UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 12, 1999

MEMORANDUM TO: Samuel J. Collins, Director
Office of Nuclear Reactor Regulation

FROM: Ashok C. Thadani, Director
Office of Nuclear Regulatory Research

SUBJECT: SPENT FUEL POOL RISK ASSESSMENT

As part of its generic study of spent fuel pool accidents, undertaken to develop generic, risk-informed regulatory requirements for plants that are being decommissioned, the Office of Nuclear Reactor Regulation (NRR) had requested the Office of Nuclear Regulatory Research (RES) to perform an evaluation of the offsite radiological consequences of a severe spent fuel pool accident. Accordingly, RES completed an in-house analysis of offsite radiological consequences, which included sensitivity and uncertainty analysis to assess the effect of critical parameters and assumptions. On May 25, 1999, RES forwarded to NRR a summary of the evaluation. A primary objective of the evaluation was to assess the effect of extended storage in a spent fuel pool, and the resulting radioactive decay, on offsite consequences. The evaluation showed about a factor-of-two reduction in prompt fatalities if the accident occurs after 1 year instead of after 30 days. The evaluation also showed that beginning evacuation three hours before the release begins reduces prompt fatalities by more than an order of magnitude.

The purpose of this letter is to forward to you a report containing the detailed technical basis of the offsite consequence evaluation. This report documents the offsite consequence calculations we performed using the MACCS code (MELCOR Accident Consequence Code System) and includes the input files used. In addition, this report documents follow-up calculations, performed since our earlier letter, to evaluate the importance of cesium to better understand why the consequence reduction from a year of decay was not greater. These follow-up calculations showed that cesium with its long half-life (30 years) is responsible for limiting the consequence reduction. For the population within 100 miles of the site, 97 percent of the societal dose was from cesium.

Through our evaluation of the effects of radioactive decay and evacuation start time on offsite consequences, we have been able to eliminate unnecessary conservatism in the consequence assessment. However, there may be unnecessary conservatism remaining which is relevant to a risk assessment of these accidents. For example, while we consider this current dose assessment complete, further assessment of accident progression could lead to lower estimates of cesium releases. (All analyses to date assumed complete release of the cesium inventory.) In addition, the decay power in the final core offload into the spent fuel pool decreases by a factor

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of three between 30 days and 1 year after final shutdown (hence the lower offsite consequences). For non-seismic events, a lower decay power provides additional time to take action to maintain cooling or to reinstate cooling in time to prevent significant fuel heat up. Memoranda from NRR (G. Holahan) to RES (T. King and J. Craig) of August 3, 1999, and August 18, 1999, requested RES perform an independent review of the NRR assessment of the frequency of a severe spent fuel pool accident. As a result of our independent review we intend to provide additional recommendations for the frequency assessment and seismic evaluation by late November. Further recommendations for the thermal hydraulic and consequence analysis will be provided by January 2000. It is our expectation that the reviews will reveal further opportunities for developing a more realistic evaluation.

Attachment: As stated

cc: G. Holahan
J. Hannon
R. Barrett
C. Paperiello

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NRR assessment of the frequency of a severe spent fuel pool accident. As a result of our review, we intend to provide additional recommendations for the frequency assessment.

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United States
Nuclear Regulatory Commission

Assessment of Offsite Consequences for a Severe Spent Fuel Pool Accident

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Office of Nuclear Regulatory Research

November 1999

Introduction

As part of its generic study of spent fuel pool accidents, undertaken to develop generic, risk-informed regulatory requirements for plants that are being decommissioned, the Office of Nuclear Reactor Regulation (NRR) had requested the Office of Nuclear Regulatory Research (RES) to perform an evaluation of the offsite radiological consequences of a severe spent fuel pool accident. Accordingly, RES completed an in-house analysis of offsite radiological consequences, which included sensitivity and uncertainty analysis to assess the effect of critical parameters and assumptions. On May 25, 1999, RES forwarded to NRR a summary of the evaluation. A primary objective of the evaluation was to assess the effect of extended storage in a spent fuel pool, and the resulting radioactive decay, on offsite consequences. The evaluation showed about a factor-of-two reduction in prompt fatalities if the accident occurs after 1 year instead of after 30 days. The evaluation also showed that beginning evacuation three hours before the release begins reduces prompt fatalities by more than an order of magnitude.

The purpose of this report is to document the detailed technical basis of the offsite consequence evaluation. This report documents the offsite consequence calculations we performed using the MACCS code (MELCOR Accident Consequence Code System) and includes the input files used. In addition, this report documents follow-up calculations, performed since our earlier letter, to evaluate the importance of cesium to better understand why the consequence reduction from a year of decay was not greater. These follow-up calculations showed that cesium with its long half-life (30 years) is responsible for limiting the consequence reduction. For the population within 100 miles of the site, 97 percent of the societal dose was from cesium.

Previous Consequence Assessments

Spent fuel pool accidents involving a sustained loss of coolant have the potential for leading to significant fuel heat up and resultant release of fission products to the environment. Such an accident would involve decay heat raising the fuel temperature to the point of exothermic cladding oxidation, which would cause additional temperature escalation to the point of fission product release. However, because fuel in a spent fuel pool has a lower decay power than fuel in the reactor vessel of an operating reactor, it will take much longer for the fuel in the spent fuel pool to heat up to the point of releasing radionuclides than in some reactor accidents.

Earlier analyses (NUREG/CR-4982[1] and NUREG/CR-6451[2]) have assessed the frequency and consequences of spent fuel pool accidents. These analyses included a limited evaluation of offsite consequences of a severe spent fuel pool accident. NUREG/CR-4982 results included consequence estimates for the societal dose for accidents occurring 30 days and 90 days after the last discharge of spent fuel into the spent fuel pool. NUREG/CR-6451 results included consequence estimates for societal dose, prompt fatalities, and cancer fatalities for accidents occurring 12 days after the last discharge of spent fuel. The work described in this current report extends the earlier analyses by calculating offsite consequences for a severe spent fuel pool accident occurring up to one year after discharge of the last load of spent fuel, and supplements that earlier analysis with additional sensitivity studies, including varying evacuation assumptions as well as other modeling assumptions. The primary objective of this analysis was to assess the effect of extended storage in a spent fuel pool, and the resulting radioactive decay, on offsite consequences. However, as part of this work, the sensitivity to a variety of other parameters was also evaluated.

The current analysis used the MACCS code[3] (version 2) to estimate offsite consequences for a severe spent fuel pool accident. Major input parameters for MACCS include radionuclide inventories, radionuclide release fractions, evacuation and relocation criteria, and population density. The specification of values for these input parameters for a severe spent fuel pool accident is discussed below.

<u>Radionuclide Inventories</u>

As discussed above, the current analysis was undertaken to assess the magnitude of the decrease in offsite consequences that could result from up to a year of decay in the spent fuel pool. To perform this work, it was necessary to have radionuclide inventories in the spent fuel pool for a decommissioned reactor at times up to 1 year after final shutdown. The inventories in the NUREG/CR-6451 analysis have not been retrievable, so those inventories could not be used. NUREG/CR-4982 contains spent fuel pool inventories for two operating reactors, a BWR (Millstone 1) and a PWR (Ginna). Because the current analysis may also be used as part of the probabilistic risk analysis of spent fuel pool accidents for the Susquehanna plant which is a BWR, the spent fuel inventories for Millstone 1 which is also a BWR were used for this analysis. These spent fuel pool inventories for Millstone 1 are given in Table 4.1 of NUREG/CR-4982 and are reproduced in Table 1 below. Two adjustments were then made to the Table 1 inventories. The first adjustment was to multiply the inventories by a factor of 1.7, because the thermal power of Susquehanna is 1.7 times higher than that of Millstone 1. The second adjustment, described in the next two paragraphs, was needed because NUREG/CR-4982 was for an operating reactor and this analysis is for a decommissioned reactor.

Because NUREG/CR-4982 was a study of spent fuel pool risk for an operating reactor, the Millstone 1 spent fuel pool inventories shown in Table 1 were for the fuel that was discharged during the 11th refueling outage (about 1/3 of the core) and the previous 10 refueling outages. The inventories shown in Table 1 did not include the fuel which remained in the vessel (about 2/3 of the core) that was used further when the reactor was restarted after the outage. Because the current study is for a decommissioned reactor, the inventories shown in Table 1 were adjusted by adding the inventories in the remaining 2/3 of the core. This remaining 2/3 of the core is expected to contain a significant amount of short half-life radionuclides in comparison with the 11 batches of spent fuel in the spent fuel pool.

The radionuclide inventories in the remaining 2/3 of the core were derived from the data in Tables A.5 and A.6 in NUREG/CR-4982. Tables A.5 and A.6 give inventory data for the 11th refueling outage. Table A.5 gives the inventories for the entire core at the time of reactor shutdown. Table A.6 gives the inventories (at 30 days after shutdown) for the batch of fuel discharged during the outage. First, the inventories for the entire core at the time of shutdown were reduced by radioactive decay to give the inventories for the entire core at 30 days after shutdown. Then, the inventories (at 30 days after shutdown) for the batch of fuel discharged were subtracted to give the inventories for the remaining 2/3 of the core at 30 days after shutdown. Inventories for the remaining 2/3 of the core at 90 days and 1 year after shutdown were subsequently calculated by reducing the 30-day inventories by radioactive decay.

Radionuclide	Half-Life	Spent Fuel Pool Inventory (Ci)		
		30 days after last discharge	90 days after last discharge	1 year after last discharge
Co-58	70.9d	2.29E4	1.26E4	8.54E2
Co-60	5.3y	3.72E5	3.15E5	2.85E5
Kr-85	10.8y	1.41E6	1.39E6	1.33E6
Rb-86	18.7d	1.01E4	1.05E3	3.84E-2
Sr-89	50.5d	8.39E6	3.63E6	8.33E4
Sr-90	28.8y	1.42E7	1.42E7	1.39E7
Y-90	28.8y	1.43E7	1.42E7	1.39E7
Y-91	58.5d	1.18E7	5.75E6	2.21E5
Zr-95	64.0d	1.94E7	1.00E7	5.10E5
Nb-95	64.0d	2.54E7	1.70E7	1.11E6
Mo-99	2.7d	1.49E4	3.12E-3	0
Tc-99m	2.7d	1.43E4	3.01E-3	0
Ru-103	37.3d	1.53E7	5.21E6	4.07E4
Ru-106	1.0y	1.72E7	1.53E7	9.13E6
Sb-127	3.8d	8.21E3	1.39E-1	0
Te-127	109d	2.21E5	1.45E5	2.52E4
Te-127m	109d	2.18E5	1.48E5	2.57E4
Te-129	33.6d	2.74E5	7.79E4	2.68E2
Te-129m	33.6d	4.21E5	1.20E5	4.12E2
Te-132	3.2d	3.74E4	8.64E-2	0
I-131	8.0d	1.22E6	6.35E3	0
I-132	3.2d	3.85E4	8.90E-2	0
Xe-133	5.2d	7.29E5	2.30E2	0

Table 1. Radionuclide inventories in the Millstone 1 spent fuel pool.

Radionuclide	Half-Life	Spent Fuel Pool Inventory (Ci)		
		30 days after last discharge	90 days after last discharge	1 year after last discharge
Cs-134	2.1y	7.90E6	7.47E6	5.80E6
Cs-136	13.2d	2.05E5	8.13E3	3.91E-3
Cs-137	30.0y	2.02E7	2.01E7	1.97E7
Ba-140	12.8d	5.19E6	1.90E5	6.41E-2
La-140	12.8d	5.97E6	2.19E5	7.37E-2
Ce-141	32.5d	1.32E7	3.61E6	1.03E4
Ce-144	284.6d	2.64E7	2.27E7	1.16E7
Pr-143	13.6d	5.44E6	2.41E5	1.90E-1
Nd-147	11.0d	1.54E6	3.36E4	1.10E-3
Np-239	2.4d	5.59E4	2.88E3	2.88E3
Pu-238	87.7y	4.51E5	4.53E5	4.54E5
Pu-239	24100y	8.89E4	8.89E4	8.89E4
Pu-240	6560y	1.30E5	1.30E5	1.30E5
Pu-241	14.4y	2.29E7	2.27E7	2.19E7
Am-241	432.7y	2.88E5	2.94E5	3.21E5
Cm-242	162.8d	1.45E6	1.12E6	3.50E5
Cm-244	18.1y	2.27E5	2.25E5	2.19E5

Table 1 (continued). Radionuclide inventories in the Millstone 1 spent fuel pool.

MACCS has a default list of 60 radionuclides that are important for offsite consequences for reactor accidents. NUREG/CR-4982 contains inventories for 40 of these 60 radionuclides. Of these 40 radionuclides, 27 have half-lives from 2.4 days to a year and 13 have half-lives of a year or greater as shown in Table 1. The half-lives of the remaining 20 radionuclides range from 53 minutes to 1.5 days as shown in Table 2. Because the largest half-life of these 20 radionuclides is 1.5 days, omitting these 20 radionuclides from the initial inventories used in the MACCS analysis should not affect doses from releases occurring after a number of days of decay.

Radionuclide	Half-Life (days)
Kr-85m	.19
Kr-87	.05
Kr-88	.12
Sr-91	.40
Sr-92	.11
Y-92	.15
Y-93	.42
Zr-97	.70
Ru-105	.19
Rh-105	1.48
Sb-129	.18
Te-131m	1.25
I-133	.87
I-134	.04
I-135	.27
Xe-135	.38
Ba-139	.06
La-141	.16
La-142	.07
Ce-143	1.38

Table 2. Half-lives of MACCS radionuclides whose inventories were not in NUREG/CR-4982.

Release Fractions

NUREG/CR-4982 also provided the fission product release fractions assumed for a severe spent fuel pool accident. These fission product release fractions are shown in Table 3. NUREG/CR-6451 provided an updated estimate of fission product release fractions. The release fractions in NUREG/CR-6451 (also shown in Table 3) are the same as those in NUREG/CR-4982, with the exception of lanthanum and cerium. NUREG/CR-6451 stated that the release fraction of lanthanum and cerium should be increased from $1x10^{-6}$ in NUREG/CR-4982 to $6x10^{-6}$, because fuel fines could be released offsite from fuel with high burnup. While RES believes that it is unlikely that fuel fines would be released offsite in any substantial amount, a sensitivity was performed using a release fraction of $6x10^{-6}$ for lanthanum and cerium to determine whether such an increase could even impact offsite consequences.

Radionuclide Group	Release Fractions	
	NUREG/CR-4982	NUREG/CR-6451
noble gases	1	1
iodine	1	1
cesium	1	1
tellurium	$2x10^{-2}$	$2x10^{-2}$
strontium	$2x10^{-3}$	$2x10^{-3}$
ruthenium	$2x10^{-5}$	$2x10^{-5}$
lanthanum	$1x10^{-6}$	$6x10^{-6}$
cerium	$1x10^{-6}$	$6x10^{-6}$
barium	$2x10^{-3}$	$2x10^{-3}$

Table 3. Release fractions for a severe spent fuel pool accident.

Modeling of Emergency Response Actions and Other Areas

Modeling of emergency response actions was essentially the same as that used for Surry in NUREG-1150. The timing of events is given in Table 4. Evacuation begins exactly two hours after emergency response officials receive notification to take protective measures. This results in the evacuation beginning approximately .8 hours after the offsite release ends. Only people within 10 miles of the spent fuel pool evacuate, and, of those people, .5% do not evacuate. Details of the evacuation modeling are given in Table 5.

People outside of 10 miles are relocated to uncontaminated areas after a specified period of time depending on the dose they are projected to receive in the first week. There are two relocation criteria. The first criterion is that, if the dose to an individual is projected to be greater that 50 rem in one week, then the individual is relocated outside of the affected area after 12 hours. The second criterion is that, if the dose to an individual is projected to be greater that 25 rem in one week, then the individual is relocated outside of the affected area after 24 hours.

Event	Time (sec)	Time (hour)
notification given to offsite emergency response officials	0	0
start time of offsite release	2400	.7
end time of offsite release	4200	1.2
evacuation begins	7200	2.0

Table 4. Timing of events.

Parameter	Value
size of evacuation zone	10 miles
sheltering in evacuation zone	no sheltering
evacuation direction	radially outward
evacuation speed	4 miles/hr
other	after evacuee reaches 20 miles from fuel pool, no further exposure is calculated

Table 5. Evacuation modeling.

After the first week, the pre-accident population in each sector (including the evacuation zone) is assumed to be present unless the dose to an individual in a sector will be greater than 4 rem over a period of 5 years. If the dose to an individual in a sector is greater than 4 rem over a period of 5 years, then the population in that sector is relocated. Dose and cost criteria are used to determine when the relocated population returns to a sector. The dose criterion is that the relocated population is returned at a time when it is estimated that an individual's dose will not exceed 4 rem over the next 5 years. The actual population dose is calculated for exposure for the next 300 years following the population's return.

<u>Offsite Consequence Results</u>

MACCS calculations for a decommissioned reactor for accidents occurring 30 days, 90 days, and 1 year after final shutdown were performed to assess the magnitude of the decrease in the offsite consequences resulting from extended decay prior to the release. These calculations were performed for a Base Case along with a number of sensitivity cases to evaluate the impact of alternative modeling. These cases are summarized in Table 6. The results of these calculations are discussed below.

Case	Population Distribution	Radionuclide Inventory	Evacuation Start Time	La/Ce Release Fraction	Evacuation Percentage
Base Case	Surry	11 batches plus rest of last core	1.4 hours after release begins	$1x10^{-6}$	99.5%
1	Surry	11 batches plus rest of last core	1.4 hours after release begins	$1x10^{-6}$	95%
2	Surry	11 batches	1.4 hours after release begins	$1x10^{-6}$	95%
3	100 people/mi^2	11 batches	1.4 hours after release begins	$1x10^{-6}$	95%
4	100 people/mi^2	11 batches plus rest of last core	1.4 hours after release begins	$1x10^{-6}$	95%
5	100 people/mi^2	11 batches plus rest of last core	3 hours before release begins	$1x10^{-6}$	95%
6	100 people/mi^2	11 batches plus rest of last core	3 hours before release begins	$6x10^{-6}$	95%
7	100 people/mi^2	11 batches plus rest of last core	3 hours before release begins	$1x10^{-6}$	99.5%

Table 6. Cases examined using the MACCS2 consequence code.

The Base Case was intended to model the offsite consequences for a severe spent fuel pool accident for a decommissioned reactor. To accomplish this, the Base Case used the Millstone 1 inventories from NUREG/CR-4982 adjusted for reactor power and the rest of the last core as discussed above. Accordingly, the Base Case used the Millstone 1 radionuclide inventories for the fuel from the first 11 refueling outages (1649 assemblies) together with the rest of the last core (413 assemblies). Because the Millstone 1 core design has 580 assemblies, the amount of fuel assumed to be in the spent fuel pool is equivalent to about 3.5 cores.

