A discussion of surveying and monitoring activities appears in Chapter 2, Section 2.7, and additional details are given in Appendix A, Section A.6.1.

4.4.6 Hauling Costs

Several of the decontamination operations produce radiological wastes as a byproduct. Operations that produce radwaste include scraping of vacant land, clearing wooded areas, pruning orchards and removing and replacing contaminated materials.

The hauling cost estimates are based on the cost of transporting the waste products in regular dump trucks. If trucks specialized for hauling radiological wastes are used, the hauling costs will be significantly higher. Hauling costs were discussed in Chapter 2, Section 2.5, and additional details appear in Appendix A, Section A.6.2

4.4.7 Waste Burial Costs

Radiological wastes generated during the decontamination effort are properly disposed of at a licensed disposal site. In the event of a major accident, it may be practical to create a disposal site somewhere within the accident area. There are at least two advantages to this approach. First, an on-site disposal area will substantially reduce hauling costs, as compared with hauling the wastes to a licensed facility off-site. Second, if a heavily contaminated area within the accident site boundaries is too costly to restore, it may be ideal as a disposal site, provided long-term access to it can be effectively restricted. Waste burial costs were addressed in Chapter 2, Section 2.6; additional details appear in Appendix A, Section A.6.3.

4.5 USER-SELECTABLE PARAMETER VALUES

The user can redefine the values of several of the parameters used in DECON. These parameters and their corresponding default values are given in Table 4.3.

In addition, the user may also specify factors by which to increase or decrease labor, capital and/or materials costs. This feature can be used to adjust costs for inflation. It can also be used to 1) increase the cost for labor because the work is done in a radioactive environment; 2) increase the effective costs of labor and capital because working in protective gear reduces worker productivity; and 3) increase the costs of labor and capital because operations are being performed on a small scale.

4.6 FLEXIBILITY OF DECON

DECON has been structured to provide flexibility with regard to the addition of new features and revisions. Changes in the cost of decontamination methods and revisions of the efficiencies of these methods can be readily made to the Reference Database with the aid of user-friendly software. We have already noted the ability to change labor, capital and/or material costs across the board through the use of user-selectable factors. Also, as noted in earlier sections, the efficiencies of many of the decontamination methods employed in DECON have not been validated through field experiments. Should such experiments be performed, incorporating the results into DECON would not be a significant task.

The software has already been included for handling 30 types of surfaces, with 233 operations currently defined and 457 methods specified. The capability to continue to expand these has been built into the code. Other variables, such as the number of time periods and the number of exposure intervals, for which there are upper limits, can be expanded if the need arises, although these are not changes that can be made in the field.

Table 4.2. Schedule of Surveying and Monitoring Activities

	Frequency in Year Following Release												
Procedure	0	1	2	3	4	5	6	7	8	9	10	D[1]	PD[2]
Aerial Survey	1	2	1	-	1	-	1	-	1	-	1	-	-
Mobile Air and Soil Sampling	1	-	-	-	-	-	-	-	-	-	-	-	-
Supplemental Water and Plant Sampling	1	-	-	-	-	-	-	-	-	-	-	-	-
Mobile Gamma Scanning	-	-	-	-	-	-	-	-	-	-	-	1	-
Survey of Building Interiors	-	-	-	-	-	-	-	-	-	-	-	1	-
Survey of Exterior Surfaces	-	-	-	-	-	-	-	-	-	-	-	1	-
Survey of Wooded Areas	-	-	-	-	-	-	-	-	-	-	-	1	-
Placement of TLDs	-	-	-	-	-	-	-	-	-	-	-	1	-
Replacement of TLDs	-	-	-	-	-	-	-	-	-	-	-	4	4
Setup of Permanent Air Samplers													
Initial Service	-	-	-	-	-	-	-	-	-	-	-	13	-
Extended Service	-	-	-	-	-	-	-	-	-	-	-	13	26
Removal of Permanent Air Samplers													
Initial Removal	-	-	-	-	-	-	-	-	-	-	-	-	1
Extended Removal	-	-	-	-	-	-	-	-	-	-	-	-	1
Soil and Crop Sampling	-	-	-	-	-	-	-	-	-	-	-	4	1

1.Activities performed in the year property is decontaminated.
2.Activities performed in the years following decontamination. See text for details.

Source: Pacific Northwest Laboratory

Table 4.3. User-Selectable Parameters and Their Default Values

Cleanup level	--
Minimum radiation level for surveying	1.0E-3 Gy/hr
Number of time periods to be analyzed	30
Deterioration factor for each land use category	all 0.0
Residual contamination factor for each land use category	all 0.0
Discount rate	0.1
Exposure factor for each surface category	all 1.0
Round-trip distance for hauling radioactive wastes	48 km
Cost to dispose of radioactive wastes	$4.86/m^3$
Shielding factors for protective gear worn by radiation workers	0.5
Latent cancer fatalities per person-Sv	2.0×10^{-2}
Number of vehicles per household	1.568
Time and day of accident	1500 hrs/Weekday
Replacement costs for trees in orchard	$2.06/tree
Replacement costs for trees in forest	$1.00/tree
Cost adjustment factors for labor, equipment, materials and fuel	all 1.0
Surveying and monitoring costs	see Section A.6.1
Hauling costs	see Section A.6.2
Waste burial costs	see Section A.6.3

4.7 INTERPRETATION OF DECON OUTPUT

In this section, we present and explain the different output reports produced by DECON. These reports are from an analysis of a simulated reactor accident at the Indian Point reactor site in New York State. A more complete analysis of this site is presented in the Chapter 5.

Each output report begins with a title page that includes a listing of the assumptions underlying each analysis. Results follow and may include some or all of five types of reports. These are:

1) Summary Results - a report that presents the main results from a decontamination analysis for the entire study area or for individual grid elements or exposure areas[*]

[*]An exposure area is an area comprising all grid elements with the same exposure level. An exposure area need not consist of contiguous grid elements.

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2) Detailed Surface Analysis - a report that provides detailed information on each surface within a grid element or exposure area, including data relating to the decontamination method used

3) Labor/Equipment Requirements - a report that gives the type and quantity of labor and equipment required to carry out the decontamination program indicated in the detailed surface analysis report

4) Surface Area Decontaminated, by Surface Type and Method -- a report that shows which decontamination methods are used on each surface type and the area decontaminated with that method

5) Surveying and Monitoring Activities -- a report that provides detailed information on the surveying and monitoring activities taking place.

