits specified by regulation. Current module structure will be modified for easy transfer of data between different features in this module and capability will be added to develop input data for human reliability tree analysis.

Consequence Analysis Module (CAM): The consequence analysis module calculates the radiological dose to members of the public and workers. This module creates input data for point estimate (deterministic) and/or probabilistic calculations for public dose determination and displays numerical and graphical results. The tool will also allow point estimate calculations of the worker dose. No revisions have been planned for this module.

Safety Assessment Module (SAM): The safety assessment module integrates and analyzes the results obtained from event frequency analysis and consequence analysis. The safety assessment is based on performance objectives for Category 1 and 2 event sequences stipulated in 10 CFR Part 63. For Category 1 event sequences, the safety assessments allowed by this module are annualized dose and combination of events, which evaluate either point estimate doses or mean dose from the probabilistic consequence analysis.

Risk Assessment Module (RAM): The total risk of the system will be evaluated using the approach developed by Benke et al. (2002). The risk calculation uses the mean initiating event and event sequence frequencies and either point estimate or probabilistic results from the consequence analysis. The tool will evaluate point estimate and complementary cumulative distribution function of the risk. This module will be added to the tool. As stated before, although not required by 10 CFR Part 63, this module provides an additional capability to obtain risk insights.

Structures, systems and components important to safety module (SSCISM): The structures, systems and components will be identified using a performance-based importance analysis. Revisions have not been planned for this module.

2.2 Mathematical Models

The PCSA Tool uses the Microsoft® Access database software and three other existing software packages: (i) System Analysis Program for Hands-on Integrated Reliability Evaluation (SAPHIRE), (ii) Radiological Safety Analysis Computer Program (RSAC), and (iii) MELCOR computer codes. The tool utilizes (i) the SAPHIRE code for event sequence analyses and quantitative frequency evaluation using event tree and fault tree models (Russel et al., 1993); (ii) the RSAC code to calculate the radiological dose to a member of the public from atmospheric release of radioactive material (Wenzel, 1994); and (iii) the MELCOR computer code to estimate building discharge fractions (U.S. Nuclear Regulatory Commission, 2000) .

3. COMPUTATIONAL APPROACH

The PCSA Tool serves two primary purposes: store data in a database and perform model analysis. The structure of the PCSA Tool is schematically illustrated in Figure 2. The figure shows the Graphical User Interface, developed using Visual Basic, controlling the functions of the tool by independently linking to databases and software packages. The project database and fixed database were created using Microsoft® Access software. The read-only failure rate database contains component failure rates obtained from actuarial data and literature citation of actuarial data sources. In addition, the tool includes failure mode checklist, human error, and performance shaping factors database. The fixed database cand be modified by the code developer only. The project database is the workbench for the tool and has been designed to perform specific data management tasks for a systematic preclosure safety analysis. In addition, the input data for model analyses and display of output data from other software packages are also managed by the database. Further details on the computational approach can be obtained from PCSA Tool Development-Progress Report (Dasgupta et al., 2001).

3.1 DATA FLOW AND USER INTERFACE

The data flow in the PCSA Tool is depicted by a typical flow diagram shown in Figure 3. The PCSA Tool will use Visual Basic, a Windows application development system, as the primary programming environment to develop a graphical user interface to connect to Microsoft® Access databases and computer codes, SAPHIRE, RSAC, and MELCOR. The graphical user interface will consist of a main window with a menu bar at the top. The menu bar will list various functions and categories into which the tool allows the entry of data. By selecting an item on the menu bar, the user will be given more specific options. Many of these options will have suboptions, which may have further suboptions. By clicking on the various options, the user will be able to navigate through various programs, forms, tables, and reports. For example, the user may enter data into a table or form, and recall the data at a later time. As discussed earlier, the Microsoft® Access database consists of project and failure rate databases. The read-only failure rate database can only be viewed through the graphical user interface. The project database provides several tables for entering, viewing, sorting and filtering of data. The graphical user interface generates input data for model analysis, stores output data, displays graphical results, and generates reports.

The modules in the tool allow the staff to perform and document independent review analyses in a structured and systematic manner. Results of the review are abstracted, as appropriate, for use in other modules of this tool. The abstraction of results into the next module will be automated, while new information is entered manually.

3.2 HARDWARE AND SOFTWARE REQUIREMENTS

The PCSA Tool is being developed to operate on an IBM compatible personal computer installed with Windows NT 4.0 or higher. The estimated disk space required is 250 megabytes maximum. The program is currently developed on a Pentium II - 266 megahertz computer with 256 megabytes of Random Access Memory. The final size and memory requirements will be determined at the completion of the tool development. Visual Basic is the chosen programming language for the tool. Visual Basic does not need to be installed on the computer for the executable to run.

The PCSA Tool is being developed using the following software: Visual Basic 6.0; Microsoft Access 97 SR–2; SAPHIRE Version 6.70; RSAC Version 5.2; MELCOR Version 1.8.5; InstallShield Professional-Windows Installer Edition 2.0; Crystal Reports Developer Edition 8.5; Component Chart 7.0; and a suite of utility codes. SAPHIRE and RSAC codes are distributed by Radiation Safety Information Computational Center, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee, 37381-6362. MELCOR is developed, supported, and distributed by Sandia National Laboratories, Albuquerque, New Mexico, 87185. InstallShield Professional-Windows Installer Edition 2.0 is distributed by InstallShield Software Corporation, Schaumburg, Illinois 60173-5108. Crystal Reports Developer Edition, Version 8.5 is distributed by Crystal Decisions, Inc., Palo Alto, California 94301-2413. Component Chart 7.0 is distributed by ComponentOne, Pittsburgh, Pennsylvania, 15213. The suite of utility codes, consisting of PCSA_LHS Version 1.0, PCSA_LHSINP Version 1.0, PCSA_PROB Version 1.0, PCSA_RSACRD Version 1.0, and PCSA_COMBAN Version 1.0 have been developed at CNWRA using the Lahey LF90 Fortran Compiler. An additional suite of utility codes, PCSA_IETCCDF Version 1.0, and PCSA_RISKCCDF Version 1.0 are being developed by CNWRA using the Lahey LF90 Fortran Compiler.

InstallShield Professional-Windows Installer Edition 2.0 will be used to create a PCSA Tool installation setup for Windows NT for distribution to the staff. The setup distribution will install SAPHIRE, RSAC, and MELCOR codes and the CNWRA developed applications. Microsoft Access software will not be required to be installed on the user's computer.

3.3 GRAPHICS AND REPORTING REQUIREMENTS

The tool currently provides graphics and reporting capabilities using the Visual Basic 6.0 chart and report modules respectively. These features, however, provide limited flexibility for display and printing. A graphical display module will be developed using Component Chart software to display the deterministic and probabilistic dose, and probabilistic risk calculation results. Additionally, Fault Tree and Event Tree models are graphically displayed using features of the SAPHIRE code. The Crystal Reports software will be used to develop, save and print reports in a convenient format. These updates are not planned for PCSA Tool Version 2.0.

3.4 PRE- AND POST- PROCESSOR

The pre- and post-processor will be an integral part of the tool to develop input data and display results from acquired software packages, particularly for conducting consequence analyses using RSAC and MELCOR codes.

3.5 SOFTWARE VALIDATION

The PCSA Tool will be validated in compliance with tht requirements of CNWRA Technical Operating Procedure, TOP-018. The PCSA Tool validation test plan will be developed by December 12, 2002. The analyses software SAPHIRE, RSAC and MELCOR will be validated independently of PCSA Tool. The validation test plan for RSAC 5.2 and MELCOR 1.8.5 have been completed. SAPHIRE 6.7 validation test plan will be developed by June 3, 2003. The validation of PCSA Tool, RSAC 5.2, MELCOR 1.8.5, and SAPHIRE 6.7 have been scheduled for completion by September 3, 2003, July 2, 2003, August 2, 2003 and June 3, 2003 respectively.

4. REFERENCES

Benke, R., B. Dasgupta, B. Sagar and A. Chowdhury. "Methodology for Preclosure Risk Assessment for Geologic Nuclear Waste Repository", 6th International Conference on Probabilistic Safety Assessment and Management, Puerto Rico, June 23-28, 2002.

Dasgupta, B., R. Benke, D. Daruwalla, A. Ghosh, R. Janetzke, and A. Chowdhury. "PCSA Tool Development—Progress Report". San Antonio, TX: Center for Nuclear Waste Regulatory Analyses. 2001.

NRC. "MELCOR Computer Code Manuals". NUREG/CR-6119, Revision 2. Washington, DC: U.S. Nuclear Regulatory Commission. 2000.

Russel, K.D., C. L. Atwood, W. J. Galyean, M. B. Sattison, and D.M. Rasmuson. "Systems Analysis Programs for Hands-on Integrated Reliability Evaluations (SAPHIRE) Version 5.0,Technical Reference Manual". NUREG/CR-6616. Idaho Falls, ID: Idaho National Engineering Laboratory. 1993.

Wenzel, D. R. "The Radiological Safety Analysis Computer Program (RSAC-5) User's Manual". WINCO-1123, Revision 1. Idaho Falls, ID: Westinghouse Idaho Nuclear Company, Inc. Idaho National Engineering Laboratory. 1994.

