21
300

R

GUSTAVO CRAGNOLINO

[signature]

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Pages 1 Through 4 Are Intentionally Left Blank

Brine Formation on Container Surface Sensitivity Analysis - Gustavo Cragnolino

Rationale

Aqueous corrosion is one of the chemical degradation processes that may lead to waste package failure. Water films on the metal surfaces will contain a variety of components, including chloride and other soluble anionic species. Chloride ions are known to promote localized corrosion and enhance general corrosion of container materials. Evaporation of water contacting the waste package could lead to increasing chloride concentrations and eventually to brine formation on the outer overpack surface enhancing the susceptibility of both the outer and inner containers to localized corrosion .

Approach

To determine the possible effect of high chloride concentrations on dose, calculations will be made using the EBSFAIL module of TPA 3.X. Waste package corrosion depends on the corrosion potential and the critical potential required to initiate localized corrosion. In EBSFAIL, the critical potential, conservatively represented by the repassivation potential, is assumed to depend only on chloride concentration and temperature. For a given temperature, localized corrosion only occurs above a critical chloride concentration, $[Cl^-]_{crit}$.

Two cases will be considered:

1) chloride concentrations below $[Cl^-]_{crit}$ for localized (pitting) corrosion

2) chloride concentrations above $[Cl^-]_{crit}$, for localized (pitting) corrosion

This study will be subject to modification as we proceed.

Parameters and Ranges

These analyses will be conducted with no disruptive scenarios (i.e., no volcanism, faulting, or seismicity). Seven repository subareas will be used. Twenty radionuclides, corresponding to 16 elements, will be used (Cm-246, U-238, Cm-245, Am-241, Np-237, Am-243, Pu-239, Pu-240, U-234, Th-230, Ra-226, Pb-210, Cs-135, I-129, Tc-99, Ni-59, C-14, Se-79, Nb-94, Cl-36).

These analyses will consider an areal mass loading 83 MTU/acre to define the temperature and relative humidity evolution with time.

Table 1. Selected Corrosion Parameters for EBSFAIL

CritChlorideConcForOuterOverpack	constant	3.0e-4 mol/L
CritChlorideConcForInnerOverpack	constant	2.0e-3 mol/L
AboveBoilingChlorideConcentration	constant	6.7 mol/L
BelowBoilingChlorideConcentration	uniform	0.003 to 6.7 mol/L

For other parameters, TPA Base Case values and ranges will be adopted.

References and/or Justification for Parameters and Ranges

The parameters "AboveBoilingChlorideConcentration" and "BelowBoilingChlorideConcentration" are selected to be consistent with values adopted by the CLST KTI. These values are based on CLST meetings on 4/3/97 and 4/8/97 and use the saturation limit of 6.7 mol/L for NaCl. The critical chloride concentrations will be those determined by CNWRA experiments and literature data on A516 steel and Alloy 825 and calculated to be appropriate for an 83 MTU/acre thermal loading.

The version of the TPA Code to be used is 3.1β [illegible]
Attached are the instructions for running the code.
A series of preliminary runs will be performed to attain familiarity with the code, while changes in the 3.1β version are made.

[illegible signature]
8/19/97

INITIAL SET UP FOR RUNNING TPA 3.1

The user needs to have an account on a SUN workstation that has Solaris operating system.

ENVIRONMENT SETUP

The set up for running the TPA code has been revised to add flexibility for data input. Now you can modify input data in the subdirectory "data" in addition to changing tpa.inp. You must not change "data" unless you know well enough about the files in this directory.

Open the file named ".cshrc.local" from your home directory using vi or any such editor. Add the following line:

```
setenv TPA (homedirectory)/TPARUN
```

Example:

```
setenv TPA /bscr3/mohanty/TPARUN
```

Note that TPARUN is just the name of the directory from which you want to run the TPA code. Therefore, you do not have to use the name TPARUN. You can use a name of your choice. After you save changes to this file, enter the following command at the prompt:

```
source .cshrc
```

Ask the IMS group if you are unable to modify or can not find the file ".cshrc.local". You can use echo command as shown below:

```
echo $TPA
```

to see if the environemnt us set correctly. If it is set correctly, you will get the following response:

```
/(name of your home directory)/TPARUN
```

LOADING BASIC FILES TO THE USER'S WORK SPACE

telnet from your pc to the SUN workstation that you have access. For example:

```
telnet sebastian
username: jdoe
password: *********

mkdir TPARUN
cd TPARUN
cp /solapps/cnwra/tpa/tpa.inp.master tpa.inp
cp /solapps/cnwra/tpa/tpanames.dbs .
mkdir data
cd data
cp /solapps/cnwra/tpa/data/* .
cd ..
```

Now the tpa.inp file is yours to change. Use vi editor, or any text editor on the SUN work station, or ftp the file to your PC/MAC to modify and ftp the file back to TPARUN.

8/20/97

DETERMINATION OF WASTE PACKAGE FAILURE

Initial run (1 realization) up to 20,000 yr simulation time 10:40 am

Run # 001

WP failure	Subareas Sub 1	Sub 2	Sub 3	Sub 4	Sub 5	Sub 6	Sub 7
Initial failure #	2	2	1	1	1	1	0
year	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic #	18	20	9	5	7	8	3
year	612.3	612.3	612.3	612.3	612.3	612.3	612.3
Volcanic #	16	0	13	0	13	0	0
year	1708.8	—	1708.8	—	1708.8	—	—
Corrosion #	1808	1937	924	517	704	804	305
year	19,538	19,538	19,538	19,538	19,086.5	19,538	19,086.5
Total WPs	1844	1959	947	523	725	818	308

Additional observations:

1) Total # of WPs: 7124
2) Main contributions to release are from Pu 239 and TC 99. Typical values are

Sub 5	Pu 239	1.71×10^{-2} Ci/yr/SA	@ 20,000 yr
	Tc 99	1.49×10^{-2} Ci/yr/SA	
Sub 6	Pu 239	1.87×10^{-2} Ci/yr/SA	@ 20,000 yr
	Tc 99	1.76×10^{-2} Ci/yr/SA	
Sub 7	Pu 239	6.799×10^{-3} Ci/yr/SA	@ 20,000 yr
	Tc 99	5.92×10^{-3} Ci/yr/SA	

2:30 pm

Run # 002

Simulation time: 20,000 yr

Number of realizations: 3

Realization # 1

WP failure	SA 1	SA 2	SA 3	SA 4	SA 5	SA 6	SA 7
Initial failure #	2	2	1	1	1	1	0
year	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic #	18	20	9	5	7	8	3
year	612.3	612.3	612.3	612.3	612.3	612.3	612.3
Volcanic #	16	0	13	0	13	0	0
year	1708.8	—	1708.8	—	1708.8	—	—
Corrosion #	1808	1937	924	517	704	809	305
yr	19,538	19,538	19,538	19,538	19,086.5	19,538.8	19,086.5
Total WPs	1844	1959	947	523	725	818	308
Release (Ci/yr/SA) @ 20,000 yr Tc 99	4.36×10^{-2}	4.70×10^{-2}	2.30×10^{-2}	1.20×10^{-2}	1.71×10^{-2}	?	?
Pu 239	3.97×10^{-2}	4.22×10^{-2}	2.38×10^{-2}	1.11×10^{-2}	1.49×10^{-2}	1.87×10^{-2}	?

Realization # 2

WP failure	SA 1	SA 2	SA 3	SA 4	SA 5	SA 6	SA 7
Initial failure #	4	4				2	1
yr	0.0	0.0				0.0	0.0
Seismic #	18	20					3
yr	19.1	19.1					19.1
Volcanic #	0	0					0
yr	—	—					—
Corrosion #	1822	0					304
yr	19,538	—					19,086.5
Total WP	1844	24					308

Incomplete data; for SA 2 release from EBSREL ~~Pu239 2.29~~ [illegible] is very low as expected

Realization #3

WP failure	SA 1	SA 2	SA 3	SA 4	SA 5	SA 6	SA 7
Initial #	13	14					
yr	0.0	0.0					
Seismic #	18	19					
yr	778	777					
Volcanic #	0	0					
yr	—	—					
Corrosion #	1813	1926					
yr	12,226	12,226					
Total WPs	1844	1959					

RUN INTERRUPTED

Incomplete data; run interrupted running SA 3

Message: "The system detected an internal processing error at location ## 0160:fff54c8c-00d:ac8c 60p00, 9084 04860064 Internal revision 9.024, 96/11/07"

Release from EBSREL in SA 2

Pu 239	2.29 Ci/yr/SA	@ 20,000 yr
Pu 240	8.15×10^{-1} Ci/yr/SA	@ 19,540 yr
Tc 99	7.44×10^{-1} Ci/yr/SA	@ 12,814 yr

High peak release of Tc 99 at ~ 13,000 yr.

J Iacofuolino 8/20/97

8/22/97

INPUT FILES FOR EBSFAIL AND EBSREL MODULES USED IN TPA RUNS

The following input parameters were used:

TPA Version 3.1β3

INPUT FILES FOR EBSFAIL AND EBSREL 8/22/97
MODULES USED IN TPA RUNS

pcl5

JOB 626

gustavo.inp

For: **bigbend!mohanty**
Date: **Fri Aug 22 11:41:56 CDT 1997**

Submit queue: IF 1 / Ethernet / UHSW
Submitted: Sun Jun 29 03:54:25 1992
Started: Sun Jun 29 03:54:25 1992

QMS
QMS 3825 Print System

QMS 3825 Print System

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INPUT FILES FOR EBSFAIL AND EBSREL MODULES USED IN TPA RUNS 8/22/97

```
---->>> EBSFAIL <<<****
**
constant
OuterWPThickness[m]
0.1
**
constant
InnerWPThickness[m]
0.02
**
constant
MetalGrainRadius[micrometer]
5.0
**
constant
GrainBoundaryThickness[micrometer]
0.0007
**
constant
DryOxidationConstant
0.00001
**
uniform
CriticalRelativeHumidityHumidAirCorrosion
0.55, 0.65
**
uniform
CriticalRelativeHumidityAqueousCorrosion
0.75, 0.85
**
constant
ThicknessOfWaterFilm[m]
0.002
**
constant
BoilingPointOfWater[C]
97.0
**
constant
OuterOverpackErpIntercept
-620.3
**
constant
TempCoefOfOuterPackErpIntercept
0.47
**
constant
OuterOverpackErpSlope
-95.2
**
constant
TempCoefOfOuterPackErpSlope
0.88
**
constant
InnerOverpackErpIntercept
422.8
**
constant
TempCoefOfInnerPackErpIntercept
```

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INPUT FILES FOR EBSFAIL AND EBSREL MODULES USED IN TPA RUNS 8/22/97

```
-4.1
**
constant
InnerOverpackErpSlope
-64.0
**
constant
TempCoefOfInnerPackErpSlope
-0.80
**
constant
OuterWPBetaKineticsParameterforOxygen
0.75
**
constant
OuterWPBetaKineticsParameterforWater
0.50
**
constant
InnerWPBetaKineticsParameterforOxygen
0.75
**
constant
InnerWPBetaKineticsParameterforWater
0.50
**
constant
OuterWPRateConstantforOxygenReduction[coulomb m/mole/yr]
3.8e12
**
constant
OuterWPRateConstantforWaterReduction[coulomb m/m^2/yr]
1.6e-1
**
constant
OuterWPActivationEnergyforOxygenReduction[J/mole]
37300.0
**
constant
OuterWPActivationEnergyforWaterReduction[J/mole]
25000.0
**
constant
InnerWPRateConstantforOxygenReduction[coulomb m/mole/yr]
3.0e10
**
constant
InnerWPRateConstantforWaterReduction[coulomb m/m^2/yr]
3.2
**
constant
InnerWPActivationEnergyforOxygenReduction[J/mole]
40000.0
**
constant
InnerWPActivationEnergyforWaterReduction[J/mole]
25000.0
**
constant
AA_1_1[C/m2/yr]
```

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INPUT FILES FOR EBSFAIL AND EBSREL MODULES USED IN TPA RUNS 8/22/97

```
3.15e5
**
constant
AA_2_1[C/m2/yr]
6.30e4
**
constant
MeasuredGalvanicCouplePotential
-0.46
**
constant
CoefForLocCorrOfOuterOverpack
8.66e-3
**
constant
ExponetForLocCorrOfOuterOverpack
0.45
**
constant
HumidAirCorrosionRate[m/yr]
1.16e-5
**
constant
LocalizedCorrRateOfInnerOverpack[m/yr]
2.5e-4
**
uniform
FractionalCouplingStrength
0.0, 0.4
**
constant
FactorForDefiningChoiceOfCritPotential
0.0
**
constant
CritChlorideConcForFirstLayer[moL/L]
3.0e-4
**
constant
CritChlorideConcForSecondLayer[moL/L]
2.0e-3
**
loguniform
ChlorideMultFactor
1.0, 100.0
**
constant
ReferencepH
9.0       Do not change
**
constant
WPsurfaceScaleThickness[m]
0.0     1.5e-3
**
constant
TortuosityOfScaleonWP
1.0       Do not change
**
constant
PorosityOfScaleonWP
```

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INPUT FILES FOR EBSFAIL AND EBSREL MODULES USED IN TPA RUNS 8/22/97

```
1.0       Do not change
**
constant
YieldStrength[MPa]
205.0
**
constant
SafetyFactor
1.4
**
constant
FractureToughness[MPa-m**0.5]
250.0
**
**          ***>>>  EBSREL  <<<***
**
constant
FowFactor
0.3
**
constant
FmultFactor
1.0
**
constant
SubAreaWetFraction
1.0
**
constant
DefectiveFractionOfWPs/cell
0.10
**
** \WP information
constant
WPInternalVolume[m3]
4.83
**
** \Thermal data
** 'temphumd.dat'     ! temfil: temp. file (output from ebspac_fail.f)
constant
FlowOnsetTemperature[C]
97.                  ! set a large number (999.) to start flow at time=0 yr
**
** \Flow parameters
** \'floebs.dat'     ! hydfil: flow parameters file
** \SF  materials
constant
SFMassPerWP[kg]
2800.
**
constant
SFMolecularWeight
250.
**
constant
SFDensity[kg/m3]
10600.
**
iconstant
SurfaceAreaModel
```

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INPUT FILES FOR EBSFAIL AND EBSREL MODULES USED IN TPA RUNS 8/22/97

```
 1
 ** \Fuel leaching
 iconstant
 IModel
 2
 **
 constant
 PhValue
 9.0
 **
 constant
 OxygenPartialPressure[atm]
 0.2
 **
 constant
 NegativeLog10CarbonateConcentration[mol/L]
 2.69897
 **
 constant
 UserLeachRate[kg/yr/m2]
 .003        ! used only when imodel = 3
 **
 constant
 SFWettedFraction
 5.e-1
 **
 ** \ Radionuclide inventory
 ** 'ebspac.nuc'              ! elefil: nuclide names, halflife,inventory
 **
 constant
 RD_backfill_Cm
 100.
 **
 constant
 RD_backfill_Pu
 100.
 **
 constant
 RD_backfill_U
 2.
 **
 constant
 RD_backfill_Am
 200.
 **
 constant
 RD_backfill_Np
 50.
 **
 constant
 RD_backfill_Th
 100.
 **
 constant
 RD_backfill_Ra
 30.
 **
 constant
 RD_backfill_Pb
 20.
```

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INPUT FILES FOR EBSFAIL AND EBSREL 8/22/97
MODULES USED IN TPA RUNS

```
**
constant
RD_backfill_Cs
200.
**
constant
RD_backfill_I
1.0
**
constant
RD_backfill_Tc
1.0
**
constant
RD_backfill_Ni
2.0
**
constant
RD_backfill_Cl
1.0
**
constant
RD_backfill_C
1.0
**
constant
RD_backfill_Se
1.0
**
constant
RD_backfill_Nb
20.
**
constant
GapFractionForCM246
0.0
**
constant
GapFractionForU238
0.0
**
constant
GapFractionForCM245
0.0
**
constant
GapFractionForAM241
0.0
**
constant
GapFractionForNP237
0.0
**
constant
GapFractionForAM243
0.0
**
constant
GapFractionForPU239
0.0
```

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INPUT FILES FOR EBSFAIL AND EBSREL MODULES USED IN TPA RUNS 8/22/97

```
**
constant
GapFractionForPU240
0.0
**
constant
GapFractionForU234
0.0
**
constant
GapFractionForTH230
0.0
**
constant
GapFractionForRA226
0.0
**
constant
GapFractionForPB210
0.0
**
**constant
**GapFractionForCS137
**0.0
**
constant
GapFractionForCS135
0.0
**
constant
GapFractionForI129
0.0
**
constant
GapFractionForTC99
0.0
**
constant
GapFractionForNI59
0.0
**
constant
GapFractionForCL36
0.0
**
constant
GapFractionForC14
0.0
**
constant
GapFractionForSE79
0.0
**
constant
GapFractionForNB94
0.0
**
** \C-14 generation
constant
InitialRadiusOfSFParticle[m]
```

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8/22/97
INPUT FILES FOR EBSFAIL AND EBSREL
MODULES USED IN TPA RUNS

```
0.5e-3
**
constant
RadiusOfSFGrain[m]
1.e-5
**
constant
SubGrainFragmentRadiusAfterTransFrac[m]
1.e-6
**
constant
ThicknessOfCladding[m]
6.1e-4
**
constant
SFC-14InventoryPerKgSF[ci]
7.2e-4
**
constant
CladC-14InventoryPerKgSF[ci]
4.89e-4
**
constant
ZyrOxideAndCrudC-14InvPerKgSF[ci]
2.48e-5
**
constant
GapAndGrainBoundaryInventoryPerKgSF[ci]
6.2e-6
**
constant
FractionOfFlowHittingWP
0.05
**
** Solubility PDFs based on review of literature by
**  R. Pabalan & D. Turner summarized in 10/18/96 memo
**
uniform
SolubilityAm[kg/m3]
2.4e-8, 2.4e-4
**
triangular
SolubilityNp[kg/m3]
1.2e-3, 3.4e-2, 2.4e-0
**
constant
Solubility_I[kg/m3]
1.29e2
**
constant
SolubilityTc[kg/m3]
9.9e1
**
constant
SolubilityCl[kg/m3]
3.6e1
**
constant
Solubility_C[kg/m3]
1.4e1
```

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8/22/97

INPUT FILES FOR EBSFAIL AND EBSREL MODULES USED IN TPA RUNS

```
**
triangular
Solubility_U[kg/m3]
2.4e-6  7.6e-3  2.4e0
**
uniform
SolubilityCm[kg/m3]
2.4e-8  2.4e-4
**
uniform
SolubilityPu[kg/m3]
2.4e-6  2.4e-4
**
loguniform
SolubilityTh[kg/m3]
2.3e-7  2.3e-1
**
triangular
SolubilityRa[kg/m3]
2.3e-7  2.3e-5  2.3e-3
**
triangular
SolubilityPb[kg/m3]
2.1e-6  6.6e-5  2.1e-3
**
constant
SolubilityCs[kg/m3]
1.35e2
**
triangular
SolubilityNi[kg/m3]
5.9e-5  1.1e-1  5.9e0
**
constant
SolubilitySe[kg/m3]
7.9e1
**
loguniform
SolubilityNb[kg/m3]
9.3e-8  9.3e-6
**
constant
FractionOfWaterIntoWP
0.9
**
constant
FlowMultiplicationFactor
1.0
**
**              ***>>>  UZFT  <<<***
endoffile
```

```
\example input file for ebsfail
|
\simulation time
  20000.00                        ! tend: simulation time leng
\                                 ! when iflag=1 (defined later)
\
 5.6820  1.8020                   ! wplen,wpdia: wp length and
 0.1000E+00  0.2000E-01           ! cthick1,cthick2: wp layers
|
\choose source of temperature data
2, 1                              ! iflag(1:emp.equation,2:tab
1                                 ! nset (temp.-rel hum. relationship to use
49.9999999                        ! timintv (used when iflag=2)
|
\other temperature parameters
0.                                ! age of fuel (not used in this version)
|
\Dry oxidation of wp outer overpack
 0.1565E+02                       ! grainr: metal grain radius
25                                ! nseries (terms in the infi
 0.8987E-03                       ! gbthick [micrometer]
 0.1000E-04                       ! constant1: used in the dry
|
\evaporation-condensation
 0.5280E+00   0.7948E+00          ! humdc1, humdc2: crit. rel.
 0.2471E-02                       ! filmthk: thickness of wate
 0.9700E+02                       ! ctemp: boiling point of wa
|
\Corrosion Parameters(Ep: pitting potential [mVshe]; Erp: re
-584.8                            ! xipto: outer overpack Ep i
3.92                              ! pttemo: temp. coef. of out
-24.5                             ! slpto: outer overpack Ep s
-1.1                              ! slpttemo: temp. coef. of o
-0.6203E+03                       ! xirpo: outer overpack Erp
 0.4700E+00                       ! rptemo: temp. coef. of out
-0.9520E+02                       ! slrpo: outer overpack Erp
 0.8800E+00                       ! slrptemo: temp. coef. of o
200.                              ! xipti: inner overpack Ep i
0.                                ! pttemi: temp. coef. of inn
-240.                             ! slpti: inner overpack Ep s
0.                                ! slpttemi: temp. coef. of i
 0.4228E+03                       ! xirpi: inner overpack Erp
-0.4100E+01                       ! rptemi: temp. coef. of inn
-0.6400E+02                       ! slrpi: inner overpack Erp
-0.8000E+00                       ! slrptemi: temp. coef. of i
 0.6276E+00  0.4442E+00           ! betaox1, betahy1: beta kin
\                                   for oxygen and water for WP outer overpack
 0.9708E+00  0.5642E+00           ! betaox2, betahy2: beta kin
\                                   oxygen and water for WP inner overpack
 0.5707E+12  0.3399E-03           ! rkox1 [c*m/y/mol], rkhy1 [
 0.4162E+05  0.2580E+05           ! gox1 [J/mol], ghy1 [J/mol]
 0.3777E+12  0.9579E+03           ! rkox2 [c*m/y/m], rkhy2 [c/
 0.4400E+05  0.2781E+05           ! gox2 [J/mol], ghy2 [J/mol]
 0.3150E+06  0.0   0.0            ! aa(1,1) [C/m2/yr], aa(1,2)
 0.6300E+05  0.0   0.0            ! aa(2,1) [C/m2/yr], aa(2,2)
-0.4600E+00                       ! eexpt: measured galvanic c
 0.8660E-02                       ! rcoef: coef. for loc. corr
 0.4500E+00                       ! rexpont: exponet for loc.
 0.1160E-04   0.2500E-03          ! cratehac:humd.air corr.rt.
 0.0000E+00                       ! xcouple, efficiency of gal
```


8/25/97

Several runs will be performed to evaluate the CORROSE.OUT output file. Minor modifications in the input parameters. Simulations as before will be for 20,000 yr and a single realization. EBSFAIL V 3.1β4 will be used in these runs.

```
 0.0000E+00                       ! xread: factor for defining
3.e-1                             ! clconc: chloride conc. [mo
 0.3000E-03                       ! clcrit1: crit. chloride co
 0.2000E-02                       ! clcrit2: crit. chloride co
 0.1000E+01                       ! cfactor: factor for changi
 0.3741E-05  0.9000E+01           ! xgas: oxygen part.pr.[atm]
 0.0000E+00  0.1000E+01  0.1000E+01 althk: scale thick;taus:
|
\Mechanical failure data
 0.2050E+03  0.1400E+01           ! yieldstr: yield strength [
 0.2500E+03                       ! dkic: fracture toughness [
|
\Runge-kutta control parameters
1.e-3, 1.e0                       ! dtini, dtmax
1.e-2, 1.e-30                     ! errrel (same as eps), errabs (same as tin
|
\end
```

8/25/97

Several runs will be performed to evaluate the CORRODE.OUT output file. Minor modifications in input parameters. Simulation as before will be run for 20,000 yr and a single realization.
EBSFAIL V3.1β4 will be used in these runs.