All of these reports, except the fourth one, are available for either grid elements or exposure areas; the fourth is produced only as a summary table for the study area. All reports except for the second are available for the whole study area. The title page and each type of output report are discussed in greater detail below.

4.7.1 Title Page and Listing of Assumptions

In preparing the data for a DECON run, the analyst is required to specify values for several of the variables and parameters; for others, he may accept default values. A complete set of these values defines the *base case*. When the analyst begins to run DECON, he has the option of changing many of these values. Therefore, it is important that the set of assumptions underlying each case be clearly identified. For this reason DECON begins each output set with: 1) a user-supplied descriptive title of the case; 2) the time and date of the computer run; and 3) a detailed list of the assumptions specified. The assumptions list from an Indian Point run dated 8:30 AM on January 15, 1990, is shown in Figure 4.2. As suggested by the title, we have imposed a requirement on the analysis; namely, wooded areas are to be treated by applying only a fixative. We have also specified the Quick-Vac option; i.e., a pre-rain cleanup. The scenario is based on Pasquill D weather stability for an SST2 accident with a cleanup level of 0.20 Sv.

Base Case - SST2, Pasq D; Qk-Vac; 0.2 Sv; Fixative on Wooded Areas

RUNNING AT 8:30 AM JANUARY 15, 1990

***** ASSUMPTIONS *****

(OUTPUT VALUES ARE IN METRIC (SI) UNITS)

	NUMBER OF GRID ELEMENTS...	9.80E+01		WASTE BURIAL COST ($/VOL).	1.15E+01
	RADIATION LIMIT, SURVEYING	6.28E-06	*	RADIATION LIMIT, CLEANUP..	2.00E-01
	FATALITIES PER PERSON-SV..	2.00E-02		TWO-WAY HAULING DISTANCE..	4.80E+01
	TIME OF ACCIDENT..........	1.50E+03		NUMBER OF TIME PERIODS....	3.00E+01
	CARS PER HOUSEHOLD........	1.57E+00	*	COST FACTOR, LABOR........	2.70E+00
*	COST FACTOR, EQUIPMENT....	2.20E+00	*	COST FACTOR, MATERIALS....	1.10E+00
*	COST FACTOR, FUEL.........	8.50E-01		DISCOUNT RATE.............	1.00E-01
	DAY OF ACCIDENT...........	WEEKDAY		DOSE PATHWAY..............	EXTER

***** RESIDUAL CONTAMINATION AND DETERIORATION FACTORS *****

LAND USE TYPE	RESID. CONTAM. FACTOR	DETERIORATION FACTOR
SINGLE-FAMILY RESIDENTIAL	*.15	*.10
MULTI-FAMILY RESIDENTIAL	*.15	*.10
COMMERCIAL	*.10	*.10
INDUSTRIAL	*.10	*.08
STREETS AND ROADS	.00	*.08
WOODED AREAS	*.05	.00
VACANT LAND	*.05	.00
LAWNS	*.07	.00
LARGE PARKING AREAS	*.05	*.08
AGRICULTURAL FIELDS	*.20	.00
ORCHARDS	*.20	.00
RESERVOIRS	*.07	.00
AUTOMOBILES	*.10	.00

NOTE: An asterisk (*) denotes a value different from a default value.

Figure 4.2. DECON Assumptions List

***** EXPOSURE FACTORS *****

SURFACE	FACTOR	SURFACE	FACTOR
AGRICULTURAL FIELDS	1.00	LAWNS	1.00
ORCHARDS	1.00	EXT. CONCRETE WALLS	1.00
VACANT LAND	1.00	AUTO EXTERIORS	1.00
WOODED LAND	1.00	AUTO INTERIORS	1.00
EXT. WOOD WALLS	1.00	AUTO TIRES	1.00
EXT. BRICK WALLS	1.00	AUTO ENG/DRV TRAIN	1.00
LINOLEUM FLOORS	1.00	....INTERIOR GLASS	1.00
WOOD FLOORS	1.00	OTHER PAVED ASPHALT	1.00
CARPETED FLOORS	1.00	OTHER PAVED CNCRETE	1.00
CONCRETE FLOORS	1.00	....EXTERIOR GLASS	1.00
INT'R WOOD/PL WALLS	1.00	RESERVOIRS	1.00
INT'R CNCRETE WALLS	1.00	HARD-SURF FURNSHNGS	1.00
ASPHALT STRTS/PRKNG	1.00	SOFT-SURF FURNSHNGS	1.00
CNCRETE STRTS/PRKNG	1.00	ELECTRONIC EQUIP	1.00
ROOFS	1.00	PAPER PRODUCTS	1.00

***** RESTRICTIONS - REQUIREMENTS *****

IDENTIFICATION NUMBER	BEGINNING EXPOSURE AREA	ENDING EXPOSURE AREA	SURFACE	RESTRICTION/ REQUIREMENT
1	4	9	-4	T

***** THE QUICK-VAC OPTION IS IN EFFECT *****

***** STUDY AREA BOUNDARIES *****

PAIR NUMBER	LOWER BOUND	UPPER BOUND

** THE STUDY AREA CONSISTS OF ALL OF THE GRID ELEMENTS **

Figure 4.2. DECON Assumptions List (Continued)

Figure 4.2 indicates that the output results are in metric units, and for radiological data the international system of units (SI) is used. The number of grid elements in the database is 98. Waste burial costs are $11.50 per cu meter. The radiation limit below which radiological surveying is not conducted is 6.28 E-6 Gy/hr. The cleanup level is 0.20 Sv; that is, all surfaces must be decontaminated to a level of 0.20 Sv or less. The asterisk (*) to the left of this item indicates that 0.20 Sv is different from the default cleanup level, which is 0.25 Sv.

The exposure risk factor is 2.0 E-02 cancer deaths per person-Sv. The average round trip hauling distance to the radiological waste disposal site is 48 km. The accident is assumed to occur at 1500 hours (3:00 PM). The optimal decontamination schedule will be determined within a 30-year planning period; that is, the optimal year to decontaminate each grid element will lie in the interval 1 to 30 years, provided that all of the surfaces within the grid element (except autos and building contents) can be decontaminated within the 30-year period. The number of cars per household is assumed to be 1.57.