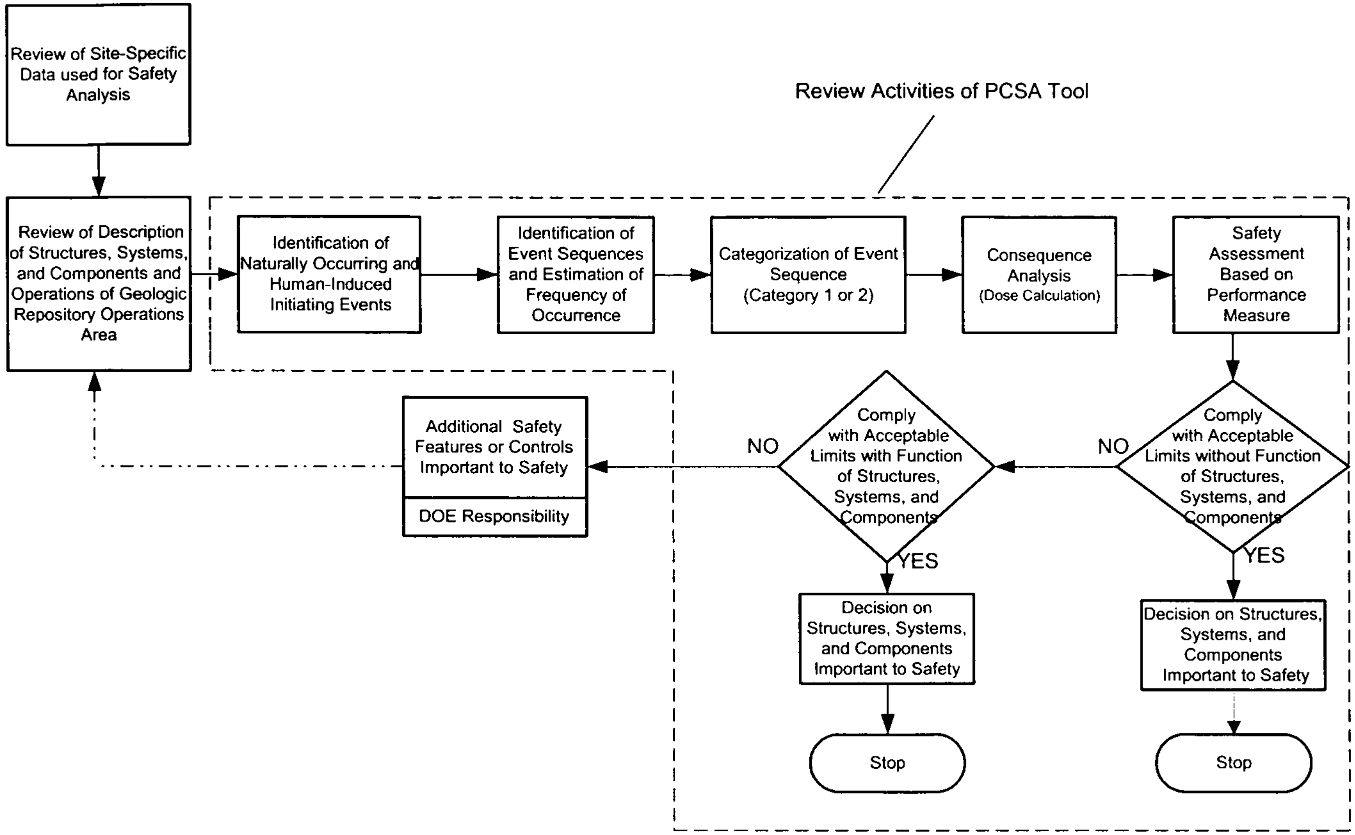
Review of Site-Specific Data used for Safety Analysis
Review Activities of PCSA Tool
Review of Description of Structures, Systems, and Components and Operations of Geologic Repository Operations Area
Identification of Naturally Occurring and Human-Induced Initiating Events
Identification of Event Sequences and Estimation of Frequency of Occurrence
Categorization of Event Sequence (Category 1 or 2)
Consequence Analysis (Dose Calculation)
Safety Assessment Based on Performance Measure
Comply with Acceptable Limits without Function of Structures, Systems, and Components
NO
YES
Decision on Structures, Systems, and Components Important to Safety
Stop
Comply with Acceptable Limits with Function of Structures, Systems, and Components
NO
YES
Decision on Structures, Systems, and Components Important to Safety
Stop
Additional Safety Features or Controls Important to Safety
DOE Responsibility

Figure 1. Preclosure Safety Analysis Review Methodology and activities of PCSA Tool

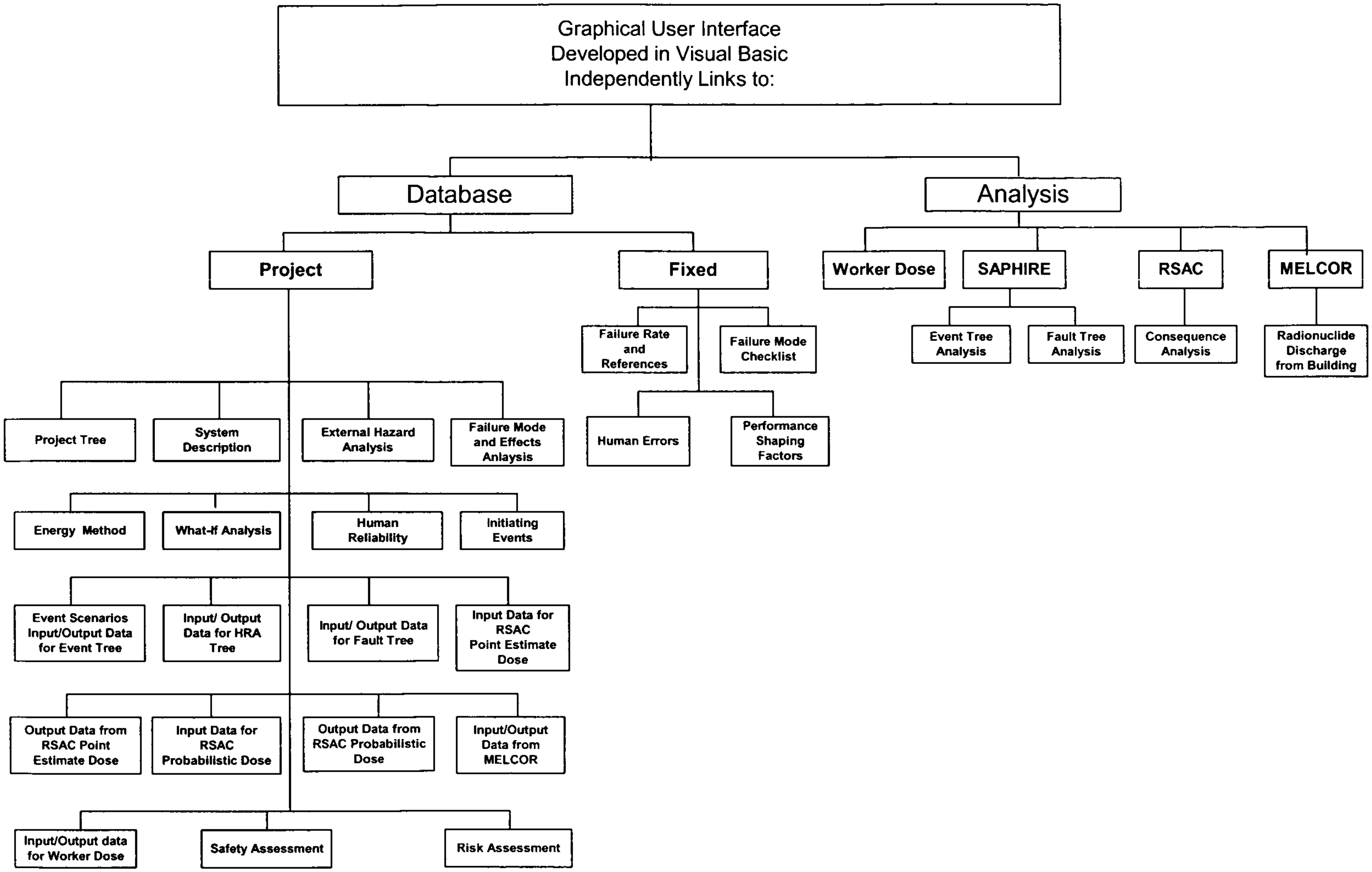
Graphical User Interface
Developed in Visual Basic
Independently Links to:
Database
Analysis
Project
Fixed
Worker Dose
SAPHIRE
RSAC
MELCOR
Failure Rate and References
Failure Mode Checklist
Event Tree Analysis
Fault Tree Analysis
Consequence Analysis
Radionuclide Discharge from Building
Human Errors
Performance Shaping Factors
Project Tree
System Description
External Hazard Analysis
Failure Mode and Effects Anlaysis
Energy Method
What-If Analysis
Human Reliability
Initiating Events
Event Scenarios Input/Output Data for Event Tree
Input/ Output Data for HRA Tree
Input/ Output Data for Fault Tree
Input Data for RSAC Point Estimate Dose
Output Data from RSAC Point Estimate Dose
Input Data for RSAC Probabilistic Dose
Output Data from RSAC Probabilistic Dose
Input/Output Data from MELCOR
Input/Output data for Worker Dose
Safety Assessment
Risk Assessment