Other modeling in the Base Case, such as the population distribution, the evacuation percentage of 99.5% of the population, and the meteorology, are from the NUREG-1150 consequence assessment model for Surry. The input files for the Base Case are given in Appendix A. The results of the Base Case are shown in Table 7.

Decay Time in Spent Fuel Pool	Distance (miles)	Prompt Fatalities	Societal Dose (person-Sv)	Cancer Fatalities
30 days	0-100	1.75	47,700	2,460
	0-500	1.75	571,000	25,800
90 days	0-100	1.49	46,300	2,390
	0-500	1.49	586,000	26,400
1 year	0-100	1.01	45,400	2,320
	0-500	1.01	595,000	26,800

Table 7. Mean consequences for the Base Case.

Table 7 shows the offsite consequences for a severe spent fuel pool accident at 30 days, 90 days, and 1 year following final reactor shutdown. The decay times for fuel transferred to the pool during the 11th refueling outage were 30 days, 90 days, and 1 year, respectively. The decay times for spent fuel in the pool from earlier refueling outages were much longer and were accounted for in the inventories used in this analysis.

These results in Table 7 show virtually no change in long-term offsite consequences (i.e., societal dose and cancer fatalities) as a function of decay time, because they are controlled by inventories of radionuclides with long half-lives and relocation assumptions. However, these results also show about a factor-of-two reduction in the short-term consequences (i.e., prompt fatalities) from 30 days to 1 year of decay. (All of the prompt fatalities occur within 10 miles of the site.) As a rough check on the prompt fatality results, the change in decay power was evaluated for an operating reactor shut down for 30 days and for 1 year. The decay power decreased by about a factor of three. This is consistent with a factor-of-two decrease in prompt fatalities. The factor-of-three decrease in decay power by radioactive decay will also increase the time it takes to heat up the spent fuel, which provides additional time to take action to mitigate the accident.

The results of Case 1, which used a lower evacuation percentage than the Base Case, are identical to the results of the Base Case shown in Table 7. Case 1 used an evacuation percentage of 95%, while the Base Case used an evacuation percentage of 99.5%. Although it might be expected to see an increase in prompt fatalities from reducing the evacuation percentage, no such increase was observed. This is due to the assumption that the release ends at 1.2 hours, while the evacuation does not begin until 2 hours.

Case 2, shown in Table 8, used a radionuclide inventory that consisted of 11 batches of spent fuel, but did not include the remaining two-thirds of the core in the vessel. This was done to facilitate comparison of the consequence results with the results of the analyses in NUREG/CR-4982 and NUREG/CR-6451. This also allowed examination of the relative contribution of the short-lived radionuclides to consequences. Because the length of time between refueling outages is on the order of a year, short-lived radionuclides in the spent fuel pool will decay away between refueling outages. As a result, all of the short-lived radionuclides are in the core at the start of the 11th refueling outage for Millstone 1. When Millstone 1 discharged one-third of its core at the beginning of the 11th refueling outage, two-thirds of its short-lived isotopes remained in the vessel. Therefore, use of 11 batches of fuel in Case 2 without the remaining two-thirds of the core represents about a factor-of-three reduction in short-lived radionuclides in the spent fuel pool from what was modeled in Case 1. As shown in Table 8, use of 11 batches of spent fuel without the remaining two-thirds of the core resulted in a factor-of-two reduction in the prompt fatalities and no change in the societal dose and cancer fatalities. This factor-of-two reduction in prompt fatalities is consistent with the factor-of-three reduction in the inventories of the short-lived radionuclides when the remaining two-thirds of the core in the vessel is not included in the consequence calculation.

Decay Time in Spent Fuel Pool	Distance (miles)	Prompt Fatalities	Societal Dose (person-Sv)	Cancer Fatalities
30 days	0-100	.89	44,900	2,280
	0-500	.89	557,000	25,100
90 days	0-100	.78	44,500	2,250
	0-500	.78	554,000	25,000
1 year	0-100	.53	43,400	2,180
	0-500	.53	567,000	25,500

Table 8. Mean consequences for Case 2.

The results of the next case, Case 3, are shown in Table 9. This case used a generic population distribution of 100 persons/mile^2 (uniform). This was done to facilitate comparison of the consequence results with the results of the analyses in NUREG/CR-4982 and NUREG/CR-6451. Use of a uniform population density of 100 persons/mile^2 results in an order-of-magnitude increase in prompt fatalities and relatively small changes in the societal dose and cancer fatalities.

Decay Time in Spent Fuel Pool	Distance (miles)	Prompt Fatalities	Societal Dose (person-Sv)	Cancer Fatalities
30 days	0-100	11.7	50,100	2,440
	0-500	11.7	449,000	20,300
90 days	0-100	10.6	50,300	2,460
	0-500	10.6	447,000	20,200
1 year	0-100	8.19	49,000	2,380
	0-500	8.19	453,000	20,500

Table 9. Mean consequences for Case 3.

The results of the next case, Case 4, are shown in Table 10. This case includes the remaining two-thirds of the core in the vessel. This was done to facilitate comparison of the consequence results with the results of the analysis in NUREG/CR-6451. As discussed above in the comparison of Case 1 with Case 2, this increases the prompt fatalities by about a factor of two with no change in the societal dose or cancer fatalities.

Decay Time in Spent Fuel Pool	Distance (miles)	Prompt Fatalities	Societal Dose (person-Sv)	Cancer Fatalities
30 days	0-100	18.3	53,500	2,610
	0-500	18.3	454,000	20,600
90 days	0-100	16.3	52,100	2,560
	0-500	16.3	465,000	21,100
1 year	0-100	12.7	50,900	2,490
	0-500	12.7	477,000	21,600

Table 10. Mean consequences for Case 4.

Heat up of fuel in a spent fuel pool following a complete loss of coolant takes much longer than in some reactor accidents. Therefore, it may be possible to begin evacuating before the release begins. Case 5, which uses an evacuation start time of three hours before the release begins, was performed to assess the impact of early evacuation. As shown in Table 11, prompt fatalities were significantly reduced and societal dose and cancer fatalities remained unchanged.

Decay Time in Spent Fuel Pool	Distance (miles)	Prompt Fatalities	Societal Dose (person-Sv)	Cancer Fatalities
30 days	0-100	.96	48,300	2,260
	0-500	.96	449,000	20,200
90 days	0-100	.83	47,500	2,220
	0-500	.83	460,000	20,700
1 year	0-100	.67	46,700	2,180
	0-500	.67	473,000	21,300

Table 11. Mean consequences for Case 5.

As noted above, NUREG/CR-6451 estimated the release of lanthanum and cerium to be a factor of six higher than that originally estimated in NUREG/CR-4982. Case 6 was performed to assess the potential impact of that higher release. The Case 6 consequence results were identical to those of Case 5 shown in Table 11. Therefore, even it were possible for fuel fines to be released offsite, there would be no change in offsite consequences as a result.

The final case, Case 7 was performed to examine the impact of a 99.5% evacuation for a case with evacuation before the release begins. This sensitivity (see Table 12) showed an order of magnitude decrease in the prompt fatalities. Again, as expected, no change in the societal dose or cancer fatalities was observed.

Decay Time in Spent Fuel Pool	Distance (miles)	Prompt Fatalities	Societal Dose (person-Sv)	Cancer Fatalities
30 days	0-100	.096	48,100	2,250
	0-500	.096	449,000	20,200
90 days	0-100	.083	47,400	2,210
	0-500	.083	460,000	20,700
1 year	0-100	.067	46,600	2,170
	0-500	.067	473,000	21,300

Table 12. Mean consequences for Case 7.

Comparison with Earlier Consequence Analyses

As a check on the above calculations and to provide additional insight into the consequence analysis for severe spent fuel pool accidents, the above calculations were compared to the consequence results reported in NUREG/CR-4982 and NUREG/CR-6451. Table 13 shows the analysis assumptions used for BWRs in these earlier reports together with those of Cases 3 and 4 of the current analysis.

NUREG/CR-4982 results included consequence estimates for societal dose for an operating reactor for severe spent fuel pool accidents occurring 30 days and 90 days after the last discharge of spent fuel into the pool. The Case 3 results were compared against the NUREG/CR-4982 results, because they use the same population density (100 persons/mile^2) and 11 batches of spent fuel in the pool. However, one difference is that Case 3 uses a radionuclide inventory that is a factor of 1.7 higher than NUREG/CR-4982 to reflect the relative power levels of Susquehanna and Millstone 1. Therefore, Case 3 was rerun with the radionuclide inventory of NUREG/CR-4982. As shown in Table 14, the Case 3 rerun results generally compared well with the NUREG/CR-4982 results.

Parameter	NUREG/CR-4982 (BWR)	NUREG/CR-6451 (BWR)	Case 3	Case 4
population density (persons/ mile^2)	100	0-30 mi: 1000 30-50 mi: 2300 (city of 10 million people, 280 outside of city) 50-500 mi: 200	100	100
meteorology	uniform wind rose, average weather conditions	representative for continental U.S.	Surry	Surry
radionuclide inventory	11 batches of spent fuel	full fuel pool after decommissioning (3300 assemblies)	11 batches of spent fuel, increased by x1.7	11 batches of spent fuel plus last of rest core, increased by x1.7
exclusion area	not reported	.4 mi	none	none
emergency response	relocation at one day if projected doses exceed 25 rem	relocation at one day if projected doses exceed 25 rem	NUREG-1150 Surry analysis (see above)	NUREG-1150 Surry analysis (see above)

Table 13. Comparison of analysis assumptions.

Decay Time in Spent Fuel Pool	Distance (miles)	Societal Dose (person-Sv)		
		NUREG/CR-4982	Case 3	Case 3 Rerun
30 days	0-50	26,000	20,900	16,700
	0-500	710,000	449,000	379,000
90 days	0-50	26,000	20,400	16,500

Table 14. Comparison with NUREG/CR-4982 results.

The NUREG/CR-6451 results included consequence estimates for societal dose, cancer fatalities, and prompt fatalities for a decommissioned reactor for a severe spent fuel pool accident occurring 12 days after the final shutdown. The Case 4 results for 30 days after final shutdown were compared against the NUREG/CR-6451 results, because (1) they included the entire last core in the spent fuel pool and (2) Case 4 had a uniform population density which could be easily adjusted to approximate that in NUREG/CR-6451. Differences between Case 4 and NUREG/CR-6451 included the population density, the amount of spent fuel in the pool, and the exclusion area size. To provide a more consistent basis to compare the NUREG/CR-6451 results with the Case 4 results, Case 4 was rerun using population densities, an amount of spent fuel, and an exclusion area size similar to NUREG/CR-6451.

The average population densities in the NUREG/CR-6451 analysis were about 1800 persons/mile^2 within 50 miles and 215 persons/mile^2 within 500 miles. Also, NUREG/CR-6451 used an inventory with substantially higher quantities of long-lived radionuclides than the 11 batches of spent fuel in NUREG/CR-4982. NUREG/CR-6451 stated that it used an inventory of Cs-137 (30 year half-life) that was three times greater than that used in NUREG/CR-4982. To provide a more consistent basis to compare with NUREG/CR-6451 long-term consequences, Case 4 was rerun using uniform population densities of 1800 persons/mile^2 within 50 miles and 215 persons/mile^2 outside of 50 miles and a power correction factor of 3 instead of 1.7. As shown in Table 15, Case 4 rerun is in generally good agreement with NUREG/CR-6451. These calculations indicate a very strong dependence of long-term consequences on population density. Remaining differences in long-term consequences may be due to remaining differences in population density and inventories as well as differences in meteorology and emergency response.

Dist. (miles)	Societal Dose (person-Sv)			Cancer Fatalities		
	NUREG/ CR-6451	Case 4	Case 4 Rerun	NUREG/ CR-6451	Case 4	Case 4 Rerun
0-50	750,000	23,600	389,000	31,900	1,260	20,800
0-500	3,270,000	454,000	1,330,000	138,000	20,600	44,900

Table 15. Comparison with NUREG/CR-6451 results (long-term consequences).

To provide a more consistent basis to compare with NUREG/CR-6451 short-term consequences, Case 4 was again rerun, this time using a uniform population density of 1000 persons/mile^2 and an exclusion area of .32 miles. As shown in Table 16, Case 4 rerun is in generally good agreement with NUREG/CR-6451. Overall, these calculations indicate a very strong dependence of short-term consequences on population density and a small dependence (about 10% change in prompt fatality results) on exclusion area size. Remaining differences in short-term consequences may be due to remaining differences in population density and inventories as well as differences in meteorology and emergency response.

Dist. (miles)	Prompt Fatalities		
	NUREG/CR-6451	Case 4	Case 4 Rerun
0-50	74	18.3	168
0-500	101	18.3	168

Table 16. Comparison with NUREG/CR-6451 results (short-term consequences).

Effect of Cesium

Cesium is volatile under severe accident conditions and was previously estimated to be completely released from fuel under these conditions. Also, the half-lives of the cesium isotopes are 2 years for cesium-134, 13 days for cesium-136, and 30 years for cesium-137. Therefore, we performed additional sensitivity calculations on the Base Case to evaluate the importance of cesium to better understand why the consequence reduction from a year of decay was not greater. The results of our calculations are shown in Table 17. As shown in this table, we found that the cesium isotopes with their relatively long half-lives were responsible for limiting the reduction in offsite consequences.

Decay Time in Spent Fuel Pool	Distance (miles)	Prompt Fatalities	Societal Dose (person-Sv)	Cancer Fatalities
1 year	0-100	1.01	45,400	2,320
1 year (without cesium)	0-100	0.00	1,460	42

Table 17. Mean consequences for the Base Case with and without cesium.

Conclusion

The primary objective of this evaluation was to assess the effect of extended storage in a spent fuel pool, and the resulting radioactive decay, on offsite consequences of a severe spent fuel pool accident at a decommissioned reactor. This evaluation was performed in support of the NRR generic evaluation of spent fuel pool risk that is being performed to support related risk-informed requirements for decommissioned reactors. This evaluation showed about a factor-of-two reduction in prompt fatalities if the accident occurs after 1 year instead of after 30 days. Sensitivity studies showed that cesium with its long half-life (30 years) is responsible for limiting the consequence reduction. For the population within 100 miles of the site, 97 percent of the societal dose was from cesium. Also, this evaluation showed that beginning evacuation three hours before the release begins reduces prompt fatalities by more than an order of magnitude.

References

1. NUREG/CR-4982, Severe Accidents in Spent Fuel Pools in Support of Generic Safety Issue 82, July 1987

2. NUREG/CR-6451, A Safety and Regulatory Assessment of Generic BWR and PWR Permanently Shutdown Nuclear Power Plants, August 1997

3. NUREG/CR-6613, Code Manual for MACCS2, May 1998

Appendix A

MACCS2 Input Files for the Base Case with Radionuclide Inventories at 30 Days Following Reactor Shutdown

This appendix contains the MACCS2 input files for the Base Case with radionuclide inventories at 30 days following reactor shutdown. MACCS2 uses a total of five input files for each run. The first file (ATMOS.INP) contains the source term and atmospheric dispersion input. The second file (EARLY.INP) contains the input for emergency response and variables that are affected during the first week of the accident. The third file (CHRONC.INP) contains the input for variables that are affected after the first week of the accident. The fourth file (METSUR.INP) gives the meteorological data. For brevity, only the beginning and end of the METSUR.INP file are shown in this appendix. Finally, the fifth file (SURSIT.INP) gives the siting information, such as offsite population in each sector.

MACCS2 Input File for the Base Case with Radionuclide Inventories at 30 Days Following Reactor Shutdown:

ATMOS.INP

```
* GENERAL DESCRIPTIVE TITLE DESCRIBING THIS "ATMOS" INPUT
*
RIATNAM1001 'IN1A.INP, Sample Problem A--Using Table-Lookup Sigmas, ATMOS input'
******************************************************************************
* GEOMETRY DATA BLOCK, LOADED BY INPGEO, STORED IN /GEOM/
*
* NUMBER OF RADIAL SPATIAL ELEMENTS
*
GENUMRAD001  26
*
*  SURRY
*
GESPAEND001      .16       .52      1.21      1.61      2.13
GESPAEND002     3.22      4.02      4.83      5.63      8.05
GESPAEND003    11.27     16.09     20.92     25.75     32.19
GESPAEND004    40.23     48.28     64.37     80.47    112.65
GESPAEND005   160.93    241.14    321.87    563.27    804.67
GESPAEND006  1609.34
******************************************************************************
* NUCLIDE DATA BLOCK, LOADED BY INPISO, STORED IN /ISOGRP/, /ISONAM/
*
* Number of pseudo-stable nuclides (used to truncate the decay chains)
*
ISNUMSTB001      27
*
* List of pseudo-stable nuclides
*
ISNAMSTB001     I-129     (daughter of Te-129 and Te-129m)
ISNAMSTB002     Xe-131m   (daughter of I-131)
ISNAMSTB003     Xe-133m   (daughter of I-133)
ISNAMSTB004     Xe-135m   (daughter of I-135)
ISNAMSTB005     Cs-135    (daughter of Xe-135 and Xe-135m)
ISNAMSTB006     Sm-147    (daughter of Pm-147)
ISNAMSTB007     U-234     (daughter of Pu-238)
ISNAMSTB008     U-235     (daughter of Pu-239)
ISNAMSTB009     U-236     (daughter of Pu-240)
ISNAMSTB010     U-237     (daughter of Pu-241)
ISNAMSTB011     Np-237    (daughter of Am-241)
ISNAMSTB012     Rb-87     (daughter of Kr-87)
ISNAMSTB013     Ba-137m   (daughter of Cs-137)
ISNAMSTB014     Rb-88     (daughter of Kr-88)
ISNAMSTB015     Y-91m     (daughter of Sr-91)
ISNAMSTB016     Zr-93     (daughter of Y-93)
ISNAMSTB017     Nb-93m    (daughter of Zr-93)
ISNAMSTB018     Nb-95m    (daughter of Zr-95)
ISNAMSTB019     Nb-97     (daughter of Zr-97 and Nb-97m)
ISNAMSTB020     Nb-97m    (daughter of Zr-97)
ISNAMSTB021     Tc-99     (daughter of Mo-99)
ISNAMSTB022     Rh-103m   (daughter of Ru-103)
ISNAMSTB023     Rh-106    (daughter of Ru-106)
ISNAMSTB024     Te-131    (daughter of Te-131m)
ISNAMSTB025     Pr-144    (daughter of Ce-144 and Pr-144m)
ISNAMSTB026     Pr-144m   (daughter of Ce-144)
ISNAMSTB027     Pm-147    (daughter of Nd-147)
*
* Number of radioactive nuclides to be considered
*
ISNUMISO001 60
*
* NUMBER OF NUCLIDE GROUPS
*
ISMAXGRP001  9
*
* WET AND DRY DEPOSITION FLAGS FOR EACH NUCLIDE GROUP
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*               WETDEP     DRYDEP
*
ISDEPFLA001     .FALSE.    .FALSE.
ISDEPFLA002     .TRUE.     .TRUE.
ISDEPFLA003     .TRUE.     .TRUE.
ISDEPFLA004     .TRUE.     .TRUE.
ISDEPFLA005     .TRUE.     .TRUE.
ISDEPFLA006     .TRUE.     .TRUE.
ISDEPFLA007     .TRUE.     .TRUE.
ISDEPFLA008     .TRUE.     .TRUE.
ISDEPFLA009     .TRUE.     .TRUE.
*
* NUCLIDE GROUP DATA FOR 9 NUCLIDE GROUPS
*
*                NUCNAM     IGROUP
*
ISOTPGRP001      Co-58         6
ISOTPGRP002      Co-60         6
ISOTPGRP003      Kr-85         1
ISOTPGRP004      Kr-85m        1
ISOTPGRP005      Kr-87         1
ISOTPGRP006      Kr-88         1
ISOTPGRP007      Rb-86         3
ISOTPGRP008      Sr-89         5
ISOTPGRP009      Sr-90         5
ISOTPGRP010      Sr-91         5
ISOTPGRP011      Sr-92         5
ISOTPGRP012      Y-90          7
ISOTPGRP013      Y-91          7
ISOTPGRP014      Y-92          7
ISOTPGRP015      Y-93          7
ISOTPGRP016      Zr-95         7
ISOTPGRP017      Zr-97         7
ISOTPGRP018      Nb-95         7
ISOTPGRP019      Mo-99         6
ISOTPGRP020      Tc-99m        6
ISOTPGRP021      Ru-103        6
ISOTPGRP022      Ru-105        6
ISOTPGRP023      Ru-106        6
ISOTPGRP024      Rh-105        6
ISOTPGRP025      Sb-127        4
ISOTPGRP026      Sb-129        4
ISOTPGRP027      Te-127        4
ISOTPGRP028      Te-127m       4
ISOTPGRP029      Te-129        4
ISOTPGRP030      Te-129m       4
ISOTPGRP031      Te-131m       4
ISOTPGRP032      Te-132        4
ISOTPGRP033      I-131         2
ISOTPGRP034      I-132         2
ISOTPGRP035      I-133         2
ISOTPGRP036      I-134         2
ISOTPGRP037      I-135         2
ISOTPGRP038      Xe-133        1
ISOTPGRP039      Xe-135        1
ISOTPGRP040      Cs-134        3
ISOTPGRP041      Cs-136        3
ISOTPGRP042      Cs-137        3
ISOTPGRP043      Ba-139        9
ISOTPGRP044      Ba-140        9
ISOTPGRP045      La-140        7
ISOTPGRP046      La-141        7
ISOTPGRP047      La-142        7
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ISOTPGRP048     Ce-141        8
ISOTPGRP049     Ce-143        8
ISOTPGRP050     Ce-144        8
ISOTPGRP051     Pr-143        7
ISOTPGRP052     Nd-147        7
ISOTPGRP053     Np-239        8
ISOTPGRP054     Pu-238        8
ISOTPGRP055     Pu-239        8
ISOTPGRP056     Pu-240        8
ISOTPGRP057     Pu-241        8
ISOTPGRP058     Am-241        7
ISOTPGRP059     Cm-242        7
ISOTPGRP060     Cm-244        7
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* WASHOUT COEFFICIENT NUMBER ONE, LINEAR FACTOR
*
WDCWASH1001  9.5E-5   (JON HELTON AFTER JONES, 1986)
*
* WASHOUT COEFFICIENT NUMBER TWO, EXPONENTIAL FACTOR
*
WDCWASH2001  0.8      (JON HELTON AFTER JONES, 1986)
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* DRY DEPOSITION DATA BLOCK, LOADED BY INPDRY, STORED IN /DRYCON/
*
* NUMBER OF PARTICLE SIZE GROUPS
*
DDNPSGRP001   1
*
* DEPOSITION VELOCITY OF EACH PARTICLE SIZE GROUP (M/S)
*
DDVDEPOS001   0.01   (VALUE SELECTED BY S. ACHARYA, NRC)
*******************************************************************************
* DISPERSION PARAMETER DATA BLOCK, LOADED BY INPDIS, STORED IN /DISPY/, /DISPZ/
*
* # of distances in plume-size tables--which can be used as an alternative to the
power-law model:
* (to utilize the power-law model, set NUM_DIST to zero or delete the following data
card)
*
NUM_DIST001   50
*
* A-stability       Distance (m)   Sigma-y (m)   Sigma-z (m)
A-STB/DIS01         1.000E+00      3.6580E-01    2.5000E-04   Tadmor/Gur (0.5-5 km)
A-STB/DIS02         1.400E+00      4.9569E-01    5.1105E-04   Tadmor/Gur (0.5-5 km)
A-STB/DIS03         2.000E+00      6.8408E-01    1.0905E-03   Tadmor/Gur (0.5-5 km)
A-STB/DIS04         3.000E+00      9.8658E-01    2.5812E-03   Tadmor/Gur (0.5-5 km)
A-STB/DIS05         4.000E+00      1.2793E+00    4.7568E-03   Tadmor/Gur (0.5-5 km)
A-STB/DIS06         5.000E+00      1.5649E+00    7.6428E-03   Tadmor/Gur (0.5-5 km)
A-STB/DIS07         6.000E+00      1.8450E+00    1.1259E-02   Tadmor/Gur (0.5-5 km)
A-STB/DIS08         8.000E+00      2.3923E+00    2.0749E-02   Tadmor/Gur (0.5-5 km)
A-STB/DIS09         1.000E+01      2.9265E+00    3.3338E-02   Tadmor/Gur (0.5-5 km)
A-STB/DIS10         1.000E+02      2.3412E+01    4.4457E+00   Tadmor/Gur (0.5-5 km)
A-STB/DIS11         1.400E+02      3.1726E+01    9.0879E+00   Tadmor/Gur (0.5-5 km)
A-STB/DIS12         2.000E+02      4.3783E+01    1.9392E+01   Tadmor/Gur (0.5-5 km)
A-STB/DIS13         3.000E+02      6.3144E+01    4.5901E+01   Tadmor/Gur (0.5-5 km)
A-STB/DIS14         4.000E+02      8.1877E+01    8.4590E+01   Tadmor/Gur (0.5-5 km)
A-STB/DIS15         5.000E+02      1.0016E+02    1.3591E+02   Tadmor/Gur (0.5-5 km)
A-STB/DIS16         6.000E+02      1.1808E+02    2.0022E+02   Tadmor/Gur (0.5-5 km)
A-STB/DIS17         8.000E+02      1.5312E+02    3.6898E+02   Tadmor/Gur (0.5-5 km)
A-STB/DIS18         1.000E+03      1.8730E+02    5.9284E+02   Tadmor/Gur (0.5-5 km)
A-STB/DIS19         1.400E+03      2.5381E+02    1.2119E+03   Tadmor/Gur (0.5-5 km)
A-STB/DIS20         2.000E+03      3.5027E+02    2.5860E+03   Tadmor/Gur (0.5-5 km)
```

A-STB/DIS21	3.000E+03	5.0516E+02	6.1210E+03	Tadmor/Gur (0.5-5 km)
A-STB/DIS22	4.000E+03	6.5503E+02	1.1280E+04	Tadmor/Gur (0.5-5 km)
A-STB/DIS23	5.000E+03	8.0128E+02	1.8124E+04	Tadmor/Gur (0.5-5 km)
A-STB/DIS24	6.000E+03	9.4470E+02	2.6700E+04	Tadmor/Gur (0.5-5 km)
A-STB/DIS25	8.000E+03	1.2250E+03	4.9205E+04	Tadmor/Gur (0.5-5 km)
A-STB/DIS26	1.000E+04	1.4985E+03	7.9057E+04	Tadmor/Gur (0.5-5 km)
A-STB/DIS27	1.400E+04	2.0305E+03	1.6161E+05	Tadmor/Gur (0.5-5 km)
A-STB/DIS28	2.000E+04	2.8022E+03	3.4485E+05	Tadmor/Gur (0.5-5 km)
A-STB/DIS29	3.000E+04	4.0414E+03	8.1625E+05	Tadmor/Gur (0.5-5 km)
A-STB/DIS30	4.000E+04	5.2404E+03	1.5042E+06	Tadmor/Gur (0.5-5 km)
A-STB/DIS31	5.000E+04	6.4104E+03	2.4169E+06	Tadmor/Gur (0.5-5 km)
A-STB/DIS32	6.000E+04	7.5577E+03	3.5605E+06	Tadmor/Gur (0.5-5 km)
A-STB/DIS33	8.000E+04	9.8000E+03	6.5615E+06	Tadmor/Gur (0.5-5 km)
A-STB/DIS34	1.000E+05	1.1988E+04	1.0542E+07	Tadmor/Gur (0.5-5 km)
A-STB/DIS35	1.400E+05	1.6245E+04	2.1551E+07	Tadmor/Gur (0.5-5 km)
A-STB/DIS36	2.000E+05	2.2418E+04	4.5986E+07	Tadmor/Gur (0.5-5 km)
A-STB/DIS37	3.000E+05	3.2332E+04	1.0885E+08	Tadmor/Gur (0.5-5 km)
A-STB/DIS38	4.000E+05	4.1924E+04	2.0059E+08	Tadmor/Gur (0.5-5 km)
A-STB/DIS39	5.000E+05	5.1284E+04	3.2229E+08	Tadmor/Gur (0.5-5 km)
A-STB/DIS40	6.000E+05	6.0463E+04	4.7480E+08	Tadmor/Gur (0.5-5 km)
A-STB/DIS41	8.000E+05	7.8401E+04	8.7500E+08	Tadmor/Gur (0.5-5 km)
A-STB/DIS42	1.000E+06	9.5906E+04	1.4059E+09	Tadmor/Gur (0.5-5 km)
A-STB/DIS43	1.400E+06	1.2996E+05	2.8738E+09	Tadmor/Gur (0.5-5 km)
A-STB/DIS44	2.000E+06	1.7935E+05	6.1324E+09	Tadmor/Gur (0.5-5 km)
A-STB/DIS45	3.000E+06	2.5866E+05	1.4515E+10	Tadmor/Gur (0.5-5 km)
A-STB/DIS46	4.000E+06	3.3540E+05	2.6750E+10	Tadmor/Gur (0.5-5 km)
A-STB/DIS47	5.000E+06	4.1028E+05	4.2979E+10	Tadmor/Gur (0.5-5 km)
A-STB/DIS48	6.000E+06	4.8372E+05	6.3316E+10	Tadmor/Gur (0.5-5 km)
A-STB/DIS49	8.000E+06	6.2723E+05	1.1668E+11	Tadmor/Gur (0.5-5 km)
A-STB/DIS50	1.000E+07	7.6726E+05	1.8747E+11	Tadmor/Gur (0.5-5 km)
*				
* B-stability	Distance (m)	Sigma-y (m)	Sigma-z (m)	
B-STB/DIS01	1.000E+00	2.7510E-01	1.9000E-03	Tadmor/Gur (0.5-5 km)
B-STB/DIS02	1.400E+00	3.7279E-01	3.2574E-03	Tadmor/Gur (0.5-5 km)
B-STB/DIS03	2.000E+00	5.1446E-01	5.7681E-03	Tadmor/Gur (0.5-5 km)
B-STB/DIS04	3.000E+00	7.4196E-01	1.1045E-02	Tadmor/Gur (0.5-5 km)
B-STB/DIS05	4.000E+00	9.6208E-01	1.7511E-02	Tadmor/Gur (0.5-5 km)
B-STB/DIS06	5.000E+00	1.1769E+00	2.5036E-02	Tadmor/Gur (0.5-5 km)
B-STB/DIS07	6.000E+00	1.3875E+00	3.3530E-02	Tadmor/Gur (0.5-5 km)
B-STB/DIS08	8.000E+00	1.7992E+00	5.3161E-02	Tadmor/Gur (0.5-5 km)
B-STB/DIS09	1.000E+01	2.2009E+00	7.6007E-02	Tadmor/Gur (0.5-5 km)
B-STB/DIS10	1.000E+02	1.7607E+01	3.0406E+00	Tadmor/Gur (0.5-5 km)
B-STB/DIS11	1.400E+02	2.3859E+01	5.2127E+00	Tadmor/Gur (0.5-5 km)
B-STB/DIS12	2.000E+02	3.2927E+01	9.2307E+00	Tadmor/Gur (0.5-5 km)
B-STB/DIS13	3.000E+02	4.7487E+01	1.7675E+01	Tadmor/Gur (0.5-5 km)
B-STB/DIS14	4.000E+02	6.1576E+01	2.8023E+01	Tadmor/Gur (0.5-5 km)
B-STB/DIS15	5.000E+02	7.5323E+01	4.0066E+01	Tadmor/Gur (0.5-5 km)
B-STB/DIS16	6.000E+02	8.8805E+01	5.3657E+01	Tadmor/Gur (0.5-5 km)
B-STB/DIS17	8.000E+02	1.1515E+02	8.5073E+01	Tadmor/Gur (0.5-5 km)
B-STB/DIS18	1.000E+03	1.4086E+02	1.2163E+02	Tadmor/Gur (0.5-5 km)
B-STB/DIS19	1.400E+03	1.9088E+02	2.0853E+02	Tadmor/Gur (0.5-5 km)
B-STB/DIS20	2.000E+03	2.6342E+02	3.6926E+02	Tadmor/Gur (0.5-5 km)
B-STB/DIS21	3.000E+03	3.7991E+02	7.0705E+02	Tadmor/Gur (0.5-5 km)
B-STB/DIS22	4.000E+03	4.9262E+02	1.1210E+03	Tadmor/Gur (0.5-5 km)
B-STB/DIS23	5.000E+03	6.0260E+02	1.6028E+03	Tadmor/Gur (0.5-5 km)
B-STB/DIS24	6.000E+03	7.1046E+02	2.1465E+03	Tadmor/Gur (0.5-5 km)
B-STB/DIS25	8.000E+03	9.2124E+02	3.4033E+03	Tadmor/Gur (0.5-5 km)
B-STB/DIS26	1.000E+04	1.1269E+03	4.8658E+03	Tadmor/Gur (0.5-5 km)
B-STB/DIS27	1.400E+04	1.5271E+03	8.3419E+03	Tadmor/Gur (0.5-5 km)
B-STB/DIS28	2.000E+04	2.1074E+03	1.4772E+04	Tadmor/Gur (0.5-5 km)
B-STB/DIS29	3.000E+04	3.0393E+03	2.8285E+04	Tadmor/Gur (0.5-5 km)
B-STB/DIS30	4.000E+04	3.9410E+03	4.4845E+04	Tadmor/Gur (0.5-5 km)
B-STB/DIS31	5.000E+04	4.8209E+03	6.4117E+04	Tadmor/Gur (0.5-5 km)
B-STB/DIS32	6.000E+04	5.6838E+03	8.5868E+04	Tadmor/Gur (0.5-5 km)