The costs for input factors in the Reference Database are in 1982 dollars and, as discussed in Section 2.2.1 in Chapter 2, they are not adjusted for working in a hostile (radiological) environment. The following cost factors are specified to adjust for inflation and for working in a hostile environment: Labor costs are increased by 170 percent; equipment costs are increased by 120 percent; materials costs are increased by 10 percent; and fuel costs are lowered by 15 percent of their 1982 values. The derivation of these values is shown in Table 4.4 below. The asterisk (*) to the left of these items in Figure 4.2 indicates that these values are different from the default values, which are all 1.0.

The cost adjustments are based on four factors that are likely to affect the cost of inputs. The first is the effect on productivity from working in protective gear. In the current case, labor and equipment costs are assumed to increase by 30 percent because the use of protective gear will slow down cleanup operations. A second factor is the increase in the cost of labor and equipment from working in a hostile environment. Because of perceived health risks from radiation exposure, workers can be expected to require a premium above normal wage rates. Suppliers of equipment are also likely to demand a premium. The third factor is inflation. The adjustments shown here are based on GNP Price Deflators (see Table 2.1 and associated text). These deflators were used to adjust price levels from 1982 to 4th quarter 1986. The fourth factor reflects a cost adjustment to allow for *additional* radiation control measures--these costs have already been adjusted upward by 14 percent. Radiation control measures include changing into protective gear, decontaminating

Table 4.4. Derivation of Cost Adjustment Factors

Type of Input	Productivity	Hostile Environ.	Inflation	Radiation Protection	Total
Labor	1.30	1.60	1.24	1.05	2.70
Equipment	1.30	1.50	1.07	1.05	2.20
Materials	-	-	1.10	-	1.10
Fuel	-	-	-	0.85	0.85

personnel and equipment, and monitoring for radiation. The amounts in the *Total* column were obtained by taking the product of the figures in the corresponding row.

Continuing with the other assumptions in Figure 4.2, a discount rate of 10 percent is applied to future costs. In addition, the accident is assumed to occur on a weekday, and the major exposure is via the external exposure pathway.

The next set of values are the residual contamination and the deterioration factors in effect for each type of land use. For example, single-family residential property is assumed to sustain a one-time loss in value of 15 percent due to residual contamination. In addition, an annual loss of 10 percent for every year that the residential property remains contaminated is assumed as a result of deterioration. Again, the asterisk to the left of the residual contamination and deterioration factors indicates values that are different from the default values.

The next set of values gives the exposure factor for each surface type. For this run, the base case values of 1.0 apply to each surface; that is, each surface will be decontaminated to the value indicated above; namely, 0.2 Sv.

Next, we see that a requirement is in effect; namely, for exposure areas 4 through 9, a fixative (T) is to be applied to surface 4, which is wooded areas. The assumptions list also reports that the Quick-Vac option is in effect.

Finally, we observe that all of the grid elements in the database, i.e., grid elements 1 through 98, are to be processed.

4.7.2 Summary Report.

A summary report for the Indian Point run is shown in Figure 4.3. This report begins by identifying the area being summarized. In this case it includes all of the grid elements in the database. Note, however, that the

SUMMARY RESULTS FOR GRID ELEMENT 1 TO GRID ELEMENT 98

*** EXTERNAL PATHWAY ***

CLEANUP LEVEL	2.00E-01	SIEVERTS	1
NUMBER OF TIME PERIODS CONSIDERED	3.00E+01		2
TOTAL SURVEYING AND MONITORING COSTS .... $	1.45E+08		3
NPV DECONTAMINATION COSTS FOR ALL PROPERTY ...$	5.69E+08		4
REAL PROPERTY			
DECONTAMINATION COSTS .... $	3.09E+08		5
SURFACE AREA THAT CAN BE DECONTAMINATED	3.36E+04	HECTARES	6
AVERAGE DECONTAMINATION COSTS	9.21E-01	$/m**2	7
SURFACE AREA REQUIRING NO DECONTAMINATION ...	6.88E+04	HECTARES	8
SURFACE AREA NOT ABLE TO DECONTAMINATE	0.00E+00	HECTARES	9
BUILDING CONTENTS			
DECONTAMINATION COSTS .... $	8.49E+08		10
NUMBER ABLE TO DECONTAMINATE	4.55E+05	UNITS	11
AVERAGE DECON COST PER UNIT .... $	1.87E+03		12
NUMBER REQUIRING NO DECONTAMINATION	3.98E+06	UNITS	13
NUMBER UNABLE TO DECONTAMINATE	0.00E+00	UNITS	14
AUTOMOBILES			
DECONTAMINATION COSTS .... $	4.94E+07		15
NUMBER ABLE TO DECONTAMINATE	1.14E+05		16
AVERAGE DECON COST PER AUTOMOBILE ....$	4.34E+02		17
NUMBER REQUIRING NO DECONTAMINATION	1.86E+05		18
NUMBER UNABLE TO DECONTAMINATE	0.00E+00		19
STUDY AREA			
NUMBER OF GRID ELEMENTS	1.60E+01		20
SIZE OF THIS AREA	4.90E+04	HECTARES	21
SIZE OF RESIDENT POPULATION	5.10E+05	PERSONS	22
LATENT CANCER FATALITIES FROM POST-DECON DOSE	1.89E+03	PERSONS	23
VALUE OF REAL PROPERTY, PRE-ACCIDENT ...... $	3.24E+10		24
VALUE OF PERSONAL PROPERTY, PRE-ACCIDENT .. $	8.67E+09		25
VALUE OF ALL PROPERTY, PRE-ACCIDENT .... $	4.10E+10		26
DECONTAMINATION ZONE			
NUMBER OF GRID ELEMENTS	1.10E+01		27
SIZE OF THIS AREA	3.55E+04	HECTARES	28
SIZE OF RESIDENT POPULATION	2.18E+05	PERSONS	29
VOLUME OF RADIOLOGICAL WASTE	2.41E+06	CUBIC METERS	30
COSTS FOR BURIAL OF RADIOLOGICAL WASTE .... $	2.78E+07		31