Figure 2. Proposed Structure for PCSA Tool

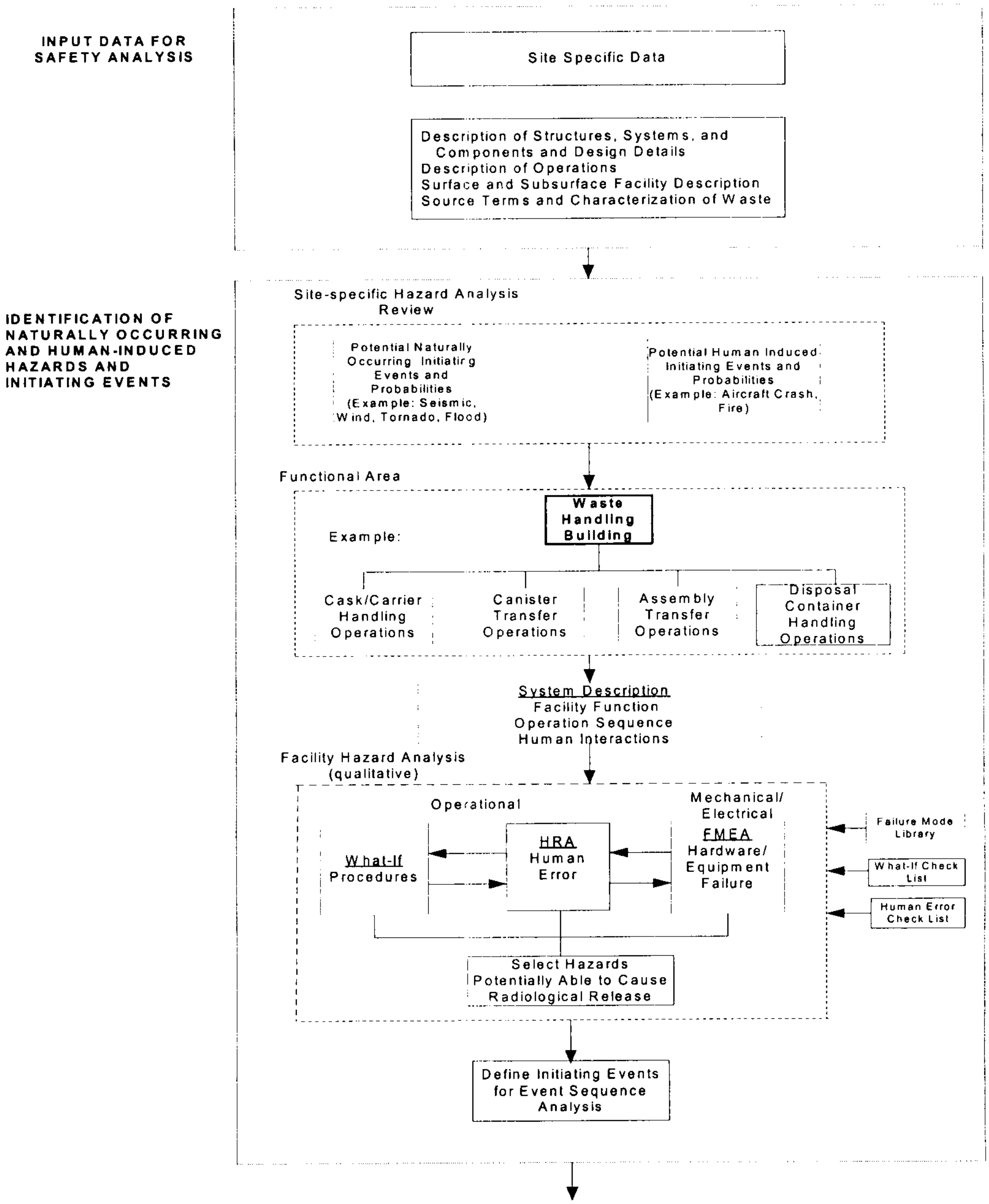
INPUT DATA FOR SAFETY ANALYSIS
Site Specific Data
Description of Structures, Systems, and Components and Design Details
Description of Operations
Surface and Subsurface Facility Description
Source Terms and Characterization of Waste
IDENTIFICATION OF NATURALLY OCCURRING AND HUMAN-INDUCED HAZARDS AND INITIATING EVENTS
Site-specific Hazard Analysis Review
Potential Naturally Occurring Initiating Events and Probabilities (Example: Seismic, Wind, Tornado, Flood)
Potential Human Induced Initiating Events and Probabilities (Example: Aircraft Crash, Fire)
Functional Area
Example:
Waste Handling Building
Cask/Carrier Handling Operations
Canister Transfer Operations
Assembly Transfer Operations
Disposal Container Handling Operations
System Description
Facility Function
Operation Sequence
Human Interactions
Facility Hazard Analysis (qualitative)
Operational
What-If
Procedures
HRA
Human Error
Mechanical/ Electrical
FMEA
Hardware/ Equipment Failure
Failure Mode Library
What-If Check List
Human Error Check List
Select Hazards Potentially Able to Cause Radiological Release
Define Initiating Events for Event Sequence Analysis

Figure 3-a. PCSA Tool Function

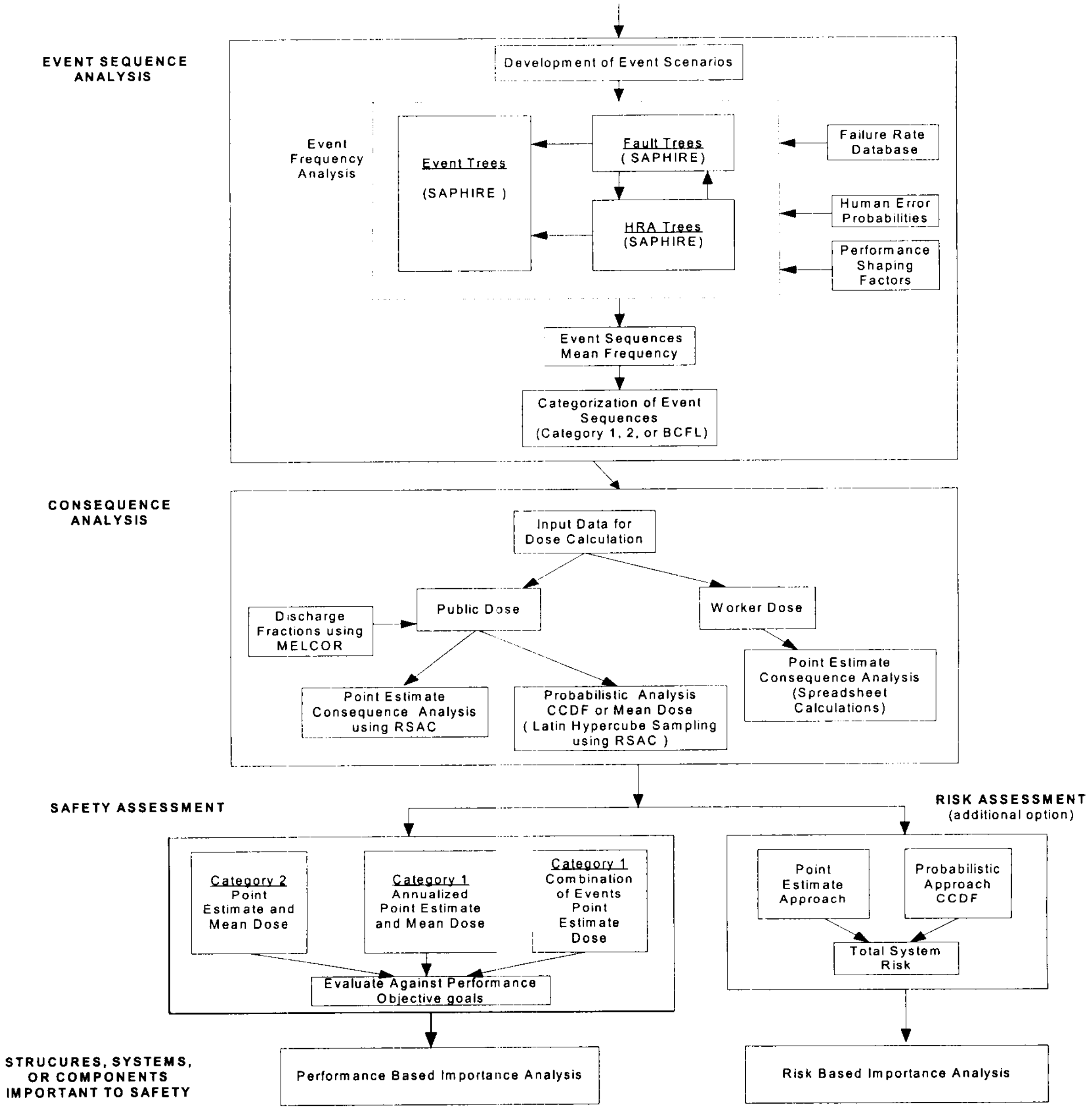
EVENT SEQUENCE ANALYSIS
Development of Event Scenarios
Event Frequency Analysis
Event Trees
(SAPHIRE)
Fault Trees
(SAPHIRE)
HRA Trees
(SAPHIRE)
Failure Rate Database
Human Error Probabilities
Performance Shaping Factors
Event Sequences Mean Frequency
Categorization of Event Sequences (Category 1, 2, or BCFL)
CONSEQUENCE ANALYSIS
Input Data for Dose Calculation
Discharge Fractions using MELCOR
Public Dose
Worker Dose
Point Estimate Consequence Analysis using RSAC
Probabilistic Analysis CCDF or Mean Dose (Latin Hypercube Sampling using RSAC)
Point Estimate Consequence Analysis (Spreadsheet Calculations)
SAFETY ASSESSMENT
RISK ASSESSMENT (additional option)
Category 2 Point Estimate and Mean Dose
Category 1 Annualized Point Estimate and Mean Dose
Category 1 Combination of Events Point Estimate Dose
Evaluate Against Performance Objective goals
Point Estimate Approach
Probabilistic Approach CCDF
Total System Risk
STRUCURES, SYSTEMS, OR COMPONENTS IMPORTANT TO SAFETY
Performance Based Importance Analysis
Risk Based Importance Analysis

Figure 3-b. PCSA Tool Function (continued)

Software Development Plan

Software Development Plan for the PCSA Tool
Revision 03

The Software Development Plan (SDP) describes the approach to be followed in the development of the PCSA Tool.