B-STB/DIS33	8.000E+04	7.3701E+03	1.3614E+05	Tadmor/Gur (0.5-5 km)
B-STB/DIS34	1.000E+05	9.0155E+03	1.9465E+05	Tadmor/Gur (0.5-5 km)
B-STB/DIS35	1.400E+05	1.2217E+04	3.3371E+05	Tadmor/Gur (0.5-5 km)
B-STB/DIS36	2.000E+05	1.6860E+04	5.9093E+05	Tadmor/Gur (0.5-5 km)
B-STB/DIS37	3.000E+05	2.4315E+04	1.1315E+06	Tadmor/Gur (0.5-5 km)
B-STB/DIS38	4.000E+05	3.1529E+04	1.7940E+06	Tadmor/Gur (0.5-5 km)
B-STB/DIS39	5.000E+05	3.8568E+04	2.5649E+06	Tadmor/Gur (0.5-5 km)
B-STB/DIS40	6.000E+05	4.5471E+04	3.4350E+06	Tadmor/Gur (0.5-5 km)
B-STB/DIS41	8.000E+05	5.8962E+04	5.4462E+06	Tadmor/Gur (0.5-5 km)
B-STB/DIS42	1.000E+06	7.2126E+04	7.7867E+06	Tadmor/Gur (0.5-5 km)
B-STB/DIS43	1.400E+06	9.7737E+04	1.3350E+07	Tadmor/Gur (0.5-5 km)
B-STB/DIS44	2.000E+06	1.3488E+05	2.3639E+07	Tadmor/Gur (0.5-5 km)
B-STB/DIS45	3.000E+06	1.9453E+05	4.5264E+07	Tadmor/Gur (0.5-5 km)
B-STB/DIS46	4.000E+06	2.5224E+05	7.1765E+07	Tadmor/Gur (0.5-5 km)
B-STB/DIS47	5.000E+06	3.0855E+05	1.0261E+08	Tadmor/Gur (0.5-5 km)
B-STB/DIS48	6.000E+06	3.6378E+05	1.3741E+08	Tadmor/Gur (0.5-5 km)
B-STB/DIS49	8.000E+06	4.7171E+05	2.1787E+08	Tadmor/Gur (0.5-5 km)
B-STB/DIS50	1.000E+07	5.7702E+05	3.1150E+08	Tadmor/Gur (0.5-5 km)
*				
* C-stability	Distance (m)	Sigma-y (m)	Sigma-z (m)	
C-STB/DIS01	1.000E+00	2.0890E-01	2.0000E-01	Tadmor/Gur (0.5-5 km)
C-STB/DIS02	1.400E+00	2.8308E-01	2.6660E-01	Tadmor/Gur (0.5-5 km)
C-STB/DIS03	2.000E+00	3.9066E-01	3.6158E-01	Tadmor/Gur (0.5-5 km)
C-STB/DIS04	3.000E+00	5.6341E-01	5.1125E-01	Tadmor/Gur (0.5-5 km)
C-STB/DIS05	4.000E+00	7.3056E-01	6.5369E-01	Tadmor/Gur (0.5-5 km)
C-STB/DIS06	5.000E+00	8.9367E-01	7.9097E-01	Tadmor/Gur (0.5-5 km)
C-STB/DIS07	6.000E+00	1.0536E+00	9.2428E-01	Tadmor/Gur (0.5-5 km)
C-STB/DIS08	8.000E+00	1.3662E+00	1.1818E+00	Tadmor/Gur (0.5-5 km)
C-STB/DIS09	1.000E+01	1.6712E+00	1.4300E+00	Tadmor/Gur (0.5-5 km)
C-STB/DIS10	1.000E+02	1.3370E+01	1.0224E+01	Tadmor/Gur (0.5-5 km)
C-STB/DIS11	1.400E+02	1.8118E+01	1.3629E+01	Tadmor/Gur (0.5-5 km)
C-STB/DIS12	2.000E+02	2.5003E+01	1.8484E+01	Tadmor/Gur (0.5-5 km)
C-STB/DIS13	3.000E+02	3.6060E+01	2.6136E+01	Tadmor/Gur (0.5-5 km)
C-STB/DIS14	4.000E+02	4.6758E+01	3.3417E+01	Tadmor/Gur (0.5-5 km)
C-STB/DIS15	5.000E+02	5.7198E+01	4.0435E+01	Tadmor/Gur (0.5-5 km)
C-STB/DIS16	6.000E+02	6.7435E+01	4.7250E+01	Tadmor/Gur (0.5-5 km)
C-STB/DIS17	8.000E+02	8.7442E+01	6.0414E+01	Tadmor/Gur (0.5-5 km)
C-STB/DIS18	1.000E+03	1.0696E+02	7.3102E+01	Tadmor/Gur (0.5-5 km)
C-STB/DIS19	1.400E+03	1.4495E+02	9.7447E+01	Tadmor/Gur (0.5-5 km)
C-STB/DIS20	2.000E+03	2.0003E+02	1.3216E+02	Tadmor/Gur (0.5-5 km)
C-STB/DIS21	3.000E+03	2.8849E+02	1.8687E+02	Tadmor/Gur (0.5-5 km)
C-STB/DIS22	4.000E+03	3.7408E+02	2.3893E+02	Tadmor/Gur (0.5-5 km)
C-STB/DIS23	5.000E+03	4.5759E+02	2.8911E+02	Tadmor/Gur (0.5-5 km)
C-STB/DIS24	6.000E+03	5.3949E+02	3.3784E+02	Tadmor/Gur (0.5-5 km)
C-STB/DIS25	8.000E+03	6.9955E+02	4.3196E+02	Tadmor/Gur (0.5-5 km)
C-STB/DIS26	1.000E+04	8.5573E+02	5.2267E+02	Tadmor/Gur (0.5-5 km)
C-STB/DIS27	1.400E+04	1.1596E+03	6.9673E+02	Tadmor/Gur (0.5-5 km)
C-STB/DIS28	2.000E+04	1.6003E+03	9.4493E+02	Tadmor/Gur (0.5-5 km)
C-STB/DIS29	3.000E+04	2.3080E+03	1.3361E+03	Tadmor/Gur (0.5-5 km)
C-STB/DIS30	4.000E+04	2.9927E+03	1.7083E+03	Tadmor/Gur (0.5-5 km)
C-STB/DIS31	5.000E+04	3.6608E+03	2.0671E+03	Tadmor/Gur (0.5-5 km)
C-STB/DIS32	6.000E+04	4.3161E+03	2.4155E+03	Tadmor/Gur (0.5-5 km)
C-STB/DIS33	8.000E+04	5.5965E+03	3.0884E+03	Tadmor/Gur (0.5-5 km)
C-STB/DIS34	1.000E+05	6.8460E+03	3.7371E+03	Tadmor/Gur (0.5-5 km)
C-STB/DIS35	1.400E+05	9.2770E+03	4.9816E+03	Tadmor/Gur (0.5-5 km)
C-STB/DIS36	2.000E+05	1.2803E+04	6.7562E+03	Tadmor/Gur (0.5-5 km)
C-STB/DIS37	3.000E+05	1.8464E+04	9.5529E+03	Tadmor/Gur (0.5-5 km)
C-STB/DIS38	4.000E+05	2.3942E+04	1.2214E+04	Tadmor/Gur (0.5-5 km)
C-STB/DIS39	5.000E+05	2.9287E+04	1.4780E+04	Tadmor/Gur (0.5-5 km)
C-STB/DIS40	6.000E+05	3.4529E+04	1.7270E+04	Tadmor/Gur (0.5-5 km)
C-STB/DIS41	8.000E+05	4.4773E+04	2.2082E+04	Tadmor/Gur (0.5-5 km)
C-STB/DIS42	1.000E+06	5.4769E+04	2.6720E+04	Tadmor/Gur (0.5-5 km)
C-STB/DIS43	1.400E+06	7.4218E+04	3.5618E+04	Tadmor/Gur (0.5-5 km)
C-STB/DIS44	2.000E+06	1.0242E+05	4.8306E+04	Tadmor/Gur (0.5-5 km)

C-STB/DIS45	3.000E+06	1.4772E+05	6.8302E+04	Tadmor/Gur (0.5-5 km)
C-STB/DIS46	4.000E+06	1.9154E+05	8.7331E+04	Tadmor/Gur (0.5-5 km)
C-STB/DIS47	5.000E+06	2.3430E+05	1.0567E+05	Tadmor/Gur (0.5-5 km)
C-STB/DIS48	6.000E+06	2.7624E+05	1.2348E+05	Tadmor/Gur (0.5-5 km)
C-STB/DIS49	8.000E+06	3.5819E+05	1.5788E+05	Tadmor/Gur (0.5-5 km)
C-STB/DIS50	1.000E+07	4.3817E+05	1.9104E+05	Tadmor/Gur (0.5-5 km)
*				
* D-stability	Distance (m)	Sigma-y (m)	Sigma-z (m)	
D-STB/DIS01	1.000E+00	1.4740E-01	3.0000E-01	Tadmor/Gur (0.5-5 km)
D-STB/DIS02	1.400E+00	1.9974E-01	3.7374E-01	Tadmor/Gur (0.5-5 km)
D-STB/DIS03	2.000E+00	2.7565E-01	4.7180E-01	Tadmor/Gur (0.5-5 km)
D-STB/DIS04	3.000E+00	3.9754E-01	6.1486E-01	Tadmor/Gur (0.5-5 km)
D-STB/DIS05	4.000E+00	5.1549E-01	7.4197E-01	Tadmor/Gur (0.5-5 km)
D-STB/DIS06	5.000E+00	6.3058E-01	8.5840E-01	Tadmor/Gur (0.5-5 km)
D-STB/DIS07	6.000E+00	7.4344E-01	9.6696E-01	Tadmor/Gur (0.5-5 km)
D-STB/DIS08	8.000E+00	9.6400E-01	1.1669E+00	Tadmor/Gur (0.5-5 km)
D-STB/DIS09	1.000E+01	1.1792E+00	1.3500E+00	Tadmor/Gur (0.5-5 km)
D-STB/DIS10	1.000E+02	9.4340E+00	6.0746E+00	Tadmor/Gur (0.5-5 km)
D-STB/DIS11	1.400E+02	1.2784E+01	7.5678E+00	Tadmor/Gur (0.5-5 km)
D-STB/DIS12	2.000E+02	1.7642E+01	9.5533E+00	Tadmor/Gur (0.5-5 km)
D-STB/DIS13	3.000E+02	2.5444E+01	1.2450E+01	Tadmor/Gur (0.5-5 km)
D-STB/DIS14	4.000E+02	3.2993E+01	1.5024E+01	Tadmor/Gur (0.5-5 km)
D-STB/DIS15	5.000E+02	4.0359E+01	1.7382E+01	Tadmor/Gur (0.5-5 km)
D-STB/DIS16	6.000E+02	4.7582E+01	1.9580E+01	Tadmor/Gur (0.5-5 km)
D-STB/DIS17	8.000E+02	6.1699E+01	2.3628E+01	Tadmor/Gur (0.5-5 km)
D-STB/DIS18	1.000E+03	7.5474E+01	2.7335E+01	Tadmor/Gur (0.5-5 km)
D-STB/DIS19	1.400E+03	1.0227E+02	3.4054E+01	Tadmor/Gur (0.5-5 km)
D-STB/DIS20	2.000E+03	1.4114E+02	4.2989E+01	Tadmor/Gur (0.5-5 km)
D-STB/DIS21	3.000E+03	2.0356E+02	5.6024E+01	Tadmor/Gur (0.5-5 km)
D-STB/DIS22	4.000E+03	2.6395E+02	6.7606E+01	Tadmor/Gur (0.5-5 km)
D-STB/DIS23	5.000E+03	3.2288E+02	7.8215E+01	Tadmor/Gur (0.5-5 km)
D-STB/DIS24	6.000E+03	3.8067E+02	8.8107E+01	Tadmor/Gur (0.5-5 km)
D-STB/DIS25	8.000E+03	4.9360E+02	1.0632E+02	Tadmor/Gur (0.5-5 km)
D-STB/DIS26	1.000E+04	6.0381E+02	1.2300E+02	Tadmor/Gur (0.5-5 km)
D-STB/DIS27	1.400E+04	8.1821E+02	1.5324E+02	Tadmor/Gur (0.5-5 km)
D-STB/DIS28	2.000E+04	1.1292E+03	1.9344E+02	Tadmor/Gur (0.5-5 km)
D-STB/DIS29	3.000E+04	1.6285E+03	2.5210E+02	Tadmor/Gur (0.5-5 km)
D-STB/DIS30	4.000E+04	2.1116E+03	3.0422E+02	Tadmor/Gur (0.5-5 km)
D-STB/DIS31	5.000E+04	2.5831E+03	3.5196E+02	Tadmor/Gur (0.5-5 km)
D-STB/DIS32	6.000E+04	3.0454E+03	3.9647E+02	Tadmor/Gur (0.5-5 km)
D-STB/DIS33	8.000E+04	3.9489E+03	4.7843E+02	Tadmor/Gur (0.5-5 km)
D-STB/DIS34	1.000E+05	4.8306E+03	5.5350E+02	Tadmor/Gur (0.5-5 km)
D-STB/DIS35	1.400E+05	6.5458E+03	6.8956E+02	Tadmor/Gur (0.5-5 km)
D-STB/DIS36	2.000E+05	9.0335E+03	8.7047E+02	Tadmor/Gur (0.5-5 km)
D-STB/DIS37	3.000E+05	1.3028E+04	1.1344E+03	Tadmor/Gur (0.5-5 km)
D-STB/DIS38	4.000E+05	1.6893E+04	1.3689E+03	Tadmor/Gur (0.5-5 km)
D-STB/DIS39	5.000E+05	2.0665E+04	1.5838E+03	Tadmor/Gur (0.5-5 km)
D-STB/DIS40	6.000E+05	2.4364E+04	1.7841E+03	Tadmor/Gur (0.5-5 km)
D-STB/DIS41	8.000E+05	3.1592E+04	2.1529E+03	Tadmor/Gur (0.5-5 km)
D-STB/DIS42	1.000E+06	3.8645E+04	2.4907E+03	Tadmor/Gur (0.5-5 km)
D-STB/DIS43	1.400E+06	5.2368E+04	3.1029E+03	Tadmor/Gur (0.5-5 km)
D-STB/DIS44	2.000E+06	7.2270E+04	3.9170E+03	Tadmor/Gur (0.5-5 km)
D-STB/DIS45	3.000E+06	1.0423E+05	5.1048E+03	Tadmor/Gur (0.5-5 km)
D-STB/DIS46	4.000E+06	1.3515E+05	6.1601E+03	Tadmor/Gur (0.5-5 km)
D-STB/DIS47	5.000E+06	1.6532E+05	7.1267E+03	Tadmor/Gur (0.5-5 km)
D-STB/DIS48	6.000E+06	1.9492E+05	8.0280E+03	Tadmor/Gur (0.5-5 km)
D-STB/DIS49	8.000E+06	2.5274E+05	9.6877E+03	Tadmor/Gur (0.5-5 km)
D-STB/DIS50	1.000E+07	3.0917E+05	1.1208E+04	Tadmor/Gur (0.5-5 km)
*				
* E-stability	Distance (m)	Sigma-y (m)	Sigma-z (m)	
E-STB/DIS01	1.000E+00	1.0460E-01	4.0000E-01	Tadmor/Gur (0.5-5 km)
E-STB/DIS02	1.400E+00	1.4174E-01	4.8983E-01	Tadmor/Gur (0.5-5 km)
E-STB/DIS03	2.000E+00	1.9561E-01	6.0717E-01	Tadmor/Gur (0.5-5 km)
E-STB/DIS04	3.000E+00	2.8211E-01	7.7506E-01	Tadmor/Gur (0.5-5 km)