Figure 4.3 Summary Report

EFFECTIVE DOSE EQUIVALENT TO RADWORKERS	4.14E+02	PERSON-SIEVERTS	32
EFF. DOSE EQUIV. TO POP. IF NOT RELOCATED ...	5.09E+04	PERSON-SIEVERTS	33
LATENT CANCER FATALITIES FROM POST-DECON DOSE	8.65E+02	PERSONS	34
*** EFFECTS ON REAL PROPERTY, WITH	FULL DECON	BUY-OUTS	
VALUE OF REAL PROPERTY, PRE-ACCIDENT	$ 1.36E+10		35
NET PRESENT VALUE OF REAL PROPERTY	$ 1.01E+10	1.01E+10	36
NET PRESENT VALUE LOSSES, REAL PROPERTY ...	$ 3.58E+09	3.58E+09	37
- RESIDUAL CONTAMINATION LOSSES	$ --------	1.39E+09	38
- DETERIORATION LOSSES	$ --------	6.15E+08	39
- LOSS FROM DEFERRED USE	$ --------	1.13E+09	40
*** EFFECTS ON PERSONAL PROPERTY, WITH	FULL DECON		
VALUE OF PERSONAL PROPERTY, PRE-ACCIDENT ..	$ 5.60E+09		41
NET PRESENT VALUE OF PERSONAL PROPERTY	$ 4.90E+09		42
*** TOTAL PROPERTY EFFECTS, WITH	FULL DECON	BUY-OUTS	
VALUE OF ALL PROPERTY, PRE-ACCIDENT	$ 1.92E+10		43
NET PRESENT VALUE OF ALL PROPERTY	$ 1.50E+10	1.50E+10	44
NET PRESENT VALUE LOSSES, ALL PROPERTY	$ 4.28E+09	4.28E+09	45
TOTAL POTENTIAL SAVINGS FROM BUY-OUT OF REAL PROPERTY			
- AT PRE-ACCIDENT PROPERTY VALUES	$ --------	0.00E+00	46
- AT NET PRESENT VALUE OF PROPERTY	$ --------	2.30E+06	47

<u>Figure 4.3</u> Summary Report (Continued)

study area itself contains only 16 grid elements, which is much fewer than the number in the database; the excluded grid elements are those that lie outside the evacuation zone.

The first line reports the cleanup level being applied to the study area; namely, 0.20 Sv. Any decontamination method selected for a particular surface must achieve a cleanup level no less than this, subject to the following three qualifications. First, if an area is very heavily contaminated, it sometimes happens that there is no method available in the Reference Database that will clean all of the surfaces sufficiently. In this case, the area is reported as being unable to be decontaminated. Second, the user may require that a specific method be used on one or more surfaces. Obviously, the cleanup level may not be achieved for these surfaces. Third, the user may specify exposure factors greater than 1.0 for some surfaces. The cleanup level always refers to surfaces with an exposure factor equal to 1.0.

Line 2 indicates that the decontamination schedule will be optimized over a 30-year period; that is, decontamination will be scheduled for that year in which the present value of the accident costs is minimized.

Line 3 gives the total surveying and monitoring costs, which are $145 million. Details regarding these surveying and monitoring activities appear in the Surveying and Monitoring Report discussed below.

The net present value of all decontamination costs, which include the transportation and disposal of radiological waste produced during decontamination operations, are shown in line 4. These amount to $569 million.

The next five lines pertain to real property; i.e. land and structures. The undiscounted costs to decontaminate real property are $309 million, and the total surface area decontaminated is 33,600 hectares, giving an average decontamination cost of $.92/m². We note in passing that the surface area within a grid element can exceed the land area because of vertical surfaces and multi-level structures. In the study area, 68,800 hectares of surface area required no decontamination since they were already within the cleanup level, while none of the surface areas fell into the "unable to decontaminate" category.

The next group of information is similar to the information preceding it except that it pertains to building contents. Building contents consist of four categories: hard-surface furnishings, soft-surface furnishings, electronic equipment and paper products. The quantity of building contents is reported in terms of <u>units</u>, where a unit is defined as the quantity of the category found in a typical residential household with the average floor area of 157.8 sq meter (1698 sq ft). Building contents units in commercial or industrial enterprises are similarly based on floor area, but they are also adjusted for the level of decontamination effort. For example, if it takes a greater effort to decontaminate the hard-surface furnishings occupying 1000 sq meters of commercial floor space as compared with the furnishings occupying 1000 sq meters of residential floor space, then the number of units of hard-surface furnishings per 1000 sq meters of commercial floor area is increased accordingly. Building contents units are addressed in greater detail in Section E.3.2.2.2 of Appendix E. Note that for this case, building contents cost $849 million to decontaminate and/or replace. This is nearly three times as costly as restoring the real property. The average cost per unit is $1870, and each household alone has four units, one from each category. This high average cost per unit suggests that a large fraction of the building contents are replaced rather than decontaminated.

Results for automobiles are similar to the results reported for real property and building contents. The quantity of automobiles is expressed in units, where a unit is a single automobile. The average cost of decontaminating an automobile is reported as $434 in line 17. We note that commercial vehicles are not currently addressed in DECON.

Information pertaining to the study area is reported in lines 20 through 26. First, the study area contains 16 grid elements, encompassing an area of 49,000 hectares, and with a population of about a half million persons. It is estimated that 1890 cancer deaths will result from the accident. Real property values and personal property values prior to the accident are reported at $32.4 billion and $8.67 billion, respectively, for a total of $41 billion.

Lines 27 through 45 in the Summary Report provide information on the decontamination zone. We see that the decontamination zone consists of the 11 grid elements requiring decontamination. Thus, the size of the decontamination zone obviously depends on the cleanup level. As reported, the decontamination zone occupies an area of 35,500 hectares, with a population of 218,000 persons. The volume of radiological waste generated during the site restoration process is 2.4 million cu meters, with a disposal cost of $27.8 million. In the site restoration process, radiation workers received a collective effective dose equivalent of 414 person-Sv. If the resident population were not relocated while the area remained contaminated, a collective effective dose equivalent of 50,900 person-Sv would have been received. Latent cancer fatalities in the decontamination zone amount to 865, about one-half of the total for the study area. Total real property values prior to the accident totaled $13.6 billion, but because of various types of losses due to the accident, this property now has a present value of $10.1 billion. Of these losses, residual contamination accounts for $1.39 billion, deterioration losses account for $615 million, and losses from deferred use account for $1.13 billion.

Real property effects are reported for two situations: Full decontamination and property buy-outs. In the former situation, the grid elements are restored irrespective of cost-effectiveness considerations; in the latter situation, grid elements are restored only if it is cost-effective to do so. Thus, losses with buy-outs will never exceed losses with full decontamination. In the present case, it is apparently cost-effective to restore the real property in all of the grid elements, since the two values are equal[10].