1.0 SCOPE

The scope of this task is to develop a PCSA Tool to provide the NRC and CNWRA staff the capability to conduct an independent confirmatory analysis and to review the DOE preclosure safety analysis. The PCSA Tool structure is modeled after the safety analysis review methodology which is based on the requirements of the 10 CFR Part 63 for preclosure safety analysis of the geologic repository operations area. The review activity and the typical tool functions consist of (i) collection of site-specific data and information on facility operations and processes , (ii) natural and human-induced, and facility hazards analysis; (iii) event sequence analysis; (iv) categorization of events; (v) consequences analysis; (vi) safety assessment; and (vii) identification of structures, systems, and components important safety. In addition, the tool will have capability to assess system risk using an approach developed by Benke et. al. (2002). The PCSA Tool will use a graphical user interface environment developed in Microsoft Visual Basic 6.0 to control the functions of the tool. The PCSA Tool makes use of the Microsoft Access database software and three other software packages: (i) SAPHIRE (Idaho National Engineering Laboratory, 1998), (ii) RSAC (Wenzel, 1994), and (iii) MELCOR (NRC, 2000). In addition, several utility codes were developed using Lahey LF90 Fortran compiler. Incorporation of consequence analysis code MACCS2 (NRC, 1998) is under consideration.

2.0 BASELINE ITEMS

The baseline items are: (1) PCSA Tool template using MS Access database; (2) PCSA Tool code developed using Visual Basic 6.0; (3) Equipment System Failure Rate database and failure mode check list database; (4) SAPHIRE Version 6.70; (5) RSAC Version 5.2; (6) MELCOR Version 1.8.5; and (7) suite of utility codes developed in Fortran PCSA_LHS Version 1.0, PCSA_LHSINP, PCSA_ PROB Version 1.0, PCSA_RSACRD Version 1.0, and PCSA_COMBAN Version 1.0, PCSA_IETCCDF Version 1.0, and PCSA_RISKCCDF Version 1.0.

3.0 PROJECT MANAGEMENT

This section contains the work breakdown structure for development of the PCSA Tool Versions 2.0 and 3.0. Note that PCSA Tool, Version 1.0 was released to NRC on 7/31/2002.

3.1 Work Breakdown Structure

Tasks	Name	Hours	Completion Date
Resources			
Software Procurement for Version 3.0			Completed
Hardware			Completed
Client Furnished			None
Project Management			
SDP Development	B. Dasgupta	5	5/ 9/2003
	R. Benke	5	5/ 9/2003
Status Reports	None		
Client Reviews	None		
Technical Tasks			
Acceptance Testing for Version 2.0	M. Menchaca	100	5/30/2003
	B. Dasgupta	10	5/30/2003
Proof-of-Concept Development for Version 3.0	B. Dasgupta	20	6/30/2002
	R. Benke	20	6/30/2002
Development of SRD for Version 3.0	B. Dasgupta	15	5/30/2003
	R. Benke	15	5/30/2003
Design and Code for Version 3.0	A. Lozano	200	12/31/2003
	D. Stead	400	12/31/2003
	R. Janetzke	65	12/31/2003
	B. Dasgupta	60	12/31/2003
	R. Benke	60	12/31/2003
Development of Final Report	B. Dasgupta	100	3/31/2004
	R. Benke	160	3/31/2004
	R. Janetzke	20	3/31/2004
	A. Ghosh	30	3/31/2004
	A. Chowdhury	30	3/31/2004
	A. Lozano	30	3/31/2004
	D. Stead	30	3/31/2004
	T. Maxwell	90	3/31/2004
User's Manual for Version 3.0	T. Maxwell	100	3/31/2004
	R. Benke	30	3/31/2004
	B. Dasgupta	30	3/31/2004
Installation Testing for Version 3.0	D. Stead	10	12/31/2003

Tasks	Name	Hours	Completion Date
Acceptance Testing for Version 3.0	TBD	160	1/31/2004
Development of Software Validation Test Plan PCSA Tool Version 3.0	B. Dasgupta	40	8/29/2003
	R. Benke	30	8/29/2003
	T. Maxwell	120	8/29/2003
Validation Testing for PCSA Tool Version 3.0	B. Dasgupta	60	5/15/2004
	R. Benke	60	5/15/2004
	T. Maxwell	120	5/15/2004
Development of Software Validation Test Report	B. Dasgupta	40	7/15/2004
	R. Benke	40	7/15/2004
	T. Maxwell	100	7/15/2004
Support Activities			
Materials	None		
Publications	R. Benke	40	9/30/2004
	B. Dasgupta	20	9/30/2004
Travel	R. Benke	20	9/30/2004
Training and preparation for training	B. Dasgupta	20	9/30/2004
	R. Benke	20	9/30/2004
ESTIMATED HOURS TOTAL:		**2525**	

3.2 Project Schedule and Milestones

Milestones			
Work Element	**Milestone Description**	**Completion Criteria**	**Estimated End Date**
Task 1 Design and populate the Equipment System Failure Rate Database	Database is populated	Project Manager Acceptance	12/31/2004
Task 2 Design and develop the PCSA software with following sub-tasks:	Software is completed and ready for test	Project Manager Acceptance	
Infrastructure			Completed
Functional Area module			Completed
External hazards module			Completed
System description			Modifications 12/15/2003
Internal hazards analysis module (What-If, FMEA, Energy Method)			Completed
Software Reliability (Qualitative)			Completed
Event Sequence module			Modifications 9/20/2002
Consequence analysis module (input/output)			Completed
Result module with search capability			Modifications 12/15/2003
Safety Analysis			Modifications 9/20/2002
SSCIS module			Development 12/15/2003
Risk Analysis module			Completed
Task 3 Design Report formats for all the forms and add the printing capability to all the Reports	Software is completed and ready for test	Project Manager Acceptance	Partial Report formats are completed 12/15/2003
Task 4 Human Error Probability Generator			
Non-Cognitive			Completed
Cognitive			12/15/2003
Task 5 Acceptance and Installation Test of PCSA Tool Ver 3.0.	Database is designed	Project Manager Acceptance	1/31/2004

Work Element	Milestone Description	Completion Criteria	Estimated End Date
Task 6 Write Validation Test Plan for PCSA Tool Version 3.0	Completed Acceptance Test Plan	Project Manager Acceptance	8/29/2003
Task 7 Validation Test the PCSA Tool Version 3.0	Successful execution of acceptance test	Project Manager Acceptance	5/15/2004
Task 8 Write a PCSA Tool final report	Completed Manual	Project Manager Acceptance	3/31/2004
Task 10 Write PCS Tool Validation Report			7/15/2004
Task 9 Update User Manual for Version 3.0	Completed Manual	Project Manager Acceptance	3/31/2004

3.3 Staffing Plan

The following table contains the project team members that are planned to execute the project.

Staffing Plan				
Team Member	Project Role	Start Date	End Date	% Commitment
B. Dasgupta	Project Lead Development, Testing, Manual, Report	11/99	9/2004	30
R. Benke	Development, Testing, Manual, Report	6/00	9/2004	25
A. Lozano	Code Development, Manual	8/00	9/2004	10
D. Stead	Code Development, Manual	4/01	9/2004	75
R. Janetzke	Code Development, Manual	3/01	9/2004	8
T. Maxwell	Testing, Manual	1/03	9/2004	50
A. Ghosh	Testing, Report	7/02	9/2004	5
A. Chowdhury	Report	7/02	9/2004	5
M. Menchaca	Acceptance Testing	3/03	5/2003	25

3.4 Risk Management

The following table contains the risk management plan for the project. The table contains each of the risks that have been identified for the project.

Risk Management			
Risk	**Probability**	**Impact to Project**	**Mitigation**
Running out of budget	Low	High	Allocate appropriate funding
Not completing in time	Medium	High	Closely monitor schedule, and add additional man-hours as necessary
Failure to implement requirements of SRD	Low	High	Verify implementation through testing

4. DEVELOPMENT PROCEDURES

4.1 Environment and Resources

The following sections describe the hardware and software resources that will be utilized during the project.

4.1.1 Hardware Resources

The following table lists the hardware resources that will be utilized during the project.

Hardware Resources			
Description	**Supplier**	**Owner**	**Purpose**
IBM Compatible PC -2 ADRIANA Pentium II **266 MHz clock** **256 MB Ram** **20(2x10)GB Hard Drives** **Monitor** 21" Super XGA monitor with resolution 1280x1024 and 32 bit color **Printer** Laser printer (shared)	□ Net Force □ NEC	□ CNWRA □ CNWRA	Software Development and Testing
IBM Compatible PC -2 ASTINIUS Pentium II **266 MHz clock** **128 MB Ram** **20(2x10)GB Hard Drives** **Monitor** 17" Super XGA monitor with resolution 1152x864 and 32 bit color **Printer** Laser printer (shared)	□ Net Force □ NEC	□ CNWRA □ CNWRA	Software Development and Testing
IBM Compatible PC -2 ALBY Pentium II **450 MHz clock** **6 GB Ram** **20(2x10)GB Hard Drives** **Monitor** 17" Super XGA monitor with resolution 1280x1024 and 32 bit color **Printer** Laser printer (shared)	□ Net Force □ NEC	□ CNWRA □ CNWRA	Software Development and Testing

4.1.2 Software Resources

The following table lists the software resources that will be utilized during the project.