ebs

RUN #003

ebspac (engineering barrier system performance assessment code)
this is the part of the code that computes wp failure time
version= 1.0
Mon Aug 25 12:28:25 1997
iflagtpa= 1
nhist3= 201
nhist= 201

calculation of waste package failure time

end of simulation time [yr]: 20000.
no. of rows of data to pass to release.f: 201

ilayer	tstop [yr]	tcan [c]	ecrit [vshe]	ecorr [vshe]	chloride flag	rthick [m]	mode
1	4.62	103.73	0.0000	0.0000	0	1.1999625E-01	dry oxd
1	9.35	117.83	0.0000	0.0000	0	1.1999250E-01	dry oxd
1	14.19	127.40	0.0000	0.0000	0	1.1998875E-01	dry oxd
1	19.14	134.03	0.0000	0.0000	0	1.1998500E-01	dry oxd
1	24.21	139.01	0.0000	0.0000	0	1.1998125E-01	dry oxd
1	29.40	142.54	0.0000	0.0000	0	1.1997750E-01	dry oxd
1	34.70	145.20	0.0000	0.0000	0	1.1997374E-01	dry oxd
1	40.14	147.03	0.0000	0.0000	0	1.1996999E-01	dry oxd
1	45.70	148.31	0.0000	0.0000	0	1.1996624E-01	dry oxd
1	51.39	149.10	0.0000	0.0000	0	1.1996249E-01	dry oxd
1	57.21	149.53	0.0000	0.0000	0	1.1995874E-01	dry oxd
1	63.17	149.64	0.0000	0.0000	0	1.1995498E-01	dry oxd
1	69.27	149.55	0.0000	0.0000	0	1.1995123E-01	dry oxd
1	75.51	149.37	0.0000	0.0000	0	1.1994748E-01	dry oxd
1	81.90	149.18	0.0000	0.0000	0	1.1994373E-01	dry oxd
1	88.44	148.91	0.0000	0.0000	0	1.1993997E-01	dry oxd
1	95.13	148.59	0.0000	0.0000	0	1.1993622E-01	dry oxd
1	101.98	197.61	0.0000	0.0000	0	1.1993212E-01	dry oxd
1	108.98	195.01	0.0000	0.0000	0	1.1992808E-01	dry oxd
1	116.16	192.53	0.0000	0.0000	0	1.1992410E-01	dry oxd
1	123.49	190.15	0.0000	0.0000	0	1.1992016E-01	dry oxd
1	131.01	187.87	0.0000	0.0000	0	1.1991626E-01	dry oxd
1	138.69	185.71	0.0000	0.0000	0	1.1991237E-01	dry oxd
1	146.56	183.64	0.0000	0.0000	0	1.1990851E-01	dry oxd
1	154.61	181.63	0.0000	0.0000	0	1.1990467E-01	dry oxd
1	162.85	179.65	0.0000	0.0000	0	1.1990084E-01	dry oxd
1	171.29	177.74	0.0000	0.0000	0	1.1989703E-01	dry oxd
1	179.92	176.24	0.0000	0.0000	0	1.1989322E-01	dry oxd
1	188.75	175.00	0.0000	0.0000	0	1.1988942E-01	dry oxd
1	197.79	173.86	0.0000	0.0000	0	1.1988562E-01	dry oxd
1	207.04	172.73	0.0000	0.0000	0	1.1988182E-01	dry oxd
1	216.51	171.69	0.0000	0.0000	0	1.1987803E-01	dry oxd
1	226.19	170.66	0.0000	0.0000	0	1.1987425E-01	dry oxd
1	236.11	169.64	0.0000	0.0000	0	1.1987046E-01	dry oxd
1	246.26	168.67	0.0000	0.0000	0	1.1986668E-01	dry oxd
1	256.64	167.78	0.0000	0.0000	0	1.1986290E-01	dry oxd
1	267.27	166.93	0.0000	0.0000	0	1.1985912E-01	dry oxd
1	278.15	166.11	0.0000	0.0000	0	1.1985535E-01	dry oxd
1	289.28	165.32	0.0000	0.0000	0	1.1985157E-01	dry oxd
1	300.68	164.54	0.0000	0.0000	0	1.1984780E-01	dry oxd
1	312.33	163.85	0.0000	0.0000	0	1.1984403E-01	dry oxd
1	324.27	163.18	0.0000	0.0000	0	1.1984026E-01	dry oxd
1	336.48	162.53	0.0000	0.0000	0	1.1983649E-01	dry oxd
1	348.98	161.87	0.0000	0.0000	0	1.1983272E-01	dry oxd
1	361.77	161.21	0.0000	0.0000	0	1.1982895E-01	dry oxd

1	374.86	160.54	0.0000	0.0000	0	1.1982518E-01	dry oxd
1	388.25	159.82	0.0000	0.0000	0	1.1982141E-01	dry oxd
1	401.96	159.10	0.0000	0.0000	0	1.1981765E-01	dry oxd
1	415.99	158.42	0.0000	0.0000	0	1.1981388E-01	dry oxd
1	430.35	157.78	0.0000	0.0000	0	1.1981012E-01	dry oxd
1	445.05	157.14	0.0000	0.0000	0	1.1980636E-01	dry oxd
1	460.09	156.50	0.0000	0.0000	0	1.1980259E-01	dry oxd
1	475.48	155.87	0.0000	0.0000	0	1.1979883E-01	dry oxd
1	491.23	155.13	0.0000	0.0000	0	1.1979507E-01	dry oxd
1	507.35	154.38	0.0000	0.0000	0	1.1979131E-01	dry oxd
1	523.85	153.57	0.0000	0.0000	0	1.1978755E-01	dry oxd
1	540.74	152.75	0.0000	0.0000	0	1.1978379E-01	dry oxd
1	558.02	151.94	0.0000	0.0000	0	1.1978003E-01	dry oxd
1	575.70	151.11	0.0000	0.0000	0	1.1977627E-01	dry oxd
1	593.80	150.27	0.0000	0.0000	0	1.1977251E-01	dry oxd
1	612.32	149.43	0.0000	0.0000	0	1.1976876E-01	dry oxd
1	631.28	148.67	0.0000	0.0000	0	1.1976500E-01	dry oxd
1	650.67	147.92	0.0000	0.0000	0	1.1976124E-01	dry oxd
1	670.53	147.13	0.0000	0.0000	0	1.1975749E-01	dry oxd
1	690.85	146.31	0.0000	0.0000	0	1.1975373E-01	dry oxd
1	711.64	145.50	0.0000	0.0000	0	1.1974998E-01	dry oxd
1	732.92	144.69	0.0000	0.0000	0	1.1974622E-01	dry oxd
1	754.70	143.89	0.0000	0.0000	0	1.1974247E-01	dry oxd
1	776.99	143.09	0.0000	0.0000	0	1.1973871E-01	dry oxd
1	799.80	142.28	0.0000	0.0000	0	1.1973496E-01	dry oxd
1	823.14	141.48	0.0000	0.0000	0	1.1973120E-01	dry oxd
1	847.04	140.62	0.0000	0.0000	0	1.1972745E-01	dry oxd
1	871.49	139.77	0.0000	0.0000	0	1.1972370E-01	dry oxd
1	896.51	138.90	0.0000	0.0000	0	1.1971994E-01	dry oxd
1	922.12	138.02	0.0000	0.0000	0	1.1971619E-01	dry oxd
1	948.33	137.15	0.0000	0.0000	0	1.1971244E-01	dry oxd
1	975.15	136.26	0.0000	0.0000	0	1.1970869E-01	dry oxd
1	1002.60	135.32	0.0000	0.0000	0	1.1970493E-01	dry oxd
1	1030.69	134.36	0.0000	0.0000	0	1.1970118E-01	dry oxd
1	1059.44	133.38	0.0000	0.0000	0	1.1969743E-01	dry oxd
1	1088.86	132.39	0.0000	0.0000	0	1.1969368E-01	dry oxd
1	1118.98	131.45	0.0000	0.0000	0	1.1968993E-01	dry oxd
1	1149.79	130.48	0.0000	0.0000	0	1.1968617E-01	dry oxd
1	1181.33	129.48	0.0000	0.0000	0	1.1968242E-01	dry oxd
1	1213.61	128.47	0.0000	0.0000	0	1.1967867E-01	dry oxd
1	1246.64	127.46	0.0000	0.0000	0	1.1967492E-01	dry oxd
1	1280.45	126.44	0.0000	0.0000	0	1.1967117E-01	dry oxd
1	1315.05	125.41	0.0000	0.0000	0	1.1966742E-01	dry oxd
1	1350.45	124.37	0.0000	0.0000	0	1.1966367E-01	dry oxd
1	1386.69	123.30	0.0000	0.0000	0	1.1965992E-01	dry oxd
1	1423.77	122.21	0.0000	0.0000	0	1.1965617E-01	dry oxd
1	1461.73	121.12	0.0000	0.0000	0	1.1965241E-01	dry oxd
1	1500.57	120.02	0.0000	0.0000	0	1.1964866E-01	dry oxd
1	1540.32	118.92	0.0000	0.0000	0	1.1964491E-01	dry oxd
1	1581.00	117.82	0.0000	0.0000	0	1.1964116E-01	dry oxd
1	1622.63	116.70	0.0000	0.0000	0	1.1963741E-01	dry oxd
1	1665.24	115.59	0.0000	0.0000	0	1.1963366E-01	dry oxd
1	1708.85	114.42	0.0000	0.0000	0	1.1912783E-01	dry oxd
1	1753.48	113.24	0.0000	0.0000	0	1.1861016E-01	dry oxd
1	1799.15	112.04	0.0000	0.0000	0	1.1808037E-01	dry oxd
1	1845.89	110.85	0.0000	0.0000	0	1.1753818E-01	dry oxd
1	1893.72	109.64	0.0000	0.0000	0	1.1698329E-01	dry oxd
1	1942.68	108.42	0.0000	0.0000	0	1.1641541E-01	dry oxd
1	1992.78	107.23	0.0000	0.0000	0	1.1583424E-01	dry oxd
1	2044.05	106.10	0.0000	0.0000	0	1.1523946E-01	dry oxd

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1      2096.53     104.98     0.0000     0.0000     0     1.1463075E-01  dry oxd
1      2150.23     103.88     0.0000     0.0000     0     1.1400780E-01  dry oxd
from mech. module: sfactor, yieldstr=     1.4000000000000     205.00000000000
from mech. module: dkic=     250.00000000000
1      2205.19     102.80    -0.5653     0.2066     1     6.1387850E-02  local
from mech. module: sfactor, yieldstr=     1.4000000000000     205.00000000000
from mech. module: dkic=     250.00000000000
1      2261.44     101.71    -0.5647     0.2058     1     4.1776017E-02  local
from mech. module: sfactor, yieldstr=     1.4000000000000     205.00000000000
from mech. module: dkic=     250.00000000000
1      2319.00     100.61    -0.5638     0.2047     1     2.6876188E-02  local
2      2377.91      99.50     0.2183     0.1436     1     1.9879298E-02  general
2      2438.20      98.42     0.2224     0.1428     1     1.9755770E-02  general
2      2499.91      97.34     0.2264     0.1421     1     1.9629350E-02  general
2      2563.05      96.26     0.2305     0.1413     1     1.9499971E-02  general
2      2627.68      95.20     0.2345     0.1406     1     1.9367563E-02  general
2      2693.82      94.15     0.2384     0.1399     1     1.9232055E-02  general
2      2761.50      93.10     0.2424     0.1391     1     1.9093374E-02  general
2      2830.77      92.10     0.2462     0.1384     1     1.8951447E-02  general
2      2901.66      91.10     0.2500     0.1377     1     1.8806197E-02  general
2      2974.22      90.09     0.2539     0.1370     1     1.8657546E-02  general
2      3048.47      89.11     0.2576     0.1363     1     1.8505415E-02  general
2      3124.46      88.16     0.2613     0.1357     1     1.8349723E-02  general
2      3202.23      87.22     0.2648     0.1350     1     1.8190386E-02  general
2      3281.81      86.31     0.2683     0.1344     1     1.8027318E-02  general
2      3363.27      85.41     0.2718     0.1338     1     1.7860433E-02  general
2      3446.63      84.51     0.2752     0.1332     1     1.7689641E-02  general
2      3531.94      83.63     0.2786     0.1326     1     1.7514850E-02  general
2      3619.24      82.80     0.2819     0.1320     1     1.7335967E-02  general
2      3708.60      81.97     0.2849     0.1314     1     1.7152897E-02  general
2      3800.04      81.15     0.2879     0.1309     1     1.6965540E-02  general
2      3893.62      80.33     0.2908     0.1303     1     1.6773797E-02  general
2      3989.40      79.53     0.2938     0.1297     1     1.6577565E-02  general
2      4087.42      78.73     0.2968     0.1292     1     1.6376739E-02  general
2      4187.73      77.95     0.2997     0.1287     1     1.6171212E-02  general
2      4290.39      77.20     0.3026     0.1282     1     1.5960873E-02  general
2      4395.46      76.46     0.3054     0.1276     1     1.5745609E-02  general
2      4502.98      75.73     0.3083     0.1272     1     1.5525306E-02  general
2      4613.02      75.00     0.3111     0.1267     1     1.5299845E-02  general
2      4725.64      74.31     0.3138     0.1262     1     1.5069106E-02  general
2      4840.89      73.62     0.3165     0.1257     1     1.4832965E-02  general
2      4958.85      72.95     0.3192     0.1253     1     1.4591295E-02  general
2      5079.56      72.27     0.3219     0.1248     1     1.4343968E-02  general
2      5203.10      71.60     0.3246     0.1244     1     1.4090850E-02  general
2      5329.53      70.95     0.3273     0.1239     1     1.3831807E-02  general
2      5458.92      70.30     0.3298     0.1235     1     1.3566699E-02  general
2      5591.34      69.65     0.3324     0.1230     1     1.3295384E-02  general
2      5726.87      69.02     0.3351     0.1226     1     1.3017718E-02  general
2      5865.56      68.39     0.3377     0.1222     1     1.2733551E-02  general
2      6007.50      67.76     0.3402     0.1218     1     1.2442731E-02  general
2      6152.77      67.13     0.3428     0.1214     1     1.2145103E-02  general
2      6301.43      66.51     0.3453     0.1209     1     1.1840507E-02  general
2      6453.58      65.89     0.3478     0.1205     1     1.1528780E-02  general
2      6609.28      65.28     0.3503     0.1201     1     1.1209755E-02  general
2      6768.64      64.67     0.3526     0.1197     1     1.0883261E-02  general
2      6931.72      64.08     0.3551     0.1193     1     1.0549123E-02  general
2      7098.62      63.50     0.3575     0.1189     1     1.0207163E-02  general
2      7269.43      62.93     0.3596     0.1186     1     9.8571968E-03  general
2      7444.24      62.37     0.3617     0.1182     1     9.4990376E-03  general
2      7623.14      61.82     0.3639     0.1178     1     9.1324934E-03  general
```

2	7806.23	61.27	0.3663	0.1175	1	8.7573680E-03	general
2	7993.60	60.73	0.3685	0.1171	1	8.3734602E-03	general
2	8185.37	60.20	0.3705	0.1168	1	7.9805646E-03	general
2	8381.62	59.67	0.3726	0.1164	1	7.5784709E-03	general
2	8582.46	59.15	0.3747	0.1161	1	7.1669636E-03	general
2	8788.01	58.64	0.3769	0.1157	1	6.7458222E-03	general
2	8998.37	58.13	0.3788	0.1154	1	6.3148213E-03	general
2	9213.66	57.62	0.3807	0.1151	1	5.8737301E-03	general
2	9433.98	57.12	0.3824	0.1147	1	5.4223124E-03	general
2	9659.46	56.63	0.3842	0.1144	1	4.9603264E-03	general
2	9890.23	56.15	0.3859	0.1141	1	4.4875246E-03	general
2	10126.39	55.65	0.3877	0.1138	1	4.0036539E-03	general
2	10368.08	55.09	0.3892	0.1134	1	3.5084551E-03	general
2	10615.43	54.55	0.3907	0.1131	1	3.0016629E-03	general
2	10868.58	53.98	0.3922	0.1127	1	2.4830061E-03	general
2	11127.65	53.39	0.3937	0.1123	1	1.9522066E-03	general
2	11392.78	52.82	0.3953	0.1119	1	1.4089805E-03	general
2	11664.12	52.25	0.3968	0.1116	1	8.5303690E-04	general
2	11941.82	51.67	0.3983	0.1112	1	2.8407760E-04	general
2	12226.01	51.07	0.3999	0.1108	1	-2.9820164E-04	general

```
===========================================================================
                wp wetting time [yr]:      2150.
                wp failure time [yr]:     11942.
    penetration by dry oxidation [m]:     5.992E-03
                echoed input data in:     echo_fail.dat
             output data are in files:    temphumd.dat and corrode.out
===========================================================================
```

ebspac (engineering barrier system performance assessment code)
this is the part of the code that computes wp failure time
version= 1.0
Mon Aug 25 12:30:42 1997

Run #004

iflagtpa= 1
nhist3= 201
nhist= 201

calculation of waste package failure time

===

end of simulation time [yr]: 20000.
no. of rows of data to pass to release.f: 201

ilayer	tstop [yr]	tcan [c]	ecrit [vshe]	ecorr [vshe]	chloride flag	rthick [m]	mode
1	4.62	103.73	0.0000	0.0000	0	1.1999625E-01	dry oxd
1	9.35	117.83	0.0000	0.0000	0	1.1999250E-01	dry oxd
1	14.19	127.40	0.0000	0.0000	0	1.1998875E-01	dry oxd
1	19.14	134.03	0.0000	0.0000	0	1.1998500E-01	dry oxd
1	24.21	139.01	0.0000	0.0000	0	1.1998125E-01	dry oxd
1	29.40	142.54	0.0000	0.0000	0	1.1997750E-01	dry oxd
1	34.70	145.20	0.0000	0.0000	0	1.1997374E-01	dry oxd
1	40.14	147.03	0.0000	0.0000	0	1.1996999E-01	dry oxd
1	45.70	148.31	0.0000	0.0000	0	1.1996624E-01	dry oxd
1	51.39	149.10	0.0000	0.0000	0	1.1996249E-01	dry oxd
1	57.21	149.53	0.0000	0.0000	0	1.1995874E-01	dry oxd
1	63.17	149.64	0.0000	0.0000	0	1.1995498E-01	dry oxd
1	69.27	149.55	0.0000	0.0000	0	1.1995123E-01	dry oxd
1	75.51	149.37	0.0000	0.0000	0	1.1994748E-01	dry oxd
1	81.90	149.18	0.0000	0.0000	0	1.1994373E-01	dry oxd
1	88.44	148.91	0.0000	0.0000	0	1.1993997E-01	dry oxd
1	95.13	148.59	0.0000	0.0000	0	1.1993622E-01	dry oxd
1	101.98	197.61	0.0000	0.0000	0	1.1993212E-01	dry oxd
1	108.98	195.01	0.0000	0.0000	0	1.1992808E-01	dry oxd
1	116.16	192.53	0.0000	0.0000	0	1.1992410E-01	dry oxd
1	123.49	190.15	0.0000	0.0000	0	1.1992016E-01	dry oxd
1	131.01	187.87	0.0000	0.0000	0	1.1991626E-01	dry oxd
1	138.69	185.71	0.0000	0.0000	0	1.1991237E-01	dry oxd
1	146.56	183.64	0.0000	0.0000	0	1.1990851E-01	dry oxd
1	154.61	181.63	0.0000	0.0000	0	1.1990467E-01	dry oxd
1	162.85	179.65	0.0000	0.0000	0	1.1990084E-01	dry oxd
1	171.29	177.74	0.0000	0.0000	0	1.1989703E-01	dry oxd
1	179.92	176.24	0.0000	0.0000	0	1.1989322E-01	dry oxd
1	188.75	175.00	0.0000	0.0000	0	1.1988942E-01	dry oxd
1	197.79	173.86	0.0000	0.0000	0	1.1988562E-01	dry oxd
1	207.04	172.73	0.0000	0.0000	0	1.1988182E-01	dry oxd
1	216.51	171.69	0.0000	0.0000	0	1.1987803E-01	dry oxd
1	226.19	170.66	0.0000	0.0000	0	1.1987425E-01	dry oxd
1	236.11	169.64	0.0000	0.0000	0	1.1987046E-01	dry oxd
1	246.26	168.67	0.0000	0.0000	0	1.1986668E-01	dry oxd
1	256.64	167.78	0.0000	0.0000	0	1.1986290E-01	dry oxd
1	267.27	166.93	0.0000	0.0000	0	1.1985912E-01	dry oxd
1	278.15	166.11	0.0000	0.0000	0	1.1985535E-01	dry oxd
1	289.28	165.32	0.0000	0.0000	0	1.1985157E-01	dry oxd
1	300.68	164.54	0.0000	0.0000	0	1.1984780E-01	dry oxd
1	312.33	163.85	0.0000	0.0000	0	1.1984403E-01	dry oxd
1	324.27	163.18	0.0000	0.0000	0	1.1984026E-01	dry oxd
1	336.48	162.53	0.0000	0.0000	0	1.1983649E-01	dry oxd
1	348.98	161.87	0.0000	0.0000	0	1.1983272E-01	dry oxd
1	361.77	161.21	0.0000	0.0000	0	1.1982895E-01	dry oxd

1	374.86	160.54	0.0000	0.0000	0	1.1982518E-01	dry oxd
1	388.25	159.82	0.0000	0.0000	0	1.1982141E-01	dry oxd
1	401.96	159.10	0.0000	0.0000	0	1.1981765E-01	dry oxd
1	415.99	158.42	0.0000	0.0000	0	1.1981388E-01	dry oxd
1	430.35	157.78	0.0000	0.0000	0	1.1981012E-01	dry oxd
1	445.05	157.14	0.0000	0.0000	0	1.1980636E-01	dry oxd
1	460.09	156.50	0.0000	0.0000	0	1.1980259E-01	dry oxd
1	475.48	155.87	0.0000	0.0000	0	1.1979883E-01	dry oxd
1	491.23	155.13	0.0000	0.0000	0	1.1979507E-01	dry oxd
1	507.35	154.38	0.0000	0.0000	0	1.1979131E-01	dry oxd
1	523.85	153.57	0.0000	0.0000	0	1.1978755E-01	dry oxd
1	540.74	152.75	0.0000	0.0000	0	1.1978379E-01	dry oxd
1	558.02	151.94	0.0000	0.0000	0	1.1978003E-01	dry oxd
1	575.70	151.11	0.0000	0.0000	0	1.1977627E-01	dry oxd
1	593.80	150.27	0.0000	0.0000	0	1.1977251E-01	dry oxd
1	612.32	149.43	0.0000	0.0000	0	1.1976876E-01	dry oxd
1	631.28	148.67	0.0000	0.0000	0	1.1976500E-01	dry oxd
1	650.67	147.92	0.0000	0.0000	0	1.1976124E-01	dry oxd
1	670.53	147.13	0.0000	0.0000	0	1.1975749E-01	dry oxd
1	690.85	146.31	0.0000	0.0000	0	1.1975373E-01	dry oxd
1	711.64	145.50	0.0000	0.0000	0	1.1974998E-01	dry oxd
1	732.92	144.69	0.0000	0.0000	0	1.1974622E-01	dry oxd
1	754.70	143.89	0.0000	0.0000	0	1.1974247E-01	dry oxd
1	776.99	143.09	0.0000	0.0000	0	1.1973871E-01	dry oxd
1	799.80	142.28	0.0000	0.0000	0	1.1973496E-01	dry oxd
1	823.14	141.48	0.0000	0.0000	0	1.1973120E-01	dry oxd
1	847.04	140.62	0.0000	0.0000	0	1.1972745E-01	dry oxd
1	871.49	139.77	0.0000	0.0000	0	1.1972370E-01	dry oxd
1	896.51	138.90	0.0000	0.0000	0	1.1971994E-01	dry oxd
1	922.12	138.02	0.0000	0.0000	0	1.1971619E-01	dry oxd
1	948.33	137.15	0.0000	0.0000	0	1.1971244E-01	dry oxd
1	975.15	136.26	0.0000	0.0000	0	1.1970869E-01	dry oxd
1	1002.60	135.32	0.0000	0.0000	0	1.1970493E-01	dry oxd
1	1030.69	134.36	0.0000	0.0000	0	1.1970118E-01	dry oxd
1	1059.44	133.38	0.0000	0.0000	0	1.1969743E-01	dry oxd
1	1088.86	132.39	0.0000	0.0000	0	1.1969368E-01	dry oxd
1	1118.98	131.45	0.0000	0.0000	0	1.1968993E-01	dry oxd
1	1149.79	130.48	0.0000	0.0000	0	1.1968617E-01	dry oxd
1	1181.33	129.48	0.0000	0.0000	0	1.1968242E-01	dry oxd
1	1213.61	128.47	0.0000	0.0000	0	1.1967867E-01	dry oxd
1	1246.64	127.46	0.0000	0.0000	0	1.1967492E-01	dry oxd
1	1280.45	126.44	0.0000	0.0000	0	1.1967117E-01	dry oxd
1	1315.05	125.41	0.0000	0.0000	0	1.1966742E-01	dry oxd
1	1350.45	124.37	0.0000	0.0000	0	1.1966367E-01	dry oxd
1	1386.69	123.30	0.0000	0.0000	0	1.1965992E-01	dry oxd
1	1423.77	122.21	0.0000	0.0000	0	1.1965617E-01	dry oxd
1	1461.73	121.12	0.0000	0.0000	0	1.1965241E-01	dry oxd
1	1500.57	120.02	0.0000	0.0000	0	1.1964866E-01	dry oxd
1	1540.32	118.92	0.0000	0.0000	0	1.1964491E-01	dry oxd
1	1581.00	117.82	0.0000	0.0000	0	1.1964116E-01	dry oxd
1	1622.63	116.70	0.0000	0.0000	0	1.1963741E-01	dry oxd
1	1665.24	115.59	0.0000	0.0000	0	1.1963366E-01	dry oxd
1	1708.85	114.42	0.0000	0.0000	0	1.1912783E-01	dry oxd
1	1753.48	113.24	0.0000	0.0000	0	1.1861016E-01	dry oxd
1	1799.15	112.04	0.0000	0.0000	0	1.1808037E-01	dry oxd
1	1845.89	110.85	0.0000	0.0000	0	1.1753818E-01	dry oxd
1	1893.72	109.64	0.0000	0.0000	0	1.1698329E-01	dry oxd
1	1942.68	108.42	0.0000	0.0000	0	1.1641541E-01	dry oxd
1	1992.78	107.23	0.0000	0.0000	0	1.1583424E-01	dry oxd
1	2044.05	106.10	0.0000	0.0000	0	1.1523946E-01	dry oxd

1	2096.53	104.98	0.0000	0.0000	0	1.1463075E-01	dry oxd
1	2150.23	103.88	0.0000	0.0000	0	1.1400780E-01	dry oxd
1	2205.19	102.80	-0.5655	-1.3493	1	1.1337031E-01	general
1	2261.44	101.71	-0.5647	-1.3471	1	1.1271790E-01	general
1	2319.00	100.61	-0.5638	-1.3449	1	1.1205022E-01	general
1	2377.91	99.50	-0.5629	-1.3428	1	1.1136691E-01	general
1	2438.20	98.42	-0.5620	-1.3406	1	1.1066760E-01	general
1	2499.91	97.34	-0.5611	-1.3384	1	1.0995191E-01	general
1	2563.05	96.26	-0.5602	-1.3363	1	1.0921947E-01	general
1	2627.68	95.20	-0.5592	-1.3342	1	1.0846989E-01	general
1	2693.82	94.15	-0.5583	-1.3321	1	1.0770275E-01	general
1	2761.50	93.10	-0.5574	-1.3300	1	1.0691766E-01	general
1	2830.77	92.10	-0.5565	-1.3280	1	1.0611418E-01	general
1	2901.66	91.10	-0.5556	-1.3260	1	1.0529190E-01	general
1	2974.22	90.09	-0.5546	-1.3240	1	1.0445036E-01	general
1	3048.47	89.11	-0.5537	-1.3221	1	1.0358912E-01	general
1	3124.46	88.16	-0.5528	-1.3202	1	1.0270772E-01	general
1	3202.23	87.22	-0.5519	-1.3183	1	1.0180568E-01	general
1	3281.81	86.31	-0.5510	-1.3165	1	1.0088253E-01	general
1	3363.27	85.41	-0.5501	-1.3147	1	9.9937766E-02	general
1	3446.63	84.51	-0.5492	-1.3129	1	9.8970881E-02	general
1	3531.94	83.63	-0.5483	-1.3111	1	9.7981361E-02	general
1	3619.24	82.80	-0.5474	-1.3094	1	9.6968674E-02	general
1	3708.60	81.97	-0.5466	-1.3078	1	9.5932280E-02	general
1	3800.04	81.15	-0.5457	-1.3062	1	9.4871622E-02	general
1	3893.62	80.33	-0.5449	-1.3045	1	9.3786132E-02	general
1	3989.40	79.53	-0.5440	-1.3029	1	9.2675230E-02	general
1	4087.42	78.73	-0.5432	-1.3013	1	9.1538320E-02	general
1	4187.73	77.95	-0.5423	-1.2998	1	9.0374793E-02	general
1	4290.39	77.20	-0.5415	-1.2983	1	8.9184027E-02	general
1	4395.46	76.46	-0.5407	-1.2968	1	8.7965382E-02	general
1	4502.98	75.73	-0.5398	-1.2953	1	8.6718208E-02	general
1	4613.02	75.00	-0.5390	-1.2939	1	8.5441835E-02	general
1	4725.64	74.31	-0.5382	-1.2925	1	8.4135581E-02	general
1	4840.89	73.62	-0.5373	-1.2911	1	8.2798745E-02	general
1	4958.85	72.95	-0.5365	-1.2898	1	8.1430612E-02	general
1	5079.56	72.27	-0.5357	-1.2885	1	8.0030450E-02	general
1	5203.10	71.60	-0.5348	-1.2871	1	7.8597508E-02	general
1	5329.53	70.95	-0.5340	-1.2858	1	7.7131018E-02	general
1	5458.92	70.30	-0.5332	-1.2845	1	7.5630196E-02	general
1	5591.34	69.65	-0.5323	-1.2832	1	7.4094238E-02	general
1	5726.87	69.02	-0.5314	-1.2820	1	7.2522321E-02	general
1	5865.56	68.39	-0.5306	-1.2807	1	7.0913602E-02	general
1	6007.50	67.76	-0.5297	-1.2795	1	6.9267222E-02	general
1	6152.77	67.13	-0.5289	-1.2782	1	6.7582297E-02	general
1	6301.43	66.51	-0.5280	-1.2770	1	6.5857926E-02	general
1	6453.58	65.89	-0.5271	-1.2757	1	6.4093186E-02	general
1	6609.28	65.28	-0.5263	-1.2745	1	6.2287130E-02	general
1	6768.64	64.67	-0.5254	-1.2733	1	6.0438791E-02	general
1	6931.72	64.08	-0.5245	-1.2721	1	5.8547181E-02	general
1	7098.62	63.50	-0.5237	-1.2710	1	5.6611285E-02	general
1	7269.43	62.93	-0.5229	-1.2699	1	5.4630067E-02	general
1	7444.24	62.37	-0.5221	-1.2687	1	5.2602466E-02	general
1	7623.14	61.82	-0.5213	-1.2676	1	5.0527396E-02	general
1	7806.23	61.27	-0.5204	-1.2665	1	4.8403746E-02	general
1	7993.60	60.73	-0.5196	-1.2655	1	4.6230378E-02	general
1	8185.37	60.20	-0.5188	-1.2644	1	4.4006129E-02	general
1	8381.62	59.67	-0.5180	-1.2634	1	4.1729807E-02	general
1	8582.46	59.15	-0.5172	-1.2623	1	3.9400193E-02	general
1	8788.01	58.64	-0.5163	-1.2613	1	3.7016039E-02	general

					1	3.4576069E-02	general
1	8998.37	58.13	-0.5155	-1.2603	1	3.2078976E-02	general
1	9213.66	57.62	-0.5148	-1.2593	1	2.9523422E-02	general
1	9433.98	57.12	-0.5141	-1.2583	1	2.6908040E-02	general
1	9659.46	56.63	-0.5133	-1.2573	1	2.4231427E-02	general
1	9890.23	56.15	-0.5126	-1.2563	1	2.1492152E-02	general
1	10126.39	55.65	-0.5119	-1.2553	1	1.9504801E-02	general
2	10368.08	55.09	0.3892	-0.1581	1	1.8998009E-02	general
2	10615.43	54.55	0.3907	-0.1587	1	1.8479352E-02	general
2	10868.58	53.98	0.3922	-0.1593	1	1.7948553E-02	general
2	11127.65	53.39	0.3937	-0.1599	1	1.7405327E-02	general
2	11392.78	52.82	0.3953	-0.1606	1	1.6849383E-02	general
2	11664.12	52.25	0.3968	-0.1612	1	1.6280424E-02	general
2	11941.82	51.67	0.3983	-0.1618	1	1.5698144E-02	general
2	12226.01	51.07	0.3999	-0.1624	1	1.5102233E-02	general
2	12516.86	50.49	0.4015	-0.1631	1	1.4492371E-02	general
2	12814.52	49.91	0.4030	-0.1637	1	1.3868230E-02	general
2	13119.14	49.34	0.4046	-0.1643	1	1.3229478E-02	general
2	13430.90	48.78	0.4061	-0.1649	1	1.2575772E-02	general
2	13749.96	48.23	0.4075	-0.1655	1	1.1906762E-02	general
2	14076.48	47.68	0.4090	-0.1661	1	1.1222089E-02	general
2	14410.65	47.13	0.4105	-0.1667	1	1.0521387E-02	general
2	14752.65	46.58	0.4120	-0.1673	1	9.8042802E-03	general
2	15102.65	46.04	0.4134	-0.1678	1	9.0703851E-03	general
2	15460.84	45.50	0.4149	-0.1684	1	8.3193087E-03	general
2	15827.42	44.98	0.4163	-0.1690	1	7.5506486E-03	general
2	16202.58	44.47	0.4176	-0.1695	1	6.7639929E-03	general
2	16586.53	43.96	0.4190	-0.1701	1	5.9589206E-03	general
2	16979.46	43.47	0.4203	-0.1706	1	5.1350004E-03	general
2	17381.60	42.98	0.4216	-0.1711	1	4.2917910E-03	general
2	17793.15	42.49	0.4229	-0.1717	1	3.4288410E-03	general
2	18214.33	42.00	0.4242	-0.1722	1	2.5456881E-03	general
2	18645.37	41.53	0.4255	-0.1727	1	1.6418593E-03	general
2	19086.51	41.07	0.4268	-0.1732	1	7.1687086E-04	general
2	19537.97	40.62	0.4280	-0.1737	1	-2.2977318E-04	general
2	20000.00	40.17	0.4292	-0.1742			