E-STB/DIS05	4.000E+00	3.6581E-01	9.2164E-01	Tadmor/Gur (0.5-5 km)
E-STB/DIS06	5.000E+00	4.4748E-01	1.0542E+00	Tadmor/Gur (0.5-5 km)
E-STB/DIS07	6.000E+00	5.2757E-01	1.1765E+00	Tadmor/Gur (0.5-5 km)
E-STB/DIS08	8.000E+00	6.8409E-01	1.3990E+00	Tadmor/Gur (0.5-5 km)
E-STB/DIS09	1.000E+01	8.3682E-01	1.6001E+00	Tadmor/Gur (0.5-5 km)
E-STB/DIS10	1.000E+02	6.6947E+00	6.4012E+00	Tadmor/Gur (0.5-5 km)
E-STB/DIS11	1.400E+02	9.0719E+00	7.8387E+00	Tadmor/Gur (0.5-5 km)
E-STB/DIS12	2.000E+02	1.2520E+01	9.7165E+00	Tadmor/Gur (0.5-5 km)
E-STB/DIS13	3.000E+02	1.8056E+01	1.2403E+01	Tadmor/Gur (0.5-5 km)
E-STB/DIS14	4.000E+02	2.3413E+01	1.4749E+01	Tadmor/Gur (0.5-5 km)
E-STB/DIS15	5.000E+02	2.8640E+01	1.6870E+01	Tadmor/Gur (0.5-5 km)
E-STB/DIS16	6.000E+02	3.3766E+01	1.8827E+01	Tadmor/Gur (0.5-5 km)
E-STB/DIS17	8.000E+02	4.3784E+01	2.2388E+01	Tadmor/Gur (0.5-5 km)
E-STB/DIS18	1.000E+03	5.3559E+01	2.5607E+01	Tadmor/Gur (0.5-5 km)
E-STB/DIS19	1.400E+03	7.2577E+01	3.1358E+01	Tadmor/Gur (0.5-5 km)
E-STB/DIS20	2.000E+03	1.0016E+02	3.8870E+01	Tadmor/Gur (0.5-5 km)
E-STB/DIS21	3.000E+03	1.4445E+02	4.9617E+01	Tadmor/Gur (0.5-5 km)
E-STB/DIS22	4.000E+03	1.8731E+02	5.9001E+01	Tadmor/Gur (0.5-5 km)
E-STB/DIS23	5.000E+03	2.2912E+02	6.7485E+01	Tadmor/Gur (0.5-5 km)
E-STB/DIS24	6.000E+03	2.7013E+02	7.5316E+01	Tadmor/Gur (0.5-5 km)
E-STB/DIS25	8.000E+03	3.5028E+02	8.9559E+01	Tadmor/Gur (0.5-5 km)
E-STB/DIS26	1.000E+04	4.2848E+02	1.0244E+02	Tadmor/Gur (0.5-5 km)
E-STB/DIS27	1.400E+04	5.8063E+02	1.2544E+02	Tadmor/Gur (0.5-5 km)
E-STB/DIS28	2.000E+04	8.0129E+02	1.5549E+02	Tadmor/Gur (0.5-5 km)
E-STB/DIS29	3.000E+04	1.1556E+03	1.9849E+02	Tadmor/Gur (0.5-5 km)
E-STB/DIS30	4.000E+04	1.4985E+03	2.3603E+02	Tadmor/Gur (0.5-5 km)
E-STB/DIS31	5.000E+04	1.8330E+03	2.6997E+02	Tadmor/Gur (0.5-5 km)
E-STB/DIS32	6.000E+04	2.1611E+03	3.0129E+02	Tadmor/Gur (0.5-5 km)
E-STB/DIS33	8.000E+04	2.8023E+03	3.5827E+02	Tadmor/Gur (0.5-5 km)
E-STB/DIS34	1.000E+05	3.4279E+03	4.0979E+02	Tadmor/Gur (0.5-5 km)
E-STB/DIS35	1.400E+05	4.6452E+03	5.0182E+02	Tadmor/Gur (0.5-5 km)
E-STB/DIS36	2.000E+05	6.4105E+03	6.2203E+02	Tadmor/Gur (0.5-5 km)
E-STB/DIS37	3.000E+05	9.2453E+03	7.9403E+02	Tadmor/Gur (0.5-5 km)
E-STB/DIS38	4.000E+05	1.1988E+04	9.4419E+02	Tadmor/Gur (0.5-5 km)
E-STB/DIS39	5.000E+05	1.4665E+04	1.0800E+03	Tadmor/Gur (0.5-5 km)
E-STB/DIS40	6.000E+05	1.7289E+04	1.2053E+03	Tadmor/Gur (0.5-5 km)
E-STB/DIS41	8.000E+05	2.2419E+04	1.4332E+03	Tadmor/Gur (0.5-5 km)
E-STB/DIS42	1.000E+06	2.7424E+04	1.6393E+03	Tadmor/Gur (0.5-5 km)
E-STB/DIS43	1.400E+06	3.7162E+04	2.0074E+03	Tadmor/Gur (0.5-5 km)
E-STB/DIS44	2.000E+06	5.1285E+04	2.4883E+03	Tadmor/Gur (0.5-5 km)
E-STB/DIS45	3.000E+06	7.3964E+04	3.1764E+03	Tadmor/Gur (0.5-5 km)
E-STB/DIS46	4.000E+06	9.5907E+04	3.7771E+03	Tadmor/Gur (0.5-5 km)
E-STB/DIS47	5.000E+06	1.1732E+05	4.3203E+03	Tadmor/Gur (0.5-5 km)
E-STB/DIS48	6.000E+06	1.3832E+05	4.8215E+03	Tadmor/Gur (0.5-5 km)
E-STB/DIS49	8.000E+06	1.7935E+05	5.7334E+03	Tadmor/Gur (0.5-5 km)
E-STB/DIS50	1.000E+07	2.1940E+05	6.5578E+03	Tadmor/Gur (0.5-5 km)
*				
* F-stability	Distance (m)	Sigma-y (m)	Sigma-z (m)	
F-STB/DIS01	1.000E+00	7.2200E-02	2.0000E-01	Tadmor/Gur (0.5-5 km)
F-STB/DIS02	1.400E+00	9.7838E-02	2.4491E-01	Tadmor/Gur (0.5-5 km)
F-STB/DIS03	2.000E+00	1.3502E-01	3.0356E-01	Tadmor/Gur (0.5-5 km)
F-STB/DIS04	3.000E+00	1.9473E-01	3.8749E-01	Tadmor/Gur (0.5-5 km)
F-STB/DIS05	4.000E+00	2.5250E-01	4.6076E-01	Tadmor/Gur (0.5-5 km)
F-STB/DIS06	5.000E+00	3.0887E-01	5.2700E-01	Tadmor/Gur (0.5-5 km)
F-STB/DIS07	6.000E+00	3.6415E-01	5.8814E-01	Tadmor/Gur (0.5-5 km)
F-STB/DIS08	8.000E+00	4.7219E-01	6.9934E-01	Tadmor/Gur (0.5-5 km)
F-STB/DIS09	1.000E+01	5.7761E-01	7.9989E-01	Tadmor/Gur (0.5-5 km)
F-STB/DIS10	1.000E+02	4.6210E+00	3.1991E+00	Tadmor/Gur (0.5-5 km)
F-STB/DIS11	1.400E+02	6.2619E+00	3.9174E+00	Tadmor/Gur (0.5-5 km)
F-STB/DIS12	2.000E+02	8.6417E+00	4.8557E+00	Tadmor/Gur (0.5-5 km)
F-STB/DIS13	3.000E+02	1.2463E+01	6.1981E+00	Tadmor/Gur (0.5-5 km)
F-STB/DIS14	4.000E+02	1.6161E+01	7.3700E+00	Tadmor/Gur (0.5-5 km)
F-STB/DIS15	5.000E+02	1.9769E+01	8.4297E+00	Tadmor/Gur (0.5-5 km)
F-STB/DIS16	6.000E+02	2.3307E+01	9.4076E+00	Tadmor/Gur (0.5-5 km)

```
F-STB/DIS17        8.000E+02     3.0222E+01     1.1186E+01   Tadmor/Gur  (0.5-5 km)
F-STB/DIS18        1.000E+03     3.6969E+01     1.2795E+01   Tadmor/Gur  (0.5-5 km)
F-STB/DIS19        1.400E+03     5.0096E+01     1.5667E+01   Tadmor/Gur  (0.5-5 km)
F-STB/DIS20        2.000E+03     6.9135E+01     1.9420E+01   Tadmor/Gur  (0.5-5 km)
F-STB/DIS21        3.000E+03     9.9707E+01     2.4789E+01   Tadmor/Gur  (0.5-5 km)
F-STB/DIS22        4.000E+03     1.2929E+02     2.9476E+01   Tadmor/Gur  (0.5-5 km)
F-STB/DIS23        5.000E+03     1.5815E+02     3.3714E+01   Tadmor/Gur  (0.5-5 km)
F-STB/DIS24        6.000E+03     1.8646E+02     3.7625E+01   Tadmor/Gur  (0.5-5 km)
F-STB/DIS25        8.000E+03     2.4178E+02     4.4739E+01   Tadmor/Gur  (0.5-5 km)
F-STB/DIS26        1.000E+04     2.9576E+02     5.1172E+01   Tadmor/Gur  (0.5-5 km)
F-STB/DIS27        1.400E+04     4.0078E+02     6.2661E+01   Tadmor/Gur  (0.5-5 km)
F-STB/DIS28        2.000E+04     5.5309E+02     7.7669E+01   Tadmor/Gur  (0.5-5 km)
F-STB/DIS29        3.000E+04     7.9767E+02     9.9142E+01   Tadmor/Gur  (0.5-5 km)
F-STB/DIS30        4.000E+04     1.0343E+03     1.1789E+02   Tadmor/Gur  (0.5-5 km)
F-STB/DIS31        5.000E+04     1.2653E+03     1.3484E+02   Tadmor/Gur  (0.5-5 km)
F-STB/DIS32        6.000E+04     1.4917E+03     1.5048E+02   Tadmor/Gur  (0.5-5 km)
F-STB/DIS33        8.000E+04     1.9343E+03     1.7893E+02   Tadmor/Gur  (0.5-5 km)
F-STB/DIS34        1.000E+05     2.3661E+03     2.0466E+02   Tadmor/Gur  (0.5-5 km)
F-STB/DIS35        1.400E+05     3.2063E+03     2.5061E+02   Tadmor/Gur  (0.5-5 km)
F-STB/DIS36        2.000E+05     4.4248E+03     3.1063E+02   Tadmor/Gur  (0.5-5 km)
F-STB/DIS37        3.000E+05     6.3815E+03     3.9651E+02   Tadmor/Gur  (0.5-5 km)
F-STB/DIS38        4.000E+05     8.2748E+03     4.7149E+02   Tadmor/Gur  (0.5-5 km)
F-STB/DIS39        5.000E+05     1.0122E+04     5.3927E+02   Tadmor/Gur  (0.5-5 km)
F-STB/DIS40        6.000E+05     1.1934E+04     6.0183E+02   Tadmor/Gur  (0.5-5 km)
F-STB/DIS41        8.000E+05     1.5475E+04     7.1563E+02   Tadmor/Gur  (0.5-5 km)
F-STB/DIS42        1.000E+06     1.8929E+04     8.1852E+02   Tadmor/Gur  (0.5-5 km)
F-STB/DIS43        1.400E+06     2.5651E+04     1.0023E+03   Tadmor/Gur  (0.5-5 km)
F-STB/DIS44        2.000E+06     3.5400E+04     1.2424E+03   Tadmor/Gur  (0.5-5 km)
F-STB/DIS45        3.000E+06     5.1053E+04     1.5858E+03   Tadmor/Gur  (0.5-5 km)
F-STB/DIS46        4.000E+06     6.6200E+04     1.8857E+03   Tadmor/Gur  (0.5-5 km)
F-STB/DIS47        5.000E+06     8.0980E+04     2.1568E+03   Tadmor/Gur  (0.5-5 km)
F-STB/DIS48        6.000E+06     9.5474E+04     2.4070E+03   Tadmor/Gur  (0.5-5 km)
F-STB/DIS49        8.000E+06     1.2380E+05     2.8621E+03   Tadmor/Gur  (0.5-5 km)
F-STB/DIS50        1.000E+07     1.5144E+05     3.2736E+03   Tadmor/Gur  (0.5-5 km)
*
*  LINEAR SCALING FACTOR FOR SIGMA-Y FUNCTION, NORMALLY 1
*
DPYSCALE001    1.
*
*  LINEAR SCALING FACTOR FOR SIGMA-Z FUNCTION,
*  NORMALLY USED FOR SURFACE ROUGHNESS LENGTH CORRECTION.
*  (Z1 / Z0) ** 0.2,   FROM CRAC2 WE HAVE  (10 CM / 3 CM) ** 0.2 = 1.27
*
DPZSCALE001    1.27
*********************************************************************** *
* EXPANSION FACTOR DATA BLOCK, LOADED BY INPEXP, STORED IN /EXPAND/
*
* TIME BASE FOR EXPANSION FACTOR (SECONDS)
*
PMTIMBAS001    600.   (10 MINUTES)
*
* BREAK POINT FOR FORMULA CHANGE (SECONDS)
*
PMBRKPNT001   3600.   (1 HOUR)
*
* EXPONENTIAL EXPANSION FACTOR NUMBER 1
*
PMXPFAC1001      0.2
*
* EXPONENTIAL EXPANSION FACTOR NUMBER 2
*
PMXPFAC2001      0.25
*************************************************************************
* PLUME RISE DATA BLOCK, LOADED BY INPLRS, STORED IN /PLUMRS/
```

```
*
* SCALING FACTOR FOR THE CRITICAL WIND SPEED FOR ENTRAINMENT OF A BOUYANT PLUME
* (USED BY FUNCTION CAUGHT)
*
PRSCLCRW001   1.
*
* SCALING FACTOR FOR THE A-D STABILITY PLUME RISE FORMULA
* (USED BY FUNCTION PLMRIS)
*
PRSCLADP001   1.
*
* SCALING FACTOR FOR THE E-F STABILITY PLUME RISE FORMULA
* (USED BY FUNCTION PLMRIS)
*
PRSCLEFP001   1.
*******************************************************************************
* RELEASE DATA BLOCK, LOADED BY INPREL, STORED IN /ATNAM2/, /MULREL/
*
RDATNAM2001 'SECOND DRAFT 1150, WORST CASE SOURCE TERM FOR EARLY FATALITIES'
*
* TIME AFTER ACCIDENT INITIATION WHEN THE ACCIDENT REACHES GENERAL EMERGENCY
* CONDITIONS (AS DEFINED IN NUREG-0654), OR WHEN PLANT PERSONNEL CAN RELIABLY
* PREDICT THAT GENERAL EMERGENCY CONDITIONS WILL BE ATTAINED
*
RDOALARM001      1300.
*
* NUMBER OF PLUME SEGMENTS THAT ARE RELEASED
*
RDNUMREL001          1
*
* SELECTION OF RISK DOMINANT PLUME
*
RDMAXRIS001          1
*
* REFERENCE TIME FOR DISPERSION AND RADIOACTIVE DECAY
*
RDREFTIM001       0.00
*
* HEAT CONTENT OF THE RELEASE SEGMENTS (W)
* A VALUE SPECIFIED FOR EACH OF THE RELEASE SEGMENTS
*
RDPLHEAT001     3.7E+6
*
* HEIGHT OF THE PLUME SEGMENTS AT RELEASE (M)
* A VALUE SPECIFIED FOR EACH OF THE RELEASE SEGMENTS
*
RDPLHITE001          0.
*
* DURATION OF THE PLUME SEGMENTS (S)
* A VALUE SPECIFIED FOR EACH OF THE RELEASE SEGMENTS
*
RDPLUDUR001       1800.
*
* TIME OF RELEASE FOR EACH PLUME (S AFTER SCRAM)
* A VALUE SPECIFIED FOR EACH OF THE RELEASE SEGMENTS
*
RDPDELAY001       3700.
*
* Initial value of sigma-y for each plume--Note: values required for each plume
*
SIGYINIT001  9.302  (initial sigma-y, calculated for 40 meter wide bldg.)
*
* Initial value of sigma-z for each plume--Note: values required for each plume
*
```

```
SIGZINIT001  23.26  (initial sigma-z, calculated for 50 meter high bldg.)
*
* Building height (meters)--Note: values required for each plume
*
WEBUILDH001   50.0  (Surry)
*
* PARTICLE SIZE DISTRIBUTION OF EACH NUCLIDE GROUP
* YOU MUST SPECIFY A COLUMN OF DATA FOR EACH OF THE PARTICLE SIZE GROUPS
*
RDPSDIST001      1.
RDPSDIST002      1.
RDPSDIST003      1.
RDPSDIST004      1.
RDPSDIST005      1.
RDPSDIST006      1.
RDPSDIST007      1.
RDPSDIST008      1.
RDPSDIST009      1.
*
* Millstone 1 spent fuel pool inventory
* - spent fuel pool contains 11 batches of spent fuel plus rest of last core
* - inventory reflects 30 days of radioactive decay since last batch
*   was put in pool
* - inventory is based on inventories in NUREG/CR-4982, July 1987
* - Millstone 1 has a power of 2011 MWt
*
*                NUCNAM        CORINV (Bq)
*
RDCORINV001      Co-58         2.430E+15
RDCORINV002      Co-60         1.690E+16
RDCORINV003      Kr-85         6.300E+16
RDCORINV004      Kr-85m        0.000E+00
RDCORINV005      Kr-87         0.000E+00
RDCORINV006      Kr-88         0.000E+00
RDCORINV007      Rb-86         7.570E+14
RDCORINV008      Sr-89         1.150E+18
RDCORINV009      Sr-90         6.110E+17
RDCORINV010      Sr-91         0.000E+00
RDCORINV011      Sr-92         0.000E+00
RDCORINV012      Y-90          6.190E+17
RDCORINV013      Y-91          1.570E+18
RDCORINV014      Y-92          0.000E+00
RDCORINV015      Y-93          0.000E+00
RDCORINV016      Zr-95         2.330E+18
RDCORINV017      Zr-97         0.000E+00
RDCORINV018      Nb-95         2.390E+18
RDCORINV019      Mo-99         1.470E+15
RDCORINV020      Tc-99m        1.290E+15
RDCORINV021      Ru-103        1.530E+18
RDCORINV022      Ru-105        0.000E+00
RDCORINV023      Ru-106        1.090E+18
RDCORINV024      Rh-105        0.000E+00
RDCORINV025      Sb-127        7.740E+14
RDCORINV026      Sb-129        0.000E+00
RDCORINV027      Te-127        2.050E+16
RDCORINV028      Te-127m       2.050E+16
RDCORINV029      Te-129        4.480E+16
RDCORINV030      Te-129m       4.460E+16
RDCORINV031      Te-131m       0.000E+00
RDCORINV032      Te-132        3.750E+15
RDCORINV033      I-131         1.300E+17
RDCORINV034      I-132         3.810E+15
RDCORINV035      I-133         0.000E+00
RDCORINV036      I-134         0.000E+00
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RDCORINV037      I-135          0.000E+00
RDCORINV038      Xe-133         6.600E+16
RDCORINV039      Xe-135         0.000E+00
RDCORINV040      Cs-134         3.810E+17
RDCORINV041      Cs-136         1.610E+16
RDCORINV042      Cs-137         8.580E+17
RDCORINV043      Ba-139         0.000E+00
RDCORINV044      Ba-140         6.100E+17
RDCORINV045      La-140         6.230E+17
RDCORINV046      La-141         0.000E+00
RDCORINV047      La-142         0.000E+00
RDCORINV048      Ce-141         1.550E+18
RDCORINV049      Ce-143         0.000E+00
RDCORINV050      Ce-144         2.350E+18
RDCORINV051      Pr-143         5.910E+17
RDCORINV052      Nd-147         1.770E+17
RDCORINV053      Np-239         6.470E+15
RDCORINV054      Pu-238         1.760E+16
RDCORINV055      Pu-239         3.870E+15
RDCORINV056      Pu-240         5.400E+15
RDCORINV057      Pu-241         9.470E+17
RDCORINV058      Am-241         1.080E+16
RDCORINV059      Cm-242         7.320E+16
RDCORINV060      Cm-244         8.700E+15
*
*  SCALING FACTOR TO ADJUST THE CORE INVENTORY FOR POWER LEVEL
*
RDCORSCA001   1.711  *  convert from Millstone to Susquehanna
*                       by multiplying by ratio of powers
*                       (3441MWt/2011MWt)
*
*
RDAPLFRC001   PARENT      (apply rel fracs the same as prior versions)
*
* RELEASE FRACTIONS FOR ISOTOPE GROUPS IN RELEASE
*
*  ISOTOPE GROUPS:
*
*            XE/KR    I      CS     TE     SR     RU     LA     CE     BA
*
RDRELFRC001 1.0E+0 1.0E+0 1.0E+0 2.0E-2 2.0E-3 2.0E-5 1.0E-6 1.0E-6 2.0E-3
*****************************************************************************
* OUTPUT CONTROL DATA BLOCK, LOADED BY INPOPT, STORED IN /STOPME/, /ATMOPT/
*
* FLAG TO INDICATE THAT THIS IS THE LAST PROGRAM IN THE SERIES TO BE RUN
*
OCENDAT1001  .FALSE. (SET THIS VALUE TO .TRUE. TO SKIP EARLY AND CHRONC)
*
OCIDEBUG001  0
*
* NAME OF THE NUCLIDE TO BE LISTED ON THE DISPERSION LISTINGS
*
OCNUCOUT001  Cs-137
*
*               NUMO
TYPEONUMBER       2
*
*              INDREL   INDRAD
TYPEOOUT001       1        9
TYPEOOUT002       1       10          XCCDF
*****************************************************************************
* METEOROLOGICAL SAMPLING DATA BLOCK
*
* METEOROLOGICAL SAMPLING OPTION CODE:
```

```
*
* METCOD = 1, USER SPECIFIED DAY AND HOUR IN THE YEAR (FROM MET FILE),
*          2, WEATHER CATEGORY BIN SAMPLING,
*          3, 120 HOURS OF WEATHER SPECIFIED ON THE ATMOS USER INPUT FILE,
*          4, CONSTANT MET (BOUNDARY WEATHER USED FROM THE START),
*          5, STRATIFIED RANDOM SAMPLES FOR EACH DAY OF THE YEAR.
*
M1METCOD001  2
*
* LAST SPATIAL INTERVAL FOR MEASURED WEATHER
*
M2LIMSPA001  25
*
* BOUNDARY WEATHER MIXING LAYER HEIGHT
*
M2BNDMXH001  1000.  (METERS)
*
* BOUNDARY WEATHER STABILITY CLASS INDEX
*
M2IBDSTB001  4      (D-STABILITY)
*
* BOUNDARY WEATHER RAIN RATE
*
M2BNDRAN001  5.     (MM/HR)
*
* BOUNDARY WEATHER WIND SPEED
*
M2BNDWND001  5.     (M/S)
*
* NUMBER OF RAIN DISTANCE INTERVALS FOR BINNING
*
M4NRNINT001  5
*
* ENDPOINTS OF THE RAIN DISTANCE INTERVALS (KILOMETERS)
*
* NOTE: THESE MUST BE CHOSEN TO MATCH THE SPATIAL ENDPOINT DISTANCES
*       SPECIFIED FOR THE ARRAY SPAEND (10 % ERROR IS ALLOWED).
*
M4RNDSTS001  3.22  5.63  11.27  20.92  32.19
*
* NUMBER OF RAIN INTENSITIY BREAKPOINTS
*
M4NRINTN001   3
*
* RAIN INTENSITY BREAKPOINTS FOR WEATHER BINNING (MILLIMETERS PER HOUR)
*
M4RNRATE001   2.  4.  6.
*
* NUMBER OF SAMPLES PER BIN
*
M4NSMPLS001  4  (THIS NUMBER SHOULD BE SET TO 4 FOR RISK ASSESSMENT)
*
* INITIAL SEED FOR RANDOM NUMBER GENERATOR
*
M4IRSEED001   79
.
*
*
*****************************************************************
* 4/14/99: J. Schaperow commented out source term number 2 of 2.*
*****************************************************************
*
*
********************** RELEASE DATA BLOCK *************
```

```
* SOURCE TERM NUMBER 2 OF 2
*
*RDATNAM2001 'RELEASE FRACTIONS OF SOURCE TERM 1 REDUCED BY A FACTOR OF TEN'
*
*            XE/KR    I      CS      TE      SR      RU      LA      CE      BA
*
*RDRELFRC001 1.0E-1 6.8E-2 6.4E-2 1.7E-2 4.2E-4 2.3E-4 1.6E-5 4.0E-5 6.3E-4
*RDRELFRC002 4.3E-4 9.5E-4 2.4E-4 1.4E-2 6.8E-3 4.7E-5 6.8E-4 7.1E-4 5.4E-3
*.
```