Software Resources			
Description	**Supplier**	**Owner**	**Purpose**
Microsoft - Visual Basic 6.0 Professional Graphical User Interface Software Development Tool	□ Microsoft	□ CNWRA	Software Development
Microsoft Access (Office 97) Database Development Tool	□ Microsoft	□ CNWRA	Database Development
Fortran-90	□ Lahey	□ CNWRA	Software Development
Microsoft-Visual Source Safe 6.0	□ Microsoft	□ CNWRA	Software Configuration
SAPHIRE Version 6.7	□ Oak Ridge National Laboratory	□ CNWRA	Fault Tree & Event Analysis
RSAC Version 5.2	□ Idaho National Environmental and Engineering Laboratory	□ CNWRA	Radiological Dose Calculations
MELCOR Version 1.8.5	□ Sandia National Laboratory	□ CNWRA	Radionuclide Transport
MACCS2 (Under consideration)	□ Sandia National Laboratory	□ CNWRA	Radiological Dose Calculations
Windows NT	□ Microsoft	□ CNWRA	Operating System
Install Shield Professional, Windows Installer Edition, V. 2.03	□ Install Shield Corporation	□ CNWRA	Operating System
Crystal Reports 9.0, Developer	□ Crystal Decisions, Inc.	□ CNWRA	Report capability

4.2 Software Development Lifecycle

The development lifecycle for the PCSA Tool includes the following seven (7) phases:

Phase	Description	Output
Analysis	Determine input formats, formulate requirements interface, and determine output requirements and format.	Software Requirements Description
Development	Develop code and perform module level testing.	Software Scientific Notebook entries Software development files
Preliminary Release of Version 1.0 Beta Version 2.0 Beta Version 3.0 Beta	Users provide developer feedback on the "look and feel" and functionality of the software. Developer uses this information to develop the final version of the software.	Scientific notebook entries
Acceptance Testing	Demonstrates whether the requirements specified in the SRD have been fulfilled.	Scientific Notebook entries Software development files
Final delivery of Version 1.0 Version 2.0 Version 3.0	Developer incorporates changes, performs necessary regression testing, and provides final version of software to users.	Final version of software Design Verification Report Software Summary Form Software Release Notice
Maintenance Version 1.0 Version2.0 Version 3.0	Developer addresses problems and identifies enhancements	Software Change Reports Software update Software Summary Form Software Release Notice
Validation	Validation PCSA Tool Version 3.0	Softwate Validation Test Plan. Software Validation Report Software Notebook entries

4.3 Coding

This section describes the coding conventions that will be applied throughout the project.

Coding Standards	
The following language(s) will be used:	□ Visual Basic 6 □ Fortran 90
The following coding style guide(s) will be used:	□ Fortran (Cook et al., 1990) □ Visual Basic (see Appendices)

4.4 Acceptance Testing

The following table lists the documentation technique and tools that will be used for acceptance testing.

Acceptance Testing Methodology	
Documentation	Tools
□ Scientific Notebook □ Software Development File □ Software Change Report □ Other:	□ Other:

5.0 CONFIGURATION MANAGEMENT

This section contains the configuration management plan for the project.

5.1 Tools

Visual Source Safe V 6.0 by Microsoft will be used to perform software configuration management.

5.2 Configuration Identification

Software version numbers will be of the form Version V.r, where V is an incrementing major version number beginning at 1 and r is an incrementing minor revision number beginning at 0.

5.3 Configuration Procedures

The software will be maintained using Visual Source Safe by Microsoft. The software will reside on the personal computer ADRIANA (in Room A108, Bldg 189, SWRI) located in directory D:\DStead\PCSA Tool.

5.3.1 Check-in/check-out Procedures

Software under development will be checked out of the repository (D:\DStead\PCSA Tool) into a developer directory for modification. Modified files will be checked back into and newly created files will be added to the repository prior to release.

5.3.2 Creating Releases and Preparing For Deliveries

New releases of the software will be created at determined times during the project at the discretion of the developer. Procedure specified in TOP-18 for creating a new release will be followed.

5.3.3 Problem Reporting and Change Control

A Software Change Report (SCR) will be used to track problems, design changes, and enhancements to the software.

5.3.4 Backups

The project repository will be used to store the baseline configuration items during development. The following parameters apply to the configuration repository.

Project Files	
Host information:	Host name: ADRIANA Directory: D:\DStead\PCSA Tool
Backup media:	□ Compact Disk (CD) □ Iomega: Zip 250 □ Hard Disk (DRACO)
Backup frequency:	□ Daily □ Weekly □ Other: As needed.
Automated backup tools:	□ Other:

6.0 REFERENCES

Benke, R., B. Dasgupta, B. Sagar and A.Chowhdury, "A Methodology for Preclosure Risk Assessment for a Geologic Nuclear Waste Repository", Probabilistic Safety Assessment and Management (PSAM6), Proceedings of the 6th Intenational Conference on Probabilistic Safety Assessment and Management, San Juan, Puerto Rico, June 23-28, 2002, Oxford: Elsevier Science, Ltd. Vol. I, pp. 983-988, 2002.

Cook, D. M., N.H. Marshall, E.S. Marwil, S.D. Matthews, and G.A. Mortensen, "Fortran Coding Guidelines", EG&G Idaho, Inc. EGG-CATT-8898 Idaho Falls, ID: U.S. Department of Energy, Idaho Operations Office February 1990.

Idaho National Engineering Laboratory. "Systems Analysis Programs for Hands-on Integrated Reliability Evaluations (SAPHIRE) Version 6.0, Saphire Reference Manual." Idaho Falls, Idaho: Idaho National Engineering Laboratory. 1998.

Wenzel, D. R. "The Radiological Safety Analysis Computer Program (RSAC-5) User's Manual". WINCO-1123, Revision 1. Idaho Falls, ID: Westinghouse Idaho Nuclear Company, Inc., Idaho National Engineering Laboratory. 1994.

U.S. Nuclear Regulatory Commission. "MELCOR Computer Code Manuals". NUREG/CR-6119, Revision 2. Washington, DC: U.S. Nuclear Regulatory Commission. October 2000.

U.S. Nuclear Regulatory Commission. NUREG–6613, "Code Manual for MACCS2; Volume, Users Guide." Washington, DC: NRC. May. 1998.

7.0 APPENDICES

Visual Basic Coding Standard

APPROVED:

Signature of Element Manager

5-22-03

Date

cc: QA
Element Manager
Principal Investigator

APPENDIX

Visual Basic Coding Standard

1. Overview

The scope of this effort is coding in the MS Visual Basic (VB) coding style. The use of good VB style will encourage consistent layout, improve the portability, and consequently reduce the coding errors during the development of the software. Experience and good judgment should be used for those situations not covered by this procedure.

2. Naming Standards

The software will use a consistent naming convention for variables throughout coding process as specified in paragraph 6.1.2, *Variable Naming Conventions*. Using a consistent standard for naming components in the program will save a significant amount of time during the code development process, and during future maintenance work.

3. Variables

Variable names are used frequently in the process of code development; most statements contain the name of at least one variable. Through the use of a consistent naming system for variables, the programmer will be able to minimize the amount of time spent tracking down the exact spelling of a variable's name.

By encoding some information about the variable itself into the variable name, the programmer can make it easier to decipher the meaning of any statement in which that variable is used, in addition to identifying errors that are otherwise difficult to find.

The attributes of a variable that are useful to encode into its name include its *scope* and its *data type* as outlined in the following paragraphs.

4. Scope

In VB, there are three scopes by which a variable may be defined. The three scopes include the following.

a. If defined within the procedure, the variable is local to that procedure.

b. If defined in the general declarations area of a form or module, then that variable can be referenced from all procedures in that form or module, and is said to have *module scope*.

c. If it is defined with Public keyword, then it is global to the application.

5. Data Types

VB supports an assortment of data types. By encoding the type of variable in its name, the programmer can visually check that the assignment to that variable is credible. This helps the programmer to identify an error quickly.

Encoding the data type into the variable name has another benefit: the capability to reuse data names. If the programmer needs to store the start date in both a string and a double, then the same root name for both variables can be used. The start date is always the StartDate; it takes on a different tag to distinguish the different formats in which it is stored.

6. File Organization

Procedures and functions within form files shall be separated by a blank line. A header description for each procedure and function will be provided where applicable.

6.1 File Naming Conventions

File names are made up of a base name, function name, and a period and extension. File names must follow the MS DOS ***8 dot 3*** convention. Supporting file structures are automatically generated.

<BASE NAME><FUNCTION>.<EXTENSION>

The categories of files are as follows:

a. Executable files - ***exe***
b. Microsoft Access 97 Database files - ***mdb***
c. Dynamic Link Library files - ***dll***
d. Help files - ***hlp***
e. Microsoft Windows INI files - ***ini***
f. Microsoft Windows Bit Map files - ***bmp***
g. Backup files - ***bak***
h. Microsoft Word 97 files - ***doc***
i. Temporary files - ***tmp***
j. Table of Contents files - ***cnt***
k. Microsoft Windows Program Information files - ***pif***

The following are examples of file names:

a. **FORM** = ***frm1553T.frm***

b. **.BAS** = ***globals.bas***

c. **MS Access Database** = ***session.mdb***

6.1.1 Object Naming Conventions

Table 6-1 defines the object naming conventions used in code development.

Table 6-1. Object Name Conventions

Object	Prefix	Comment
Checkbox	chk	
Combo box	cbo	
Command Button	cmd	
Common dialog box	dlg	
Communications	com	
Data	dat	
Directory List box	dir	
Drive List Box	drv	
File list box	fil	
Frame	fra	
Group Push Button	gpb	
Horizontal Scroll bar	hsb	
Image	img	
Label	lbl	
List Box	lst	
List View	lsv	
Mask Edit Box	meb	
MDI Form	mdifrm	
Menu	mnu	
MSFlexgrid	grd	
Option button	opt	
Panel	pan	
Picture Box	pic	
Progress Bar	prb	
SS Frame	ssf	
SS Tab	sst	
Status Bar	stb	
Tab Pages	tab	
Tab Strip	tbs	
Text Box	txt	
Timer	tmr	
Tool Bar	tlb	
Tree View	trv	
True DBGrid	tdbg	Apex software
True Grid VBX	tdgrd	Apex software
Vertical scroll bar	vsb	

6.1.2 Variable Naming Conventions

Table 6-2 defines the Variable Naming Conventions used in code development.