```
=====================================================================
                 wp wetting time [yr]:     2150.
                 wp failure time [yr]:     19538.
      penetration by dry oxidation [m]:    5.992E-03
                echoed input data in:      echo_fail.dat
              output data are in files:    temphumd.dat and corrode.out
=====================================================================
```

RUN ~~#003~~ Very low value O_2 partial pressure: 0.37×10^{-5} at
In RUN #003 after wetting time = 2150 yr
outer overpack fail by localized corrosion in
2377 − 2150 = 227 yr. because E_{corr} = 0.207 V_{SHE}
is higher than E_{rp} (steel).

For Alloy 825 E_{rp} (825) < E_{corr} = 0.207 V_{SHE}
and general corrosion occurred giving failure
time of 11,942 yr.

RUN #004
In RUN #004 after wetting time = 2150 yr
outer overpack fail by general corrosion in
10,126 − 2150 = 7976 yr because E_{corr} =
− 1.349 V_{SHE} << E_{rp} (steel).

For alloy 825 E_{rp} (825) < E_{corr} = −0.158 V_{SHE}
and only general corrosion occurred with a
failure time of 19,538 yr.

The output seems to be consistent with assumptions

Galcopolin
8/25/97

8/29/97

DETERMINATION OF WASTE PACKAGE FAILURE

These runs will be performed for Subareas 1-7 using a small number of realizations to compare results

RUN # 005 Subarea 1-7
Single Realization

WP failure	SA#1	SA #2	SA#3	SA#4	SA#5	SA#6	SA#7
Initial #	/	15	7	4	6	6	2
yr		0.0	0.0	0.0	0.0	0.0	0.0
Seismic #		19	9	5	7	8	3
yr		612.3	612.3	612.3	612.3	612.3	612.3
Volcanic #		0 gm	13	0	13	0	0
yr		—	1708.8	—	1708.8	—	—
Corrosion #		1924	0	0	0	0	0
yr		3989.4	—	—	—	—	—
Total #		1958	29	9	26	14	5
Total WPs	1844	1958	947	523	725	818	308

RUN # 006 Subarea 1 ≡ Whole repository
Realizations: 7
Simulation time: 25,000 yr.

WP failure	#1	#2	#3	#4	#5	#6	#7
Initial #	3	*	11	44			
yr	0.0		0.0	0.0			
Seismic #	18		79	79			
yr	17.7		17.7	2028.3			
Volcanic #	0		0	0	RUN INTERRUPTED		
yr	—		—	41501			
Corrosion #	~~1823~~ 7921		7852	7819			
yr	3047.8	gm	3203.8	2974.4			

* error in psquery and value sp; resume execution after

pause but does not provide ebsfaildata → release

Examples de output obtained in RUN #002 8/20/97 (page 9) are given below. Print-out of the screen providing release for EBS and failure for WP. (various failure types)

For Subarea 4.

```
Telnet To Goliath
           Tc99  1.2024E-05 [Ci/yr/SA] at  2.000E+04 yr
           Cl36  8.3305E-07 [Ci/yr/SA] at  2.000E+04 yr
           Se79  2.8909E-08 [Ci/yr/SA] at  2.000E+04 yr
          Np237  9.8035E-10 [Ci/yr/SA] at  2.000E+04 yr
------------------------------------------------------------
    subarea   4 of   7          realization    1 of    1
------------------------------------------------------------
exec: calling uzflow
exec: calling nfenv
exec: calling ebsfail
      ebsfail: time of WP failure =    19538.0  yr
exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
exec: failed WPs from SEISMIC   event =      5 at time =    612.3 yr
exec: failed WPs from CORROSION event =    517 at time =  19538.0 yr
  *** failed WPs: all WPs failed ***
exec: calling ebsrel
          Highest release rates from Sub Area  4
           Tc99  1.1970E-02 [Ci/yr/SA] at  2.000E+04 yr
          Pu239  1.1107E-02 [Ci/yr/SA] at  2.000E+04 yr
          Pu240  3.8551E-03 [Ci/yr/SA] at  2.000E+04 yr
          Am243  2.3671E-03 [Ci/yr/SA] at  2.000E+04 yr
           Ni59  2.1367E-03 [Ci/yr/SA] at  2.000E+04 yr
           U234  1.1960E-03 [Ci/yr/SA] at  2.000E+04 yr
exec: calling uzft
```

For Subarea 5:

```
Telnet To Goliath
     Cl36   3.8305E-07 [Ci/yr/SA] at  2.000E+04 yr
     Se79   2.0500E-07 [Ci/yr/SA] at  2.000E+04 yr
     U234   6.7014E-08 [Ci/yr/SA] at  2.000E+04 yr
--------------------------------------------------------------------
    subarea   5 of   7          realization   1 of    1
--------------------------------------------------------------------
exec: calling uzflow
exec: calling nfenv
exec: calling ebsfail
      ebsfail: time of WP failure =    19086.5  yr
exec: failed WPs from INITIAL   event =       1 at time =      0.0 yr
exec: failed WPs from SEISMIC   event =       7 at time =    612.3 yr
exec: failed WPs from VOLCANIC  event =      13 at time =   1708.8 yr
exec: failed WPs from CORROSION event =     704 at time =  19086.5 yr
  *** failed WPs: all WPs failed ***
exec: calling ebsrel
                Highest release rates from Sub Area  5
             Pu239  1.7100E-02 [Ci/yr/SA] at  2.000E+04 yr
              Tc99  1.4933E-02 [Ci/yr/SA] at  2.000E+04 yr
             Pu240  5.9366E-03 [Ci/yr/SA] at  2.000E+04 yr
             Am241  3.4862E-03 [Ci/yr/SA] at  2.500E+03 yr
             Am243  3.0124E-03 [Ci/yr/SA] at  1.954E+04 yr
              Ni59  2.6754E-03 [Ci/yr/SA] at  2.000E+04 yr
exec: calling uzft
```

As noted before greater releases are from Tc 99 and Pu 239.

Galeapalini
8/29/97

9/3/97

Additional runs to attain familiarity with the code and evaluate time required for runs.

RUN #007 Simulation time: 20,000 yr
Number of realizations: 1

WP failure	SA 1	SA 2	SA 3	SA 4	SA 5	SA 6	SA 7
Initial #	16	17	8	5	6	7	3
yr.	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic #	18	19	9	5	7	8	3
yr	612.3	612.3	612.3	612.3	612.3	612.3	612.3
Volcanic #	0	0	0	1	3	1	0
yr	—	~~6931.7~~ gal	—	6931.7	6931.7	6931.7	—
Corrosion #	1810	1923	930	0	0	0	0
yr	3281.8	3281.8	3281.8	—	—	—	—
WP failure #	*18~~44~~ gal	1959	947	11	16	16	6
Total WPs	1844	1959	947	523	725	818	309

Releases: SA 1 Pu 239 9.03×10^{-2} Ci/yr
Am 241 4.46×10^{-3} Ci/yr
Tc 99 1.10×10^{-3} Ci/yr @ 3450 yr

SA 2 Pu 239 9.65×10^{-2} Ci/yr
Am 241 4.73×10^{-2} Ci/yr
Tc 99 3.47×10^{-2} Ci/yr

Running times SA 1 ~ 6 minutes
SA 2 ~ 11 minutes

The complete run for 1 realization took more than 50 minutes.

Galeapalini
9/3/97

9/5/97

RUN # 008 Simulation time: 10,000 yr
Number of realizations: 1

WP failure	SA1	SA2	SA3	SA4	SA5	SA6	SA7
Initial #	16	17	8	5	6	7	3
yr	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic #	18	19	9	5	7	8	3
yr	606.8	606.8	606.8	606.8	606.8	606.8	606.8
Volcanic #	0	0	0	1	3	1	0
yr	—	—	—	7038.2	7038.2	7038.2	—
Corrosion #	1810	1923	930	0	0	0	0
yr.	3304.6	3226.8	3304.6	—	—	—	—
Total WP fail	1844	1959	947	11	16	16	6
Total WPs	1844	1959	947	523	725	818	309

With minor variations in failure time for various failure types results are identical to RUN # 007 (9/3/97) p. 19.
Due to shorter simulation time (10,000 yr vs 20,000 yr) the ~~simul~~ run took only 8 minutes for 1 realization.

RUN # 009. Simulation time 20,000 yr.
Number of realizations: 7

The run will be limited to one subarea = whole repository to conduct the run in a relatively short time (total # of WPs is equal to 7943)

WP failure	#1	#2	#3	#4	#5	#6	#7
Initial #	41	52	8	66	32	17	73
yr	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seismic #	79	79	79	79	79	79	~~31~~ 78
yr	612.3	19.1	1845.9	1020	63.2	896.5	~~216.5~~ 475
Volcanic #	17	28	51	58	0	0	31
yr	3708.6	8381.6	5329.5	1799.1	—	—	216.5
Corrosion #	0	0	7805	7740	7832	7847	7760
yr.	—	—	19086.5	2761.5	2563.1	3281.8	3048.5
WP failed #	137	159	7943	7943	7943	7943	7942?
Gas ~~Release (Ci/yr)~~							
Dose (mrem/yr)							
Pu 240	3.79×10^{2}	6.45×10^{3}	2.8×10^{1}	—	6.51×10^{0}	—	—
@ yr	3709	8382	2	—	—	—	—
Pu 239	3.14×10^{2}	7.49×10^{3}	2.57×10^{1}	—	6.68×10^{0}	—	—
@ yr	3709	8382	—	—	—	—	—
Am 243	—	1.67×10^{3}	3.66×10^{1}	—	8.65×10^{1}	—	—
Np 237	—	4.13×10^{2}	—	—	—	—	—
Pu 242	—	4.63×10^{1}	—	—	—	—	—
Pb 210	—	—	—	1.86×10^{0}	—	—	—

The total run time was 21 minutes.
Results are significantly different from those in RUN # 006 (8/29/97) p. 16. However, it's not clear why dose is higher in #1 and #2 than in #3 and #4 when in these two cases more WPs failed.

Giacopolino
9/5/97

8 September, 1997

NOTE TO: KTI Teams

FROM: TSPA&I Team

SUBJECT: STANDARDIZATION OF SENSITIVITY ANALYSES

In response to the inquiries made concerning how to benchmark the sensitivity analyses, below are some guidelines for the purpose of establishing consistency from one team to another.

Time frame: 10,000 yr

In some cases, there may be a need to run for longer time periods, such as 100,000 yr. This time will require an extremely long run-time (days.....). The TSPA&I team will provide a peak dose versus time plot for your use in judging how long a simulation to do.

Location of Critical Group: 5 Km

TSPA&I will make available results for 5Km at 10,000 yrs and 20 Km at 100,000 yrs.

Number of subareas: 7

Sampled Parameters: Sample the parameters that are appropriate to your particular module. TSPA&I will provide an input file with the mean of all parameters. For parameters that are not in your module, but are important to sample, TSPA&I KTI recommends using 3 nominal values, such as a low, medium, and high value for infiltration.

Reminders:

Remember to save your input files for the purposes of debugging and documentation.

Calculate correlation coefficients for your sampled parameters and the module output; your sampled parameters and dose.

From: Sitakanta Mohanty
Subject: Release of TPA Code Version 3.1
09-08-97 12:19 PM

TPA code users:

TPA code version 3.1 is now available for use. To avoid confusion, please get rid of all beta versions of TPA 3.1, including data associated with previous beta versions. The data set available with the TPA 3.1 is considered the base case. This base case may change if NRC provides us with new data. A draft handout is also available that includes description of the base case data set. The draft handout has sufficient details to get started with using the TPA code. A copy of the draft handout can be obtained from Cathy.

-Sitakanta

You can do the following to get rid of old versions of the TPA code:

If the name of your old working directory for TPA code, for example, is TPARUN5, then use the commands

```
unalias rm
rm -r TPARUN5
```

The last command line will not work if you are currently in the directory TPARUN5.

Setting up the Environment file:

Modify the .cshrc.local file by adding one extra line.

```
   setenv tpa3_1 /(pathname)/TPARUN
```

Path name can be found by typing the command pwd.

Example: If the path name is /bscr3/mohanty, then

```
        setenv tpa3_1 /bscr3/mohanty/TPARUN
```

Now get rid of all old setenv lines in the file .cshrc.local corresponding to the beta versions. Save the file and type:

```
        source .cshrc
```

To ensure correct setting of the environment, type:

```
        echo $tpa3_1
```

If your path (for example) is /bscr3/mohanty/TPARUN, echo command will display it on the screen.

To copy the new directory of files:

```
        mkdir TPARUN
        cd TPARUN
        cp /solapps/cnwra/tpa3_1/tpa.inp.master tpa.inp
        cp -r /solapps/cnwra/tpa3_1/data .
```

Running the code:

```
        /solapps/cnwra/tpa3_1/tpa.e
```

Sensitivity Analyses for the Evolution of the Near-Field Environment (ENFE) KTI
September 23, 1997

Four sets of analyses are planned:

1) Cement effects

2) Chloride and oxygen effects

3) Iron oxide effects

4) Natural analog oxidation rate controlled release

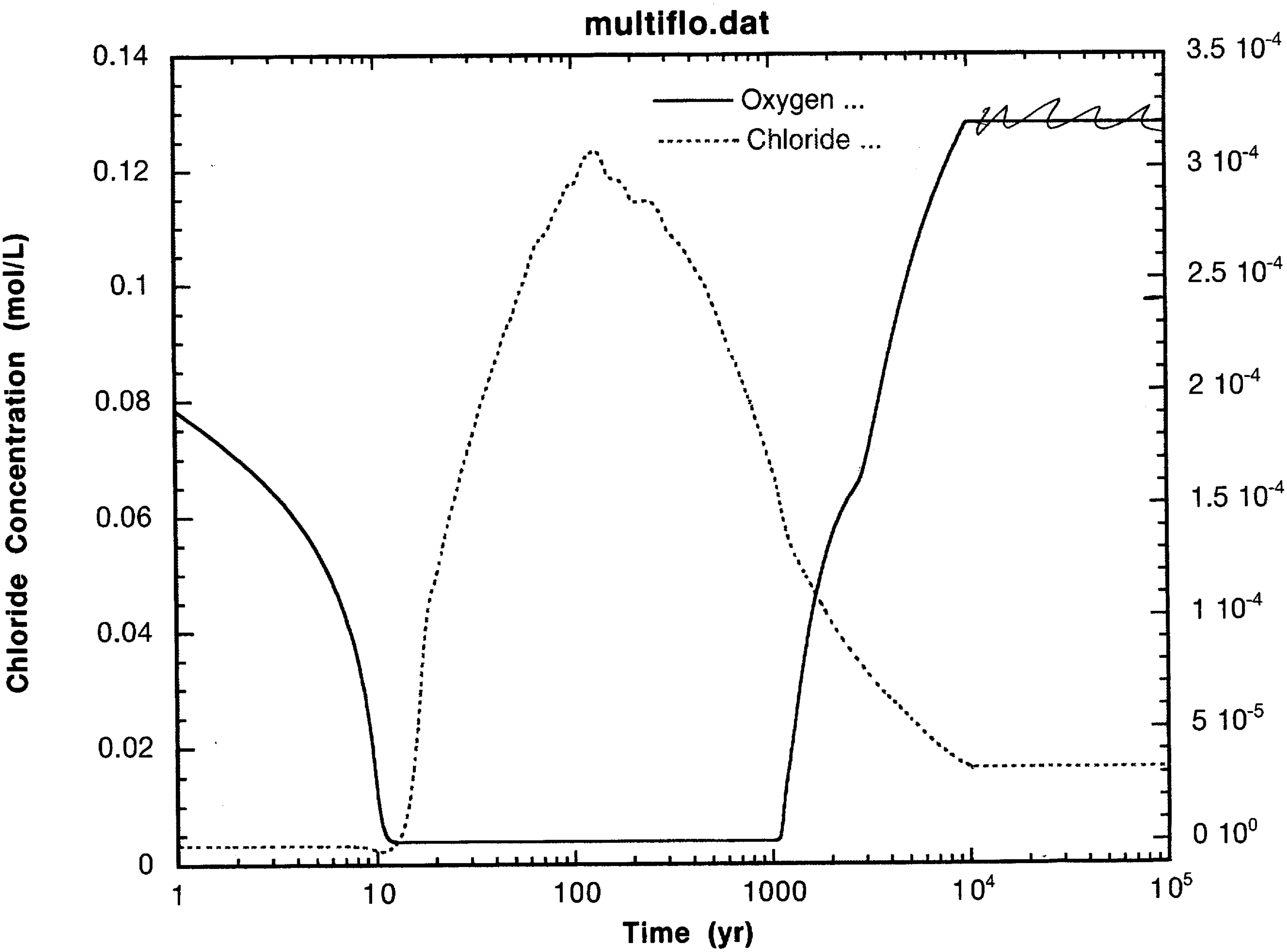
For each of these sets, runs will be conducted using the mean value base case and varying parameters as described below to approximate postulated near-field effects on repository performance. These analyses will be conducted with no disruptive scenarios (i.e., no volcanism, faulting, nor seismicity). Seven repository subareas will be used. Twenty radionuclides will be used (Cm-246, U-238, Cm-245, Am-241, Np-237, Am-243, Pu-239, Pu-240, U-234, Th-230, Ra-226, Pb-210, Cs-135, I-129, Tc-99, Ni-59, C-14, Se-79, Nb-94, Cl-36). We will consider a 10K year time frame, with runs extended to longer periods (e.g., 100K years) as determined to be necessary. The primary performance measure will be peak dose (PKTEDE). The analyses described here may be modified in response to interim results obtained during the conduct of the analyses.

Chloride and Oxygen Effects

Sensitivity analyses of chloride and oxygen concentrations in the near-field aqueous environment will investigate the counter balancing roles of these two species on the onset of localized corrosion of the waste package and their effects on waste package life. During heating of the repository the chloride concentration increases while oxygen decreases due to purging by boiling of ambient groundwater in the partially saturated tuff host rock. Conversely, as the repository cools, the chloride concentration decreases while oxygen increases. Water films on the metal surfaces will contain a variety of components, including chloride and other soluble anionic species. Chloride ions are known to promote localized corrosion and enhance general corrosion of container materials. Evaporation of water contacting the waste package could lead to increasing chloride concentrations and eventually to brine formation on the outer overpack surface enhancing the susceptibility of both the outer and inner containers to localized corrosion

In the figure attached output of MULTIFLO is shown for oxygen partial pressure and Cl⁻ concentration

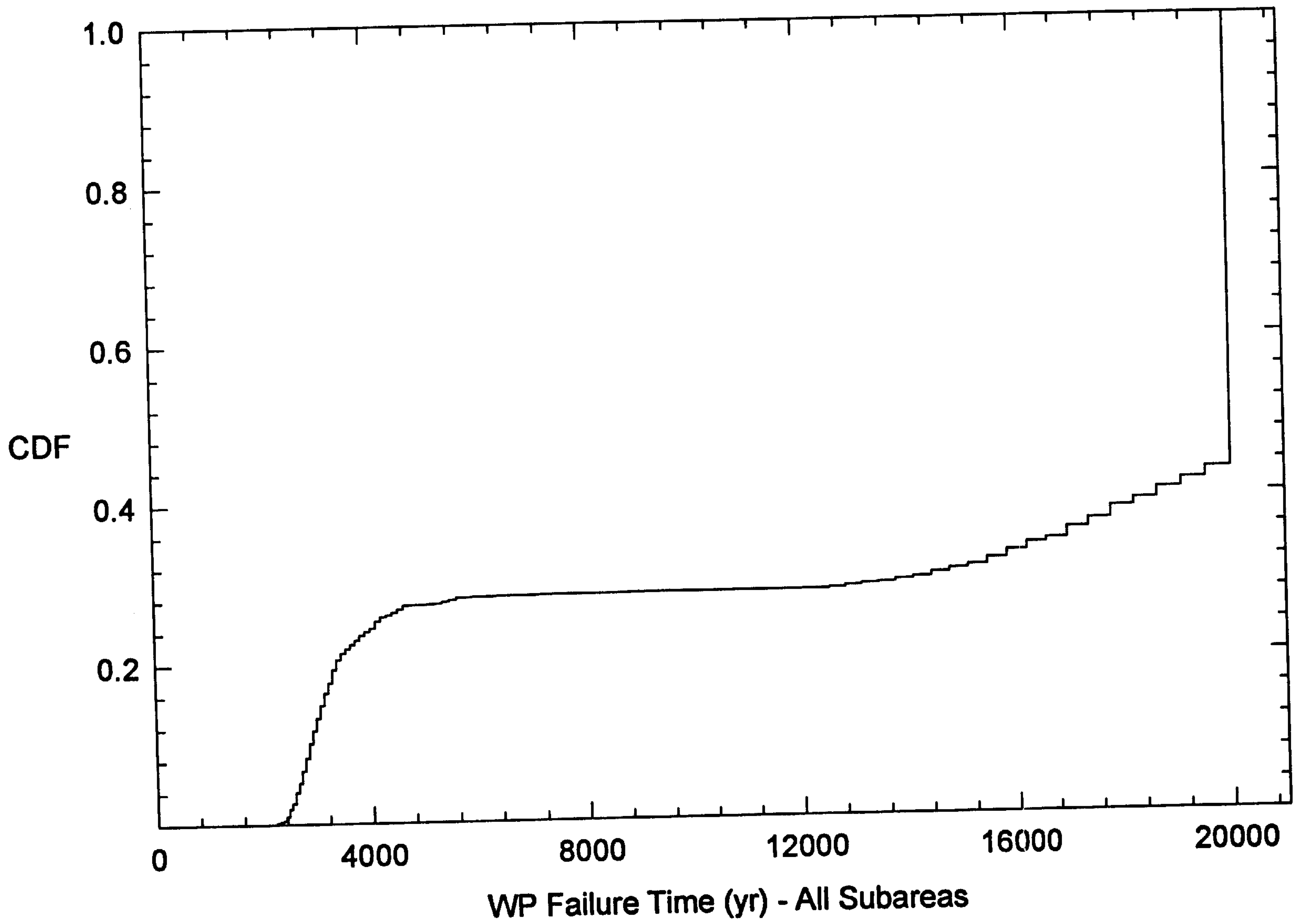
To determine the possible effect of varying chloride and oxygen concentrations on dose, calculations will be made by modifying the values of these parameters in the EBSFAIL module of TPA 3.1. Waste package corrosion depends on the corrosion potential and the critical potential required to initiate localized corrosion. In EBSFAIL the corrosion potential is strongly dependent on oxygen concentration and the critical potential, conservatively represented by the repassivation potential, is assumed to depend only on chloride concentration and temperature. For a given temperature, localized corrosion only occurs above a critical chloride concentration, $[Cl^-]_{crit}$. From an estimate of the near-field environment over time as predicted by MULTIFLO, the impact of chloride and oxygen concentrations on peak dose will be evaluated.



10/2/97

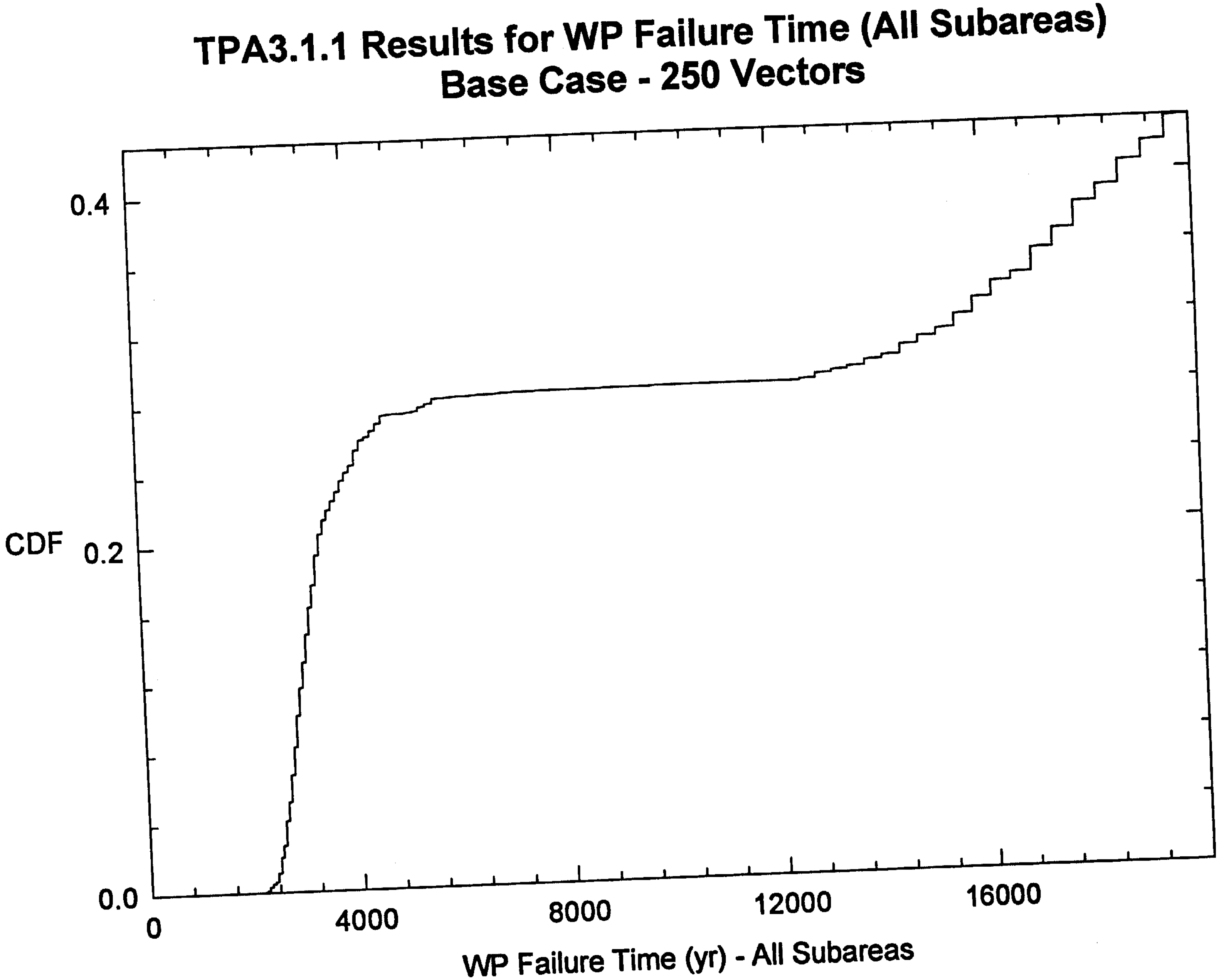
PLOTS OF WP FAILURE TIME FOR BASE CASE AND VARIATIONS

TPA3.1.1 Results for WP Failure Time (All Subareas)
Base Case - 250 Vectors



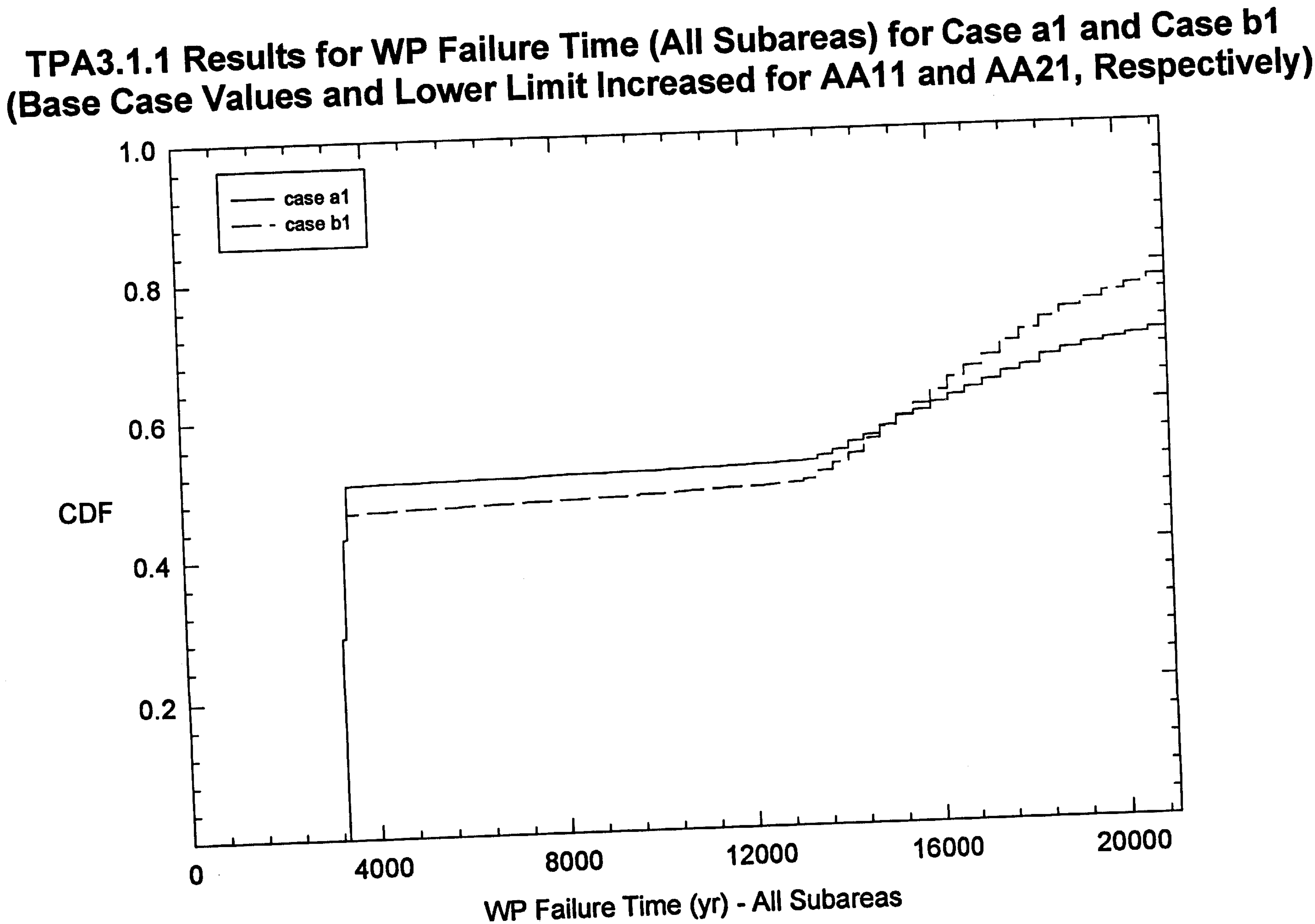
10/2/97

PLOTS OF WP FAILURE TIME FOR BASE CASE AND VARIATIONS



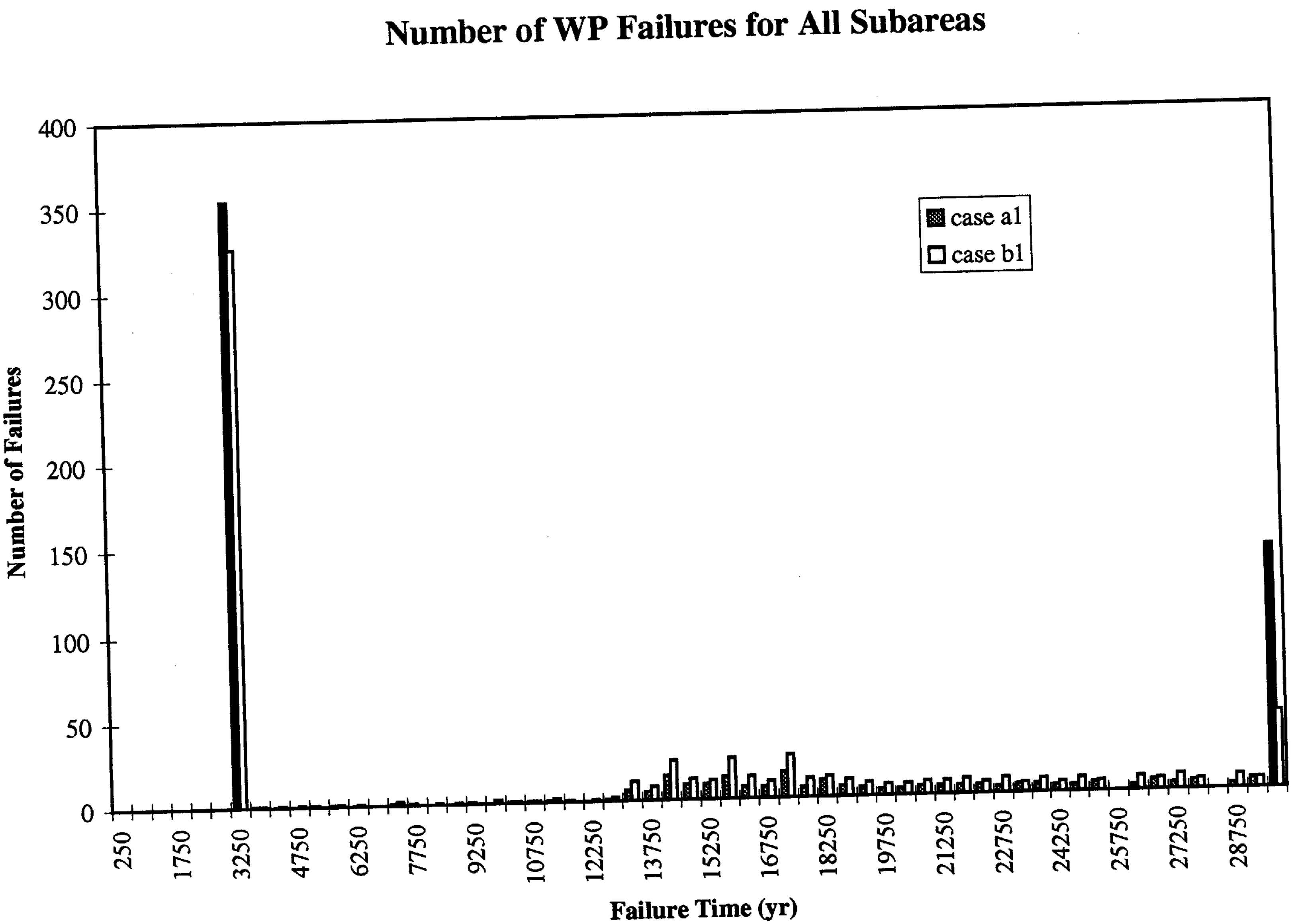
10/2/97

PLOTS OF WP FAILURE TIME FOR BASE CASE AND VARIATIONS



10/2/97

PLOTS OF WP FAILURE TIME FOR BASE CASE AND VARIATIONS



10/6/97

Robert RICE will start to run a preliminary set of cases for various values of the Chloride Multiplication Factor within the range of variation use in the base case (1 to 30) and the oxygen partial pressure will be 0.21 at (constant). Two simulations times (10000 and 20000 yr) will be used and three values of the Chloride Multiplication Factor (1, 15.5 and 30). WP failure times and peak dose at time will be recorded. The results are in tables below.

WP Failure Time (corrosion)

Case	Cl-Mult. Factor	SA1	SA2	SA3	SA4	SA5	SA6	SA7
3	1.0 @ 10,000 yr	—	—	—	—	—	—	—
4	@ 20,000 yr	—	—	—	—	—	—	—
1	15.5 @ 10,000 yr	3384.3	3384.3	3384.3	3465.9	—	—	—
2	@ 20,000 yr	3363.3	3363.3	3363.3	3446.6	—	—	—
5	30.0 @ 10,000 yr	3384.3	3384.3	3384.3	3465.9	—	3722.1	—
6	@ 20,000 yr	3363.3	3363.3	3363.3	3446.6	—	3708.6	—

Peak Dose and Time

Cl- Mult. Factor	10,000 yr	20,000 yr
1.0	27.6 mrem/yr @ 7,376 yr	32.5 mrem/yr @ 20,000 yr
15.5	27.6 mrem/yr @ 7,376 yr	4,738 mrem/yr @ 20,000 yr
30.0	27.6 mrem/yr @ 7,376 yr	4,741 mrem/yr @ 20,000 yr

Major effect of Cl⁻ concentration for Cl⁻ Mult. factor between 1 and 15.5. less important between 15.5 & 30.0 for WP failure time.

For peak dose major effect seen at 20,000 yr between 1.0 and 15.5.

[signature]
10/10/97

10/10/97

From: Sitakanta Mohanty
Subject: base-case outputs
10-10-97 10:49 AM

Sensitivity Analyses Group:

The followings are the directories containing output files from various TPA code base case runs. You may be interested in *.res, *.abb, and *.hdr files and in some directories you may have more information than you need. Results are available for 100 realizations.

These directories can be found at

/solapps/cnwra/tpa3_11/A_sens

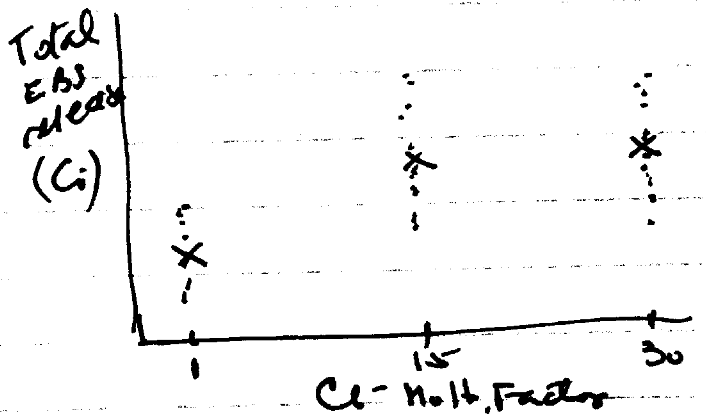
Directory name	Content	Computer run at
3.1.20ka.5km.KTI	5km, 20000 yr, all scenarios ON,	NRC
3.1.100ka.20km.KTI	20km, 100000 yr, all scenarios ON,	NRC
3.1.20ka.5km.ns.sm	5km, 20000 yr, all scenarios OFF,	CNWRA
3.1.100ka.20km.ns.sm	20km, 100000 yr, all scenarios OFF,	CNWRA
3.1.20ka.5km.mean.sm	5 km, 20000 yr, all scenarios OFF (mean values)	CNWRA

As you may have heard at yesterday's telecon, Virginia Colten-Bradley wants you to use these files (at least a part, if not all). If you notice any discrepancies, please report to me immediately. Thanks.

-Sitakanta

Bob: I'd like to have these plots.

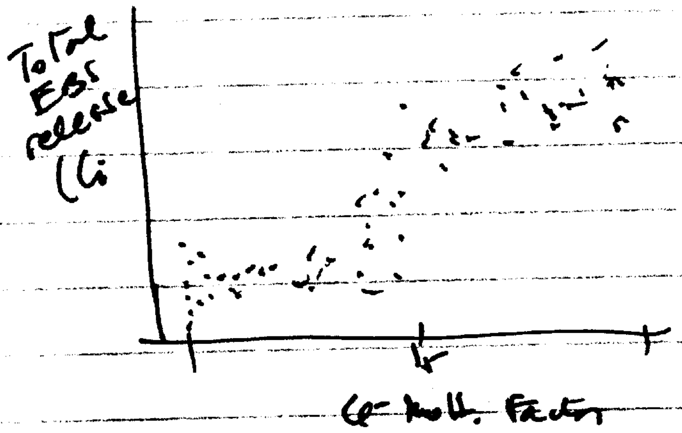
① Total EBS release vs Cl⁻ Multiplication Factor (10 vectors)



		Cases
Plot a)	10^4 years	1, 3, 5
Plot b)	2×10^4 years.	2, 4, 6
Plot c)	3×10^4 years.	8, 9

X: average

② Total EBS release vs. Cl⁻ (Case 7)



I'd like to do these two runs

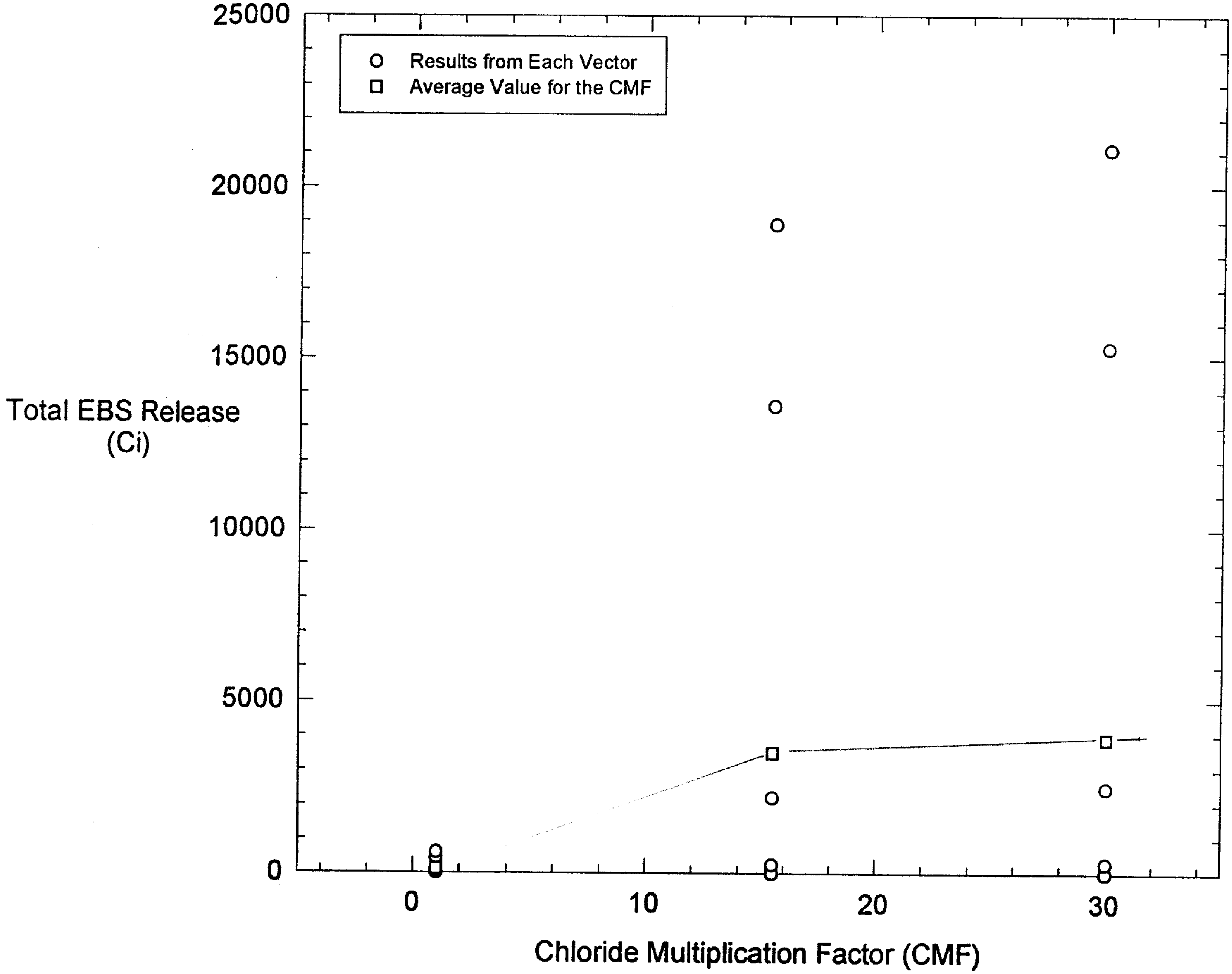
Case 11 100 realizations 10^4 yrs.

Case 12 idem 3×10^4 yrs

{ Cl⁻ multiplicat fact 1 → 30
{ Oxygen partial pressure 2.1×10^{-5} → 0.21

The results of the 6 runs (6 cases) listed in p.27 (10/6/97) are plotted in terms of EBS release. The case number is identified in table (p. 27).

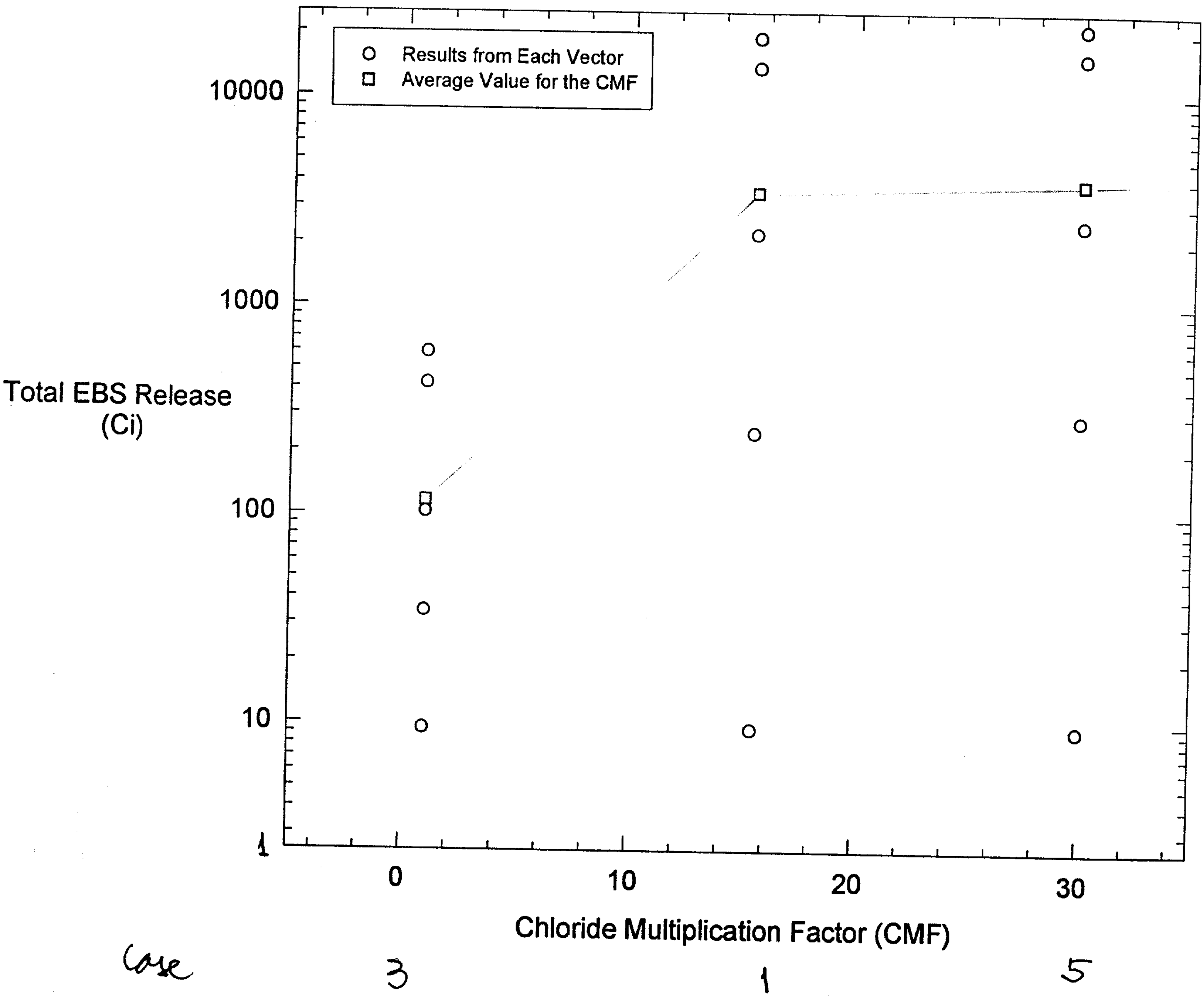
TPA3.1.1 Results of Total EBS Release (Ci) for Chloride Multiplication Factors of 1, 15.5, and 30 (10,000 years and 10 Vectors)



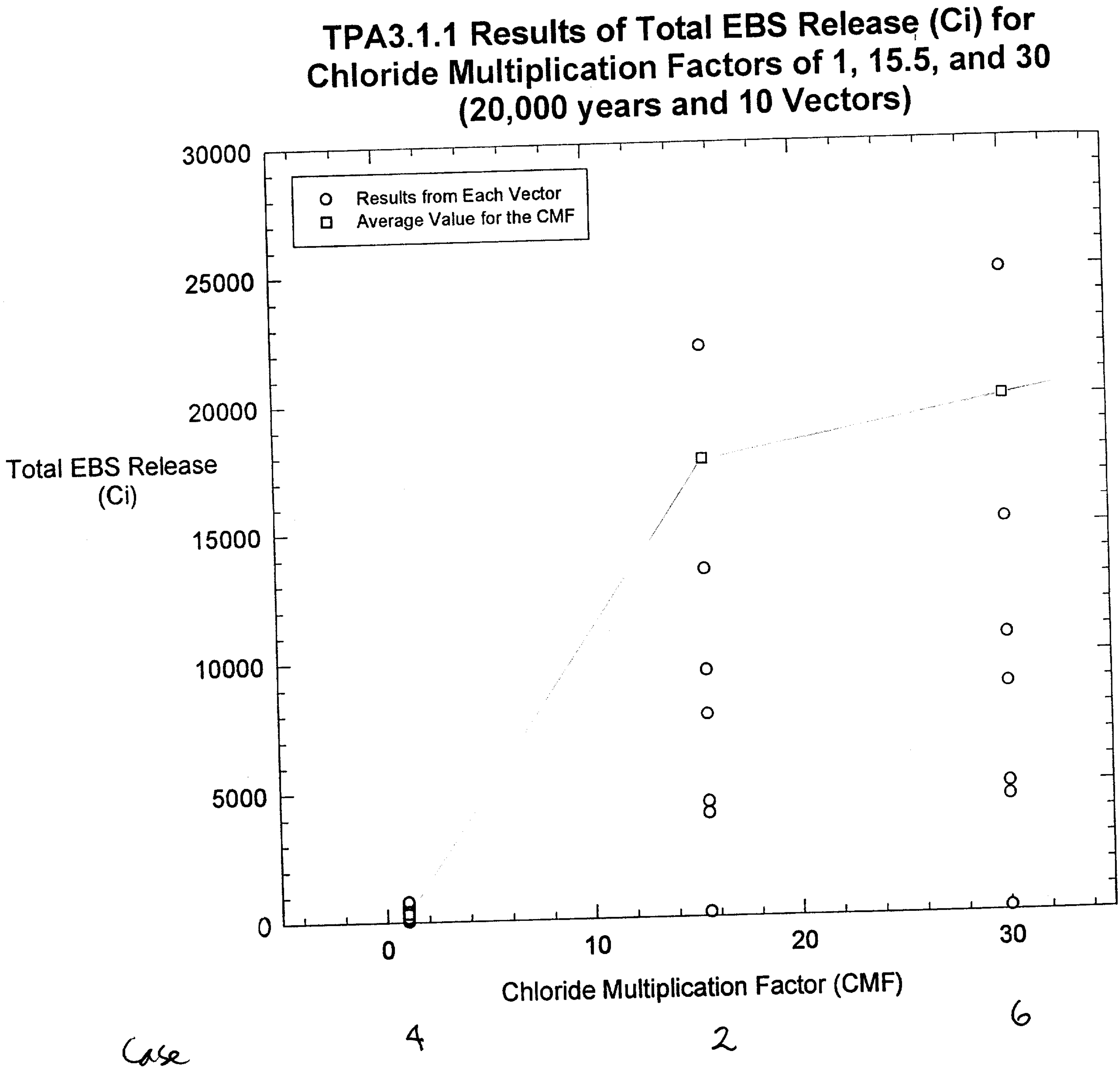
Case 3 1 5

The results of the 6 runs (6 cases) listed in p.27 (10/6/97) are plotted in terms of EBS release. The case number is identified in table (p.27).

TPA3.1.1 Results of Total EBS Release (Ci) for Chloride Multiplication Factors of 1, 15.5, and 30 (10,000 years and 10 Vectors)

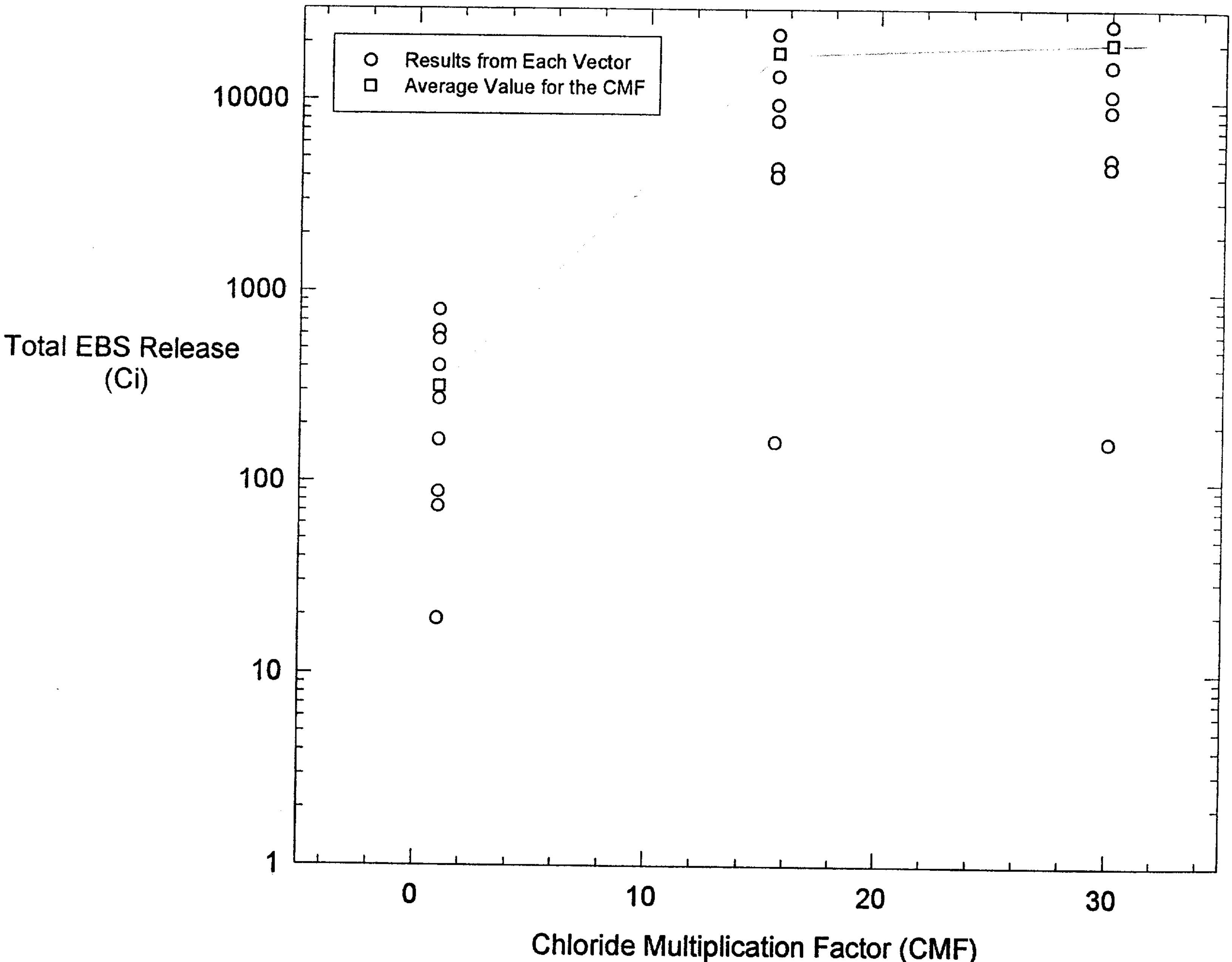


The results of the 6 runs (6 cases) listed in p.27 (10/6/97) are plotted in terms of EBS release. The case number is identified in table (p.27).



The results of the 6 runs (6 cases) listed in p.27 (10/6/97) are plotted in terms of EBS release. The case number is identified in table (p.27).

TPA3.1.1 Results of Total EBS Release (Ci) for Chloride Multiplication Factors of 1, 15.5, and 30 (20,000 years and 10 Vectors)



Case 4 2 6

Case 7: Number of realizations : 100
Simulation time : 10,000 yr
Chloride Multiplication Factor : Uniform (1, 30)
Oxygen partial pressure : Constant (0.21 at)

icount= 700

there are 100 vectors
subareas = 7
sim time = 10000.0000000000

for subarea = 1

bin number	lower limit	upper limit	midpt bin	frequency
1	0.00	500.00	250.00	0
2	500.00	1000.00	750.00	0
3	1000.00	1500.00	1250.00	0
4	1500.00	2000.00	1750.00	0
5	2000.00	2500.00	2250.00	0
6	2500.00	3000.00	2750.00	0
7	3000.00	3500.00	3250.00	66
8	3500.00	4000.00	3750.00	0
9	4000.00	4500.00	4250.00	0
10	4500.00	5000.00	4750.00	0
11	5000.00	5500.00	5250.00	0
12	5500.00	6000.00	5750.00	0
13	6000.00	6500.00	6250.00	0
14	6500.00	7000.00	6750.00	0
15	7000.00	7500.00	7250.00	0
16	7500.00	8000.00	7750.00	0
17	8000.00	8500.00	8250.00	1 ✓
18	8500.00	9000.00	8750.00	0
19	9000.00	9500.00	9250.00	0
20	9500.00	10000.00	9750.00	33

total number in bins = 100

for subarea = 2

bin number	lower limit	upper limit	midpt bin	frequency
1	0.00	500.00	250.00	0
2	500.00	1000.00	750.00	0
3	1000.00	1500.00	1250.00	0
4	1500.00	2000.00	1750.00	0
5	2000.00	2500.00	2250.00	0
6	2500.00	3000.00	2750.00	0
7	3000.00	3500.00	3250.00	71
8	3500.00	4000.00	3750.00	0
9	4000.00	4500.00	4250.00	0
10	4500.00	5000.00	4750.00	0
11	5000.00	5500.00	5250.00	0
12	5500.00	6000.00	5750.00	0
13	6000.00	6500.00	6250.00	0
14	6500.00	7000.00	6750.00	0
15	7000.00	7500.00	7250.00	1 ✓
16	7500.00	8000.00	7750.00	0
17	8000.00	8500.00	8250.00	0
18	8500.00	9000.00	8750.00	0
19	9000.00	9500.00	9250.00	0
20	9500.00	10000.00	9750.00	28

total number in bins = 100

for subarea = 3

bin number	lower limit	upper limit	midpt bin	frequency
1	0.00	500.00	250.00	0

2	500.00	1000.00	750.00	0
3	1000.00	1500.00	1250.00	0
4	1500.00	2000.00	1750.00	0
5	2000.00	2500.00	2250.00	0
6	2500.00	3000.00	2750.00	0
7	3000.00	3500.00	3250.00	63
8	3500.00	4000.00	3750.00	1
9	4000.00	4500.00	4250.00	0
10	4500.00	5000.00	4750.00	0
11	5000.00	5500.00	5250.00	0
12	5500.00	6000.00	5750.00	0
13	6000.00	6500.00	6250.00	0
14	6500.00	7000.00	6750.00	0
15	7000.00	7500.00	7250.00	0
16	7500.00	8000.00	7750.00	0
17	8000.00	8500.00	8250.00	0
18	8500.00	9000.00	8750.00	0
19	9000.00	9500.00	9250.00	0
20	9500.00	10000.00	9750.00	36

total number in bins = 100

for subarea = 4

bin number	lower limit	upper limit	midpt bin	frequency
1	0.00	500.00	250.00	0
2	500.00	1000.00	750.00	0
3	1000.00	1500.00	1250.00	0
4	1500.00	2000.00	1750.00	0
5	2000.00	2500.00	2250.00	0
6	2500.00	3000.00	2750.00	0
7	3000.00	3500.00	3250.00	51
8	3500.00	4000.00	3750.00	0
9	4000.00	4500.00	4250.00	0
10	4500.00	5000.00	4750.00	0
11	5000.00	5500.00	5250.00	0
12	5500.00	6000.00	5750.00	0
13	6000.00	6500.00	6250.00	0
14	6500.00	7000.00	6750.00	0
15	7000.00	7500.00	7250.00	1
16	7500.00	8000.00	7750.00	0
17	8000.00	8500.00	8250.00	0
18	8500.00	9000.00	8750.00	0
19	9000.00	9500.00	9250.00	0
20	9500.00	10000.00	9750.00	48

total number in bins = 100

for subarea = 5

bin number	lower limit	upper limit	midpt bin	frequency
1	0.00	500.00	250.00	0
2	500.00	1000.00	750.00	0
3	1000.00	1500.00	1250.00	0
4	1500.00	2000.00	1750.00	0