Effects on personal property are given in lines 41 and 42. Prior to the accident, all personal property within the decontamination zone has a value of $5.6 billion, but immediately after the accident, this value falls to $4.9 billion. Total real and personal property effects are reported in lines 43 through 45. The net present value of the affected property is shown as $15.0

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[10]Actually, it is not cost-effective to decontaminate Grid Element #8. Because the cost to restore this grid element has a net present value of -$2.24 million, this loss is too small to show up as a difference in line 45 between the full decontamination and the buy-out losses.

billion, for a net loss of $4.28 billion. As discussed previously, the net present value of the property is the worth of the property immediately after the accident has taken place and reflects several effects. First, it reflects any loss due to residual contamination and/or deterioration; it also takes into consideration the fact that the property will be unavailable for use for a period of time not less than one year; and, finally, it subtracts from the property's original value the present value cost to decontaminate it and to carry out the surveying and monitoring activities.

If the cost of restoring a grid element exceeds the value of the real property it contains, a *negative* value is reported for the net present value of the property in the individual summary reports. In addition, when the analysis is performed on the basis of grid elements (as in the present case) rather than exposure areas, the overall summary will show the potential savings if, say, the government buys the real property from the owners and then does not incur the cost of restoring it. Two buy-out options are considered in lines 46 and 47. Line 46 reports the amount that would be saved by acquiring the property from its owners based on its pre-accident value and then not restoring it. This concept is useful for compensation purposes. Line 47 reports the amount that would be saved by acquiring the property from its owners based on its post-accident value and then not restoring it. This latter concept is useful in measuring the *social benefit* (the benefit to society) from not restoring the property.

In the summary reports for individual grid elements or exposure areas, there are items that do not appear in the overall summary report. For example, the individual summaries give the contamination level on horizontal, outside surfaces on the 14th day following the accident. Also reported are the first year in which all surfaces within the grid element--apart from automobiles and building contents--can be decontaminated, as well as the optimal year in which to decontaminate the property. Because a grid element will not be decontaminated unless all of the surfaces within it can be decontaminated--with the exception of automobiles and building contents, which are readily removable from the grid element--the optimal year often turns out to be the first year in which all surfaces can be decontaminated.

The individual grid element summaries also report the average annual deterioration factor. After an accident, a property is likely to suffer from neglect if the cleanup does not take place soon after the accident. The deterioration factor gives the fraction of value that the property loses each year from deterioration. Since the analyst can specify a different deterioration factor for each land use, the deterioration factor reported in this table is a *weighted* average of the individual deterioration factors; the weight for each land use within a grid element is defined as the value of the real property in that land use divided by the total value of all the real property.

The individual summaries also include the average of the residual contamination factors for the grid element. Since the analyst can specify a different residual contamination factor for each land use, the average reported in the summary is a weighted average of the individual factors; the weights are the same as for the deterioration factors.

4.7.3 Detailed Surface Analysis Report

A Detailed Surface Analysis Report for Grid Element #8 is presented in Figure 4.4. Although this particular report applies to a grid element, a similar report can be generated for an exposure area.

This grid element lies in Westchester County, an affluent suburb of New York City. With an area of 1.6 km^2 and a population of just over 1000 people, the grid element has a pre-accident real property value estimated at $65 million.

For the scenario being considered (SST2, Pasquill D), the heaviest off-site contamination from the accident is found in this grid element. The summary report for this grid element, which has not been reproduced here, reports that horizontal, exterior surfaces have an exposure level of 30 Sv measured 14 days following the release. Also reported is that the property-related costs are minimized if this grid element is decontaminated in year 30. It is also likely that if restoration is deferred beyond year 30 restoration costs would be even lower.

Column 1 of Figure 4.4 shows the surface types contained in this grid element, and the second column reports the number of hectares of surface area for each surface type. For example, we see that this grid element contains 5.91 hectares of agricultural fields. Footnote 1 indicates that automobile units are the number of automobiles, and the units for the four building contents categories (hard-surface furnishings, soft-surface furnishings, electronic equipment and paper products) are building contents units, which are defined in Section E.3.2.2. of Appendix E.

Column 3 gives the exposure level from each surface in the reported year, which in this case is year 30. The next column gives a symbol for the decontamination method to be used. For agricultural fields, the symbol **Tx** means to apply a fixative and then remove a 20 to 30 cm layer of soil from the surface. Each letter in a method code represents a decontamination operation. A description of each operation code is given in Table 1.1 of Chapter 1[a].

---

[a]If more than one description is given for a single letter code, the appropriate description should be apparent from the surface being decontaminated.

DETAILED SURFACE RESULTS FOR GRID ELEMENT 8, FOR PERIOD 30.