Table 6-2. Variable Naming Conventions

Type	Prefix	Comments
Static	sta	staiInitialize
Constant	con	consName
Variant	var	
Integer	i	
Long	l	
Single	f	
Double	d	
Currency	cur	
String	s	
Byte	by	
Boolean	b	
Date	da	
Object	obj	
Global (Public)	g	glbiArrayCounter
Array	ary	
Database	db	
Recordset	rs	
Workspace	ws	

Notes:

1. Variables i, j, k, l, m, and n will be reserved to be integers and used in places where their value is unambiguous:

```
For i = 1 to iArrayLength
     sReceiveData(i) = "&H"+ sTemp
next i
```

2. All variables will be defined and at the beginning of each form, subroutine or event.

6.2 Program Files

Program files describe the contents of a particular file. A description of the purpose of the objects in the files (whether they are functions, external data declarations or definitions, or other) is more useful than a list of the object names. The program files may optionally contain author(s), revision control information, or references.

6.3 Other Files

An example is *rcvb5.ini* file, which might initialize the RS-232 communication ports and identify the operating system or contain paths to bitmaps.

6.4 Comments

The comments should describe *what* is happening, *how* it is being done, *what the* parameters mean, *which* globals are used or modified, and any restrictions or bugs. Comments that are clear from the code should be avoided due to the information becoming outdated. Comments that disagree with the code are of no value. Short comments should be *what* comments, such as "compute mean value," rather than *how* comments such as "sum of values divided by n."

6.4.1 Standard Structure for a Form (Used in Load event)

The following outline illustrates the standard structure for a *Form (used in Load event)*.

```
'*********************************************************************
' Southwest Research Institute
'*********************************************************************
'SRD Section Reference: 2
'
'File Type:    Form
'
'File Name:    frmSigMon.frm
'
'Use:          This file communicates through the RS232 Port to the
'              LASTE to provide real time feed back of signal states
'              on the A-10.
'
'Description:  Data from the LASTE is queried by this form.
'               (1) First a Control Y (Chr$(25)) is sent.
'              The expected response is (in hex):  0D0D0A3E3E.
'               (2) LASTE is then asked for data on each signal.
'              The query format is: MRP XXXXCR  where XXXX is the
'              signal address and CR is a carriage return.
'               (3) LASTE then responds with a 26 character data
'              string.  Characters 17, 18, 19 and 20 hold the
'              signal values.
'
'Modification History:
' Date         Software Developer  Reason
' 11-13-96     Ima Engineer        Created
' 12-12-96     Vendela Kirsebom    Changed GUI interface
'*********************************************************************

'***********************Variable Definition**************************
Dim iLengthString As Integer
Dim sCR As String 'Carriage Return
Dim sLF As String 'Line Feed
Dim sLASTETermination As String
Dim cString As String
Dim i, j, k As Integer
Dim sControlY As String
Dim sReceiveStr As String
Dim sSendCommand(4) As String 'LASTE query

'*******  Error Trapping *******
On Error GoTo frmLASTEFunctionsErrorHandler
```

```
<Body of Program>

Exit Sub

frmLASTEFunctionsErrorHandler:
  Select Case Err.Number
    Case 55
        MsgBox ("File Already Open")
    Case 53 'File does not exist
        MsgBox ("Otp.ini does not exist in C:\Windows - ending program")
        End
    Case Else
        MsgBox ("Error is: " & Err.Number)
        End ' End Program
End Select
Resume Next
End Sub
```

6.4.2 Object Structure

The following outline defines the Object Structure (buttons, subroutines, etc.) used in the development of code.

```
'*********************************************************************
'Use:           The event allows the user to cancel the RS232
'               communications.
'
'Description:   When the user presses the Cancel command button a
'               global flag (glbbyteStopFlag) is set True.  The main form
'               frmSignalMonitor) periodically checks the state of the flag.
'               If the flag is True then the form is unloaded and the MDI
'               form (mdifrmSignalMonitor) is displayed.
'
'Modification History:
' Date          Software Developer      Reason
' 11-13-96      Ima Engineer Jr.        Created
' 12-12-96      Vendela Kirsebom        Changed GUI interface
'*********************************************************************

'**********************Variable Definition***************************
Dim sTempString as string    'Used for cache

'*******  Error Trapping *******
On Error GoTo cmdCancelErrorHandler

<Body of routine >

Exit Sub

cmdCancelErrorHandler:
  Select Case Err.Number
    Case 55
        MsgBox ("File Already Open")
    Case 53    'File does not exist
        MsgBox ("Otp.ini does not exist in C:\Windows - ending program")
        End
    Case Else
        MsgBox ("Error is: " & Err.Number)
        End     'End Program
End Select
Resume Next
End Sub
```

6.5 Declarations

Declarations should be placed in the *declaration section* of the form or module.

Software Development Plan for the PCSA Tool
Revision 02

The Software Development Plan (SDP) describes the approach to be followed in the development of the PCSA Tool.

1.0 SCOPE

The scope of this task is to develop a PCSA Tool to provide the NRC and CNWRA staff the capability to conduct an independent confirmatory analysis and to review the DOE preclosure safety analysis. The PCSA Tool structure is modeled after the safety analysis review methodology which is based on the requirements of the 10 CFR Part 63 for preclosure safety analysis of the geologic repository operations area. The review activity and the typical tool functions consist of (i) site-specific natural and human-induced hazard analysis; (ii) facility hazard analysis; (iii) event sequence analysis; (iv) categorization of events; (v) consequences analysis; (vi) safety assessment; and (vii) identification of structures, systems, and components important safety. In addition, the tool will have capability to assess system risk using an approach developed by Benke et. al. (2002). The PCSA Tool will use a graphical user interface environment developed in Microsoft Visual Basic 6.0 to control the functions of the tool. The PCSA Tool makes use of the Microsoft Access database software and three other software packages: (i) SAPHIRE (Russel et al., 1993), (ii) RSAC (Wenzel, 1994), and (iii) MELCOR (NRC, 2000). In addition, several utility codes were developed using Lahey LF90 Fortran compiler.

2.0 BASELINE ITEMS

The baseline items are: (1) PCSA tool template using MS Access database; (2) PCSA tool code developed using Visual Basic 6.0; (3) Equipment System Failure Rate database and failure mode check list database; (4) SAPHIRE Version 6.70; (5) RSAC Version 5.2; (6) MELCOR Version 1.8.5; and (7) suite of utility codes developed in Fortran PCSA_LHS Version 1.0, PCSA_LHSINP, PCSA_ PROB Version 1.0, PCSA_RSACRD Version 1.0, and PCSA_COMBAN Version 1.0, PCSA_IETCCDF Version 1.0, and PCSA_RISKCCDF Version 1.0.

2/15

3.0 PROJECT MANAGEMENT

This section contains the work breakdown structure for development of the PCSA Tool Versions 1.0, 2.0 and 3.0. Note that PCSA Tool, Version 1.0 Beta was released to NRC on October10, 2001.

3.1 Work Breakdown Structure

Tasks	Name	Hours	Completion Date
Resources			
Software Procurement for Version 3.0	A. Lozano	5	9/20/2002
	D. Stead	10	
Hardware	None		
Client Furnished	None		
Project Management			
SDP Development	B. Dasgupta	5	6/ 30/2000
	R. Benke	5	6/ 30/2000
	R. Janetzke	5	6/ 30/2000
Status Reports	None		
Client Reviews	None		
Technical Tasks			
Proof-of-Concept Development for Version 2.0	B. Dasgupta	20	7/20/2002
	R. Benke	20	7/20/2002
Development of SRD for Version 3.0	B. Dasgupta	15	9/10/2002
	R. Benke	15	9/10/2002
Design and Code for Version 2.0	A. Lozano	120	9/10/2002
	D. Stead	370	9/10/2002
	R. Janetzke	65	9/20/2002
	B. Dasgupta	60	7/20/2002
	R. Benke	40	9/20/2002
Development of Progress Report/User's Manual for Version 2.0	B. Dasgupta	100	8/20/2002
	R. Benke	160	8/20/2002
	R. Janetzke	20	8/20/2002
	A. Ghosh	30	8/20/2002
	A. Chowdhury	30	8/20/2002
	A. Lozano	20	8/20/2002
	D. Stead	20	8/20/2002
Installation Testing for Version 2.0	A. Lozano	10	9/20/2002
	D. Stead	40	9/20/2002
Acceptance Testing for Version 1.0	B. Dasgupta	5	7/3/2002
	R. Benke	10	7/3/2002
	K. Stiles	40	7/3/2002
Acceptance Testing for Version 2.0	B. Dasgupta	5	10/15/2002
	R. Benke	10	10/15/2002
	A. Ghosh	20	10/15/2002
Development of Software Validation Test Plan PCSA Tool Version 3.0	B. Dasgupta	10	7/15/2002
	R. Benke	30	7/15/2002
	K. Stiles	120	7/15/2002

3/15

Tasks	Name	Hours	Completion Date
Validation Testing for PCSA Tool Version 3.0	B. Dasgupta	TBD	9/15/2002
	R. Benke	TBD	9/15/2002
	A. Ghosh	TBD	9/15/2002
Development of Software Validation Test Report Version 3.0	B. Dasgupta	TBD	9/15/2002
	R. Benke	TBD	9/15/2002
	A. Ghosh	TBD	9/15/2002
Support Activities			
Materials	None		
Publications	R. Benke	15	9/20/2002
	B. Dasgupta	20	8/30/2002
Travel	R. Benke	20	6/28/2002
Training and preparation for training	B. Dasgupta	20	8/30/2002
	R. Benke	20	8/30/2002
ESTIMATED HOURS TOTAL:		**1530**	

4/19

3.2 Project Schedule and Milestones

Milestones			
Work Element	**Milestone Description**	**Completion Criteria**	**Estimated End Date**
Task 1 Design and populate the Equipment System Failure Rate Database	Database is populated	Project Manager Acceptance	9/20/2002
Task 2 Acceptance and Installation Test of PCSA Tool Ver 1.	Database is designed	Project Manager Acceptance	7/5/2002
Task 3 Design and develop the PCSA software with following sub-tasks:	Software is completed and ready for test	Project Manager Acceptance	
Infrastructure			Completed
Functional Area module			Completed
External hazards module			Completed
System description and Internal hazards analysis module			Incorporation of Human Reliability 9/20/2002
Event Sequence module			Modifications 9/20/2002
Consequence analysis module (input/output)			Completed
Result module with search capability			Modifications 9/20/2002
Safety Analysis and SSCIS module			Modifications 9/20/2002
Risk Analysis module			Development 9/20/2002
Task 4 Design Report formats for all the forms and add the printing capability to all the Reports	Software is completed and ready for test	Project Manager Acceptance	Partial Report formats are completed 9/20/2002
Task 6 Prepare an Acceptance Test Plan for PCSA Tool Version 2.0	Completed Acceptance Test Plan	Project Manager Acceptance	10/20/2002
Task 7 Test the PCSA Tool Version 2.0	Successful execution of acceptance test	Project Manager Acceptance	10/20/2002
Task 8 Write a PCSA Tool Progress report/ User Manual for Version 2.0	Completed Manual	Project Manager Acceptance	8/20/2002

5/15

3.3 Staffing Plan

The following table contains the project team members that are planned to execute the project.