5	2000.00	2500.00	2250.00	0
6	2500.00	3000.00	2750.00	0
7	3000.00	3500.00	3250.00	0
8	3500.00	4000.00	3750.00	0
9	4000.00	4500.00	4250.00	0
10	4500.00	5000.00	4750.00	0
11	5000.00	5500.00	5250.00	0

12	5500.00	6000.00	5750.00	0
13	6000.00	6500.00	6250.00	0
14	6500.00	7000.00	6750.00	0
15	7000.00	7500.00	7250.00	0
16	7500.00	8000.00	7750.00	0
17	8000.00	8500.00	8250.00	0
18	8500.00	9000.00	8750.00	0
19	9000.00	9500.00	9250.00	0
20	9500.00	10000.00	9750.00	100

total number in bins = 100

for subarea = 6

bin number	lower limit	upper limit	midpt bin	frequency
1	0.00	500.00	250.00	0
2	500.00	1000.00	750.00	0
3	1000.00	1500.00	1250.00	0
4	1500.00	2000.00	1750.00	0
5	2000.00	2500.00	2250.00	0
6	2500.00	3000.00	2750.00	0
7	3000.00	3500.00	3250.00	0
8	3500.00	4000.00	3750.00	24
9	4000.00	4500.00	4250.00	0
10	4500.00	5000.00	4750.00	0
11	5000.00	5500.00	5250.00	0
12	5500.00	6000.00	5750.00	0
13	6000.00	6500.00	6250.00	0
14	6500.00	7000.00	6750.00	0
15	7000.00	7500.00	7250.00	0
16	7500.00	8000.00	7750.00	0
17	8000.00	8500.00	8250.00	1
18	8500.00	9000.00	8750.00	0
19	9000.00	9500.00	9250.00	0
20	9500.00	10000.00	9750.00	75

total number in bins = 100

for subarea = 7

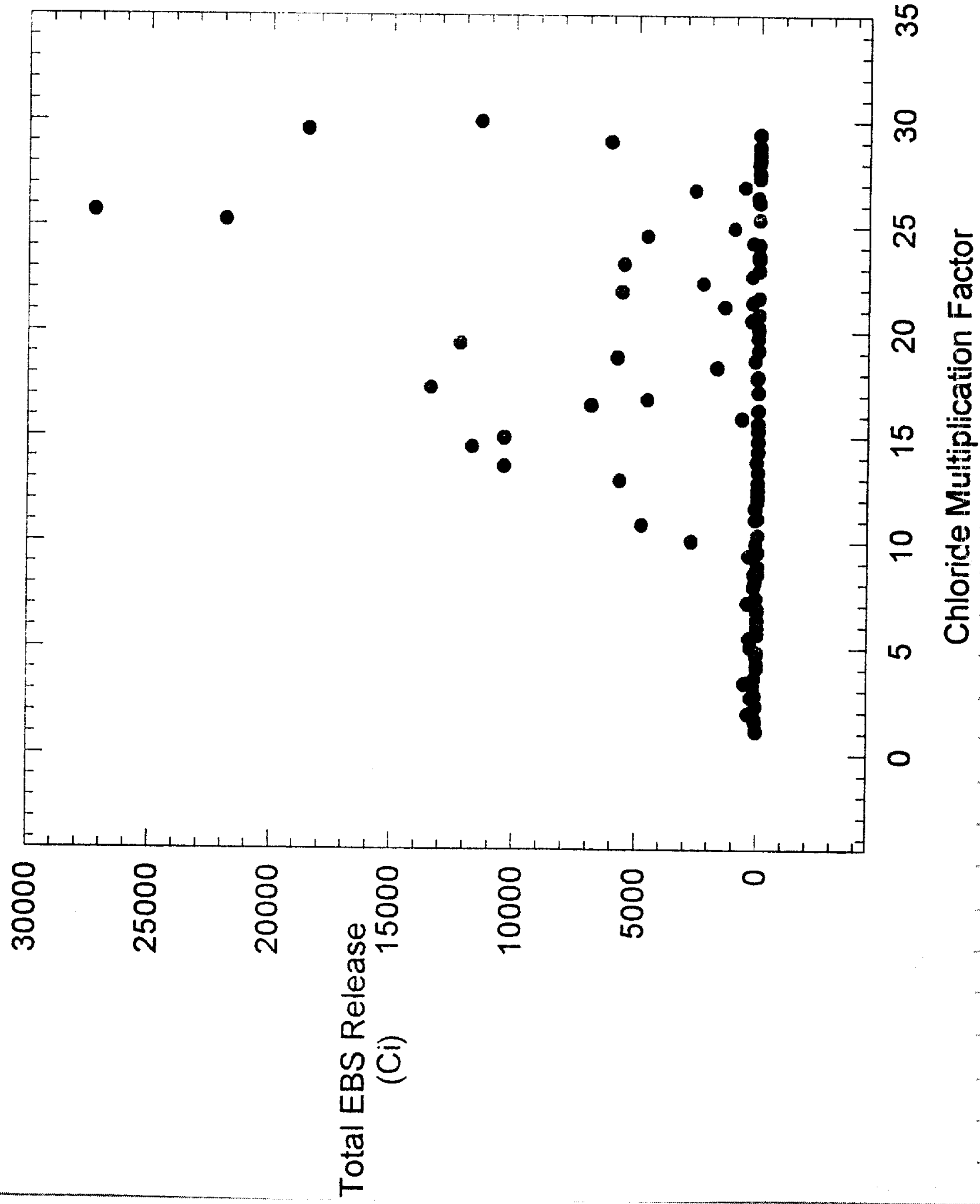
bin number	lower limit	upper limit	midpt bin	frequency
1	0.00	500.00	250.00	0
2	500.00	1000.00	750.00	0
3	1000.00	1500.00	1250.00	0
4	1500.00	2000.00	1750.00	0
5	2000.00	2500.00	2250.00	0
6	2500.00	3000.00	2750.00	0
7	3000.00	3500.00	3250.00	0
8	3500.00	4000.00	3750.00	0
9	4000.00	4500.00	4250.00	0
10	4500.00	5000.00	4750.00	0
11	5000.00	5500.00	5250.00	0
12	5500.00	6000.00	5750.00	0
13	6000.00	6500.00	6250.00	0
14	6500.00	7000.00	6750.00	0
15	7000.00	7500.00	7250.00	0
16	7500.00	8000.00	7750.00	0
17	8000.00	8500.00	8250.00	0
18	8500.00	9000.00	8750.00	0
19	9000.00	9500.00	9250.00	0
20	9500.00	10000.00	9750.00	100

total number in bins = 100

WP failure time

failure times by subarea for CMF = 1 to 30 (uniform) and 100 vectors								
vector	CMF	sa1	sa2	sa3	sa4	sa5	sa6	sa7
98	1.1	10000	10000	10000	10000	10000	10000	10000
57	1.5	10000	10000	10000	10000	10000	10000	10000
69	1.7	10000	10000	10000	10000	10000	10000	10000
32	1.9	10000	10000	10000	10000	10000	10000	10000
9	2.3	10000	10000	10000	10000	10000	10000	10000
34	2.7	10000	10000	10000	10000	10000	10000	10000
30	2.8	10000	10000	10000	10000	10000	10000	10000
84	3.3	10000	10000	10000	10000	10000	10000	10000
93	3.4	10000	10000	10000	10000	10000	10000	10000
45	3.6	10000	10000	10000	10000	10000	10000	10000
8	4.1	10000	10000	10000	10000	10000	10000	10000
35	4.3	10000	10000	10000	10000	10000	10000	10000
5	4.7	10000	10000	10000	10000	10000	10000	10000
64	4.8	10000	10000	10000	10000	10000	10000	10000
48	5.1	10000	10000	10000	10000	10000	10000	10000
39	5.5	10000	10000	10000	10000	10000	10000	10000
54	5.7	10000	10000	10000	10000	10000	10000	10000
67	6.0	10000	10000	10000	10000	10000	10000	10000
87	6.4	10000	10000	10000	10000	10000	10000	10000
88	6.7	10000	10000	10000	10000	10000	10000	10000
47	6.9	10000	10000	10000	10000	10000	10000	10000
19	7.2	10000	10000	10000	10000	10000	10000	10000
49	7.4	10000	10000	10000	10000	10000	10000	10000
94	7.9	10000	10000	10000	10000	10000	10000	10000
28	8.2	10000	10000	10000	10000	10000	10000	10000
74	8.5	10000	10000	10000	10000	10000	10000	10000
75	8.6	10000	10000	10000	10000	10000	10000	10000
66	8.9	10000	10000	10000	10000	10000	10000	10000
50	9.4	10000	7205.3	10000	10000	10000	10000	10000
44	9.6	10000	3384.3	10000	10000	10000	10000	10000
79	10.0	10000	3384.3	10000	10000	10000	10000	10000
85	10.1	10000	3384.3	10000	10000	10000	10000	10000
83	10.4	10000	3384.3	10000	10000	10000	10000	10000
3	10.9	8101.3	3384.3	10000	10000	10000	10000	10000
40	11.1	3384.3	3384.3	10000	10000	10000	10000	10000
20	11.2	3384.3	3384.3	10000	10000	10000	10000	10000
80	11.7	3384.3	3384.3	3634.7	10000	10000	10000	10000
86	12.0	3384.3	3384.3	3384.3	10000	10000	10000	10000
46	12.2	3384.3	3384.3	3384.3	10000	10000	10000	10000
68	12.5	3384.3	3384.3	3384.3	10000	10000	10000	10000
10	12.8	3384.3	3384.3	3384.3	10000	10000	10000	10000
37	13.0	3384.3	3384.3	3384.3	10000	10000	10000	10000
53	13.4	3384.3	3384.3	3384.3	10000	10000	10000	10000
22	13.6	3384.3	3384.3	3384.3	10000	10000	10000	10000
29	13.8	3384.3	3384.3	3384.3	10000	10000	10000	10000
31	14.3	3384.3	3384.3	3384.3	10000	10000	10000	10000
73	14.5	3384.3	3384.3	3384.3	10000	10000	10000	10000
18	14.8	3384.3	3384.3	3384.3	10000	10000	10000	10000
77	15.0	3384.3	3384.3	3384.3	7038.2	10000	10000	10000
65	15.3	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
95	15.7	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
52	15.9	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
17	16.3	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
72	16.5	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
56	16.8	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
26	17.2	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
38	17.4	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
99	17.8	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
42	17.9	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
2	18.3	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
71	18.7	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
61	18.8	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
13	19.1	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
27	19.5	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
92	19.7	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
1	20.1	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
90	20.2	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
16	20.6	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
76	20.8	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
14	21.2	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
24	21.4	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
51	21.6	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
23	21.9	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
15	22.3	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
81	22.7	3384.3	3384.3	3384.3	3465.9	10000	10000	10000
89	22.9	3384.3	3384.3	3384.3	3465.9	10000	8293.3	10000
70	23.2	3384.3	3384.3	3384.3	3465.9	10000	3811.6	10000
63	23.5	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
97	23.7	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
7	24.1	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
62	24.2	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
36	24.5	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
4	24.9	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
58	25.3	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
96	25.4	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
12	25.7	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
55	26.2	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
11	26.4	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
100	26.7	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
21	26.9	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
33	27.3	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
78	27.6	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
41	28.0	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
25	28.1	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
43	28.5	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
82	28.8	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
6	29.0	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
91	29.4	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
59	29.6	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000
60	30.0	3384.3	3384.3	3384.3	3465.9	10000	3722.1	10000

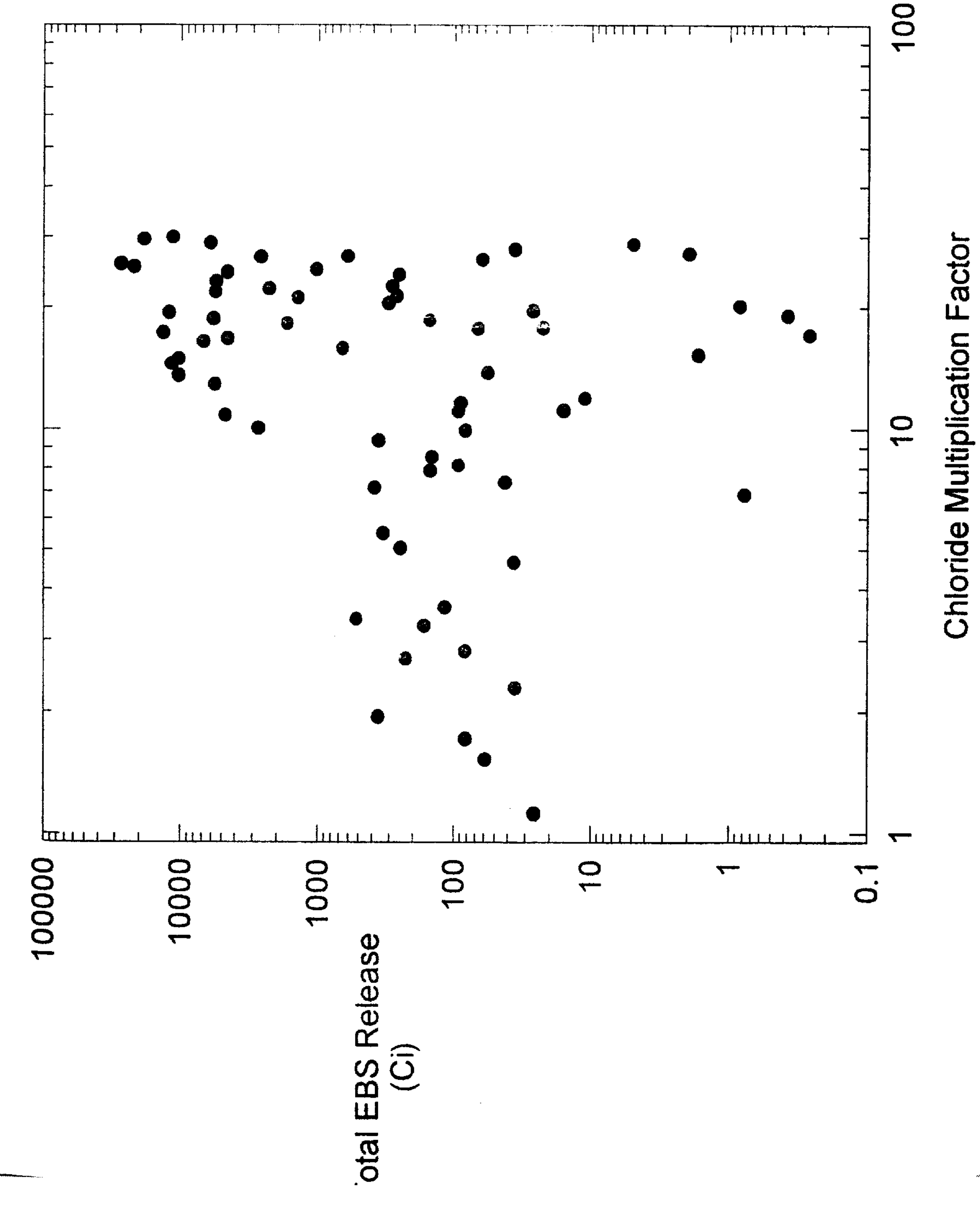
J- Plots of release from EBS for Case 7 in linear and logarithmic scale, and corresponding plot for dose (20 km critical group)



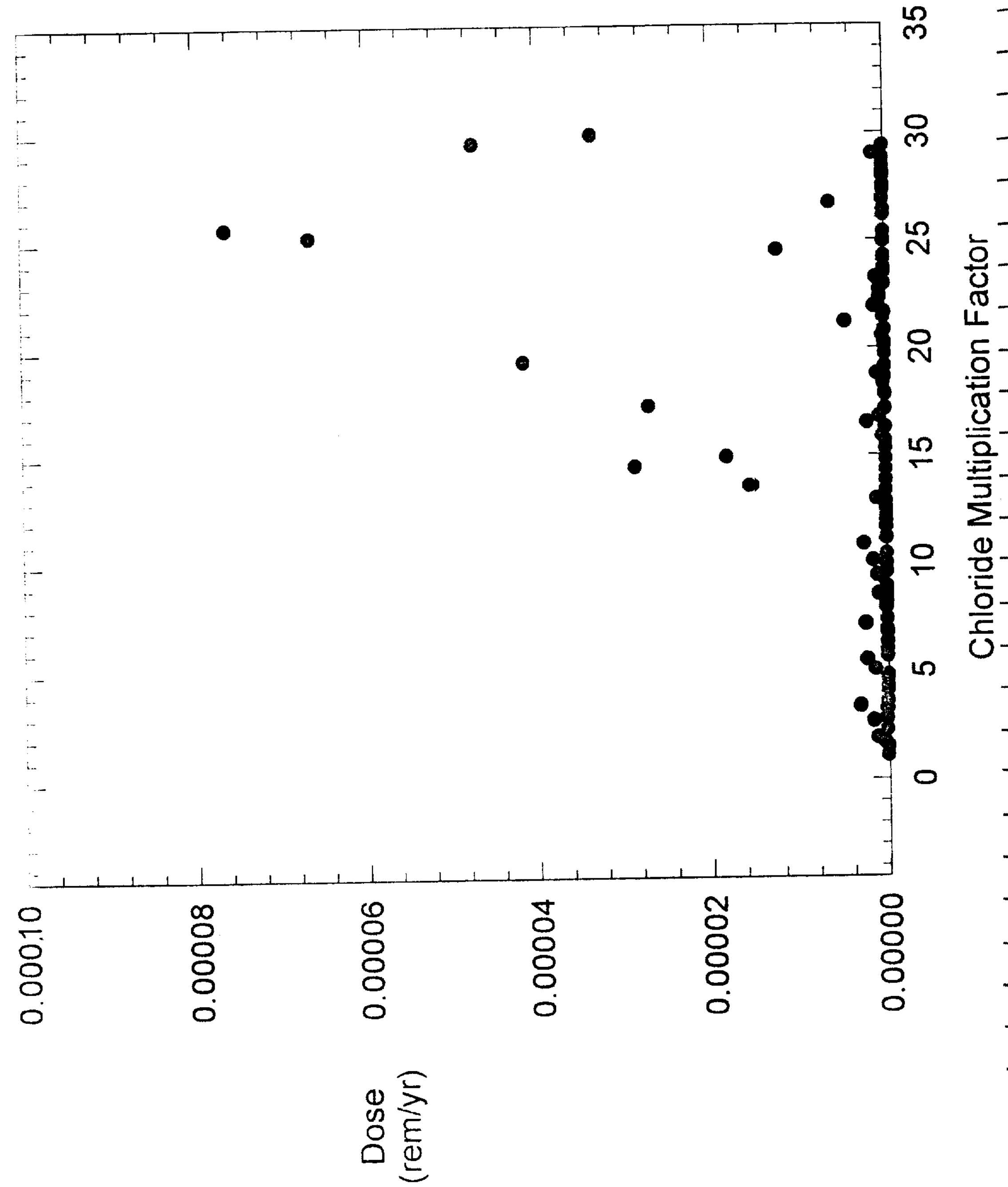
TPA3.1.1 Results of Total EBS Release (Ci) for Chloride Multiplication Factors 1 to 30 (uniform) (10,000 years and 100 Vectors)

5- Plots of release from EBS for Case 7 in linear and logarithmic scale, and corresponding plot for dose (20 km critical group)

TPA3.1.1 Results of Total EBS Release (Ci) for Chloride Multiplication Factors 1 to 30 (uniform) (10,000 years and 100 Vectors)



5- Plots of release from EBS for Case 7 in linear and logarithmic scale. and corresponding plot for dose (20 km critical group)



TPA3.1.1 Results of Dose (rem/yr) for Chloride Multiplication Factors 1 to 30 (uniform) (10,000 years, 100 Vectors, and 20 km Critical Group)

Case 8: Number of realizations: 10
Simulation time: 30 000 yr
Chloride Multiplication factor: constant (15.5)
Oxygen partial pressure: constant (0.21 at)

subarea = 4
average wp fail time = 3478.5000000000

1	9	5	0.9000	28629.8000
2	10	5	0.8000	28629.8000
3	3	5	0.7000	28629.8000
4	4	5	0.6000	28629.8000
5	1	5	0.5000	28629.8000
6	2	5	0.4000	28629.8000
7	8	5	0.3000	28629.8000
8	7	5	0.2000	28629.8000
9	5	5	0.1000	28629.8000
10	6	5	0.0000	28629.8000

subarea = 5
average wp fail time = 28629.800000000

1	7	6	0.9000	27968.1000
2	8	6	0.8000	27968.1000
3	2	6	0.7000	27968.1000
4	3	6	0.6000	27968.1000
5	1	6	0.5000	27968.1000
6	10	6	0.4000	27968.1000
7	6	6	0.3000	27968.1000
8	5	6	0.2000	27968.1000
9	9	6	0.1000	27968.1000
10	4	6	0.0000	27968.1000

subarea = 6
average wp fail time = 27968.100000000

1	9	7	0.9000	28629.8000
2	8	7	0.8000	28629.8000
3	10	7	0.7000	28629.8000
4	2	7	0.6000	28629.8000
5	3	7	0.5000	28629.8000
6	1	7	0.4000	28629.8000
7	6	7	0.3000	28629.8000
8	7	7	0.2000	28629.8000
9	4	7	0.1000	28629.8000
10	5	7	0.0000	28629.8000

subarea = 7
average wp fail time = 28629.800000000

icount= 70

there are 10 vectors
subareas = 7
sim time = 30000.000000000

1	4	1	0.9000	3307.8000
2	9	1	0.8000	3307.8000
3	10	1	0.7000	3307.8000
4	3	1	0.6000	3307.8000
5	6	1	0.5000	3307.8000
6	5	1	0.4000	3307.8000
7	7	1	0.3000	3307.8000
8	2	1	0.2000	3307.8000
9	8	1	0.1000	3307.8000
10	1	1	0.0000	3307.8000

subarea = 1
average wp fail time = 3307.8000000000

1	4	2	0.9000	3307.8000
2	3	2	0.8000	3307.8000
3	10	2	0.7000	3307.8000
4	6	2	0.6000	3307.8000
5	5	2	0.5000	3307.8000
6	7	2	0.4000	3307.8000
7	9	2	0.3000	3307.8000
8	2	2	0.2000	3307.8000
9	1	2	0.1000	3307.8000
10	8	2	0.0000	3307.8000

subarea = 2
average wp fail time = 3307.8000000000

1	8	3	0.9000	3392.2000
2	7	3	0.8000	3392.2000
3	1	3	0.7000	3392.2000
4	5	3	0.6000	3392.2000
5	6	3	0.5000	3392.2000
6	9	3	0.4000	3392.2000
7	10	3	0.3000	3392.2000
8	3	3	0.2000	3392.2000
9	2	3	0.1000	3392.2000
10	4	3	0.0000	3392.2000

subarea = 3
average wp fail time = 3392.2000000000

1	3	4	0.9000	3478.5000
2	2	4	0.8000	3478.5000
3	6	4	0.7000	3478.5000
4	10	4	0.6000	3478.5000
5	7	4	0.5000	3478.5000
6	8	4	0.4000	3478.5000
7	4	4	0.3000	3478.5000
8	9	4	0.2000	3478.5000
9	5	4	0.1000	3478.5000
10	1	4	0.0000	3478.5000