*** EXTERNAL PATHWAY ***

SURFACE	AREA (ha) 1/	EXPOSURE (Sv)	METH 2/	3/	RESIDUAL (Sv)	AVG.COST ($/ha)	TOT.COST ($)	RATE (m**2/hr)
AGRICULTURAL FIELDS	5.91E+00	9.63E+00	Tx		5.39E-02	9.14E+04	5.40E+05	8.75E+02
ORCHARDS	2.90E-01	9.63E+00	TRx		9.24E-02	1.24E+05	3.60E+04	9.80E+01
VACANT LAND	3.42E+01	9.63E+00	TNx		5.39E-02	1.34E+05	4.59E+06	5.20E+01
WOODED LAND	2.54E+01	9.63E+00	T	~	8.67E+00	1.21E+04	3.07E+05	5.60E+03
ASPHALT STRTS/PRKNG	8.70E+00	9.63E+00	vCF		1.58E-01	2.11E+04	1.84E+05	4.30E+03
OTHER PAVED ASPHALT	5.88E-01	9.63E+00	vCF		1.58E-01	2.19E+04	1.29E+04	2.15E+03
CNCRETE STRTS/PRKNG	6.08E+00	9.63E+00	vCF		1.58E-01	2.11E+04	1.29E+05	4.30E+03
OTHER PAVED CNCRETE	2.35E+00	9.63E+00	VC	#	1.85E-01	2.04E+04	4.79E+04	2.15E+03
LAWNS	5.03E+01	9.63E+00	R		1.93E-01	1.42E+05	7.13E+06	4.00E+01
RESERVOIRS	9.53E+00	9.63E+00	rxr		1.54E-01	9.38E+04	8.94E+05	6.56E+02
ROOFS	8.16E+01	9.63E+00	R		9.63E-02	4.71E+05	3.85E+07	2.40E+01
EXT. WOOD WALLS	1.17E+01	9.63E-01	W		1.44E-01	2.43E+03	2.84E+04	2.03E+02
EXT. BRICK WALLS	2.48E+00	9.63E-01	W		1.44E-01	2.43E+03	6.04E+03	2.03E+02
EXT. CONCRETE WALLS	1.54E+01	9.63E-01	W		1.06E-01	2.43E+03	3.75E+04	2.03E+02
INT'R WOOD/PL WALLS	3.69E+01	4.81E-01	V		2.41E-02	4.76E+03	1.76E+05	6.90E+01
INT'R CNCRETE WALLS	7.58E+00	4.81E-01	V		1.69E-01	4.76E+03	3.61E+04	6.90E+01
CARPETED FLOORS	7.22E+00	4.82E+00	VTR		2.60E-02	4.41E+05	3.19E+06	3.70E+00
LINOLEUM FLOORS	8.56E+00	4.82E+00	v		1.81E-01	9.52E+03	8.14E+04	6.90E+01
WOOD FLOORS	2.03E+00	4.82E+00	vF		1.73E-01	3.13E+04	6.35E+04	4.00E+01
CONCRETE FLOORS	1.17E+01	4.82E+00	vF		1.85E-01	3.13E+04	3.66E+05	4.00E+01
HARD-SURF FURNSHNGS	3.56E+03	4.82E+00	vR		1.44E-01	2.02E+04	7.21E+07	8.00E-03
SOFT-SURF FURNSHNGS	2.42E+03	4.82E+00	vR		6.50E-02	4.49E+03	1.09E+07	1.59E-01
ELECTRONIC EQUIP	3.97E+03	4.81E-01	V		1.69E-01	1.99E+02	7.90E+05	2.19E-01
PAPER PRODUCTS	3.78E+03	9.63E-01	k		1.93E-02	1.95E+03	7.35E+06	1.50E-01
AUTO EXTERIORS	8.91E+02	9.63E+00	TJJ		6.93E-02	4.82E+02	4.30E+05	2.50E-01
AUTO INTERIORS	8.91E+02	2.89E+00	Vz		8.67E-02	7.60E+02	6.77E+05	1.25E-01
AUTO TIRES, (PER 4)	8.91E+02	9.63E+00	R		9.63E-03	3.19E+02	2.84E+05	1.00E+00
AUTO ENG/DRV TRAIN	8.91E+02	9.63E+00	IEE		1.01E-01	2.56E+02	2.28E+05	1.00E+00

NOTES:

1/ Area measures do not apply to autos and building contents; values are the number of automobiles and the number of building contents units.

2/ ---- = Decontamination not required //// = Unable to decontaminate surface

3/ + = Method is required \ = Restricted operation is in effect
Quick-Vac: # = in effect * = w/restricted operation ~ = w/required method

<u>Figure 4.4</u> Detailed Surface Analysis Report

The symbol ~ that appears in column 4 to the right of the decontamination method for *wooded land* means that we have *required* that only a fixative (denoted by T) be used for this surface category. This symbol also indicates that the forest floor is to be vacuum cleaned to remove loose contaminants prior to precipitation and application of the fixative. The idea here is that since wooded areas are very costly to decontaminate--$215,000 per hectare in this case--a pre-rain vacuuming followed by an application of a fixative at $12,100 per hectare may be a preferred option. Access to this wooded area would have to be restricted.

The symbol # in column 4 to the right of the decontamination method for *other paved concrete* means that small paved concrete areas will be vacuumed prior to precipitation. At some subsequent time, they will be further decontaminated using a strippable coating (C). If these surfaces can be vacuumed prior to a rainfall, the cleanup level can be met by the method VC at a cost of $20,400 per hectare. Without this pre-rain vacuuming, the method vCF would be needed to achieve the cleanup level at a cost of $21,900 per hectare.

There are other possibilities that are not shown in Figure 4.4. For example, if interior plaster walls had an exposure level of 0.164 Sv prior to decontamination, then the line in Figure 4.4 for that surface would be:

```
INT'R WOOD/PL WALLS 3.69E+01 1.64E-01 ----  ........ ........ ........ ........
```

As the footnote explains for the symbol ----, this means that interior wooden or plaster walls do not require decontamination since they are already below the 0.20 Sv cleanup level.

If, for example, scraping equipment could not be made available for the decontamination of orchards, so that we had to prohibit scraping operations, we would have seen the following line for orchards:

```
ORCHARDS             2.90E-01 9.63E+00 ////\ ******** ******** ******** ********
```

The symbol //// indicates that this surface category could not be successfully decontaminated with the other methods in the Reference Database. In addition, the symbol \ indicates that a restriction is in effect.

If we prohibited the use of water on exterior brick walls, the line for exterior brick walls in Figure 4.4 would be:

```
EXT. BRICK WALLS     1.42E+00 9.63E-01 F   \ 1.25E-01 2.18E+04 3.09E+04 4.00E+01
....EXTERIOR GLASS   1.06E+00 9.63E-01 W     1.44E-01 2.43E+03 2.59E+03 2.03E+02
```

As in the previous example, the symbol \ in column 4 means that a restriction is in effect for that surface. As a result foam (F) is selected as the

decontamination method. Note also that exterior glass windows and doors on exterior brick walls are now separately identified. This is because a different method is to be used on these glass surfaces--low-pressure water wash (W). The reason that a simple foaming (F) was not selected for exterior glass is that a simple foaming is not a *currently defined method* for exterior glass surfaces. (However, using the RD-INPUT program, it would be very easy--and appropriate--to add it, since F is already a defined operation for exterior glass.)

Column 5 reports the exposure level after the decontamination method has been applied. These values should be at or below the required cleanup level, unless 1) the method was required, 2) the surface could not be decontaminated, or 3) a less restrictive exposure factor was specified for that surface.

Column 6 gives the cost per hectare of applying the decontamination method to the corresponding surface. This cost includes the hauling and disposal of any radiological waste products generated in the cleanup process. In wooded areas and orchards, if trees are removed, the decontamination costs include replacement with small trees. In the case of automobile and building contents categories, the cost per unit is reported rather than the cost per hectare.

The total cost to decontaminate the indicated surface area is reported in column 7. This value is simply the product of the values in columns 2 and 6. The last column gives the rate, in square meters per hour, at which the indicated method can be applied.