MACCS2 Input File for the Base Case with Radionuclide Inventories at 30 Days Following Reactor Shutdown:

EARLY.INP

```
* GENERAL DESCRIPTIVE TITLE DESCRIBING THIS "EARLY" INPUT FILE
*
MIEANAM1001 'IN2A.INP, Sample Problem A of NUREG/CR-4691, Vol. 1, EARLY input'
DCF_FILE001 'DOSDATA.INP'  (DCF file of MACCS 1.5.11.1)
*
*               ORGNAM          ORGFLG
*
MIORGDEF001  'A-SKIN'         .TRUE.
MIORGDEF002  'A-RED MARR'     .TRUE.
MIORGDEF003  'A-LUNGS'        .TRUE.
MIORGDEF004  'A-THYROIDH'     .TRUE.
MIORGDEF005  'A-STOMACH'      .TRUE.
MIORGDEF006  'A-LOWER LI'     .FALSE.  (does not contribute to early fatalities)
MIORGDEF007  'L-EDEWBODY'     .TRUE.
MIORGDEF008  'L-RED MARR'     .TRUE.
MIORGDEF009  'L-BONE SUR'     .TRUE.
MIORGDEF010  'L-BREAST'       .TRUE.
MIORGDEF011  'L-LUNGS'        .TRUE.
MIORGDEF012  'L-THYROID'      .TRUE.
MIORGDEF013  'L-LOWER LI'     .TRUE.
MIORGDEF014  'L-BLAD WAL'     .TRUE.
MIORGDEF015  'L-LIVER'        .FALSE.
MIORGDEF016  'L-THYROIDH'     .TRUE.
*
* FLAG TO INDICATE THAT THIS IS THE LAST PROGRAM IN THE SERIES TO BE RUN
*
MIENDAT2001  .FALSE.   (SET THIS VALUE TO .TRUE. TO SKIP CHRONC)
*
* DISPERSION MODEL OPTION CODE:  1  *  STRAIGHT LINE
*                                2  *  WIND-SHIFT WITH ROTATION
*                                3  *  WIND-SHIFT WITHOUT ROTATION
*
MIIPLUME001  2
*
* NUMBER OF FINE GRID SUBDIVISIONS USED BY THE MODEL
*
MINUMFIN001  7    (3, 5 OR 7 ALLOWED)
*
* LEVEL OF DEBUG OUTPUT REQUIRED, NORMAL RUNS SHOULD SPECIFY ZERO
*
MIIPRINT001  0
*
* LOGICAL FLAG SIGNIFYING THAT THE BREAKDOWN OF RISK BY WEATHER CATEGORY
* BIN ARE TO BE PRESENTED TO SHOW THEIR RELATIVE CONTRIBUTION TO THE MEAN
*
*               RISBIN
*
MIRISCAT001   .FALSE.
*
* FLAG INDICATING IF WIND-ROSES FROM ATMOS ARE TO BE OVERRIDDEN
*
MIOVRRID001  .FALSE.  (USE THE WIND ROSE CALCULATED FOR EACH WEATHER BIN)
**************************************************************************
* POPULATION DISTRIBUTION DATA BLOCK, LOADED BY INPOPU, STORED IN /POPDAT/
*
PDPOPFLG001  FILE
*
*PDPOPFLG001  UNIFORM
*PDIBEGIN001  1    (SPATIAL INTERVAL AT WHICH POPULATION BEGINS)
*PDPOPDEN001  50. (POPULATION DENSITY (PEOPLE PER SQUARE KILOMETER))
**************************************************************************
* SHIELDING AND EXPOSURE FACTORS, LOADED BY INDFAC, STORED IN /EADFAC/
*
* THREE VALUES OF EACH PROTECTION FACTOR ARE SUPPLIED,
```

```
* ONE FOR EACH TYPE OF ACTIVTY:
*
* ACTIVITY TYPE:
*     1 - EVACUEES WHILE MOVING
*     2 - NORMAL ACTIVITY IN SHELTERING AND EVACUATION ZONE
*     3 - SHELTERED ACTIVITY
*
* CLOUD SHIELDING FACTOR
*
*    SITE         GG   PB   SEQ  SUR  ZION
*    SHELTERING   0.7  0.5  0.65 0.6  0.5
*
*               EVACUEES  NORMAL  SHELTER
*
SECSFACT001      1.      0.75     0.6   *  SURRY SHELTERING VALUE
*
* PROTECTION FACTOR FOR INHALATION
*
SEPROTIN001      1.      0.41      0.33  * VALUES FOR NORMAL ACTIVITY AND
*                                          SHELTERING SELECTED BY NRC STAFF
*
* BREATHING RATE (CUBIC METERS PER SECOND)
*
SEBRRATE001  2.66E-4  2.66E-4  2.66E-4
*
* SKIN PROTECTION FACTOR
*
SESKPFAC001  1.0      0.41     0.33    * VALUES FOR NORMAL ACTIVITY AND
*                                        SHELTERING SELECTED BY NRC STAFF
*
* GROUND SHIELDING FACTOR
*
*    SITE         GG   PB   SEQ  SUR  ZION
*    SHELTERING   0.25 0.1  0.2  0.2  0.1
*
SEGSHFAC001      0.5     0.33     0.2   * VALUE FOR NORMAL ACTIVITY SELECTED BY
*                                         NRC STAFF
*
* RESUSPENSION INHALATION MODEL CONCENTRATION COEFFICIENT (/METER)
*
*   RESCON = 1.E-4 IS APPROPRIATE FOR MECHANICAL RESUSPENSION BY VEHICLES.
*   RESHAF = 2.11 DAYS CAUSES 1.E-4 TO DECAY IN ONE WEEK TO 1.E-5, THE VALUE
*   OF RESCON USED IN THE FIRST TERM OF THE LONG-TERM RESUSPENSION EQUATION
*   USED IN CHRONC.
*
SERESCON001   1.E-4     (RESUSPENSION IS TURNED ON)
*
* RESUSPENSION CONCENTRATION COEFFICIENT HALF-LIFE (SEC)
*
SERESHAF001   1.82E5    (2.11 DAYS)
*******************************************************************************
* EVACUATION ZONE DATA BLOCK, LOADED BY EVNETW, STORED IN /NETWOR/, /EOPTIO/
*
* SPECIFIC DESCRIPTION OF THE EMERGENCY RESPONSE SCENARIO BEING USED
*
EZEANAM2001  'EVACUATION WITHIN 10 MILES, RELOCATION MODELS APPLY ELSEWHERE'
*
* THE TYPE OF WEIGHTING TO BE APPLIED TO THE EMERGENCY RESPONSE SCENARIOS
* YOU MUST SUPPLY A VALUE OF 'TIME' OR 'PEOPLE'
*
EZWTNAME001  'PEOPLE'
*
* WEIGHTING FRACTION APPLICABLE TO THIS SCENARIO
*
```

```
EZWTFRAC001  0.995
*
* LAST RING IN THE MOVEMENT ZONE
*
EZLASMOV001     15    (EVACUEES DISAPPEAR AFTER TRAVELING TO 20 MILES)
*
*  Flag defining the time at which evacuees "enter" the destination element
*
*TRAVELPOINT   'CENTERPOINT' (new option implemented at MACCS2 v. 1.11f)
TRAVELPOINT   'BOUNDARY'    (functionality derived from MACCS circa 1984)
*
* RADIAL EVACUATION SPEED (M/S)
*
EZESPEED001     1.8   1.8    1.8          (SURRY)
EZEVATYP001     'RADIAL'
EZDURBEG001     86400.0
EZDURMID001     0.0
EZREFPNT001     'ALARM'
EZNUMEVA001      12
EZDLTSHL001    7200.  7200.  7200.  7200.  7200.  7200.
EZDLTSHL002    7200.  7200.  7200.  7200.  7200.  7200.
EZDLTEVA001      0.     0.     0.     0.     0.     0.
EZDLTEVA002      0.     0.     0.     0.     0.     0.
*************************************************************************
* SHELTER AND RELOCATION ZONE DATA BLOCK, LOADED BY INPEMR,
*                                         STORED IN /INPSRZ/, /RELOCA/
*
* DURATION OF THE EMERGENCY PHASE (SECONDS FROM PLUME ARRIVAL)
*
SRENDEMP001  604800.   (ONE WEEK)
*
* CRITICAL ORGAN FOR RELOCATION DECISIONS
*
SRCRIORG001 'L-EDEWBODY'
*
* HOT SPOT RELOCATION TIME (SECONDS FROM PLUME ARRIVAL)
*
SRTIMHOT001  43200.    (ONE-HALF DAY)
*
* NORMAL RELOCATION TIME (SECONDS FROM PLUME ARRIVAL)
*
SRTIMNRM001  86400.    (ONE DAY)
*
* HOT SPOT RELOCATION DOSE CRITERION THRESHOLD (SIEVERTS)
*
SRDOSHOT001  0.5     (50 REM DOSE TO WHOLE BODY IN 1 WEEK TRIGGERS RELOCATION)
*
* NORMAL RELOCATION DOSE CRITERION THRESHOLD (SIEVERTS)
*
SRDOSNRM001  0.25    (25 REM DOSE TO WHOLE BODY IN 1 WEEK TRIGGERS RELOCATION)
*****************************************************************************
* EARLY FATALITY MODEL PARAMETERS, LOADED BY INEFAT, STORED IN /EFATAL/
*
* NUMBER OF EARLY FATALITY EFFECTS
*
EFNUMEFA001   2
*
*             ORGNAM        EFFACA   EFFACB   EFFTHR
*
EFATAGRP001 'A-RED MARR'      3.8       5.0     1.5
EFATAGRP002 'A-LUNGS'        10.0       7.0     5.0
*****************************************************************************
* EARLY INJURY MODEL PARAMETERS, LOADED BY INEINJ, STORED IN /EINJUR/
*
```

```
* NUMBER OF EARLY INJURY EFFECTS
*
EINUMEIN001  7
*
*             EINAME             ORGNAM     EISUSC EITHRE EIFACA EIFACB
*
EINJUGRP001 'PRODROMAL VOMIT'  'A-STOMACH'  1.     .5     2.     3.
EINJUGRP002 'DIARRHEA'         'A-STOMACH'  1.     1.     3.     2.5
EINJUGRP003 'PNEUMONITIS'      'A-LUNGS'    1.     5.    10.     7.
EINJUGRP004 'SKIN ERYTHEMA'    'A-SKIN'     1.     3.     6.     5.
EINJUGRP005 'TRANSEPIDERMAL'   'A-SKIN'     1.    10.    20.     5.
EINJUGRP006 'THYROIDITIS'      'A-THYROIDH' 1.    40.   240.     2.
EINJUGRP007 'HYPOTHYROIDISM'   'A-THYROIDH' 1.     2.    60.     1.3
****************************************************************************
* ACUTE EXPOSURE CANCER PARAMETERS, LOADED BY INACAN STORED IN /ACANCR/.
*
* NUMBER OF ACUTE EXPOSURE CANCER EFFECTS
*
LCNUMACA001   7
*
* THRESHOLD DOSE FOR APPLYING THE DOSE DEPENDENT REDUCTION FACTOR
*
LCDDTHRE001   0.2  (LOWEST DOSE FOR WHICH DDREFA WILL BE APPLIED)
*
* DOSE THRESHOLD FOR LINEAR DOSE RESPONSE (Sv)
*
LCACTHRE001   0.0  (LINEAR-QUADRATIC MODEL IS NOT BEING USED)
*
*             ACNAME     ORGNAM     ACSUSC DOSEFA DOSEFB CFRISK   CIRISK  DDREFA
*
LCANCERS001 'LEUKEMIA' 'L-RED MARR'  1.0    1.0    0.0   9.70E-3  0.0     2.0
LCANCERS002 'BONE'     'L-BONE SUR'  1.0    1.0    0.0   9.00E-4  0.0     2.0
LCANCERS003 'BREAST'   'L-BREAST'    1.0    1.0    0.0   5.40E-3  1.7E-2  1.0
LCANCERS004 'LUNG'     'L-LUNGS'     1.0    1.0    0.0   1.55E-2  0.0     2.0
LCANCERS005 'THYROID'  'L-THYROIDH'  1.0    1.0    0.0   7.20E-4  7.2E-3  1.0
LCANCERS006 'GI'       'L-LOWER LI'  1.0    1.0    0.0   3.36E-2  0.0     2.0
LCANCERS007 'OTHER'    'L-EDEWBODY'  1.0    1.0    0.0   2.76E-2  0.0     2.0
****************************************************************************
* RESULT 1 OPTIONS BLOCK, LOADED BY INOUT1, STORED IN /INOUT1/
* TOTAL NUMBER OF A GIVEN EFFECT (LATENT CANCER, EARLY DEATH, EARLY INJURY)
*
* NUMBER OF DESIRED RESULTS OF THIS TYPE
*
TYPE1NUMBER    32
*
TYPE1OUT001    'ERL FAT/TOTAL'                1  26   NOCCDF (0 TO 1000 MILES)
TYPE1OUT002    'ERL INJ/PRODROMAL VOMIT'      1  26   NOCCDF
TYPE1OUT003    'ERL INJ/DIARRHEA'             1  26
TYPE1OUT004    'ERL INJ/PNEUMONITIS'          1  26
TYPE1OUT005    'ERL INJ/THYROIDITIS'          1  26
TYPE1OUT006    'ERL INJ/HYPOTHYROIDISM'       1  26
TYPE1OUT007    'ERL INJ/SKIN ERYTHEMA'        1  26
TYPE1OUT008    'ERL INJ/TRANSEPIDERMAL'       1  26
TYPE1OUT009    'CAN FAT/TOTAL'                1  26   NOCCDF
TYPE1OUT010    'CAN FAT/LUNG'                 1  26
TYPE1OUT011    'CAN FAT/THYROID'              1  26
TYPE1OUT012    'CAN FAT/BREAST'               1  26
TYPE1OUT013    'CAN FAT/GI'                   1  26
TYPE1OUT014    'CAN FAT/LEUKEMIA'             1  26
TYPE1OUT015    'CAN FAT/BONE'                 1  26
TYPE1OUT016    'CAN FAT/OTHER'                1  26
TYPE1OUT017    'CAN INJ/THYROID'              1  26
TYPE1OUT018    'CAN INJ/BREAST'               1  26
TYPE1OUT019    'CAN FAT/TOTAL'                1  19   CCDF  (0 TO 50 MILES)
```

```
TYPE1OUT020    'ERL FAT/TOTAL'                  1  12        (0 TO 10 MILES)
TYPE1OUT021    'ERL INJ/PRODROMAL VOMIT'        1  12
TYPE1OUT022    'ERL INJ/DIARRHEA'               1  12
TYPE1OUT023    'ERL INJ/PNEUMONITIS'            1  12
TYPE1OUT024    'ERL INJ/THYROIDITIS'            1  12
TYPE1OUT025    'ERL INJ/HYPOTHYROIDISM'         1  12
TYPE1OUT026    'ERL INJ/SKIN ERYTHEMA'          1  12
TYPE1OUT027    'ERL INJ/TRANSEPIDERMAL'         1  12
TYPE1OUT028    'CAN FAT/TOTAL'                  1  12
TYPE1OUT029    'ERL FAT/TOTAL'                  1  21        (0 TO 100 MILES)
TYPE1OUT030    'ERL FAT/TOTAL'                  1  25        (0 TO 500 MILES)
TYPE1OUT031    'CAN FAT/TOTAL'                  1  21        (0 TO 100 MILES)
TYPE1OUT032    'CAN FAT/TOTAL'                  1  25        (0 TO 500 MILES)
*******************************************************************************
* RESULT 2 OPTIONS BLOCK, LOADED BY INOUT2, STORED IN /INOUT2/
* FURTHEST DISTANCE AT WHICH A GIVEN RISK OF EARLY DEATH IS EXCEEDED.
*
* NUMBER OF DESIRED RESULTS OF THIS TYPE
*
TYPE2NUMBER  1
*
*           FATALITY RISK THRESHOLD
*
TYPE2OUT001  0.
*******************************************************************************
* RESULT 3 OPTIONS BLOCK, LOADED BY INOUT3, STORED IN /INOUT3/
* NUMBER OF PEOPLE WHOSE DOSE TO A GIVEN ORGAN EXCEEDS A GIVEN THRESHOLD.
*
* NUMBER OF DESIRED RESULTS OF THIS TYPE
*
TYPE3NUMBER  3
*
*               ORGAN NAME    DOSE THRESHOLD (Sv)
*
TYPE3OUT001    'A-RED MARR'         1.5
TYPE3OUT002    'A-LUNGS'            5.0
TYPE3OUT003    'L-EDEWBODY'         0.05
*******************************************************************************
* RESULT 4 OPTIONS BLOCK, LOADED BY INOUT4, STORED IN /INOUT4/
* 360 DEGREE AVERAGE RISK OF A GIVEN EFFECT AT A GIVEN DISTANCE.
*
* POSSIBLE TYPES OF EFFECTS ARE:
*
*   'ERL FAT/TOTAL'
*   'ERL INJ/INJURY NAME'
*   'CAN FAT/CANCER NAME'
*   'CAN FAT/TOTAL'
*
* NUMBER OF DESIRED RESULTS OF THIS TYPE
*
TYPE4NUMBER  5
*
*           RADIAL INDEX   TYPE OF EFFECT
*
TYPE4OUT001       1          'ERL FAT/TOTAL'
TYPE4OUT002       2          'ERL FAT/TOTAL'
TYPE4OUT003       3          'ERL FAT/TOTAL'
TYPE4OUT004       4          'ERL FAT/TOTAL'
TYPE4OUT005       5          'ERL FAT/TOTAL'
*******************************************************************************
* RESULT 5 OPTIONS BLOCK, LOADED BY INOUT5, STORED IN /INOUT5/
*
* TOTAL POPULATION DOSE TO A GIVEN ORGAN BETWEEN TWO DISTANCES.
*
```

```
* NUMBER OF DESIRED RESULTS OF THIS TYPE
*
TYPE5NUMBER     5
*
*             ORGAN       I1DIS5     I2DIS5
*
TYPE5OUT001 'L-EDEWBODY'       1          12              (0-10 MILES)
TYPE5OUT002 'L-EDEWBODY'       1          19     NOCCDF   (0-50 MILES)
TYPE5OUT003 'L-EDEWBODY'       1          26     NOCCDF   (0-1000 MILES)
TYPE5OUT004 'L-EDEWBODY'       1          21              (0-100 MILES)
TYPE5OUT005 'L-EDEWBODY'       1          25              (0-500 MILES)
******************************************************************************
* RESULT 6 OPTIONS BLOCK, LOADED BY INOUT6, STORED IN /INOUT6/
*
* CENTERLINE DOSE TO AN ORGAN VS DIST BY PATHWAY, PATHWAY NAMES ARE AS FOLLOWS:
*
*  PATHWAY NAME:
*    'CLD'     - CLOUDSHINE
*    'GRD'     - GROUNDSHINE
*    'INH ACU' - "ACUTE DOSE EQUIVALENT" FROM DIRECT INHALATION OF THE CLOUD
*    'INH LIF' - "LIFETIME DOSE COMMITMENT" FROM DIRECT INHALATION OF THE CLOUD
*    'RES ACU' - "ACUTE DOSE EQUIVALENT" FROM RESUSPENSION INHALATION
*    'RES LIF' - "LIFETIME DOSE COMMITMENT" FROM RESUSPENSION INHALATION
*    'TOT ACU' - "ACUTE DOSE EQUIVALENT" FROM ALL PATHWAYS
*    'TOT LIF' - "LIFETIME DOSE COMMITMENT" FROM ALL PATHWAYS
*
* NUMBER OF DESIRED RESULTS OF THIS TYPE
*
TYPE6NUMBER     0
*
*             ORGNAM         PATHNM       I1DIS6   I2DIS6
*
*TYPE6OUT001  'A-RED MARR'    'TOT ACU'      1        19       (0-50 MILES)
*TYPE6OUT002  'A-LUNGS'       'TOT ACU'      1        19       (0-50 MILES)
*TYPE6OUT003  'L-EDEWBODY'    'TOT LIF'      1        26       (0-1000 MILES)
******************************************************************************
* RESULT 7 OPTIONS BLOCK, LOADED BY INOUT7, STORED IN /INOUT7/
*
* CENTERLINE RISK OF A GIVEN EFFECT VS DISTANCE
*
* NUMBER OF DESIRED RESULTS OF THIS TYPE
*
TYPE7NUMBER   0
*
*                    NAME            I1DIS7        I2DIS7
*
*TYPE7OUT001     'ERL FAT/TOTAL'        1             19         (0-50 MILES)
*TYPE7OUT002     'CAN FAT/TOTAL'        1             26         (0-1000 MILES)
******************************************************************************
* RESULT 8 OPTIONS BLOCK, LOADED BY INOUT8, STORED IN /INOUT8/
*
* POPULATION WEIGHTED FATALITY RISK BETWEEN 2 DISTANCES
*
* NUMBER OF DESIRED RESULTS OF THIS TYPE
*
TYPE8NUMBER   2
*
*                NAME      I1DIS8  I2DIS8
*
TYPE8OUT001 'ERL FAT/TOTAL'   1       5     NOCCDF  (0-EXCL ZONE + 1 MI)
TYPE8OUT002 'CAN FAT/TOTAL'   1      12     NOCCDF  (0-10 MILES)
******************************************************************************
* RESULT A OPTIONS BLOCK, LOADED BY INOUTA, STORED IN /INOUTA/
*
```

```
* peak dose to a given organ
*
*             NUMA
TYPEANUMBER    1
*
*                ORGNAM     I1DISA  I2DISA
TYPEAOUT001 'L-EDEWBODY'  1        26
.
*******************************************************************************
* EMERGENCY RESPONSE SCENARIO NUMBER 2
*******************************************************************************
* EVACUATION ZONE DATA BLOCK, LOADED BY EVNETW, STORED IN /NETWOR/, /EOPTIO/
*
* SPECIFIC DESCRIPTION OF THE EMERGENCY RESPONSE SCENARIO BEING USED
*
EZEANAM2001  'NO EVACUATION, RELOCATION MODELS APPLY EVERYWHERE'
*
* WEIGHTING FRACTION APPLICABLE TO THIS SCENARIO
*
EZWTFRAC001  0.005
*
* LAST RING IN THE MOVEMENT ZONE
*
EZLASMOV001      0    (A ZERO TURNS OFF THE EVACUATION MODEL)
.
```