```
icount=   70


there are   10 vectors
 # subareas =    7
 sim time =      30000.000000000

    1          4          1          0.9000         3307.8000
    2          9          1          0.8000         3307.8000
    3         10          1          0.7000         3307.8000
    4          3          1          0.6000         3307.8000
    5          6          1          0.5000         3307.8000
    6          5          1          0.4000         3307.8000
    7          7          1          0.3000         3307.8000
    8          2          1          0.2000         3307.8000
    9          8          1          0.1000         3307.8000
   10          1          1          0.0000         3307.8000

 subarea =     1
 average wp fail time =      3307.8000000000

    1          4          2          0.9000         3307.8000
    2          3          2          0.8000         3307.8000
    3         10          2          0.7000         3307.8000
    4          6          2          0.6000         3307.8000
    5          5          2          0.5000         3307.8000
    6          7          2          0.4000         3307.8000
    7          9          2          0.3000         3307.8000
    8          2          2          0.2000         3307.8000
    9          1          2          0.1000         3307.8000
   10          8          2          0.0000         3307.8000

 subarea =     2
 average wp fail time =      3307.8000000000

    1          8          3          0.9000         3392.2000
    2          7          3          0.8000         3392.2000
    3          1          3          0.7000         3392.2000
    4          5          3          0.6000         3392.2000
    5          6          3          0.5000         3392.2000
    6          9          3          0.4000         3392.2000
    7         10          3          0.3000         3392.2000
    8          3          3          0.2000         3392.2000
    9          2          3          0.1000         3392.2000
   10          4          3          0.0000         3392.2000