4.7.4 Labor and Equipment Requirements Report

The Labor and Equipment Requirements report is shown in Figure 4.5. Although this sample report applies to the whole study area, similar reports can be obtained for an individual grid element or exposure area. The results in Figure 4.5 are for the same case as shown in the Summary report in Figure 4.2, except that the results here are without a required method on wooded areas.

The Labor and Equipment Requirements report lists the labor and equipment requirements for carrying out the decontamination program indicated in the Detailed Surface Analysis reports. For example, we see from Figure 4.5 that 66,300 man-hours are required for *drivers of heavy trucks*, and 7,100 hours of *front end loaders* are to be used.

TOTAL LABOR AND EQUIPMENT REQUIREMENTS
(MAN/EQUIPMENT HOURS)

TYPE OF LABOR/EQUIPMENT	HOURS
DRIVER, HEAVY TRUCK	6.63E+04
OPERATOR, MED. EQUIPMENT	1.94E+04
OPERATOR, LIGHT EQUIPMENT	1.91E+02
OPERATOR, FARM EQUIPMENT	1.55E+01
BUILDING LABORER	9.25E+05
COMMON LABORER	8.94E+04
CLEANING WORKER	2.09E+05
FARM LABORER	5.91E+01
PAINTER	1.81E+03
CARPENTER	4.45E+05
TILE LAYER	1.95E+04
FOREMAN	9.91E+04
PILOT	4.54E+01
FLIGHT CREWMAN	4.54E+01
AIR GROUND CREWMAN	9.08E+01
SPRAY OPERATOR	3.43E+03
ROOFER	1.36E+05
ROOFER HELPER	6.80E+04
ELECTRONIC TECHNICIAN	1.81E+04
FRONT END LOADER	7.10E+03
5000 GAL. SPRAY TRUCK W/PUMP&BOOM	1.90E+02
BULLDOZER	4.15E+02
AIRPLANE	4.54E+01
WEED SPRAYER	1.03E+01
ORCHARD BLAST SPRAYER	5.17E+00
TRACTOR W/PLOW	1.55E+01
PICKUP TRUCK	1.26E+04
VACUUM, HAND	1.36E+05
PAINT SPRAY EQUIPMENT	5.24E+03
VACUUMIZED STREET SWEEPER	5.17E+01
10-TON ROLLER	5.18E+03
BACK HOE	1.26E+04
TOW TRUCK	8.91E+02
GRADER	6.66E+03
VEHICLE WASHING EQUIPMENT	7.13E+03
DUMP TRUCK	6.52E+04
SMALL TANK-SPRAY TRUCK	9.28E+00
ENGINE STEAM CLEANER	8.91E+02
COPYING MACHINE	1.69E+04

Figure 4.5 Labor and Equipment Requirements Report

4.7.5 Decontamination Methods Report

The Decontamination Methods report is shown in Figure 4.6. This report is produced only for the entire study area. For a grid element or exposure area, the same information is available in the Detailed Surface Analysis report. This report lists each surface type found in the study area and gives the selected decontamination methods and the associated surface areas. As already discussed, each letter in the method code represents a decontamination operation as defined in Table 1.1. If a surface type lies in a grid element or exposure area in which not all of the surfaces can be decontaminated (other than the automobile and building contents surface categories), then, instead of a method code, that surface will be reported as "UNABLE TO DECONTAMINATE". An asterisk (*) appears before the decontamination method symbol if the surface is to receive a pre-rain vacuuming.

From the Decontamination Methods report, we see that different methods are used on the same surface type. This is not surprising since different and more effective methods will have to be used if the same surface is found in more heavily contaminated areas.

4.7.6 Surveying and Monitoring Report

A Surveying and Monitoring Activities report is presented Figure 4.7. It is for the same case as the previous two figures. Although this figure is for an entire study area, similar reports can be produced for an individual grid element or exposure area.

The figure lists five categories of surveying and monitoring activities: surveys, sampling, mobile gamma scan, permanent air samplers, and TLDs. Individual activities under these categories are listed according to their *areas* (in hectares), *cost per square meter*, *NPV costs*, and the *coverage rate* (in square meters per hour). NPV stands for *Net Present Value*, meaning that these costs have been discounted.

Surveys. Four types of surveys are listed: aerial, building interiors, exterior surfaces, and wooded areas. For example, the aerial survey is conducted over an area of 49,000 hectares at a cost of $0.0000161/m². The NPV cost of this activity is $22,200, and the coverage rate is 324 million m²/hr.

Sampling. Sampling efforts include air and soil samples, water and plant samples, and soil and crop samples taken at different locations.

Permanent Air Samplers. Additional air sampling efforts at fixed locations involve setup, servicing, and removal of air sampling stations.

TOTAL AREA DECONTAMINATED, BY SURFACE AND METHOD

SURFACE TYPE	METHOD	AREA (HECTARES)
AGRICULTURAL FIELDS	WWWW	1.993E+02
AGRICULTURAL FIELDS	X	1.119E+02
AGRICULTURAL FIELDS	A	3.405E+02
AGRICULTURAL FIELDS	YG	1.518E+01
AGRICULTURAL FIELDS	TX	3.374E+01
AGRICULTURAL FIELDS	Tx	5.905E+00
ORCHARDS	WWWW	1.963E+01
ORCHARDS	TDX	1.091E+01
ORCHARDS	TRX	7.918E+00
ORCHARDS	TRx	1.034E+00
VACANT LAND	*TNX	8.807E+01
VACANT LAND	TNx	3.425E+01
VACANT LAND	A	6.580E+03
WOODED LAND	*T	3.738E+03
EXT. WOOD WALLS	W	9.951E+01
EXT. BRICK WALLS	W	2.121E+01
LINOLEUM FLOORS	V	5.795E+02
LINOLEUM FLOORS	v	8.555E+00
WOOD FLOORS	V	1.129E+02
WOOD FLOORS	v	1.159E+01
WOOD FLOORS	VF	5.217E+00
WOOD FLOORS	vF	2.029E+00
CARPETED FLOORS	V	2.641E+02
CARPETED FLOORS	VF	1.507E+02
CARPETED FLOORS	VTR	6.709E+01
CONCRETE FLOORS	V	4.167E+02
CONCRETE FLOORS	v	2.366E+02
CONCRETE FLOORS	VF	9.689E+01
CONCRETE FLOORS	vF	1.169E+01
INT'R WOOD/PL WALLS	V	1.286E+02
INT'R CNCRETE WALLS	V	2.691E+01
ASPHALT STRTS/PRKNG	W	8.827E+02
ASPHALT STRTS/PRKNG	*W	1.815E+02
ASPHALT STRTS/PRKNG	*VC	2.236E+01
ASPHALT STRTS/PRKNG	*F	4.969E+01
ASPHALT STRTS/PRKNG	vCF	8.695E+00
CNCRETE STRTS/PRKNG	W	6.332E+02
CNCRETE STRTS/PRKNG	*W	1.300E+02
CNCRETE STRTS/PRKNG	*VC	1.564E+01
CNCRETE STRTS/PRKNG	*F	3.476E+01
CNCRETE STRTS/PRKNG	vCF	6.083E+00
ROOFS	V	4.757E+03
ROOFS	*V	2.774E+03
ROOFS	*W	1.560E+03
ROOFS	WW	4.665E+02
ROOFS	*WW	2.099E+02
ROOFS	R	8.164E+01
LAWNS	W	5.224E+03
LAWNS	WWW	1.072E+03
LAWNS	R	4.666E+02
EXT. CONCRETE WALLS	W	1.362E+02
AUTO EXTERIORS	TJ	1.107E+05
AUTO EXTERIORS	TJJ	3.183E+03