MACCS2 Input File for the Base Case with Radionuclide Inventories at 30 Days Following Reactor Shutdown:

CHRONC.INP

```
* GENERAL DESCRIPTIVE TITLE DESCRIBING THIS "CHRONC" INPUT FILE
*
CHCHNAME001 'IN3A_N.INP, Sample Problem A, "New" COMIDA2-Based Food Model'
*********************************************************************************
* EMERGENCY RESPONSE COST DATA BLOCK
*
* DAILY COST FOR A PERSON WHO IS EVACUATED (DOLLARS/PERSON-DAY)
*
CHEVACST001  27.00   (INCLUDES FOOD AND HOUSING COSTS BUT NOT LOST INCOME)
*
* DAILY COST FOR A PERSON WHO IS RELOCATED (DOLLARS/PERSON-DAY)
*
CHRELCST001  27.00   (INCLUDES FOOD AND HOUSING COSTS BUT NOT LOST INCOME)
*********************************************************************************
* LONG TERM PROTECTIVE ACTION DATA BLOCK
*
* Duration of the intermediate phase period--at version 1.11c TMIPND is no
* longer processed.  The new input variable DUR_INTPHAS is the period's
* duration, not the time after plume arrival at which the period ends.
*
DUR_INTPHAS   0.0    (in seconds)   (no intermediate phase)
*
* LONG-TERM PHASE DOSE PROJECTION PERIOD, THE DURATION OF THE EXPOSURE
* PERIOD OVER WHICH THE LONG-TERM DOSE CRITERION IS EVALUATED (SECONDS)
*
CHTMPACT001   1.58E8            (5 YEARS)
*
* DOSE CRITERION FOR INTERMEDIATE PHASE RELOCATION (Sv)
*
CHDSCRTI001   1.0E5             (NO INTERMEDIATE PHASE RELOCATION)
*
* DOSE CRITERION FOR LONG-TERM PHASE RELOCATION (Sv)
*
CHDSCRLT001    0.04
*
* CRITICAL ORGAN NAME FOR LONG-TERM ACTIONS
*
CHCRTOCR001 'L-EDEWBODY'
*
* Long Term Exposure Period    Previously permanently set to:
*    one million years = 3.15 E13 seconds
*    MACCS2 allowable range is 3.15E7 to 1.E10
*
CHEXPTIM001    1.E10
*********************************************************************************
* DECONTAMINATION PLAN DATA BLOCK
*
* NUMBER OF LEVELS OF DECONTAMINATION
*
CHLVLDEC001  2
*
* DECONTAMINATION TIMES CORRESPONDING TO THE LVLDEC LEVELS OF DECONTAMINATION
*  (SECONDS)
*
CHTIMDEC001   5.184E6  1.0368E7    (60, 120 DAYS)
*
* DOSE REDUCTION FACTORS CORRESPONDING TO THE LVLDEC LEVELS OF DECONTAMINATION
*
CHDSRFCT001   3.      15.
*
* COST OF FARM DECONTAMINATION PER FARMLAND UNIT AREA (DOLLARS/HECTARE)
*  FOR THE VARIOUS LEVELS OF DECONTAMINATION
*
CHCDFRM0001   562.5   1250.
```

```
*
* COST OF NONFARM DECONTAMINATION PER RESIDENT PERSON (DOLLARS/PERSON)
*  FOR THE VARIOUS LEVELS OF DECONTAMINATION
*
CHCDNFRM001   3000.   8000.
*
* FRACTION OF FARMLAND DECONTAMINATION COST DUE TO LABOR
*  FOR THE VARIOUS DECONTAMINATION LEVELS
*
CHFRFDL0001  .3      .35
*
* FRACTION OF NON-FARM DECONTAMINATION COST DUE TO LABOR
*  FOR THE VARIOUS DECONTAMINATION LEVELS
*
CHFRNFDL001  .7      .5
*
* FRACTION OF TIME WORKERS IN FARM AREAS SPEND IN CONTAMINATED AREAS
*  FOR THE VARIOUS DECONTAMINATION LEVELS
*
CHTFWKF0001  .10     .33
*
* FRACTION OF TIME WORKERS IN NON-FARM AREAS SPEND IN CONTAMINATED AREAS
*  FOR THE VARIOUS DECONTAMINATION LEVELS
*
CHTFWKNF001  .33     .33
*
* AVERAGE COST OF DECONTAMINATION LABOR (DOLLARS/MAN-YEAR)
*
CHDLBCST001   35000.
********************************************************************************
* INTERDICTION COST DATA BLOCK
*
* DEPRECIATION (DETERIORATION) RATE DURING INTERDICTION PERIOD (PER YEAR)
*
CHDPRATE001     .20    (VALUE OBTAINED FROM WASH-1400, APPENDIX 6)
*
* INVESTMENT INCOME RETURN (DISCOUNT RATE) DURING INTERDICTION PERIOD (PER YEAR)
* THIS VALUE SHOULD BE DERIVED AS A REAL RETURN RATE ADJUSTED FOR INFLATION
*
CHDSRATE001     .12    (VALUE OBTAINED FROM WASH-1400, APPENDIX 6)
*
* POPULATION RELOCATION COST (DOLLARS/PERSON):
*  ALTERNATIVE HOUSING, MOVING COSTS, AND LOST INCOME FOR PEOPLE IN
*  AREAS WHICH REQUIRE DECONTAMINATION, INTERDICTION, OR CONDEMNATION
*
CHPOPCST001   5000.
********************************************************************************
* GROUNDSHINE WEATHERING DEFINITION DATA BLOCK
*
* NUMBER OF TERMS IN THE GROUNDSHINE WEATHERING RELATIONSHIP (EITHER 1 OR 2)
*
CHNGWTRM001    2
*
* GROUNDSHINE WEATHERING COEFFICIENTS
*
CHGWCOEF001    0.5    0.5            (JON HELTON)
*
* HALF LIVES CORRESPONDING TO THE GROUNDSHINE WEATHERING COEFFICIENTS (S)
*
CHTGWHLF001    1.6E7  2.8E9          (JON HELTON)
********************************************************************************
* RESUSPENSION WEATHERING DEFINITION DATA BLOCK
*
* NUMBER OF TERMS IN THE RESUSPENSION WEATHERING RELATIONSHIP
```

```
*
CHNRWTRM001    3
*
* RESUSPENSION CONCENTRATION COEFFICIENTS    (/ METER)
*  RELATIONSHIP BETWEEN GROUND CONCENTRATION AND INSTANTANEOUS AIR CONC.
*
CHRWCOEF001  1.0E-5   1.0E-7   1.0E-9  (VALUES HERE SELECTED BY JON HELTON)
*
* HALF-LIVES CORRESPONDING TO THE RESUSPENSION CONCENTRATION COEFFICIENTS (S)
*
CHTRWHLF001  1.6E7    1.6E8    1.6E9   (6 MONTHS, 5 YEARS, 50 YEARS)
******************************************************************************
* SITE REGION DESCRIPTION DATA BLOCK
*
* FRACTION OF AREA THAT IS LAND IN THE REGION
*
CHFRACLD001   0.95   (ROUGH GUESS VALUE, SITE FILE OVERRIDES THIS VALUE)
*
* FRACTION OF LAND DEVOTED TO FARMING IN THE REGION
*
CHFRCFRM001   0.382  (VIRGINIA STATE VALUE, SITE FILE OVERRIDES THIS VALUE)
*
* AVERAGE VALUE OF ANNUAL FARM PRODUCTION IN THE REGION (DOLLARS/HECTARE)
*  (CASH RECEIPTS FROM FARMING PLUS VALUE OF HOME CONSUMPTION)/(LAND IN FARMS)
*
CHFRMPRD001   371.0  (VIRGINIA STATE VALUE, SITE FILE OVERRIDES THIS VALUE)
*
* FRACTION OF FARM PRODUCTION RESULTING FROM DAIRY PRODUCTION IN THE REGION
*  (VALUE OF MILK PRODUCED)/(CASH RECEIPTS FROM FARMING PLUS HOME CONSUMPTION)
*
CHDPFRCT001   0.198  (VIRGINIA STATE VALUE, SITE FILE OVERRIDES THIS VALUE)
*
* VALUE OF FARM WEALTH (DOLLARS/HECTARE)
*  (AVERAGE VALUE PER HECTARE OF FARM LAND AND BUILDINGS TO 100 MILES)
*
CHVALWF0001   2613.  *  SURRY
*
* FRACTION OF FARM WEALTH IN IMPROVEMENTS FOR THE REGION
*
CHFRFIM0001   0.25  *  SURRY
*
* NON-FARM WEALTH, PROPERTY AND IMPROVEMENTS FOR THE REGION (DOLLARS/PERSON)
*  THE VALUE OF ALL RESIDENTIAL, BUSINESS, AND PUBLIC ASSETS WHICH WOULD BE
*  LOST IN THE EVENT OF PERMANENT INTERDICTION (CONDEMNATION) OF THE AREA
*
CHVALWNF001   84000.  *  SURRY
*
* FRACTION OF NON-FARM WEALTH IN IMPROVEMENTS FOR THE REGION
*
CHFRNFIM001   0.8
******************************************************************************
CHFDPATH001 'NEW'
*
* name of the COMIDA2 binary output file
*
BIN_FILE001 'SAMP_A.BIN'   (revised data file of 8/12/95)
*
* Dose limits triggering first year crop disposal of the separate
* milk and non-milk components of the diet, corresponding in purpose,
* more or less, to the MACCS 1.5 input variables PSCMLK and PSCOTH
*
* For NUREG-1150 calculations, the maximum allowable ground concentrations for
* production of milk and non-milk crops contaminated by an accident occurring
* in the growing season were derived based on an assumed maximum allowable
```

```
* dose of 5 rem effective or 15 rem thyroid, per the 1982 FDA guidance that's
* reprinted in the 1992 EPA PAG Manual.  For purposes of comparison against
* the prior results, it is being assumed, for simplicity, that milk and
* non-milk crops contribute equally to the first year dose.  Thus, the 5 rem
* effective dose limit used in NUREG-1150 is equally split between milk and
* non-milk crops, with 2.5 rem allowed for each.  Similarly, the 15 rem
* thyroid limit is split into 7.5 and 7.5 rem for the milk and non-milk
* portions of the diet.
*
*              effective     thyroid  (doses in sieverts)
DOSEMILK001     0.025          0.075
DOSEOTHR001     0.025          0.075
*
* Annual dose limits for the subsequent year's (i.e., after the first year)
* interdiction of BOTH the milk and non-milk (combined) components of the diet
*
* Note: the long-term food critera, GCMAXR, used for NUREG-1150 wre based on
* an ingestion dose integrated from zero to infinity.  It is not possible to
* translate those parameter values into corresponding annual dose limits, as is
* required by the COMIDA2-based food model.  The "total" dose limits used in
* NUREG-1150 for "root uptake", 0.5 rem effective and 1.5 rem thyroid, are used
* here as annual dose limits for interdiction of food production in years the
* years subsequent to the accident.
*
*              effective     thyroid  (doses in sieverts)
DOSELONG001     0.005          0.015
*
* NUMBER OF NUCLIDES IN THE WATER INGESTION PATHWAY MODEL
*
CHNUMWPI001    4
*
* TABLE OF NUCLIDE DEFINITIONS IN THE WATER INGESTION PATHWAY MODEL
*
* IF A SITE DATA FILE IS DEFINED, THE DATA DEFINING THE WATERSHED INGESTION
*  FACTOR IS SUPERSEDED BY THE CORRESPONDING DATA IN THE SITE DATA FILE
*
*                         INITIAL      ANNUAL    INGESTION FACTOR
*              WATER      WASHOFF      WASHOFF    ((Bq INGESTED)/
*             NUCLIDE     FRACTION      RATE       (Bq IN WATER))
*
*              NAMWPI      WSHFRI       WSHRTA          WINGF
CHWTRISO001    Sr-89        0.01        0.004           5.0E-6
CHWTRISO002    Sr-90        0.01        0.004           5.0E-6
CHWTRISO003    Cs-134       0.005       0.001           5.0E-6
CHWTRISO004    Cs-137       0.005       0.001           5.0E-6
*******************************************************************************
* SPECIAL OPTIONS DATA BLOCK
*
* DETAILED PRINT OPTION CONTROL SWITCHES, LOOK AT THE CODE BEFORE TURNING ON!!
*          KSWDSC
*
CHKSWTCH001    0
*******************************************************************************
* DEFINE THE TYPE 9 RESULTS
*
* LONG-TERM POPULATION DOSE IN A GIVEN REGION BROKEN DOWN BY THE 12 PATHWAYS
*
* NUMBER OF RESULTS OF THIS TYPE THAT ARE BEING REQUESTED
* FOR EACH RESULT YOU REQUEST, THE CODE WILL PRODUCE A SET OF 12
*
TYPE9NUMBER    2      (UP TO 10 ALLOWED)
*
*              ORGNAM         INNER       OUTER
*
```

```
TYPE9OUT001    'L-EDEWBODY'        1            26     (0-1000 MILES)
TYPE9OUT002    'L-EDEWBODY'        1            19     (0-50 MILES)
*******************************************************************************
* ECONOMIC COST RESULTS IN A REGION BROKEN DOWN BY 12 TYPES OF COSTS
*
* NUMBER OF RESULTS OF THIS TYPE THAT ARE BEING REQUESTED
* FOR EACH RESULT YOU REQUEST, THE CODE WILL PRODUCE A SET OF 12
*
TYP10NUMBER   2       (UP TO 10 ALLOWED)
*
*               INNER       OUTER
*
TYP10OUT001       1           26     (0-1000 MILES)
TYP10OUT002       1           19     (0-50 MILES)
*******************************************************************************
* DEFINE A FLAG THAT CONTROLS THE PRODUCTION OF THE ACTION DISTANCE RESULTS
*
* SPECIFYING A VALUE OF .TRUE. TURNS ON ALL 8 OF THE ACTION DISTANCE RESULTS,
* A VALUE OF .FALSE. WILL ELIMINATE THE ACTION DISTANCE RESULTS FROM THE OUTPUT.
*
TYP11FLAG11  .TRUE.
*******************************************************************************
* IMPACTED AREA/POPULATION RESULTS IN A REGION BROKEN DOWN BY 6 TYPES OF IMPACTS
*
* NUMBER OF RESULTS OF THIS TYPE THAT ARE BEING REQUESTED
* FOR EACH RESULT YOU REQUEST, THE CODE WILL PRODUCE A SET OF 8
*
TYP12NUMBER   2       (UP TO 10 ALLOWED)
*
*               INNER       OUTER
*
TYP12OUT001       1           26     (0-1000 MILES)
TYP12OUT002       1           19     (0-50 MILES)
*******************************************************************************
* Maximal annual food ingestion dose to an individual, requested by IXOT13
*
* This result is calculated after accounting for temporary or
* permanent interdiction.  It is only available for the "new" food model.
*
* NUMBER OF RESULTS OF THIS TYPE THAT ARE BEING REQUESTED
*
TYP13NUMBER   20   (UP TO 10 ALLOWED)
*
* IRAD13 is the radial spatial interval at which results are requested
*
* ORGN13 is the name of the organ for which results are requested
*  (allowable values for ORGN13 are 'EFFECTIVE' or 'THYROID')
*
*          IRAD13   ORGN13
*
TYP13OUT001   2    EFFECTIVE
TYP13OUT002   4    EFFECTIVE
TYP13OUT003   6    EFFECTIVE
TYP13OUT004   8    EFFECTIVE
TYP13OUT005  10    EFFECTIVE
TYP13OUT006  12    EFFECTIVE
TYP13OUT007  14    EFFECTIVE
TYP13OUT008  16    EFFECTIVE
TYP13OUT009  18    EFFECTIVE
TYP13OUT010  20    EFFECTIVE
TYP13OUT011   2    THYROID
TYP13OUT012   4    THYROID
TYP13OUT013   6    THYROID
TYP13OUT014   8    THYROID
```