 subarea =     3
 average wp fail time =      3392.2000000000

    1          3          4          0.9000         3478.5000
    2          2          4          0.8000         3478.5000
    3          6          4          0.7000         3478.5000
    4         10          4          0.6000         3478.5000
    5          7          4          0.5000         3478.5000
    6          8          4          0.4000         3478.5000
    7          4          4          0.3000         3478.5000
    8          9          4          0.2000         3478.5000
    9          5          4          0.1000         3478.5000
   10          1          4          0.0000         3478.5000
```

Case 9 Number of realizations: 10
Simulation time: 30,000 yr.
Chloride Multiplication Factor: Constant (1.0)
Oxygen partial pressure: Constant (0.21 at

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icount= 70

there are 10 vectors
subareas = 7
sim time = 30000.000000000

the average failure time (yr) is 27880.042857143

1	4	1	0.9000	27321.5000
2	10	1	0.8000	27321.5000
3	7	1	0.7000	27321.5000
4	5	1	0.6000	27321.5000
5	6	1	0.5000	27321.5000
6	8	1	0.4000	27321.5000
7	2	1	0.3000	27321.5000
8	1	1	0.2000	27321.5000
9	9	1	0.1000	27321.5000
10	3	1	0.0000	27321.5000

subarea = 1
average wp fail time = 27321.500000000

1	4	2	0.9000	27321.5000
2	7	2	0.8000	27321.5000
3	10	2	0.7000	27321.5000
4	6	2	0.6000	27321.5000
5	9	2	0.5000	27321.5000
6	5	2	0.4000	27321.5000
7	8	2	0.3000	27321.5000
8	1	2	0.2000	27321.5000
9	3	2	0.1000	27321.5000
10	2	2	0.0000	27321.5000

subarea = 2
average wp fail time = 27321.500000000

1	4	3	0.9000	27321.5000
2	7	3	0.8000	27321.5000
3	3	3	0.7000	27321.5000
4	6	3	0.6000	27321.5000
5	5	3	0.5000	27321.5000
6	9	3	0.4000	27321.5000
7	8	3	0.3000	27321.5000
8	1	3	0.2000	27321.5000
9	10	3	0.1000	27321.5000
10	2	3	0.0000	27321.5000

subarea = 3
average wp fail time = 27321.500000000

1	8	4	0.9000	27968.1000
2	6	4	0.8000	27968.1000
3	7	4	0.7000	27968.1000
4	10	4	0.6000	27968.1000
5	2	4	0.5000	27968.1000
6	3	4	0.4000	27968.1000
7	1	4	0.3000	27968.1000
8	9	4	0.2000	27968.1000
9	5	4	0.1000	27968.1000

10	4	4	0.0000	27968.1000

subarea = 4
average wp fail time = 27968.100000000

1	10	5	0.9000	28629.8000
2	9	5	0.8000	28629.8000
3	3	5	0.7000	28629.8000
4	4	5	0.6000	28629.8000
5	1	5	0.5000	28629.8000
6	2	5	0.4000	28629.8000
7	8	5	0.3000	28629.8000
8	7	5	0.2000	28629.8000
9	5	5	0.1000	28629.8000
10	6	5	0.0000	28629.8000

subarea = 5
average wp fail time = 28629.800000000

1	6	6	0.9000	27968.1000
2	7	6	0.8000	27968.1000
3	8	6	0.7000	27968.1000
4	2	6	0.6000	27968.1000
5	1	6	0.5000	27968.1000
6	10	6	0.4000	27968.1000
7	9	6	0.3000	27968.1000
8	5	6	0.2000	27968.1000
9	3	6	0.1000	27968.1000
10	4	6	0.0000	27968.1000

subarea = 6
average wp fail time = 27968.100000000

1	8	7	0.9000	28629.8000
2	9	7	0.8000	28629.8000
3	10	7	0.7000	28629.8000
4	2	7	0.6000	28629.8000
5	3	7	0.5000	28629.8000
6	1	7	0.4000	28629.8000
7	6	7	0.3000	28629.8000
8	7	7	0.2000	28629.8000
9	4	7	0.1000	28629.8000
10	5	7	0.0000	28629.8000

subarea = 7
average wp fail time = 28629.800000000

Case 10: Number of realizations : 30
Simulation time : 30,000 yr
Chloride Multiplication factor : constant (15.5)
Oxygen partial pressure : constant (0.21 at)

[signature]
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icount= 210

there are 30 vectors
subareas = 7
sim time = 30000.000000000

1	13	1	0.9667	3307.8000
2	12	1	0.9333	3307.8000
3	27	1	0.9000	3307.8000
4	15	1	0.8667	3307.8000
5	14	1	0.8333	3307.8000
6	9	1	0.8000	3307.8000
7	8	1	0.7667	3307.8000
8	29	1	0.7333	3307.8000
9	11	1	0.7000	3307.8000
10	28	1	0.6667	3307.8000
11	10	1	0.6333	3307.8000
12	25	1	0.6000	3307.8000
13	21	1	0.5667	3307.8000
14	24	1	0.5333	3307.8000
15	22	1	0.5000	3307.8000
16	23	1	0.4667	3307.8000
17	16	1	0.4333	3307.8000
18	17	1	0.4000	3307.8000
19	20	1	0.3667	3307.8000
20	19	1	0.3333	3307.8000
21	26	1	0.3000	3307.8000
22	18	1	0.2667	3307.8000
23	4	1	0.2333	3307.8000
24	30	1	0.2000	3307.8000
25	6	1	0.1667	3307.8000
26	5	1	0.1333	3307.8000
27	2	1	0.1000	3307.8000
28	1	1	0.0667	3307.8000
29	3	1	0.0333	3307.8000
30	7	1	0.0000	3307.8000

subarea = 1
average wp fail time = 3307.8000000000

1	13	2	0.9667	3307.8000
2	12	2	0.9333	3307.8000
3	11	2	0.9000	3307.8000
4	27	2	0.8667	3307.8000
5	14	2	0.8333	3307.8000
6	15	2	0.8000	3307.8000
7	8	2	0.7667	3307.8000
8	28	2	0.7333	3307.8000
9	9	2	0.7000	3307.8000
10	10	2	0.6667	3307.8000
11	7	2	0.6333	3307.8000
12	21	2	0.6000	3307.8000
13	25	2	0.5667	3307.8000
14	20	2	0.5333	3307.8000
15	23	2	0.5000	3307.8000
16	22	2	0.4667	3307.8000
17	17	2	0.4333	3307.8000
18	26	2	0.4000	3307.8000
19	16	2	0.3667	3307.8000

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20	19	2	0.3333	3307.8000
21	18	2	0.3000	3307.8000
22	24	2	0.2667	3307.8000
23	4	2	0.2333	3307.8000
24	5	2	0.2000	3307.8000
25	6	2	0.1667	3307.8000
26	1	2	0.1333	3307.8000
27	30	2	0.1000	3307.8000
28	3	2	0.0667	3307.8000
29	2	2	0.0333	3307.8000
30	29	2	0.0000	3307.8000

subarea = 2
average wp fail time = 3307.8000000000

1	26	3	0.9667	3392.2000
2	3	3	0.9333	3392.2000
3	29	3	0.9000	3392.2000
4	17	3	0.8667	3392.2000
5	30	3	0.8333	3392.2000
6	14	3	0.8000	3392.2000
7	27	3	0.7667	3392.2000
8	16	3	0.7333	3392.2000
9	8	3	0.7000	3392.2000
10	4	3	0.6667	3392.2000
11	15	3	0.6333	3392.2000
12	13	3	0.6000	3392.2000
13	23	3	0.5667	3392.2000
14	1	3	0.5333	3392.2000
15	22	3	0.5000	3392.2000
16	24	3	0.4667	3392.2000
17	7	3	0.4333	3392.2000
18	18	3	0.4000	3392.2000
19	2	3	0.3667	3392.2000
20	19	3	0.3333	3392.2000
21	21	3	0.3000	3392.2000
22	20	3	0.2667	3392.2000
23	25	3	0.2333	3392.2000
24	9	3	0.2000	3392.2000
25	12	3	0.1667	3392.2000
26	5	3	0.1333	3392.2000
27	28	3	0.1000	3392.2000
28	6	3	0.0667	3392.2000
29	11	3	0.0333	3392.2000
30	10	3	0.0000	3392.2000

subarea = 3
average wp fail time = 3392.2000000000

1	19	4	0.9667	3478.5000
2	25	4	0.9333	3478.5000
3	2	4	0.9000	3478.5000
4	29	4	0.8667	3478.5000
5	17	4	0.8333	3478.5000
6	11	4	0.8000	3478.5000
7	30	4	0.7667	3478.5000
8	5	4	0.7333	3478.5000
9	18	4	0.7000	3478.5000
10	3	4	0.6667	3478.5000
11	24	4	0.6333	3478.5000

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12	23	4	0.6000	3478.5000
13	7	4	0.5667	3478.5000
14	28	4	0.5333	3478.5000
15	9	4	0.5000	3478.5000
16	20	4	0.4667	3478.5000
17	6	4	0.4333	3478.5000
18	10	4	0.4000	3478.5000
19	22	4	0.3667	3478.5000
20	21	4	0.3333	3478.5000
21	1	4	0.3000	3478.5000
22	27	4	0.2667	3478.5000
23	12	4	0.2333	3478.5000
24	4	4	0.2000	3478.5000
25	13	4	0.1667	3478.5000
26	14	4	0.1333	3478.5000
27	15	4	0.1000	3478.5000
28	8	4	0.0667	3478.5000
29	16	4	0.0333	3478.5000
30	26	4	0.0000	3478.5000

subarea = 4
average wp fail time = 3478.5000000000

1	25	5	0.9667	28629.8000
2	28	5	0.9333	28629.8000
3	26	5	0.9000	28629.8000
4	27	5	0.8667	28629.8000
5	30	5	0.8333	28629.8000
6	29	5	0.8000	28629.8000
7	24	5	0.7667	28629.8000
8	8	5	0.7333	28629.8000
9	7	5	0.7000	28629.8000
10	11	5	0.6667	28629.8000
11	9	5	0.6333	28629.8000
12	10	5	0.6000	28629.8000
13	2	5	0.5667	28629.8000
14	3	5	0.5333	28629.8000
15	1	5	0.5000	28629.8000
16	6	5	0.4667	28629.8000
17	5	5	0.4333	28629.8000
18	4	5	0.4000	28629.8000
19	20	5	0.3667	28629.8000
20	19	5	0.3333	28629.8000
21	18	5	0.3000	28629.8000
22	23	5	0.2667	28629.8000
23	21	5	0.2333	28629.8000
24	22	5	0.2000	28629.8000
25	12	5	0.1667	28629.8000
26	14	5	0.1333	28629.8000
27	13	5	0.1000	28629.8000
28	17	5	0.0667	28629.8000
29	15	5	0.0333	28629.8000
30	16	5	0.0000	28629.8000

subarea = 5
average wp fail time = 28629.800000000

1	14	6	0.9667	27968.1000
2	29	6	0.9333	27968.1000
3	1	6	0.9000	27968.1000

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4	28	6	0.8667	27968.1000
5	7	6	0.8333	27968.1000
6	20	6	0.8000	27968.1000
7	8	6	0.7667	27968.1000
8	12	6	0.7333	27968.1000
9	9	6	0.7000	27968.1000
10	13	6	0.6667	27968.1000
11	23	6	0.6333	27968.1000
12	21	6	0.6000	27968.1000
13	30	6	0.5667	27968.1000
14	22	6	0.5333	27968.1000
15	4	6	0.5000	27968.1000
16	24	6	0.4667	27968.1000
17	11	6	0.4333	27968.1000
18	18	6	0.4000	27968.1000
19	3	6	0.3667	27968.1000
20	25	6	0.3333	27968.1000
21	2	6	0.3000	27968.1000
22	16	6	0.2667	27968.1000
23	6	6	0.2333	27968.1000
24	27	6	0.2000	27968.1000
25	17	6	0.1667	27968.1000
26	10	6	0.1333	27968.1000
27	26	6	0.1000	27968.1000
28	19	6	0.0667	27968.1000
29	15	6	0.0333	27968.1000
30	5	6	0.0000	27968.1000

subarea = 6
average wp fail time = 27968.100000000

1	24	7	0.9667	28629.8000
2	28	7	0.9333	28629.8000
3	27	7	0.9000	28629.8000
4	26	7	0.8667	28629.8000
5	29	7	0.8333	28629.8000
6	25	7	0.8000	28629.8000
7	30	7	0.7667	28629.8000
8	8	7	0.7333	28629.8000
9	7	7	0.7000	28629.8000
10	6	7	0.6667	28629.8000
11	10	7	0.6333	28629.8000
12	9	7	0.6000	28629.8000
13	11	7	0.5667	28629.8000
14	2	7	0.5333	28629.8000
15	1	7	0.5000	28629.8000
16	5	7	0.4667	28629.8000
17	3	7	0.4333	28629.8000
18	4	7	0.4000	28629.8000
19	23	7	0.3667	28629.8000
20	19	7	0.3333	28629.8000
21	20	7	0.3000	28629.8000
22	18	7	0.2667	28629.8000
23	22	7	0.2333	28629.8000
24	21	7	0.2000	28629.8000
25	13	7	0.1667	28629.8000
26	14	7	0.1333	28629.8000
27	12	7	0.1000	28629.8000
28	17	7	0.0667	28629.8000
29	16	7	0.0333	28629.8000

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30	15	7	0.0000	28629.8000

subarea = 7
average wp fail time = 28629.800000000

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In addition to WP failure time the total EBS release and the dose for Case 10 are listed below from CUMREL XLS

Total EBS Release vector	Case10 cum rel (Ci)
1	1.19E+04
2	2.37E+04
3	3.51E+04
4	7.37E+03
5	4.12E+04
6	9.14E+04
7	5.09E+03
8	1.35E+04
9	2.38E+04
10	3.53E+04
11	3.99E+03
12	2.61E+04
13	5.76E+04
14	4.45E+04
15	4.65E+04
16	9.30E+02
17	8.75E+03
18	5.67E+04
19	5.42E+04
20	2.45E+04
21	1.52E+04
22	3.42E+04
23	3.69E+04
24	2.12E+04
25	6.10E+04
26	3.17E+04
27	1.47E+04
28	6.47E+04
29	4.89E+04
30	2.90E+04
average	3.23E+04
min	9.30E+02
max	9.14E+04

Dose vector	Case10 dose (rem/yr)
1	2.47E-04
2	3.43E-04
3	5.01E-04
4	1.53E-04
5	3.66E-04
6	1.20E-03
7	9.03E-05
8	2.41E-04
9	2.43E-05
10	7.04E-04
11	7.72E-05
12	6.15E-05
13	1.17E-03
14	6.89E-04
15	8.86E-04
16	1.41E-05
17	1.14E-04
18	7.58E-04
19	1.04E-03
20	4.18E-04
21	1.54E-04
22	7.12E-04
23	3.49E-05
24	3.54E-04
25	1.27E-03
26	6.70E-04
27	1.68E-05
28	1.11E-03
29	1.03E-03
30	6.17E-04
average	5.02E-04
min	1.41E-05
max	1.27E-03

Two runs will be performed using 100 realizations and simulation times of 10,000 and 30000 yrs. in which the Chloride Multiplication factor will be varied from 1 to 30 (uniform) and the oxygen partial pressure from 2.1×10^{-5} at to 0.21 at. (triangular with maximum at 0.21 at) These runs will be case 11 (started 10/10/97). and Case 12.

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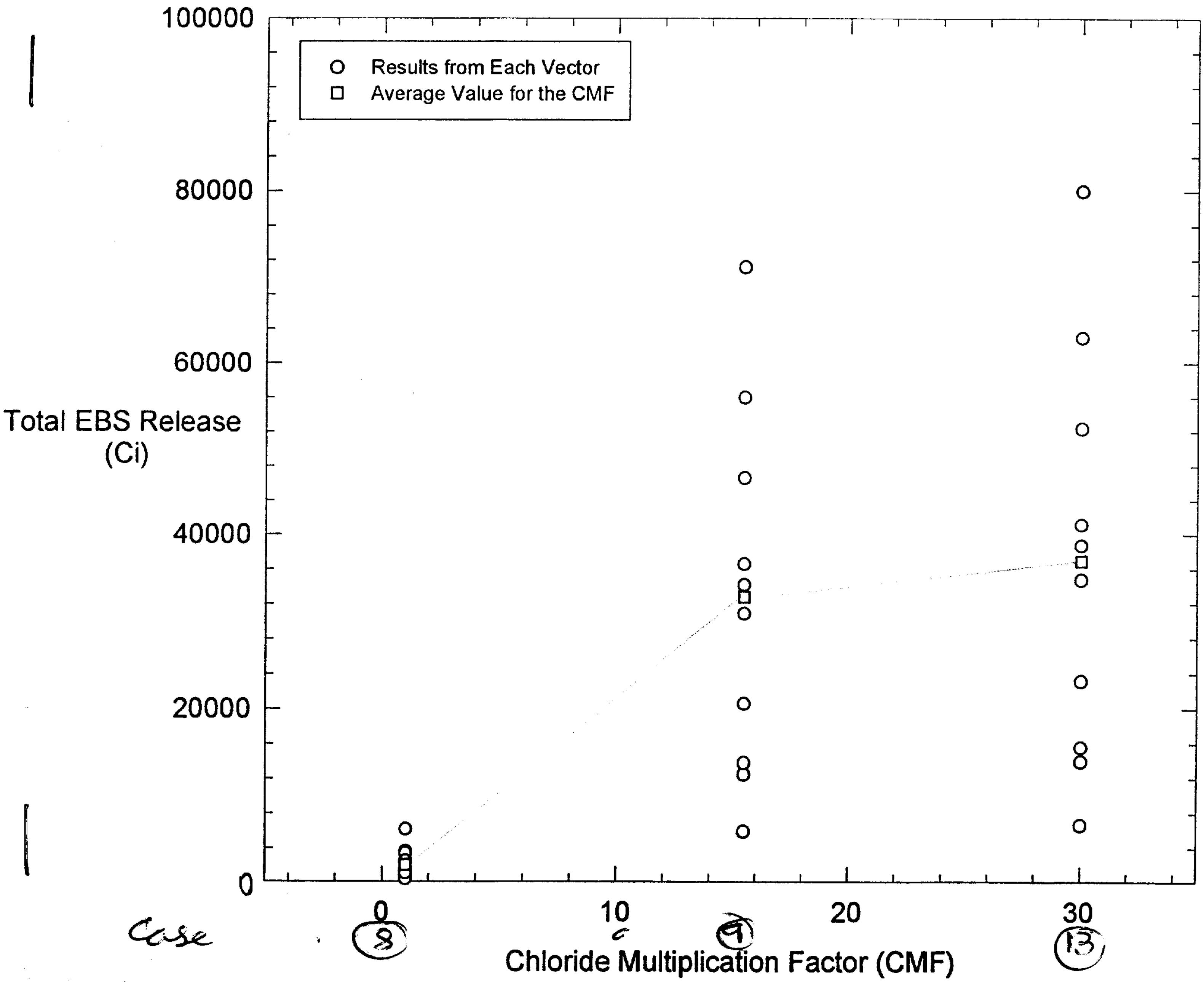
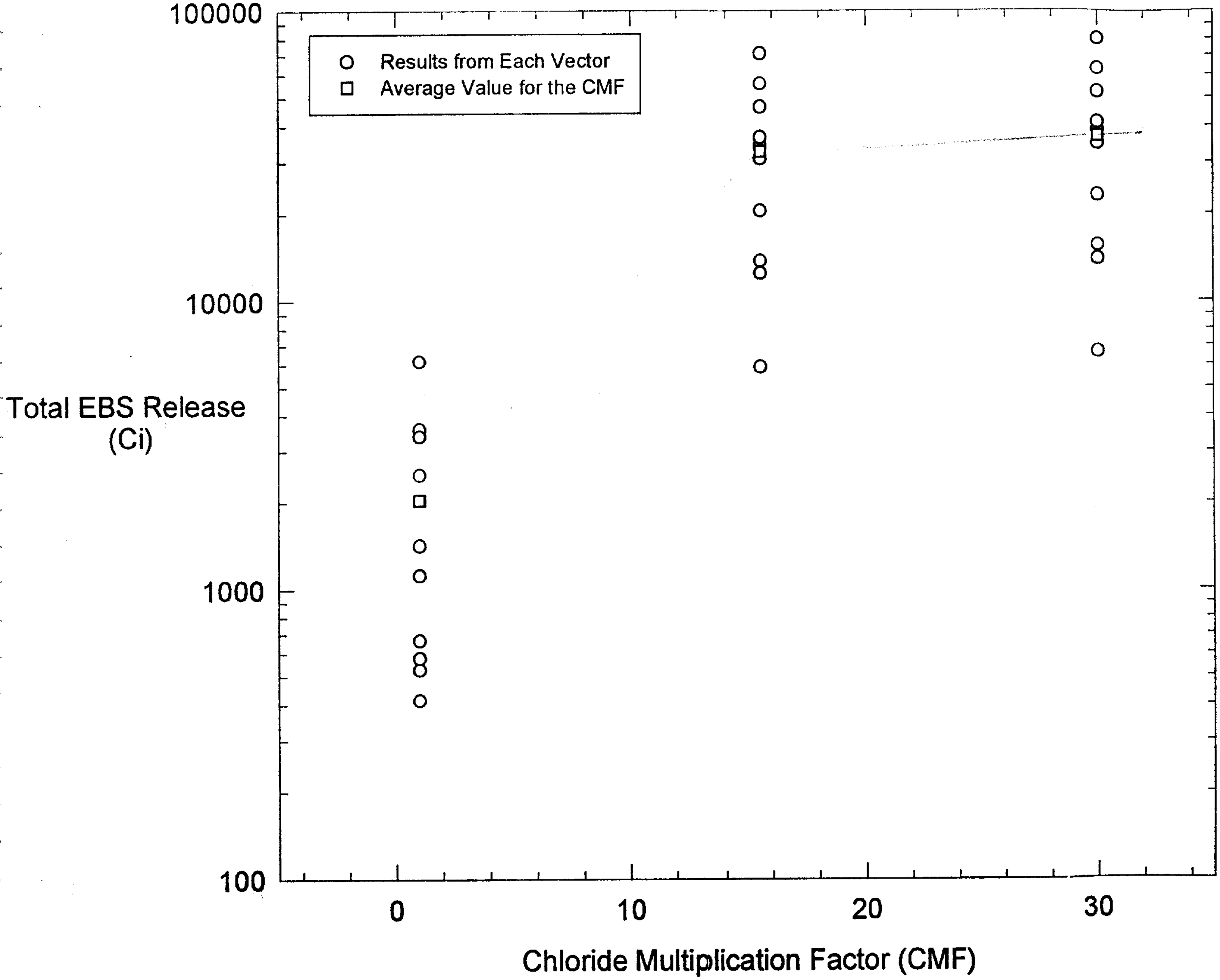
Case 13: Number of realizations 10
Simulation time: 30 000 yr
Chloride Multiplication factor: constant (30)
Oxygen partial pressure: Constant (0.21 at)

TPA3.1.1 Results of Total EBS Release (Ci) for Chloride Multiplication Factors of 1, 15.5, and 30 (30,000 years and 10 Vectors)



Case 13: Number of realizations 10 10/14/97
Simulation time: 30 000 yr
Chloride Multiplication factor: constant (30)
Oxygen partial pressure: Constant (0.21 at)

TPA3.1.1 Results of Total EBS Release (Ci) for Chloride Multiplication Factors of 1, 15.5, and 30 (30,000 years and 10 Vectors)



The summary of total EBS release for all cases with constant oxygen partial pressure of 0.21 at, base case for all input parameters and Chloride Multiplication factor constant at three different value are listed in the attached tables. The data corresponds to 10,000, 20,000 and 30,000 yr simulation time using 10 realizations (vectors). Data plotted in figures in p. 29 and p. 38.

CUMREL.XLS

Total EBS Release

vector	Case1 cum rel (Ci)	Case2 cum rel (Ci)	Case3 cum rel (Ci)	Case4 cum rel (Ci)	Case5 cum rel (Ci)	Case6 cum rel (Ci)	Case8 cum rel (Ci)	Case9 cum rel (Ci)	Case13 cum rel (Ci)
1	9.44E+00	3.30E+04	9.44E+00	6.18E+02	9.44E+00	3.72E+04	5.60E+04	3.59E+03	6.30E+04
2	0.00E+00	1.62E+02	0.00E+00	1.91E+01	0.00E+00	1.62E+02	3.42E+04	5.28E+02	3.88E+04
3	1.36E+04	3.35E+04	4.21E+02	5.58E+02	1.53E+04	3.78E+04	4.66E+04	3.39E+03	5.24E+04
4	0.00E+00	1.34E+04	0.00E+00	2.70E+02	0.00E+00	1.52E+04	3.09E+04	1.42E+03	3.48E+04
5	1.89E+04	4.93E+04	5.94E+02	7.97E+02	2.11E+04	5.57E+04	7.12E+04	6.18E+03	8.00E+04
6	0.00E+00	7.81E+03	0.00E+00	1.64E+02	0.00E+00	8.84E+03	2.06E+04	6.67E+02	2.32E+04
7	0.00E+00	2.21E+04	0.00E+00	4.05E+02	0.00E+00	2.49E+04	3.66E+04	2.49E+03	4.12E+04
8	0.00E+00	4.44E+03	0.00E+00	8.79E+01	0.00E+00	5.00E+03	1.25E+04	5.79E+02	1.40E+04
9	2.46E+02	4.00E+03	3.42E+01	7.37E+01	2.87E+02	4.50E+03	5.91E+03	4.14E+02	6.64E+03
10	2.21E+03	9.50E+03	1.02E+02	1.65E+02	2.48E+03	1.07E+04	1.38E+04	1.12E+03	1.56E+04
average	3.50E+03	1.77E+04	1.16E+02	3.16E+02	3.91E+03	2.00E+04	3.28E+04	2.04E+03	3.70E+04
min	0.00E+00	1.62E+02	0.00E+00	1.91E+01	0.00E+00	1.62E+02	5.91E+03	4.14E+02	6.64E+03
max	1.89E+04	4.93E+04	5.94E+02	7.97E+02	2.11E+04	5.57E+04	7.12E+04	6.18E+03	8.00E+04

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10/14/97

10/20/97

Case 14: Number of realizations: 100
Simulation time: 20,000 yr
Chloride Multiplication Factor: uniform (1-30)
Oxygen partial pressure: triangular
(2.1×10^{-5} at, 0.21 at, 0.21 at)

WP failure times for 20,000 years, 100 Vectors, and 5 km Critical Gr

time (year)	all subareas (a corrosion failure occurs at this time)
500	0
1500	0
2500	58
3500	60
4500	23
5500	8
6500	1
7500	0
8500	0
9500	2
10500	1
11500	0
12500	1
13500	3
14500	1
15500	6
16500	15
17500	11
18500	9
19500	10
no failures in any subarea for this vector	41

Because plots in p. 29 and 38 (see also table in p. 39) exhibited an increase in both EBS release and in dose (only data in EBS release is shown) when Chloride Multiplication Factor is increased from 1 to 15.5, three runs will be conducted at a Chloride Multiplication Factor of 8.25

Case 15: Simulation Time: 10,000 yr
Case 16: Simulation Time: 20,000 yr
Case 17: Simulation Time: 30,000 yr.

As before only 10 realizations will be performed using the input parameters for the base case and an oxygen partial pressure constant and equal to 0.21 at.

To complete the sensitivity analyses ~~3~~ 2 more runs will be performed to evaluate effect of flow parameters on EBS release and dose using 10 realizations and a simulation time of 10000 yr. Chloride Multiplication Factor will be constant at ~~one~~ 15.5 and oxygen partial pressure at 0.21 at.

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10/22/97

The list of all the runs conducted by Robert Rice are given below up to date. The number refers to the CASE # in previous pages following Gustavo