Staffing Plan

Team Member	Project Role	Start Date	End Date	% Commitment
B. Dasgupta	Project Lead Development, Testing, Report	11/99	9/20/2002	17
R. Benke	Development, Testing, Report	6//00	9/20/2002	23
A. Lozano	Code Development, Manual	8/00	9/20/2002	10
D. Stead	Code Development, Manual	4/01	9/20/2002	29
R. Janetzke	Code Development, Manual	3/01	8/30/2002	6
K. Stiles	Testing	6/02	8/15/2002	10
A. Ghosh	Testing, Report	7/02	8/30/2002	3
A. Chowdhury	Report	7/02	8/30/2002	2

3.4 Risk Management

The following table contains the risk management plan for the project. The table contains each of the risks that have been identified for the project.

Risk Management

Risk	Probability	Impact to Project	Mitigation
Running out of budget	Low	High	Allocate appropriate funding
Not completing in time	Medium	High	Closely monitor schedule, and add additional man-hours as necessary
Failure to implement requirements of SRD	Low	High	Verify implementation through testing

C/19

4. DEVELOPMENT PROCEDURES

4.1 Environment and Resources

The following sections describe the hardware and software resources that will be utilized during the project.

4.1.1 Hardware Resources

The following table lists the hardware resources that will be utilized during the project.

Hardware Resources			
Description	**Supplier**	**Owner**	**Purpose**
IBM Compatible PC -2 ADRIANA Pentium II **266 MHz clock** **256 MB Ram** **20(2x10)GB Hard Drives** **Monitor** 21" Super XGA monitor with resolution 1280x1024 and 32 bit color **Printer** Laser printer (shared)	□ Net Force □ NEC	□ CNWRA □ CNWRA	Software Development and Testing
IBM Compatible PC -2 ASTINIUS Pentium II **266 MHz clock** **128 MB Ram** **20(2x10)GB Hard Drives** **Monitor** 17" Super XGA monitor with resolution 1152x864 and 32 bit color **Printer** Laser printer (shared)	□ Net Force □ NEC	□ CNWRA □ CNWRA	Software Development and Testing
IBM Compatible PC -2 AIBY Pentium II **450 MHz clock** **6 GB Ram** **20(2x10)GB Hard Drives** **Monitor** 17" Super XGA monitor with resolution 1280x1024 and 32 bit color **Printer** Laser printer (shared)	□ Net Force □ NEC	□ CNWRA □ CNWRA	Software Development and Testing

4.1.2 Software Resources

The following table lists the software resources that will be utilized during the project.

Software Resources

Description	Supplier	Owner	Purpose
Microsoft - Visual Basic 6.0 Professional Graphical User Interface Software Development Tool	□ Microsoft	□ CNWRA	Software Development
Microsoft Access (Office 97) Database Development Tool	□ Microsoft	□ CNWRA	Database Development
Fortran-90	□ Lahey	□ CNWRA	Software Development
Microsoft-Visual Source Safe 6.0	□ Microsoft	□ CNWRA	Software Configuration
SAPHIRE Version 6.7	□ Oak Ridge National Laboratory	□ CNWRA	Fault Tree & Event Analysis
RSAC Version 5.2	□ Oak Ridge National Laboratory	□ CNWRA	Radiological Dose Calculations
MELCOR Version 1.8.5	□ Sandia National Laboratory	□ CNWRA	Radionuclide Transport
MACCS2	□ Sandia National Laboratory	□ CNWRA	Radiological Dose Calculations
Windows NT	□ Microsoft	□ CNWRA	Operating System
Install Shield Professional, Windows Installer Edition, V. 2.03	□ Install Shield Corporation	□ CNWRA	Operating System
Crystal Reports 8.5, Developer Edition	□ Crystal Decisions, Inc.	□ CNWRA	Report capability
Component Chart 7.0	□ Component One	□ CNWRA	Graphical display of results

8/19

4.2 Software Development Lifecycle

The development lifecycle for the PCSA Tool includes the following seven (7) phases:

Phase	Description	Output
Analysis	Determine input formats, formulate requirements interface, and determine output requirements and format.	Software Requirements Description
Development	Develop code and perform module level testing.	Software Scientific Notebook entries Software development files
Preliminary Release Version 1.0 Beta	Users provide developer feedback on the "look and feel" and functionality of the software. Developer uses this information to develop the final version of the software.	Scientific notebook entries
Acceptance Testing	Demonstrates whether the requirements specified in the SRD have been fulfilled.	Scientific Notebook entries Software development files
Final delivery PCSA Tool Version 1.0	Developer incorporates changes, performs necessary regression testing, and provides final version of software to users.	Final version of software Design Verification Report Software Summary Form Software Release Notice
Maintenance	Developer addresses problems and identifies enhancements (Versions 2.0 and 3.0)	Software Change Reports Software update Software Summary Form Software Release Notice
Validation	Validation PCSA Version 3.0	Softwate Validation Test Report. Software Validation Report Software Notebook entries

4.3 Coding

This section describes the coding conventions that will be applied throughout the project.

Coding Standards	
The following language(s) will be used:	□ Visual Basic 6 □ Fortran 90
The following coding style guide(s) will be used:	□ Fortran (Cook et al., 1990) □ Visual Basic (see Appendices)

7/19

4.4 Acceptance Testing

The following table lists the documentation technique and tools that will be used for acceptance testing.

Acceptance Testing Methodology	
Documentation	**Tools**
□ Scientific Notebook □ Software Development File □ Software Change Report □ Other:	□ Other:

5.0 CONFIGURATION MANAGEMENT

This section contains the configuration management plan for the project.

5.1 Tools

Visual Source Safe by Microsoft will be used to perform software configuration management.

5.2 Configuration Identification

Software version numbers will be of the form Version V.r, where V is an incrementing major version number beginning at 1 and r is an incrementing minor revision number beginning at 0.

5.3 Configuration Procedures

The software will be maintained using Visual Source Safe by Microsoft. The software will reside on the personal computer ADRIANA (in Room A108, Bldg 189, SWRI) located in directory D:\DStead\PCSA Tool.

5.3.1 Check-in/check-out Procedures

Software under development will be checked out of the repository into a developer directory for modification. Modified files will be checked back into and newly created files will be added to the repository under the following conditions:

- As needed to provide other developers with the latest set of changes,
- Periodically during development when new functionality is added,
- Upon completion of major tasks defined in the SDP, or
- Before major milestones.

When a file is checked in, the developer will generate comments describing the modification.

5.3.2 Creating Releases and Preparing For Deliveries

New releases of the software will be created at determined times during the project at the discretion of the developer. Procedure specified in TOP-18 for creating a new release will be followed.

5.3.3 Problem Reporting and Change Control

A Software Change Report (SCR) will be used to track problems, design changes, and enhancements to the software.

5.3.4 Backups

The project repository will be used to store the baseline configuration items during development. The following parameters apply to the configuration repository.

Project Files	
Host information:	Host name: ADRIANA Directory: D:\DStead\PCSA Tool
Backup media:	□ Compact Disk (CD) □ Iomega: Zip 250 □ Iomega: Jaz 2GB
Backup frequency:	□ Daily □ Weekly □ Other: As needed.
Automated backup tools:	□ Other:

6.0 REFERENCES

Benke, R., B. Dasgupta, B. Sagar and A.Chowhdury, "Methodology for Preclosure Risk Assessment for Geologic Nuclear Waste Repository", 6th International Conference on Probabilistic Safety Assessment and Management, Puerto Rico, June 23-28, 2002 (Accepted).

Cook, D. M., N.H. Marshall, E.S. Marwil, S.D. Matthews, and G.A. Mortensen, "Fortran Coding Guidelines", EG&G Idaho, Inc. EGG-CATT-8898 Idaho Falls, ID: U.S. Department of Energy, Idaho Operations Office February 1990.

Russel, K.D., C. L. Atwood, W. J. Galyean, M. B. Sattison, and D.M. Rasmuson. "Systems Analysis Programs for Hands-on Integrated Reliability Evaluations (SAPHIRE) Version 5.0,Technical Reference Manual". NUREG/CR-6616. Idaho Falls, ID: Idaho National Engineering Laboratory. 1993.

Wenzel, D. R. "The Radiological Safety Analysis Computer Program (RSAC-5) User's Manual". WINCO-1123, Revision 1. Idaho Falls, ID: Westinghouse Idaho Nuclear Company, Inc., Idaho National Engineering Laboratory. 1994.

U.S. Nuclear Regulatory Commission. "MELCOR Computer Code Manuals". NUREG/CR-6119, Revision 2. Washington, DC: U.S. Nuclear Regulatory Commission. October 2000.