TYP13OUT015	10	THYROID
TYP13OUT016	12	THYROID
TYP13OUT017	14	THYROID
TYP13OUT018	16	THYROID
TYP13OUT019	18	THYROID
TYP13OUT020	20	THYROID

MACCS2 Input File for the Base Case with Radionuclide Inventories at 30 Days Following Reactor Shutdown:

METSUR.INP

SURRY MET, NRC-12/12/88, CREATED 12/22/88
MACCS FORMAT--NUREG-1150

1	1	16	146	0
1	2	1	146	0
1	3	16	126	0
1	4	1	96	0
1	5	4	146	0
1	6	4	126	0
1	7	16	86	0
1	8	1	126	0
1	9	2	126	0
1	10	4	154	0
1	11	1	194	0
1	12	13	245	0
1	13	13	254	0
1	14	15	251	0
1	15	15	241	0
1	16	15	173	0
1	17	15	135	0
1	18	15	96	0
1	19	14	146	0
1	20	15	156	0
1	21	16	136	0
1	22	16	146	0
1	23	16	156	0
1	24	1	146	0
2	1	16	146	0
2	2	1	146	0
2	3	16	126	0
2	4	1	96	0
2	5	4	146	0
2	6	4	126	0
2	7	16	86	0
2	8	1	126	0
2	9	2	126	0
2	10	4	154	0
2	11	1	194	0
2	12	13	245	0
2	13	13	254	0
2	14	15	251	0
2	15	15	241	0
2	16	15	173	0
2	17	15	135	0
2	18	15	96	0
2	19	14	146	0
2	20	15	156	0
2	21	16	136	0
2	22	16	146	0
2	23	16	156	0
2	24	1	146	0
3	1	16	176	0
3	2	16	146	0
.				
.				
.				
362	2	10	265	0
362	3	10	265	0
362	4	9	235	0
362	5	8	245	0
362	6	9	255	0
362	7	8	245	0
362	8	8	265	0
362	9	8	304	0
362	10	9	342	0

362	11	9	451	0
362	12	9	421	0
362	13	9	381	0
362	14	9	351	0
362	15	8	301	0
362	16	9	283	0
362	17	9	225	0
362	18	9	255	0
362	19	9	265	0
362	20	9	215	0
362	21	9	155	0
362	22	9	145	0
362	23	9	146	0
362	24	9	146	0
363	1	9	136	0
363	2	9	146	0
363	3	9	136	0
363	4	8	116	0
363	5	7	126	0
363	6	9	86	0
363	7	9	86	0
363	8	9	136	0
363	9	9	95	0
363	10	9	114	0
363	11	10	173	0
363	12	13	162	0
363	13	10	153	0
363	14	13	114	0
363	15	11	124	0
363	16	13	84	0
363	17	14	55	0
363	18	14	76	0
363	19	14	86	0
363	20	14	66	0
363	21	14	76	0
363	22	14	56	0
363	23	13	56	0
363	24	12	56	0
364	1	12	56	0
364	2	11	56	0
364	3	6	96	0
364	4	7	96	0
364	5	8	96	0
364	6	5	116	0
364	7	7	195	0
364	8	6	195	0
364	9	8	184	0
364	10	7	222	0
364	11	6	271	0
364	12	6	291	0
364	13	6	331	0
364	14	6	321	0
364	15	6	381	0
364	16	7	384	0
364	17	6	404	0
364	18	7	414	0
364	19	7	324	0
364	20	7	235	0
364	21	6	165	0
364	22	7	195	0
364	23	7	265	0
364	24	8	385	0
365	1	8	385	0
365	2	8	325	0

365	3	7	185	0
365	4	7	195	0
365	5	6	185	0
365	6	4	156	0
365	7	5	126	0
365	8	5	156	0
365	9	5	175	0
365	10	7	302	0
365	11	8	321	0
365	12	9	461	0
365	13	9	361	0
365	14	9	331	0
365	15	7	164	0
365	16	4	94	0
365	17	8	55	0
365	18	13	165	0
365	19	13	155	0
365	20	14	86	0
365	21	14	56	0
365	22	12	96	0
365	23	13	96	0
365	24	13	96	0

10.54 18.90 19.24 14.12

MACCS2 Input File for the Base Case with Radionuclide Inventories at 30 Days Following Reactor Shutdown:

SURSIT.INP

```
MACCS SITE DATA FILE FOR SURRY (JLS, 11/10/88)
SECPOP POP DISTRIBUTION FROM 1980 CENSUS DATA ALTERED USING 0-10 MI NRC DATA
 26 SPATIAL INTERVALS
 16 WIND DIRECTIONS
  7 CROP CATEGORIES
  4 WATER PATHWAY ISOTOPES
  2 WATERSHEDS
 59 ECONOMIC REGIONS
SPATIAL DISTANCES
     0.16      0.52      1.21      1.61      2.13      3.22      4.02      4.83
     5.63      8.05     11.27     16.09     20.92     25.75     32.19     40.23
    48.28     64.37     80.47    112.65    160.93    241.14    321.87    563.27
   804.67   1609.34
POPULATION
       0.        0.        0.        0.        0.        0.        4.        5.
       6.       25.     3341.     7107.     2173.        0.     1305.      474.
    2252.     2945.     5403.    20169.   112004.  3431358.  1355700.  2742710.
 2487346.   104331.
       0.        0.        0.        0.        1.        2.        9.       13.
      15.       63.     1667.     3550.     1330.     1072.     3198.     2425.
     515.     9469.     5317.     7120.    13586.   198785.  1058744. 20508438.
 3290082.   830354.
       0.        0.        0.        0.        0.        0.        5.        6.
       8.       31.      822.     1752.     4543.     1713.     1597.     2296.
    6535.     1775.        0.     8555.    48596.   119411.   233382.  3003954.
 7620063.  1169436.
       0.        0.        0.        0.        0.        0.        1.        1.
       2.       11.      543.     1157.     3820.     1621.     3364.        0.
       0.      129.     6679.    11858.        0.        0.        0.        0.
       0.        0.
       0.        0.        0.        0.        0.        0.        0.        0.
       0.        0.     4798.    10202.    10348.    10480.     9570.        0.
       0.     2317.     1756.        0.        0.        0.        0.        0.
       0.        0.
       0.        0.        0.        0.        0.        0.        1.        1.
       1.        7.     8316.    17684.    16340.    30419.    39474.    74998.
   24195.    80412.    57477.        0.        0.        0.        0.        0.
       0.        0.
       0.        0.        0.        0.        0.        0.        0.        0.
       0.        0.        0.        0.     1722.     6433.    36763.    20632.
  126203.   372471.    68327.     8599.     6339.     1057.        0.        0.
       0.        0.
       0.        0.        0.        0.        0.        0.        2.        2.
       3.       13.      127.      273.     1649.     4571.     3441.     7838.
   11747.    19019.     3360.    36387.    10447.    12402.        0.        0.
       0.        0.
       0.        0.        5.        4.        8.       23.       14.       20.
      23.       93.      301.      650.        0.        0.     1264.     4065.
    1106.    14665.     4071.    18006.    37417.    89072.    81626.        0.
       0.        0.
       0.        0.        0.        0.        0.        0.       19.       25.
      29.      117.       45.      105.        0.      510.      951.     1521.
    1223.    17636.     4926.    30765.    53265.   289674.   216165.   479431.
  280809.  8801784.
       0.        0.        0.        0.        1.        2.       14.       20.
      23.       93.      155.      338.      125.     1079.        0.     1355.
    2765.      154.     5296.    21409.    62228.   523803.   479588.  1538059.
 1526840.  3099458.
       0.        0.        0.        0.        1.        2.       14.       20.
      23.       93.      110.      240.     1056.        0.       50.     1396.
     915.     3153.     4132.    16295.    35596.   239712.   709522.  2845970.
 3957581. 10560254.
       0.        0.        0.        0.        0.        0.       25.       33.
      38.      154.       30.       70.      450.        0.      980.      517.
```

```
     155.      66531.      40902.       9557.      44818.     194801.     376828.    1492286.
 2250273.  12145932.
       0.          0.          0.          0.          0.          0.          7.          9.
      12.         47.         31.         69.          0.        380.        281.        445.
    1986.      32459.     183133.     193630.      30369.     203275.      94113.    1328987.
 5086913.  19537940.
       0.          0.          0.          0.          0.          0.          0.          0.
       0.          0.        223.        477.          0.       1026.        609.       2575.
    2794.       6593.      96857.     107328.      47585.     156826.     101785.    4175263.
 7535605.   9667977.
       0.          0.          0.          0.          0.          0.         15.         20.
      23.         92.       2503.       5326.       3508.       1826.       1884.        275.
    3965.       2084.       6270.      10765.     103787.     970659.     472558.    1396088.
 1969210.      73968.
LAND FRACTION
1.00 1.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.80 1.00 1.00 0.95 0.75 0.70 0.85
1.00 0.85 0.70 0.75 0.55 0.70 0.60 1.00 1.00 0.95
1.00 1.00 1.00 1.00 0.90 0.70 0.40 0.00 0.00 0.45 1.00 0.95 0.40 0.60 1.00 1.00
0.90 0.45 0.60 0.20 0.50 0.50 0.30 0.25 0.50 0.60
1.00 1.00 1.00 1.00 1.00 1.00 0.00 0.00 0.00 0.05 1.00 1.00 0.20 1.00 0.70 0.30
0.85 0.20 0.00 0.20 0.00 0.00 0.00 0.00 0.00 0.00
1.00 1.00 1.00 1.00 1.00 0.80 0.10 0.00 0.00 0.00 1.00 1.00 0.75 0.30 0.40 0.00
0.15 0.00 0.45 0.30 0.00 0.00 0.00 0.00 0.00 0.00
1.00 1.00 1.00 1.00 1.00 0.60 0.00 0.00 0.00 0.00 0.95 1.00 1.00 0.70 0.40 0.10
0.00 0.50 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
1.00 1.00 1.00 1.00 1.00 0.70 0.00 0.00 0.00 0.80 0.90 0.75 0.85 1.00 1.00 0.70
0.15 0.25 0.25 0.00 0.00 0.00 0.00 0.00 0.00 0.00
1.00 1.00 1.00 1.00 1.00 1.00 0.55 0.50 0.25 0.15 0.00 0.10 0.00 0.10 0.50 0.60
0.85 1.00 1.00 0.40 0.40 0.05 0.00 0.00 0.00 0.00
1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 0.90 0.35 0.40 0.80 1.00 1.00 1.00
1.00 1.00 1.00 1.00 0.95 0.20 0.00 0.00 0.00 0.00
1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
1.00 1.00 1.00 1.00 1.00 0.80 0.40 0.00 0.00 0.20
1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
1.00 1.00 1.00 1.00 1.00 1.00 1.00 0.75 0.50 0.40
1.00 1.00 0.70 0.40 0.20 0.75 0.95 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
1.00 1.00 1.00 1.00 0.95 1.00 1.00 1.00 1.00 0.80
1.00 1.00 0.00 0.00 0.00 0.00 0.05 0.70 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
1.00 1.00 1.00 1.00 0.95 0.90 1.00 1.00 1.00 1.00
1.00 1.00 0.00 0.00 0.00 0.00 0.00 0.15 0.70 0.90 1.00 1.00 1.00 1.00 1.00 1.00
1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
1.00 1.00 0.00 0.00 0.00 0.00 0.00 0.00 0.20 0.50 0.40 0.30 0.25 0.75 0.80 0.85
0.85 0.95 1.00 1.00 1.00 1.00 1.00 1.00 0.90 0.85
1.00 1.00 0.00 0.00 0.00 0.00 0.00 0.15 0.80 0.75 0.80 0.85 0.95 1.00 1.00 1.00
1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 0.50 0.45
1.00 1.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.90 1.00 1.00 1.00 1.00 1.00 1.00
1.00 1.00 1.00 0.95 0.80 0.85 1.00 1.00 0.55 0.95
REGION INDEX
44445050505050504444444444444444444444441818 7283054
444444444444445044444444444444444444444418 728301917
4444444444445050504444444444444444445044185050505050
4444444444444450505044444444445044504444505050505050
4444444444445050505044444444444450445050505050505050
4444444444445050504444444444444444444450505050505050
4444444444444444444450445044444444444444313150505050
4444444444444444444444444444444444444431313150505050
44444444444444444444444444444444444431313131315050 8
444444444444444444444444444444444444443131313138 9 8
444444444444444444444444444444444444444431313138 9 1
4444505050504444444444444444444444444444444444314040
4444505050505044444444444444444444444444444444461511
4444505050505050444444444444444444444444444444463347
4444505050505044444444444444444444444444444444365320
4444505050505050505044444444444444444444441818363053
```

```
WATERSHED INDEX
1 1 2 2 2 2 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 2 2 2 2 1 1 2 1 1 1 1 1 1 2 2 2 2 2 2 1
1 1 1 1 1 1 2 2 2 2 1 1 2 1 1 2 1 2 2 2 2 2 2 2 2 2
1 1 1 1 1 1 2 2 2 2 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2
1 1 1 1 1 1 2 2 2 2 1 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2
1 1 1 1 1 1 2 2 2 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2
1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 1 1 1 1 2 2 2 2 2 2 2
1 1 1 1 1 1 1 1 1 1 2 2 1 1 1 1 1 1 1 1 1 2 2 2 2 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2
1 1 1 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 2 2 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 2 2 2 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 2 2 2 2 2 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 2 2 2 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 2 2 2 2 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
CROP SEASON AND SHARE
  1 PASTURE                 90. 270.   0.41
  2 STORED FORAGE          150. 240.   0.13
  3 GRAINS                 150. 240.   0.21
  4 GRN LEAFY VEGETABLES   150. 240.   0.002
  5 OTHER FOOD CROPS       150. 240.   0.004
  6 LEGUMES AND SEEDS      150. 240.   0.15
  7 ROOTS AND TUBERS       150. 240.   0.003
WATERSHED DEFINITION                 1111111111222222222233333333334444444444
  1 Sr-89                                5.0E-6     0.0
  2 Sr-90                                5.0E-6     0.0
  3 Cs-134                               5.0E-6     0.0
  4 Cs-137                               5.0E-6     0.0
REGIONAL ECONOMIC DATA
  1 ALA                .354 .040      459.     1824.     62000.
  2 ARIZ               .516 .104      110.      682.     74000.
  3 ARK                .483 .041      466.     2049.     61000.
  4 CALIF              .330 .144     1022.     4394.     93000.
  5 COLO               .522 .048      211.      971.     83000.
  6 CONN               .160 .294     1605.     4980.    107000.
  7 DEL                .534 .042     1723.     3428.     82000.
  8 FLA                .375 .080      832.     3341.     80000.
  9 GA                 .363 .060      613.     1885.     73000.
 10 IDAHO              .279 .144      343.     1562.     61000.
 11 ILL                .806 .044      709.     3900.     86000.
 12 IND                .713 .079      611.     3283.     72000.
 13 IOWA               .938 .060      695.     3133.     73000.
 14 KANS               .917 .035      281.     1204.     81000.
 15 KY                 .571 .112      482.     1838.     61000.
 16 LA                 .354 .074      459.     3284.     61000.
 17 MAINE              .079 .260      662.     1133.     70000.
 18 MD                 .429 .216      956.     4489.     93000.
 19 MASS               .136 .249     1349.     2563.     97000.
 20 MICH               .313 .247      658.     2187.     81000.
 21 MINN               .597 .223      516.     2111.     82000.
 22 MISS               .470 .054      403.     2084.     53000.
 23 MO                 .703 .102      322.     1647.     76000.
 24 MONT               .657 .030       61.      563.     65000.
 25 NEBR               .962 .031      318.     1148.     75000.
 26 NEV                .127 .139       63.      601.     84000.
 27 N.H.               .096 .482      518.     2018.     87000.
 28 N.J.               .203 .129     1399.     6477.    102000.
 29 N.MEX              .590 .144       53.      473.     63000.
 30 N.Y.               .310 .589      711.     1378.     94000.
 31 N.C.               .352 .065      860.     2658.     68000.
 32 N.DAK              .924 .048      164.      948.     69000.
 33 OHIO               .602 .175      581.     2686.     76000.
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34	OKLA	.751	.060	204.	1508.	67000.
35	OREG	.292	.111	236.	1203.	73000.
36	PA	.303	.447	855.	2534.	78000.
37	R.I.	.108	.213	1062.	6438.	80000.
38	S.C.	.290	.084	472.	1843.	62000.
39	S.DAK	.915	.091	145.	587.	65000.
40	TENN	.509	.153	360.	1850.	66000.
41	TEX	.816	.064	164.	1492.	74000.
42	UTAH	.225	.259	123.	1286.	60000.
43	VT	.286	.789	628.	1472.	73000.
44	VA	.382	.198	371.	2075.	84000.
45	WASH	.377	.154	476.	1948.	82000.
46	W.VA	.246	.224	150.	1728.	58000.
47	WIS	.517	.591	723.	1751.	76000.
48	WYO	.561	.028	43.	380.	70000.
49	BRIT COL	.377	.154	476.	1948.	60000.
50	OCEAN	.000	.000	0.	0.	0.
51	SASKAT	.657	.030	61.	563.	60000.
52	MANITOBA	.924	.048	164.	948.	60000.
53	ONTARIO	.597	.223	516.	2111.	60000.
54	QUEBEC	.310	.589	711.	1378.	60000.
55	NOVA SCOT	.079	.260	662.	1133.	60000.
56	BAJA CAL	.330	.144	1022.	4394.	10000.
57	SONORA	.516	.104	110.	682.	10000.
58	CHIHUAHUA	.590	.144	53.	473.	10000.
59	COAHUILA	.816	.064	164.	1492.	10000.

END