Figure 4.6 Decontamination Methods by Surface Type and Area

SURFACE TYPE	METHOD	AREA (HECTARES)
AUTO INTERIORS	V	1.805E+04
AUTO INTERIORS	v	7.385E+03
AUTO INTERIORS	Vz	8.913E+02
AUTO TIRES, (PER 4)	R	8.277E+03
AUTO TIRES, (PER 4)	W	5.579E+04
AUTO TIRES, (PER 4)	J	3.179E+04
AUTO TIRES, (PER 4)	S	1.805E+04
AUTO ENG/DRV TRAIN	I	5.579E+04
AUTO ENG/DRV TRAIN	E	4.984E+04
AUTO ENG/DRV TRAIN	IE	5.093E+03
AUTO ENG/DRV TRAIN	IEE	3.183E+03
OTHER PAVED ASPHALT	W	6.087E+01
OTHER PAVED ASPHALT	*W	1.250E+01
OTHER PAVED ASPHALT	*VC	1.511E+00
OTHER PAVED ASPHALT	*F	3.358E+00
OTHER PAVED ASPHALT	vCF	5.876E-01
OTHER PAVED CNCRETE	W	2.435E+02
OTHER PAVED CNCRETE	*W	5.000E+01
OTHER PAVED CNCRETE	*vW	1.343E+01
OTHER PAVED CNCRETE	*VC	8.395E+00
RESERVOIRS	r	8.168E+02
RESERVOIRS	rX	2.246E+02
RESERVOIRS	rxr	3.403E+01
HARD-SURF FURNSHNGS	V	1.302E+05
HARD-SURF FURNSHNGS	vv	7.432E+04
HARD-SURF FURNSHNGS	vC	2.034E+04
HARD-SURF FURNSHNGS	vR	1.271E+04
SOFT-SURF FURNSHNGS	V	9.265E+04
SOFT-SURF FURNSHNGS	vF	5.333E+04
SOFT-SURF FURNSHNGS	R	2.003E+04
SOFT-SURF FURNSHNGS	vR	2.418E+03
ELECTRONIC EQUIP	V	1.416E+04
PAPER PRODUCTS	oo	2.159E+04
PAPER PRODUCTS	k	1.349E+04

* QUICK-VAC IS APPLIED PRIOR TO RAIN

Figure 4.6 Decontamination Methods by Surface Type and Area (Continued)

Additional information on surveying and monitoring activities appears in Section 2.7 of Chapter 2 and Section A.6.1 of Appendix A.

4.8 PRODUCING COMPLEMENTARY CUMULATIVE DISTRIBUTION FUNCTIONS

The analyst can produce complementary cumulative distribution functions (CCDFs) for all of the major results produced by DECON. A CCDF is a function that gives the likelihood of a variable taking on a value less than (or greater than) some given value. The likelihood is estimated from a set of sample data. Typically, CCDFs for reactor accidents are generated from randomly selected accident start times. The start times determine the meteorology prevailing at the time of radiological release, and this in turn affects

SURVEYING AND MONITORING ACTIVITIES. DECON PERIOD IS 1.

SURFACE	AREA (ha)	COST ($/m**2)	NPV COST ($)	RATE (m**2/hr)
SURVEYS				
AERIAL	4.90E+04	1.61E-05	2.22E+04	3.24E+08
BLDG INTERIORS	4.74E+04	4.60E-01	1.97E+08	1.54E+02
EXTER SURFACES	5.21E+04	2.30E-01	1.08E+08	3.08E+02
WOODED AREAS	7.40E+03	4.60E-01	3.07E+07	1.54E+02
SAMPLING				
MOBILE AIR/SOIL	4.90E+04	3.23E-06	1.58E+03	7.55E+07
WATER & PLANT	4.90E+04	3.26E-06	1.60E+03	7.55E+07
SOIL & CROP	1.55E+03	7.30E-04	7.30E+04	1.16E+06
MOBILE GAMMA SCAN	4.37E+04	7.28E-04	2.87E+05	2.58E+05
PERMANENT AIR SAMPLERS				
INITIAL SETUP	4.90E+04	2.73E-05	1.21E+04	2.91E+07
INITIAL SRVCNG	4.90E+04	1.32E-06	7.59E+03	5.44E+07
EXTENDED SRVCNG	4.90E+04	9.70E-07	9.80E+04	----
INITIAL REMOVAL	4.90E+04	8.16E-07	3.26E+02	5.44E+07
EXTENDED REMOVAL	4.90E+04	4.45E-09	1.61E+01	9.96E+09
TLDS				
PLACEMENT	4.90E+04	3.29E-06	1.45E+03	1.81E+07
REPLACEMENT	4.90E+04	2.08E-06	3.71E+04	3.03E+07

Figure 4.7 Surveying and Monitoring Report

the dispersion of the contaminants. The relative frequency with which different meteorologies are sampled results in a frequency distribution for the DECON variables.

CCDFs can be produced for the DECON variables identified in Table 4.5. To produce CCDFs, run DECON for up to 200 start times. For each run, DECON will add a set of values to the CCDF.DAT file for the variables shown in Table 4.5. Finally, the CCDF program is run to produce a CCDF for each variable the user selects.