```
gustavo1
 TPA 3.1, Job started: Wed Oct  8 15:43:16 1997

gustavo2
 TPA 3.1, Job started: Wed Oct  8 16:30:28 1997

gustavo3
 TPA 3.1, Job started: Thu Oct  9 07:37:31 1997

gustavo4
 TPA 3.1, Job started: Thu Oct  9 08:13:41 1997

gustavo5
 TPA 3.1, Job started: Thu Oct  9 08:59:32 1997

gustavo6
 TPA 3.1, Job started: Thu Oct  9 09:27:06 1997

gustavo7
 TPA 3.1, Job started: Wed Oct  8 17:57:57 1997

gustavo8
 TPA 3.1, Job started: Thu Oct  9 10:28:53 1997

gustavo9
 TPA 3.1, Job started: Thu Oct  9 11:29:09 1997

gustavo10
 TPA 3.1, Job started: Thu Oct  9 14:25:53 1997

gustavo11
 TPA 3.1, Job started: Fri Oct 10 11:59:25 1997

gustavo12
 TPA 3.1, Job started: Mon Oct 13 07:44:46 1997

gustavo13
 TPA 3.1, Job started: Tue Oct 14 09:17:53 1997

gustavo14
 TPA 3.1, Job started: Fri Oct 17 16:41:56 1997

gustavo15
 TPA 3.1, Job started: Mon Oct 20 16:38:43 1997

gustavo16
 TPA 3.1, Job started: Mon Oct 20 17:04:27 1997

gustavo17
 TPA 3.1, Job started: Mon Oct 20 17:45:20 1997

gustavo18
 TPA 3.1, Job started: Mon Oct 20 18:46:56 1997

gustavo19
 TPA 3.1, Job started: Tue Oct 21 09:40:04 1997

gustavo20
 TPA 3.1, Job started: Tue Oct 21 10:31:00 1997
```

A brief description of all cases are gve is listed in the attached table (p. 43)

Two additional tables (p 44 and p 45) provide total EBS Release and DOSE for the cases in which 10 realizations were used to evaluate the effect of chloride

Summary of Cases for TPA3.1.1 Runs

Case	Realizations	time (yr)	Chloride Multiplication Factor	Oxygen Partial Pressure	Distance to Critical Group	Other
1	10	10,000	15.5	0.21	20	--
2	10	20,000	15.5	0.21	20	--
3	10	10,000	1	0.21	20	--
4	10	20,000	1	0.21	20	--
5	10	10,000	30	0.21	20	--
6	10	20,000	30	0.21	20	--
7	100	10,000	uniform (1 - 30)	0.21	20	--
8	10	30,000	15.5	0.21	20	--
9	10	30,000	1	0.21	20	--
10	30	30,000	15.5	0.21	20	--
11	100	10,000	uniform (1 - 30)	triangular (2.1e-5,2.1e-1,2.1e-1)	20	--
12	100	30,000	uniform (1 - 30)	triangular (2.1e-5,2.1e-1,2.1e-1)	20	--
13	10	30,000	30	0.21	20	--
14	100	20,000	uniform (1 - 30)	triangular (2.1e-5,2.1e-1,2.1e-1)	5	--
15	10	10,000	8.25	0.21	20	--
16	10	20,000	8.25	0.21	20	--
17	10	30,000	8.25	0.21	20	--
18	10	10,000	15.5	0.21	20	Fow = 1,FMult = 0.05, and SAWetFr = 0.5
19	10	10,000	15.5	0.21	20	Fow = 1,FMult = 0.05, SAWetFr = 0.5 (no corr)
20	100	20,000	uniform (1 - 30)	triangular (2.1e-5,2.1e-1,2.1e-1)	5	Fow = 1,FMult = 0.05, SAWetFr = 0.5 (no corr)

CUMREL.XLS

Total EBS Release

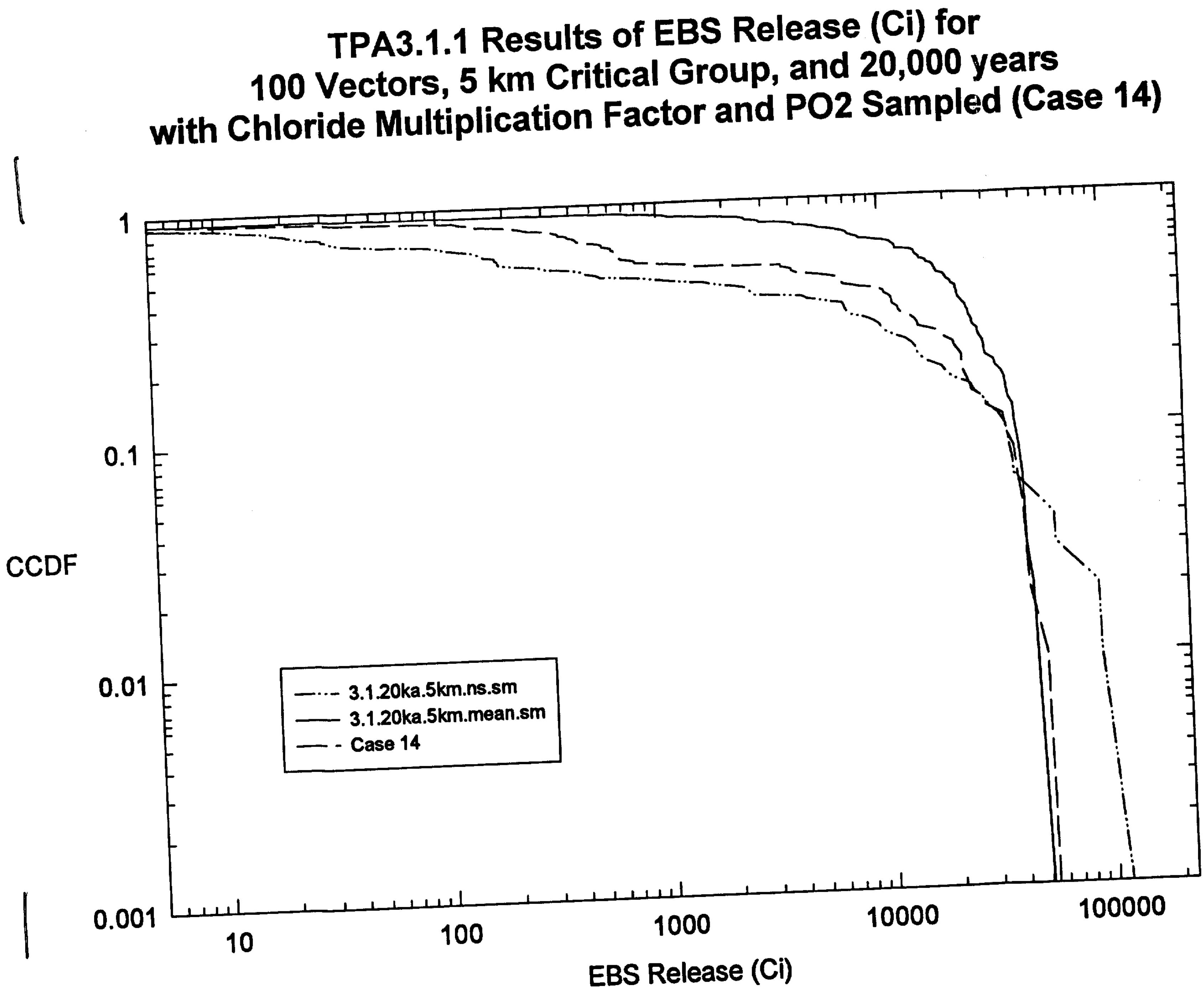
vector	Case1 cum rel (Ci)	Case2 cum rel (Ci)	Case3 cum rel (Ci)	Case4 cum rel (Ci)	Case5 cum rel (Ci)	Case6 cum rel (Ci)	Case8 cum rel (Ci)	Case9 cum rel (Ci)	Case13 cum rel (Ci)	Case 15 cum rel (Ci)	Case 16 cum rel (Ci)	Case 17 cum rel (Ci)	Case 18 cum rel (Ci)
1	9.44E+00	3.30E+04	9.44E+00	6.18E+02	9.44E+00	3.72E+04	5.60E+04	3.59E+03	6.30E+04	9.44E+00	6.18E+02	3.59E+03	5.11E+03
2	0.00E+00	1.62E+02	0.00E+00	1.91E+01	0.00E+00	1.62E+02	3.42E+04	5.28E+02	3.88E+04	0.00E+00	1.91E+01	5.28E+02	9.15E+03
3	1.36E+04	3.35E+04	4.21E+02	5.58E+02	1.53E+04	3.78E+04	4.66E+04	3.39E+03	5.24E+04	4.21E+02	5.58E+02	3.39E+03	1.02E+04
4	0.00E+00	1.34E+04	0.00E+00	2.70E+02	0.00E+00	1.52E+04	3.09E+04	1.42E+03	3.48E+04	0.00E+00	2.70E+02	1.42E+03	1.10E+04
5	1.89E+04	4.93E+04	5.94E+02	7.97E+02	2.11E+04	5.57E+04	7.12E+04	6.18E+03	8.00E+04	5.94E+02	7.97E+02	6.18E+03	1.21E+04
6	0.00E+00	7.81E+03	0.00E+00	1.64E+02	0.00E+00	8.84E+03	2.06E+04	6.67E+02	2.32E+04	0.00E+00	1.64E+02	6.67E+02	1.23E+04
7	0.00E+00	2.21E+04	0.00E+00	4.05E+02	0.00E+00	2.49E+04	3.66E+04	2.49E+03	4.12E+04	0.00E+00	4.05E+02	2.49E+03	1.34E+04
8	0.00E+00	4.44E+03	0.00E+00	8.79E+01	0.00E+00	5.00E+03	1.25E+04	5.79E+02	1.40E+04	0.00E+00	8.79E+01	5.79E+02	1.34E+04
9	2.46E+02	4.00E+03	3.42E+01	7.37E+01	2.87E+02	4.50E+03	5.91E+03	4.14E+02	6.64E+03	3.42E+01	7.37E+01	4.14E+02	1.39E+04
10	2.21E+03	9.50E+03	1.02E+02	1.65E+02	2.48E+03	1.07E+04	1.38E+04	1.12E+03	1.56E+04	1.02E+02	1.65E+02	1.12E+03	1.46E+04
average	3.50E+03	1.77E+04	1.16E+02	3.16E+02	3.91E+03	2.00E+04	3.28E+04	2.04E+03	3.70E+04	1.16E+02	3.16E+02	2.04E+03	1.15E+04
min	0.00E+00	1.62E+02	0.00E+00	1.91E+01	0.00E+00	1.62E+02	5.91E+03	4.14E+02	6.64E+03	0.00E+00	1.91E+01	4.14E+02	5.11E+03
max	1.89E+04	4.93E+04	5.94E+02	7.97E+02	2.11E+04	5.57E+04	7.12E+04	6.18E+03	8.00E+04	5.94E+02	7.97E+02	6.18E+03	1.46E+04

CUMREL.XLS

Dose

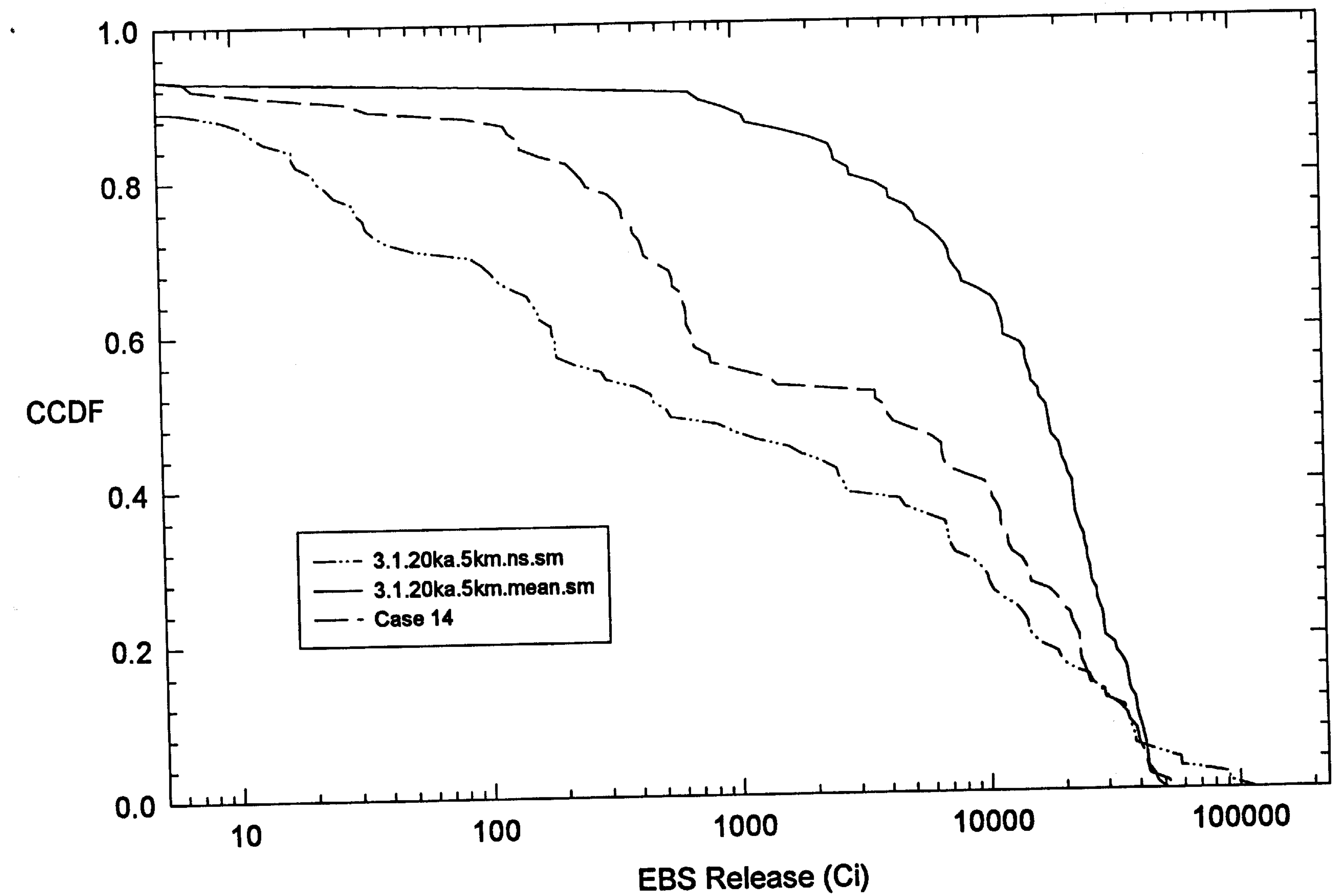
vector	Case1 dose (rem/yr)	Case2 dose (rem/yr)	Case3 dose (rem/yr)	Case4 dose (rem/yr)	Case5 dose (rem/yr)	Case6 dose (rem/yr)	Case8 dose (rem/yr)	Case9 dose (rem/yr)	Case13 dose (rem/yr)	Case 15 dose (rem/yr)	Case 16 dose (rem/yr)	Case 17 dose (rem/yr)	Case 18 dose (rem/yr)
1	0.00E+00	5.83E-05	0.00E+00	1.43E-06	0.00E+00	6.23E-05	1.06E-03	2.80E-05	1.33E-03	0.00E+00	1.43E-06	2.80E-05	3.61E-05
2	0.00E+00	1.04E-19	0.00E+00	1.04E-19	0.00E+00	1.04E-19	4.61E-05	9.27E-07	5.06E-05	0.00E+00	1.04E-19	9.27E-07	2.38E-05
3	4.63E-05	4.47E-04	3.16E-06	1.80E-05	4.64E-05	4.77E-04	8.54E-04	4.58E-05	1.20E-03	3.16E-06	1.80E-05	4.58E-05	4.63E-05
4	0.00E+00	1.63E-05	0.00E+00	3.75E-07	0.00E+00	1.71E-05	4.27E-04	1.12E-05	5.19E-04	0.00E+00	3.75E-07	1.12E-05	4.26E-05
5	6.15E-05	6.10E-04	4.33E-06	2.48E-05	6.15E-05	6.43E-04	1.21E-03	6.26E-05	1.71E-03	4.33E-06	2.48E-05	6.26E-05	4.36E-05
6	0.00E+00	8.69E-06	0.00E+00	2.06E-07	0.00E+00	8.97E-06	2.43E-04	6.68E-06	2.81E-04	0.00E+00	2.06E-07	6.68E-06	4.26E-05
7	0.00E+00	3.71E-05	0.00E+00	9.04E-07	0.00E+00	4.02E-05	7.19E-04	1.84E-05	9.17E-04	0.00E+00	9.04E-07	1.84E-05	3.97E-05
8	0.00E+00	4.25E-06	0.00E+00	9.84E-08	0.00E+00	4.28E-06	1.24E-04	3.15E-06	1.43E-04	0.00E+00	9.84E-08	3.15E-06	3.92E-05
9	2.70E-11	1.18E-05	2.70E-11	1.03E-06	2.70E-11	1.20E-05	1.27E-04	2.96E-06	1.46E-04	2.70E-11	1.03E-06	2.96E-06	5.09E-09
10	1.38E-08	5.80E-05	1.38E-08	3.20E-06	1.38E-08	5.94E-05	2.74E-04	8.52E-06	3.69E-04	1.38E-08	3.20E-06	8.52E-06	1.04E-07
average	1.08E-05	1.25E-04	7.50E-07	5.00E-06	1.08E-05	1.32E-04	5.09E-04	1.88E-05	6.67E-04	7.50E-07	5.00E-06	1.88E-05	3.14E-05
min	0.00E+00	1.04E-19	0.00E+00	1.04E-19	0.00E+00	1.04E-19	4.61E-05	9.27E-07	5.06E-05	0.00E+00	1.04E-19	9.27E-07	5.09E-09
max	6.15E-05	6.10E-04	4.33E-06	2.48E-05	6.15E-05	6.43E-04	1.21E-03	6.26E-05	1.71E-03	4.33E-06	2.48E-05	6.26E-05	4.63E-05

Plots (linear and logarithmic) of CCDF for EBS Release for Case 14 compared to mean and base case



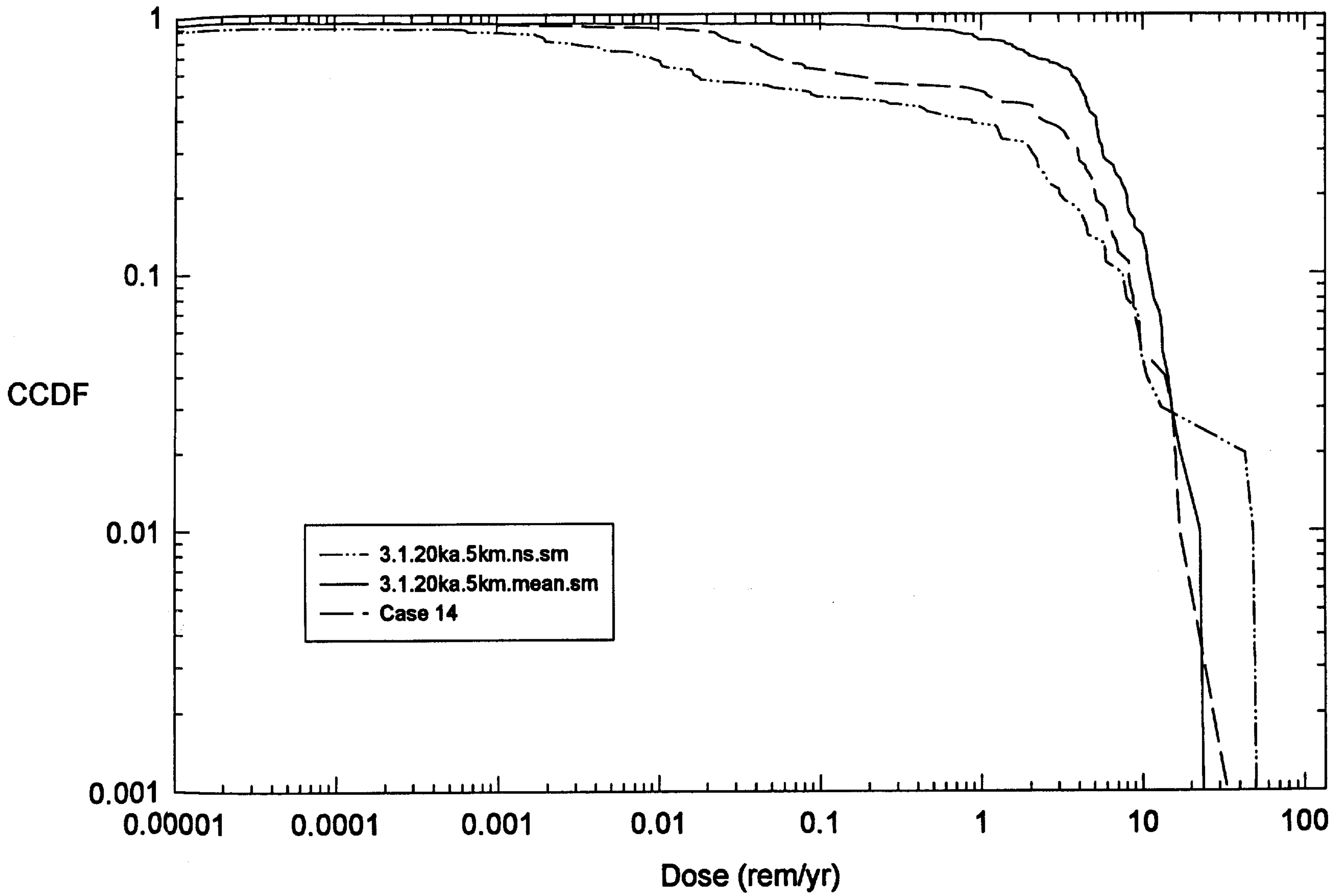
Plots (linear and logarithmic) of CCDF for EBS Release for Case 14 compared to mean and base case

TPA3.1.1 Results of EBS Release (Ci) for 100 Vectors, 5 km Critical Group, and 20,000 years with Chloride Multiplication Factor and PO2 Sampled (Case 14)



Plots (linear and logarithmic) of CCDF for DOSE for Case 14 compared to mean and base case

TPA3.1.1 Results of Dose (rem/yr) for 100 Vectors, 5 km Critical Group, and 20,000 years with Chloride Multiplication Factor and PO2 Sampled (Case 14)



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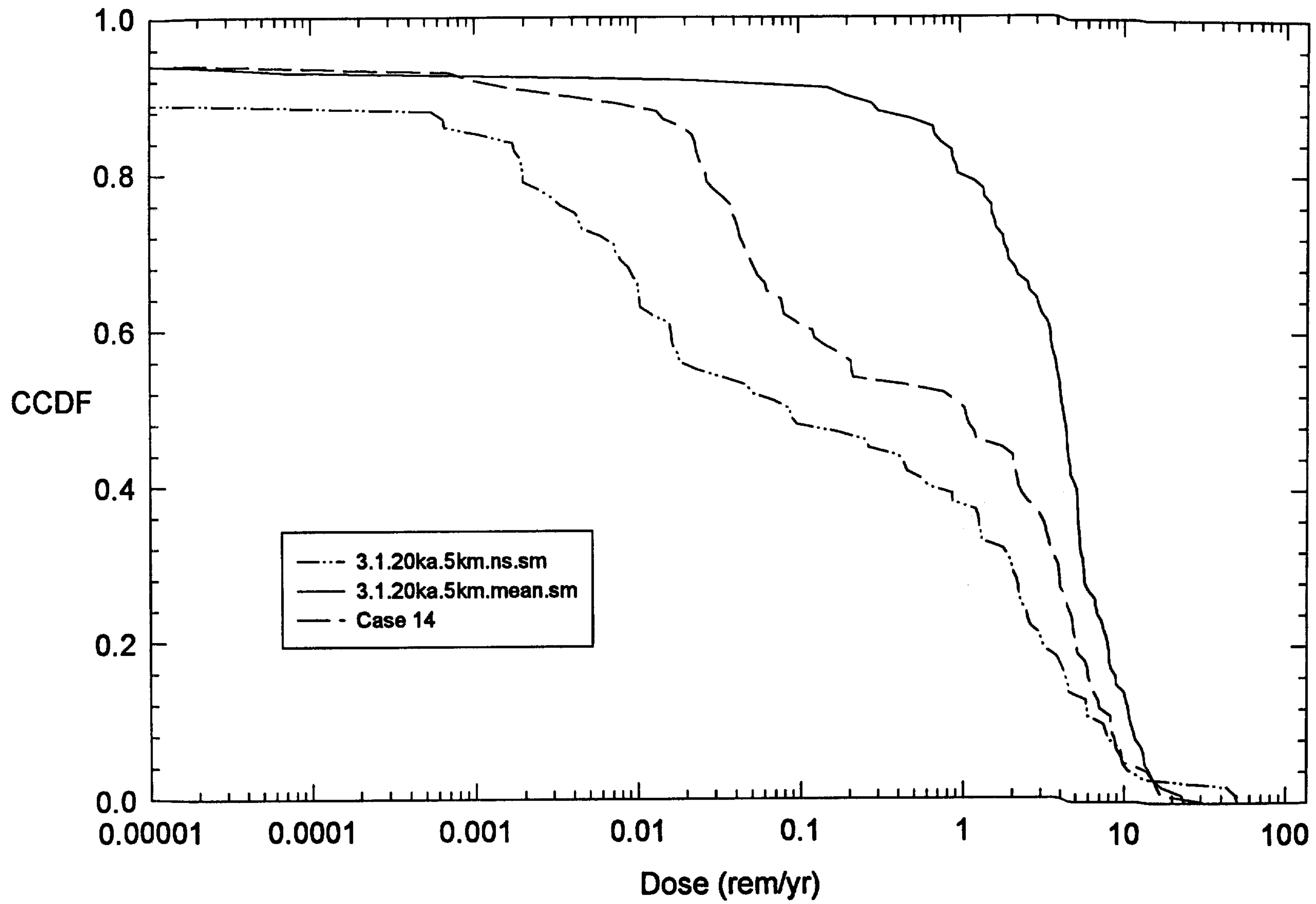
Plots (linear and logarithmic) of CCDF for DOSE for Case 14 compared to mean and base case

TPA3.1.1 Results of Dose (rem/yr) for 100 Vectors, 5 km Critical Group, and 20,000 years with Chloride Multiplication Factor and PO2 Sampled (Case 14)



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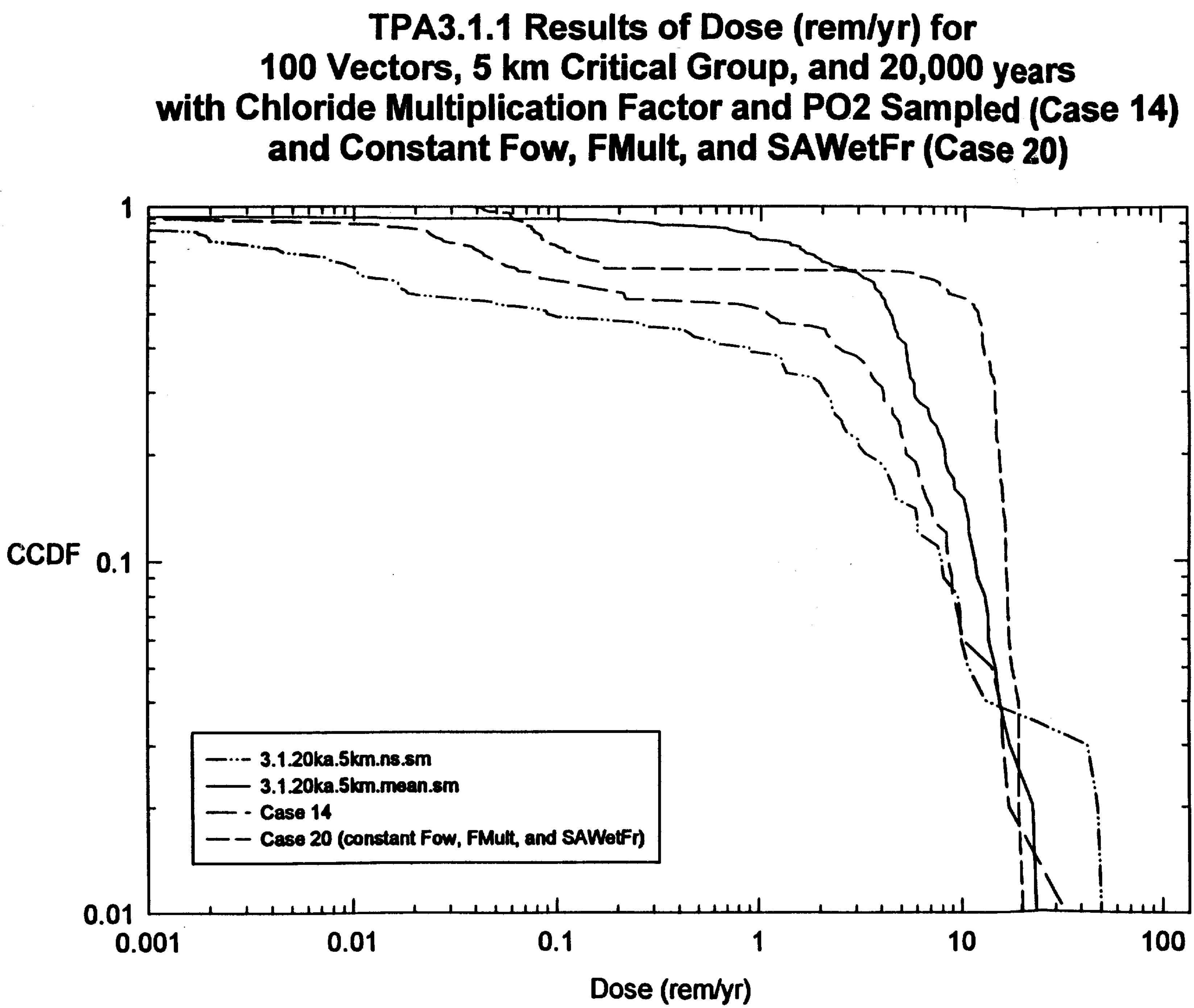
Plots of CCDF for Dose comparing Case 14 and 20 with base case and mean.



Sensitivity analyses for the effect of Chloride Multiplication factor (1 to 30) and oxygen partial pressure (2.1×10^{-5} to 0.21 at) was completed.

- Results were plotted for EBS Release and Dose as a function of Chloride Multiplication Factor when this factor was varied but kept constant for each case.
- Scatterplots were completed for several cases where Chloride Multiplication Factor was varied with an uniform distribution from 1 to 30 and oxygen partial pressure from 2.1×10^{-5} to 0.21 at with a triangular distribution.
- CCDF plots were used for comparison with base case

A report ~~was~~ will be ~~pre~~ prepared with all the results of the analyses.

Signature
10/23/97