7.0 APPENDICES

Visual Basic Programming Procedures, Processes and Metrics

APPROVED:

Signature of Element Manager

6-28-2002

Date

cc: QA
Element Manager
Principal Investigator

12/19

APPENDIX

Visual Basic Programming Procedures, Processes, and Metrics

13/19

1. OVERVIEW

The scope of this effort is coding in the MS Visual Basic (VB) coding style. The use of good VB style will encourage consistent layout. improve the portability, and consequently reduce the coding errors during the development of the software. Experience and good judgment should be used for those situations not covered by this procedure.

2. NAMING STANDARDS

The software will use a consistent naming convention for variables throughout coding process as specified in paragraph 6.1.2, *Variable Naming Conventions*. Using a consistent standard for naming components in the program will save a significant amount of time during the code development process, and during future maintenance work.

3. VARIABLES

Variable names are used frequently in the process of code development; most statements contain the name of at least one variable. Through the use of a consistent naming system for variables, the programmer will be able to minimize the amount of time spent tracking down the exact spelling of a variable's name.

By encoding some information about the variable itself into the variable name, the programmer can make it easier to decipher the meaning of any statement in which that variable is used, in addition to identifying errors that are otherwise difficult to find.

The attributes of a variable that are useful to encode into its name include its *scope* and its *data type* as outlined in the following paragraphs.

4. SCOPE

In VB, there are three scopes by which a variable may be defined. The three scopes include the following.

a. If defined within the procedure, the variable is local to that procedure.

b. If defined in the general declarations area of a form or module, then that variable can be referenced from all procedures in that form or module, and is said to have *module scope*.

c. If it is defined with Public keyword, then it is global to the application.

5. DATA TYPE

VB supports an assortment of data types. By encoding the type of variable in its name, the programmer can visually check that the assignment to that variable is credible. This helps the programmer to identify an error quickly.

Encoding the data type into the variable name has another benefit: the capability to reuse data names. If the programmer needs to store the start date in both a string and a double, then the same root name for both variables can be used. The start date is always the StartDate; it takes on a different tag to distinguish the different formats in which it is stored.

6. FILE ORGANIZATION

Procedures and functions within form files shall be separated by several blank lines. A header description for each procedure and function will be provided where applicable.

6.1 File Naming Conventions

File names are made up of a base name, function name, and a period and extension. File names must follow the MS DOS *8 dot 3* convention. Supporting file structures are automatically generated.

<BASE NAME><FUNCTION>.<EXTENSION>

The categories of files are as follows:

a. Executable files – ***exe***
b. Microsoft Access 97 Database files – ***mdb***
c. Dynamic Link Library files – ***dll***
d. Help files – ***hlp***
e. Microsoft Windows INI files – ***ini***
f. Microsoft Windows Bit Map files – ***bmp***
g. Backup files – ***bak***
h. Microsoft Word 97 files – ***doc***
i. Temporary files – ***tmp***
j. Table of Contents files – ***cnt***
k. Microsoft Windows Program Information files - ***pif***

The following are examples of file names:

a. **FORM** = ***frm1553T.frm***

b. **.BAS** = ***globals.bas***

c. **MS Access Database** = ***session.mdb***

6.1.1 Object Naming Conventions

Table 6-1 defines the object naming conventions used in code development.

15/19

Table 6-1. Object Name Conventions

Object	Prefix	Comment
Checkbox	chk	
Combo box	cbo	
Command Button	cmd	
Common dialog box	cmdlg	
Communications	com	
Data	dat	
Directory List box	dir	
Drive List Box	drv	
File list box	fil	
Frame	fra	
Group Push Button	gpb	
Horizontal Scroll bar	hsb	
Image	img	
Label	lbl	
List Box	lst	
List View	lsv	
Mask Edit Box	meb	
MDI Form	mdifrm	
Menu	mnu	
MSFlexgrid	fgrd	
Option button	opt	
Panel	pan	
Picture Box	pic	
Progress Bar	prb	
SS Frame	ssf	
SS Tab	sst	
Status Bar	stb	
Tab Pages	tab	
Tab Strip	tbs	
Text Box	txt	
Timer	tmr	
Tool Bar	tlb	
Tree View	trv	
True DBGrid	tdbg	Apex software
True Grid VBX	tdgrd	Apex software
Vertical scroll bar	vsb	

6.1.2 Variable Naming Conventions

Table 6-2 defines the Variable Naming Conventions used in code development.

Table 6-2. Variable Naming Conventions

Type	Prefix	Comments
Static	sta	staiInitialize
Constant	con	consName
Variant	var	
Integer	i	

Type	Prefix	Comments
Long	l	
Single	f	
Double	d	
Currency	cur	
String	s	
Byte	by	
Boolean	b	
Date	da	
Object	obj	
Global (Public)	glb	glbiArrayCounter
Function or Subroutine	fn	fnCheckCommPort
Array	ary	
Database	db	
Recordset	rec	
Workspace	ws	

Notes:

1. Variables i, j, k, l, m, and n will be reserved to be integers and used in places where their value is unambiguous:

```
For I = 1 to iArrayLength
        sReceiveData(I) = "&H"+ sTemp
next I
```

2. All variables will be defined and at the beginning of each form, subroutine or event.

6.2 Program Files

Program files describe the contents of a particular file. A description of the purpose of the objects in the files (whether they are functions, external data declarations or definitions, or other) is more useful than a list of the object names. The program files may optionally contain author(s), revision control information, or references.

6.3 Other Files

An example is *rcvb5.ini* file, which might initialize the RS-232 communication ports and identify the operating system or contain paths to bitmaps.

6.4 Comments

The comments should describe *what* is happening, *how* it is being done, *what the* parameters mean, *which* globals are used or modified, and any restrictions or bugs. Comments that are clear from the code should be avoided due to the information becoming outdated. Comments that disagree with the code are of no value. Short comments should be *what* comments, such as "compute mean value," rather than *how* comments such as "sum of values divided by n." Comments that describe data structures, algorithms, etc., should be in block comment form.

17/19

6.4.1 Standard Structure for a Form (Used in Load event)

The following outline illustrates the standard structure for a *Form (used in Load event)*.

```
'*************************************************************************************
'
'   SOUTHWEST RESEARCH INSTITUTE
'
'*************************************************************************************
'
' FILE TYPE   : Form
'
' FILE NAME   : frmSigMon.frm
'
' FILE USE    :
'
'    This file communicates through the RS232 Port to the LASTE to
'    Provide real time feed back of signal states on the A-10.
'
'   DESCRIPTION :
'
'   Data from the LASTE is queried by this form.
'
'(1) First a Control Y (Chr$(25)) is sent.  The expected response is (in hex):  0D0D0A3E3E.
'
'(2) LASTE is then asked for data on each signal.  The query format is:
'    MRP XXXXCR  where XXXX is the signal address and CR is a carriage return.
'
'(3) LASTE then responds with a 26 character data string.  Characters 17, 18, 19 and 20 hold the
'    signal values.
'
'   MODIFICATION HISTORY
'
'   Date          Engineer              Reason
'
' 11-13-96    Ima Engineer              Created
' 12-12-96    Vendela Kirsebom          Changed GUI interface
'*************************************************************************************

'******************************Variable Definition***************************************
Dim iLengthString As Integer
Dim sCR As String 'Carriage Return
Dim sLF As String 'Line Feed
Dim sLASTETermination As String
Dim cString As String
Dim i, j, k As Integer
Dim sControlY As String
Dim sReceiveStr As String
Dim sSendCommand(4) As String 'LASTE query

'******* Error Trapping *******

On Error GoTo frmLASTEFunctionsErrorHandler
```

```
<Body of Program >

Exit Sub

frmLASTEFunctionsErrorHandler:

Select Case Err.Number
   Case 55
      MsgBox ("File Already Open")
   Case 53 'File does not exist
      MsgBox ("Otp.ini does not exist in C:\Windows - ending program")
      End
   Case Else
      MsgBox ("Error is: " & Err.Number)
      End ' End Program
End Select
Resume Next
End Sub
```

6.4.2 Object Structure

The following outline defines the Object Structure (buttons, subroutines, etc.) used in the development of code.

```
'*****************************************************************************************************
' USE   :

'  The event allows the user to cancel the RS232 communications.
'
'  DESCRIPTION :
'
'  When the user presses the Cancel command button a global flag (glbbyteStopFlag) is set
'  True.  The main form (frmSignalMonitor) periodically checks the state of the flag.  If the flag is
'  True then the form is unloaded and the MDI form (mdifrmSignalMonitor) is displayed.
'
'  HISTORY
;
' Date          Engineer                  Reason
'
' 11-13-96     Ima Engineer Jr.          Created
' 12-12-96     Vendela Kirsebom          Changed GUI interface
'*****************************************************************************************
'
'******************************Variable Definition***************************************
Dim sTempString as string 'Used for cache

'******* Error Trapping *******
On Error GoTo cmdCancelErrorHandler

<Body of routine >

Exit Sub

cmdCancelErrorHandler:

Select Case Err.Number
   Case 55
```

```
        MsgBox ("File Already Open")
    Case 53 'File does not exist
        MsgBox ("Otp.ini does not exist in C:\Windows - ending program")
        End
    Case Else
        MsgBox ("Error is: " & Err.Number)
        End ' End Program
End Select
Resume Next
End Sub
```

6.5 Declarations

Global declarations should be placed in *globals.bas* if they are used by multiple forms; otherwise, they should be placed in the *declaration section* of the form.

6.6 Function Declarations

Function declarations should be placed in descriptive VB modules using the file naming convention of XXX.bas (i.e. BusMon.bas) if they are used by multiple forms; otherwise, they should be placed in the *function declaration section* of the form.

7. METRICS

Software performance will be defined using the following criteria:

a. User feedback
b. I/O performance (i.e. fast enough to meet RS-232 communications)

Since software performance is subjective, use the previous versions of software (where applicable) as the baseline for performance and will produce a product that consists of similar performance characteristics. However, the final performance criteria will be left up to the User.